General Surgery

الجـــراحة العـــامة

By Staff Members

Our website
http://veterinarysurgery.itgo.com

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ASEPTIC TECHNIQUE GUIDE

Terminology

Sepsis: -

Presence of living pathogenic microorganism within the tissue

Sterile: -

Complete absence microorganisms

Sanitize: -

Reduction of the number of microorganisms to a safe level

Antiseptics: -

They are drugs, substances, or chemicals that applied topically to the living tissue to kill microorganisms

Disinfectants: -

They are drugs, substances, or chemicals that applied to inanimate objects or non-living surfaces to kill microorganisms

Characters of Ideal Antiseptic or Disinfectant

1-Safe, not absorbed by the skin of the animal, and neither harmful to living tissue nor corrosive for non-living surfaces

2-Highly effective against all microorganism at low concentration

3-Effective in presence of organic matter

4-Soluble in water, stable, penetrate tissue surface

5-Incompatible with other drugs

6-Fast acting with long duration

7-Non staining and odorless

Mechanism of Action of Antiseptics and Disinfectants

1-Coagulation of bacterial cell protein

2-Alteration of cell wall permeability leading to loss of essential substances or entry of unneeded substances

3-Interference with enzymatic system

METHODS OF STERILIZATION

I-PHYSICAL STERILIZATION

A-Heat

Physical sterilization by dry or moist heat is the most commonly used method of sterilization

1-Dry heat (flaming or baking)

A-Direct flaming: -

Advantages: -

Simple, easy, and cheap method

Disadvantages: -

Dullness of sharp instruments

B-Hot air Oven: -

It is an effective method of sterilizing metal instruments and glassware (1-2 hours at a temperature over 200°C)

Advantages: -

Excellent method of sterilization

Disadvantages: -

1-High cost

2-Unsuitable for sterilization of plastic or rubbery materials

2-Moist heat

It is a method commonly used for sterilizing instruments, clothes, suture materials, and any other utensils

A-Boiling: -

Boiling can be performed by using distilled water (to which sodium carbonate 2 % can be added) at 100°C for at least 20 minutes. It can be used

for sterilization of suture materials (silk), syringes and needles

Advantages: -

Simple, easy, and cheap method

Disadvantages: -

It is not recommended for aseptic surgery since;

1-It is not effective in killing bacterial spores

2-It tends to dull sharp instruments

B-Steam under pressure sterilization (autoclaving): -

An autoclave is a self-locking machine that sterilizes with steam under pressure. Sterilization is achieved by the high temperature of steam under pressure. The high pressure also ensures saturation of wrapped surgical packs.

All instruments must be double wrapped in linen or special paper or placed in a special metal box equipped with a filter before sterilization. 'Flashing' is when an instrument is autoclaved unwrapped for a shorter period of time. Flashing is often used when a critical instrument is dropped

Autoclave Settings	Temperature	Pressure (PSI)	Time (min)
General Wrapped Items	120°C (250°F)	20	30
Bottled Solutions	120°C (250°F)	20	30
Flashing	131°C (270°F)	30	4-7

Advantages: -

It is a good penetrating, bactericidal and economical method

Disadvantages: -

1-It dulls sharp instruments

2-It scorches fabrics

3-It may leave packs wet

4-It will not sterilize grease or oil materials

B-Radiation Sterilization

High energy ionizing radiation destroys microorganisms and is used to sterilize pre-packed surgical equipment. It is used for instruments that can't be sterilized by heat or chemicals. Radiation sterilization is being promoted as an alternative to ETO sterilization. Care needs to be taken because not all materials can be irradiated successfully. Currently it is used by manufacturers, but not used in veterinary hospitals. Common sources of radiation include electron beam and Cobalt-60

II-COLD (CHEMICAL) STERILIZATION

Glutaraldehyde (Cidex) that is bactericidal, fungicidal, viricidal, and sporicidal and it is the most common disinfectant, usually 3 hours exposure time is needed to destroy spores. Instruments must be dry before immersion.

1-Oxidizing agents

These substances liberate nascent oxygen and so it is affected by the presence of organic matters

A-Halogens (Chlorine): -

B-Peroxides (H2O2): -

C-Potassium permanganate: -

2-Reducing agents

An example of reducing agent is formalin, which is formaldehyde 40% in water. It is not affected by organic matter and has the ability to form toxoid with bacterial toxins. It can be used as urinary antiseptic in acidic urine, as it is released from hexamine. It can be used in the form of gas when mixed with Potassium permanganates.

3-Heavy metal

A-Mercury salts: -

i-Mercuric chloride used as skin antiseptic

ii-Mercuric nitrate and oxide used as eye ointment

iii-Bin iodide of mercury % in lanoline used as blister or counter irritant

iv-Organic mercury compounds act as disinfectants by liberating mercury ions as thiomersolates for wounds, skin, and instruments

B-Silver salts: -

Silver nitrate is an astringent that can be used for corneal ulcers

C-Copper salts: -

Copper sulfate % can be used as astringent fungicidal and germicidal

D-Zinc salts: -

Like zinc sulfate, zinc oxide, and zinc chloride

E-Arsenical salts: -

Arsanilic acid can be used orally as intestinal antiseptic

4-Acid and alkalis

Caustic soda and quick lime can be used for disinfection of buildings but they are corrosive

5-Alcohols

Ethyl alcohol 70% can be used for skin disinfection

6-Phenol and its derivatives

A-Phenol: -

It can be used as 2% solution for disinfection, or it can be used as it is for corneal ulcers

B-Crysol: -

Used as 0.5. % as intestinal antiseptic

C-Lysol: -

It can be used for disinfection of non-living objects

D-Chloroxylenol (Dittol®): -

It is none irritant antiseptic for intact skin in concentration of 2%

E-Picric acid: -

It is used as antiseptic for burns

7-Alcohol-formalin mixture (equal volumes) or organic dyes (acriflavin)

They are used for sterilization of optical instruments and catheters

2-GAS STERILIZATION (ETHYLENE OXIDE GAS, EO)

It is a colorless gas, very toxic and flammable with odor similar to ether and its use requires special equipment. It is used for heat sensitive instruments like plastics, suture material, lenses and finely sharpened instruments

Advantages: -

1-It is both bactericidal and sporicidal

2-Their penetration and effectiveness at relatively low temperatures make them useful for sterilizing surgical supplies made of leather, wool, paper, plastics and other materials that would be damaged by the heat

3-It sterilizes electrical and optical equipment effectively and do not dull instruments

Disadvantages: -

Materials that have been sterilized with Ethylene Oxide must be aerated for 1 to 7 days, depending on the material, otherwise residual gas may diffuse from it and irritates living tissues.

In order to perform aseptic surgery technique, strict measures should be performed to prevent contamination of the surgical wound, and in order to achieve this, the *operating room*, the *surgery packs*, the *patient*, and the *surgeon* must follow rigid routine procedures to insure such aseptic surgery technique.

PREOPERATIVE PREPARATION

I-OPERATING or SURGERY ROOM

Control of contamination starts with construction of the surgery room to limit or to prevent contamination as much as possible

1-Construction of operating room

It is preferred to be isolated. It must be subjected to rigid policies. It should be constructed with one exit (one door) in order to restrict

unnecessary movement of personnel as well as to minimize the opening and closing of doors during surgery. The operating room should be in direct connection with the surgery preparation room and the surgical scrub area (used for preparation of surgical patients and used as post-surgical recovery room).

The operating room should be supplied with good lighting facilities, casting beds, operating tables, instrument carts, and trolleys. Permanently installed hydraulic operating table is likely to be used in large animal surgery room. When circumstances entail that surgery must be carried out in an open yard, the clinician must select the site most suitable for the procedure. If a minor surgical procedure is to be carried out on the standing position and measures should be taken, to secure the animal either in stanchion or in a box stall. When recumbency is mandatory, consideration must be given to the area or location in which the surgery will be performed preferably in a grass field or paddock in which a casting bed is required. The major drawbacks to this are the saturation of air with dust as well as the insect problems.

2-Surgery room cleanliness

Cleaning of the surgery room should be done by well-trained housekeeping personnel. Daily cleaning consists of damp dusting of all flat surfaces, lights, and furniture approximately one hour before surgery. Weekly cleansing routines must be established and it consists of whipping down of walls and ceilings with a germicidal cleaning solution. Cabinets and other operating room equipment should be cleansed. Operating tables should be cleansed after each operation with germicidal solution. Buckets should be carefully cleansed and disinfected. After surgery, areas contaminated by organic debris like blood and other body fluids should be cleaned with detergent and disinfectant

II-SURGERY PACKS

All materials and equipment used in a surgical procedure or entering the operative field must be sterilized. Instruments and materials must be clean prior to sterilization. Post-operative cleaning to remove blood can be facilitated by soaking all materials and instruments in cold water and detergent. Gowns, drapes and other fabrics must be laundered. After drying the equipment and supplies they are arranged for pack preparation. The instruments and materials included in a pack vary with the surgical procedure or with the surgeon preference. All materials are

packed either in sterilizing drums or wrapped with clean towel and double thick paper without contamination. Autoclaving is the most widely used method of surgical pack sterilization. Properly wrapped sterilized packs will remain sterile for up to 6 months if properly stored. Packs stored in sealed plastic bags remain sterile for up to one year.

The Instruments: -

Instrument trays are presented, with the assistant carefully removing the paper wrap or cover and then the surgeon places the instruments on the sterile wrapped instrument stand. Instruments should preferably be sterilized by one of the first two methods listed below:

1-Autoclaving by steam, 750 mm/Hg at 120° C for 30 minutes or at 131° C for three minutes for non-packed instruments, or for a shorter time in higher vacuum or higher pressure autoclaves

2-Gas sterilization by ethylene oxide followed by air drying for several days to avoid diffusion of residual gases from the materials into animal tissues – some acrylic plastic materials, polystyrene and certain lensed instruments may be damaged during this process. Note that ethylene oxide is cancerigenic.

3-Cold (chemical) sterilization in commercially available solutions, however prolonged immersion is necessary. Health and safety problems exist with products such as glutaraldehyde (Rapidex® Arnolds Vet).

4-Simple boiling of instruments is a poor, slow and tiresome means of sterilization particularly liable to cause damage. The minimal period of boiling is 30 minutes, longer at altitudes over 300 minutes. Addition of alkali to the sterilizer increases bactericidal efficiency and boiling time may be safely reduced to 15 minutes. Corrosion is avoided by the addition of 0.5–1% washing soda (Na2CO3), while accumulation of lime in serrations or joints is removed by leaving instruments in 5% acetic acid overnight, then brushing off

III-PREPARATION OF THE PATIENT

1-Preparation of the operative site

Bovine surgery involving regions where adequate skin preparation is feasible (i.e. with avoidable microbial contamination of tissues or sterile materials) should be performed under aseptic conditions. Instruments and

cloths should be sterile. Preparation of operative field (e.g. flank) includes;

1-Close clip wide area, minimum 60 cm cranial-caudal and 90 cm vertically (Preferable to shaving)

2-Alternatively shave operative field after application of disinfectant, soap and water (Schick model razor is suitable)

3-Wash area with soap and water twice, then scrub it with povidone iodine solution (e.g. Betadine®), dry it off, and finally wash with 70% alcohol and rescrub

4-Repeat this procedure three times before re-spraying with diluted povidone iodine solution

5-Place sterile towel on suitable flat surface for instruments, use sterilized gauze swabs, instruments and suture materials, and sterile gloves

2-Draping the patient

Large impervious sterile towels or disposable drapes (rubber or plastic) are useful for placing on the site. The basic set of drapes pack consists of 4 pieces, each approximately 120x90 cm, and one main drape 200x250 cm with a rectangular window. The caudal drape is applied first, leaving a double thickness adjacent to the prepared area then the cranial drape is applied in a similar manner

The side drapes are then placed, leaving a suitable area exposed for the incision and the drapes are held in position with towel forceps. The patient and the entire operating table are then covered with the main drape that has a window that should enclose the area of the incision. The head of the patient is left uncovered for purposes of observation during surgery

IV-PREPARATION OF THE SURGEON AND ASSISTANTS

Members of the surgical team and operating room personnel should be appropriately clothed. Observation gowns and disposable shoe covers can be worn over the usual clothes of operating room personnel and others entering the operating room. Caps and masks are also necessary. Cloth flaps, masks and gowns must be laundered after each use

Preparation of hands or hand disinfection (scrubbing up): -

The cap and mask should be worn before scrubbing commences. Before preparation of the hands for sterile surgery, the fingernails are cut short Hands are kept in contact with the disinfectant for at least five minutes. Effective hand sterilization procedures include;

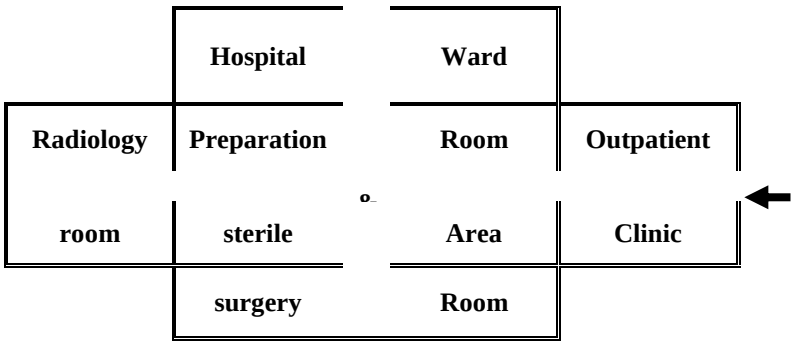
1-Chlorhexidine scrub

2-Chlorhexidine 0.5% concentrate in 90% ethyl alcohol with 1% glycerine as emollient (cheapest), in which 10 ml is first applied to clean dry hands and permitted to dry, before further application and five minutes scrub-up commercially available povidone-iodine soap

3-Hexachlorophane suspension applied first dry then wet, but after scrub up (5 minutes) must be fully rinsed off (pHisoHex®, Zalpon)

Gowning and Gloving: -

The sterile gown and towel wrap or drums are opened by an assistant. The gown is lifted from the sterile wrap and held away from the table. The surgeon unfolds the gown by placing his hands in the appropriate armholes. The arms are pushed in the sleeves to the cuff. An assistant closes the neck and ties the inside waist tie. The gloves are worn and folded over the cuffs of the sleeves. Some operations need rigid aseptic precautions so that two pairs of gloves should be worn.



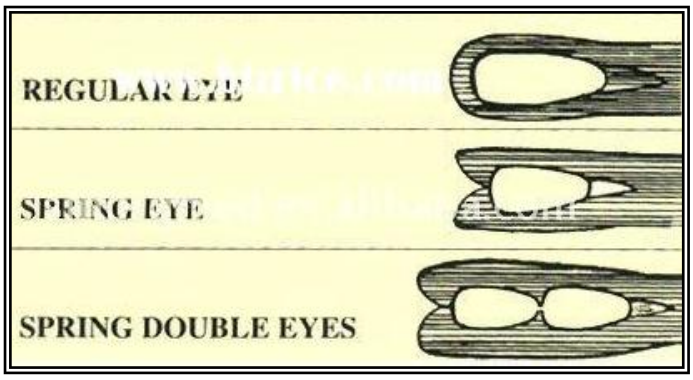
SUTURE MATERIALS & SUTURE PATTERNS

I-NEEDLES

1-Classification according to the eye

A-Closed eye needle: -

It resembles the household sewing needle with one or two eyes. Double strand of the suture passes through the tissue and causes much trauma



B-Swaged-on needle (Eyeless or Atraumatic needle): -

It is permanently attached to the suture, and causes minimal tissue trauma.

2-Classification according to the body or the shaft

A-Straight needle or long stemmed needle: -

Like flessa needle or household sewing needle. It is no longer be used.

B-Half curved needle: -

Half of the needle is curved and the other half is straight.

C-Curved needle: -

It is ¼, 3/8, 1/2, or 5/8 circle, and it is the most famous type of needles.

D-Hook needle (Heavy bound bodied): -

The needle resembles hook.

3-Classification according to the point and the shaft

A-Conventional cutting or conventional sharp needle: -

The point is sharp with the cutting edge being provided at the concave surface

B-Reverse cutting or reverse sharp needle: -

The same as above but the cutting edge is provided on the convex surface to minimize cutting of the tissue

C-Taper cut needle: -

The point is cutting but the body is round

D-Non-cutting needle (round needle): -

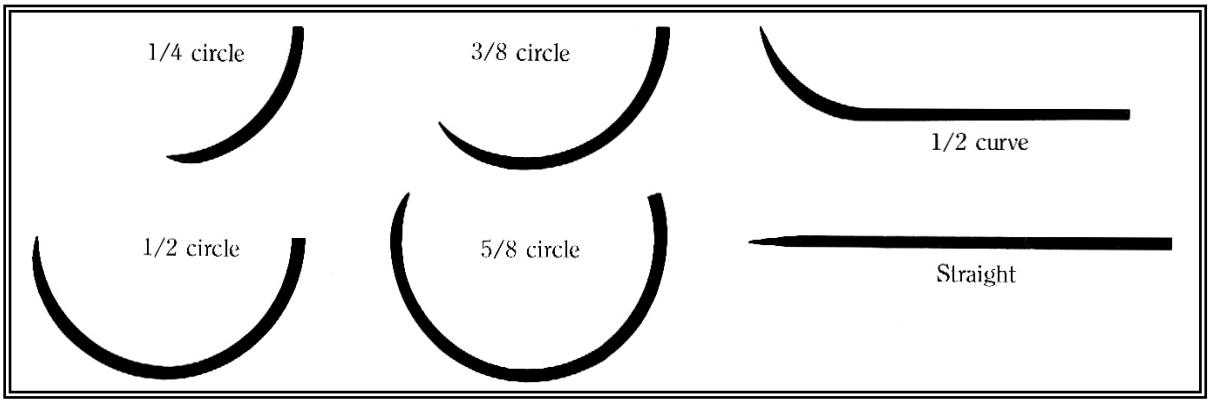
The point is round and the body is oval, and it causes minimal traumatization of tissue

E-Blunt point needle (Ethiguard blunt taper point): -

The tip of point is blunt

F-Spatulated needle: -

This type of needle has wide body in relation to the length of the needle and it has two cutting edges.



II-SUTURE MATERIALS

Suture materials are those filaments used to suture the edges of the wound to permit healing

CHARACTERISTICS OF IDEAL SUTURE MATERIAL

1-Maintain their strength until the wound has healed

2-Have minimal tissue reaction

3-Not favorable for bacterial growth

4-Non-capillary, non-allergic, and non-carcinogenic

5-Easily handled with good knot security

6-Cheap

Unfortunately, ideal suture material has not been found yet and surgeon should be familiar with advantages and disadvantages of suture material to be used.

1-Absorbable suture materials

A-Surgical catgut: -

It is a popular cheap suture material of collagen obtained from the submucosa of sheep or serosa of beef intestine, sterilized by gamma radiation and preserved in 85% alcohol, and can't be re-sterilized. Plain catgut loses its strength rapidly (3-7 days). Chromic catgut is obtained by exposure of plain catgut to chromium salts that increases strength of the filaments, decreases tissue reaction, and prolongs duration of absorption (10-20 days).

Factors affect absorption rate

1-The diameter of the filaments

2-Exposure to gastric enzymes

3-Infection

4-Blood supply

As the knot-holding ability decreases when the suture material is wet, the ends should be left slightly longer to minimize the chance of knot untying. However, this type of suture material is a protein and has high tissue reaction when compared with synthetic forms.

B-Collagen: -

It is a natural suture material related somewhat to catgut, and obtained from the flexor tendons of steers.

Advantages:

1-Smoother

2-Causes less inflammation than catgut

3-More uniform than catgut

4-It has less fray tendency and used mainly in ophthalmic surgery

C-Polyglycolic acid (Dexon®)& Polyglactin 910 (Vicryl®): -

They are synthetic polymers, containing no proteins, absorbable suture materials, and have minimal tissue reaction when compared with catgut.

They handle like silk and do not swell when they are wet. They drag through tissues and cut soft organs, so they are coated with absorbable lubricant to make them smoother, however, dragging can be considered as advantage when continuous suture patterns are used, as the suture material will not be slide out of the tissue. Polyglycolic acid (Dexon®) is absorbed after 40-60 days while and Polyglactin 910 (Vicryl®) is absorbed after 90 days.

D-Polylactic acid: -

It is a mono or multifilament, synthetic polymer, absorbable suture material (over 1 year)

2-Non-Absorbable Suture Materials

A-Silk: -

It is a protein filament produced by silkworm, braided, dyed, and coated with wax or silicone. It is used mainly for suturing of the skin, but it can't be used in infected wound because of its capillarity action. Its absorption is so slaw and when used internally it may last years to disappear. A synthetic form of silk was manufactured like Mersilk®.

B-Cotton: -

Advantages: -

Lower possibility of laceration so it is used for treatment of vaginal or uterine prolapse (vaginal tape)

Disadvantages: -

It is a plant origin filament that has a higher tissue reaction and higher possibility of infection than silk

C-Nylon (Dermalon®, Ethilon®& Nurolon®): -

It is a synthetic, inert, polymer that has poor knot security. Monofilament (Dermalon® & Ethilon®) is preferred than multifilament when infection of the wound is expected although the multifilament braided nylon (Nurolon®) has some degree of roughness, better knot retention, and better handling properties.

D-Polypropylene (Prolene®) and Polyethylene: -

They are polyolefins that are usually represented in monofilament form. They have greater knot security and better handling than nylon. They are

preferred than braided synthetic materials in infected wounds and can be absorbed over two years

E-Polymerized caprolactam (Supramid ®& Vetafil®): -

It is a synthetic multi-filamentous suture material made from materials related to nylon and coated to minimized capillarity, so it can be used for suturing of skin but it has poor knot security compared with silk. Like all multi-filamentous suture materials, it shouldn't be used in infected wounds.

F-Polyesters: -

It is multi-filamentous polyester that consists of Dacron, which may be plain or uncoated (Mersilene® & Dacron®), Teflon-coated Dacron (Polydek®) or polybutylate-coated Dacron (Ethibond®), or Teflon-impregnated Dacron (Tevdek® & Ethiflex®).

The uncoated form has more tissue drag, more capillarity action, and higher knot-holding ability than coated or impregnated forms. It must not be used in infected wound.

G-Stainless steel: -

It is a non-reactive, monofilament or multifilament of iron alloy (iron-nickel-chromium), difficult to be handled because it kinks, and it has good knot security but the knot tends to be bulky.

It can be re-sterilized but it has great tendency for cutting the tissues or the gloves.

Considerations in Choosing Suture Materials

I-PHYSICAL PROPERTIES

1-Durability

Durability of the suture in the wound is affected by many factors like;

A-The diameter of the filament: -

The smaller the diameter of the filament, the faster the absorption and the lower the durability

B-Exposure to gastric enzymes: -

Exposure to gastric juice increases absorption rate and decreases durability.

C-Infection: -

Presence of infection increases the rate of absorption and decreases durability, as the body will get rid of the suture materials rapidly.

D-Blood supply of the wound: -

The higher the blood supply the greater the rate of absorption and the lower the durability, as the body will get rid of the suture materials rapidly.

E-Rate of healing & Tension of the suture line: -

The wounds with high healing rate and low suture line tension need less durable suture materials while those with slow healing rate and high suture line tension, need more durable suture materials.

2-Handling ability and knot security

Good suture material should has good handling ability, minimal capillarity, and good knot security, unfortunately, there is no suture material yet has all phenomena.

3-Sterilization

Most of suture materials are represented already sterile.

Ethylene oxide gas: -

It is a suitable method of sterilization of all suture materials.

Autoclaving: -

It is a suitable method of sterilization of most suture materials (except for catgut), but multiple autoclaving for more than three times reduces the strength of the suture material.

Gamma irradiation: -

Gamma irradiation adversely affects polyglycolic acid and polypropylene.

4-Biological Properties

Tissue reaction ensues as a result of;

1-Traumatization of the tissue by the needle, so atraumatic needle is preferred

2-Dragging of the suture material, so monofilament suture materials are preferred than multifilament

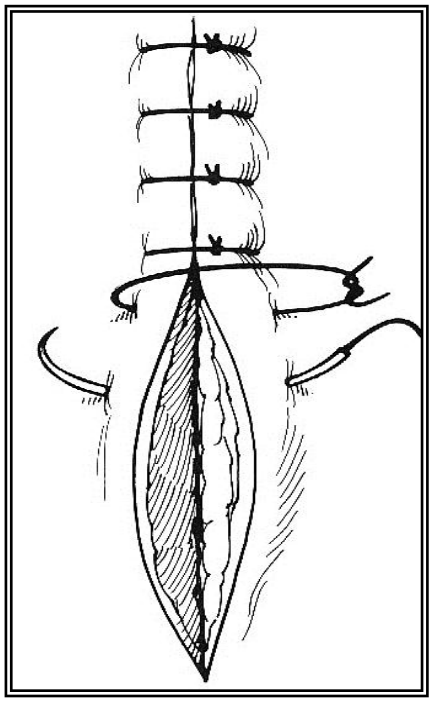
3-Chemical structure of the suture material, as most of synthetic absorbable materials hydrolyzed into chemical components that adversely affect multiplication of bacteria controversial to catgut, which is a protein that is suitable for bacterial growth.

4-Physical structure of the filament, as monofilament suture materials are preferred than multifilament materials as the former has lower chance of keeping microorganism inside it than the later

III-SUTURE PATTERNS

1-Basic Suture Patterns

A-Simple interrupted suture



Technique: -

It is a simple pattern by which the needle is inserted perpendicular at a right angle at one side of the wound (considerable distance far from the edge according to the species), passes through the wound, and exits at the same distance from other wound edge at the other side of the wound, then after the two free ends knotted, accordingly this pattern opposes the skin. This pattern is used in tissues that will not be subjected to a lot of tension.

Advantages: -

1-Simplicity

2-Opposition of the skin

3-Parallel to the blood supply of the wound and not retard healing

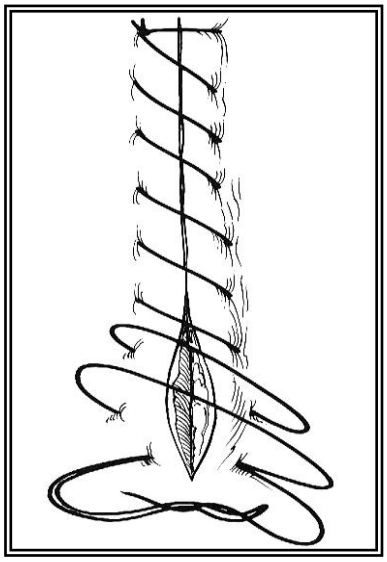
4-When one knot untied; the other knots maintain the strength of the suture line

Disadvantages: -

1-Time consuming because of the high number of knots

2-Consuming of large amount of silk material

3-Not suitable for areas subjected to tension



B-Simple continuous suture

Technique: -

It is the same as simple interrupted but it has only two knots, one at the beginning and the other at the end of the wound. This pattern is used for tissues that will not be subjected to a lot of tension.

Advantages: -

1-Simplicity

2-Opposition of the skin

3-It is performed faster than simple interrupted pattern

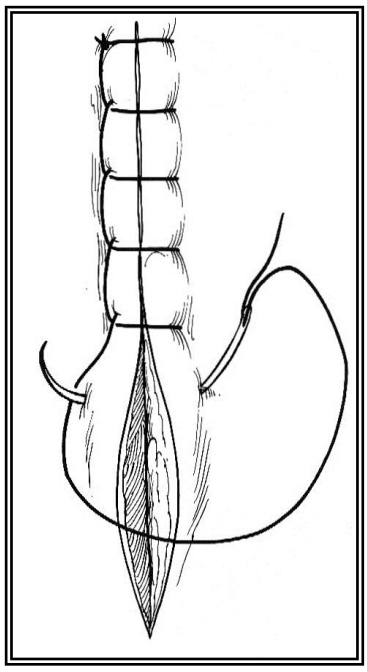
4-Consumption of lesser amount of silk

5-It is parallel to the blood supply so it will not cause retardation of healing

Disadvantage: -

1-When one stitch is untied the strength of the suture line can't be maintained

2-Not suitable for areas subjected to tension



C-Continuous lockstitch (Ford interlocking suture)

Technique: -

It is a modification of continuous suture pattern. After the needle is inserted perpendicular on the wound and exits from the other side, it is drawn through the performed loop and tightened.

Advantages: -

1-Simplicity

2-Opposition of the skin

3-Consumption of lesser amount of silk and lesser time than simple interrupted

4-Relative maintenance of the suture line strength when one stitch is untied

5-It is parallel to the blood supply so it will not cause retardation of healing

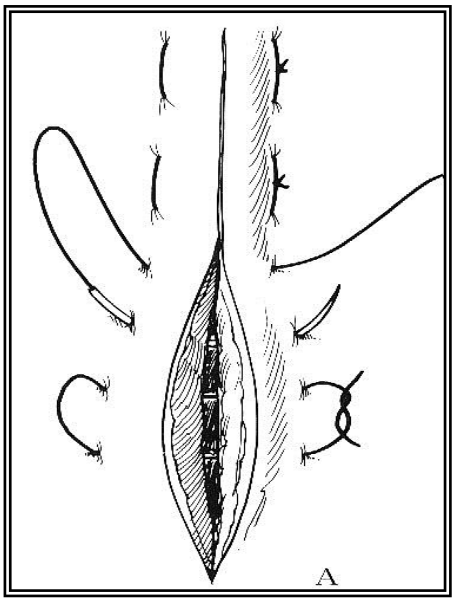
Disadvantage: -

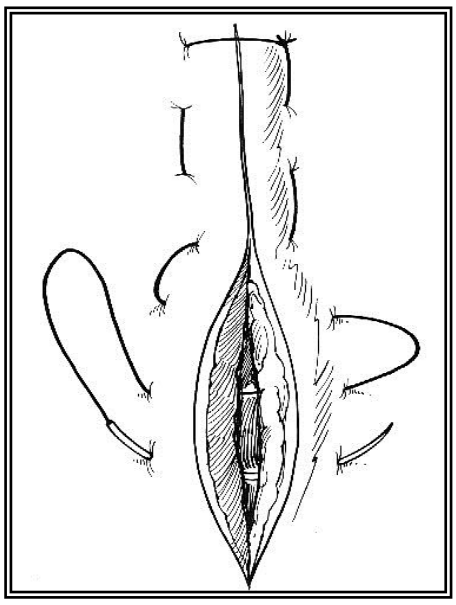
1-It is not as simple as the previously mentioned patterns

2-Time consuming than simple continuous pattern

3-Not suitable for areas subjected to tension

D-Horizontal mattress suture





Techniques: -

This pattern can be performed either in interrupted or continuous manners. With respect to the interrupted pattern, the needle passes through one side of the wound at point number one and exits from the other side at point number two, in the same manner as simple interrupted pattern, leaving considerable length of tissue on both sides (according to species), then at a considerable distance lower to the exit point, the needle is reinserted at point three and passes to the 1st side again to exit through point number four (at lower level than entrance point one), thus two pieces of the silk can be seen parallel to the incision. The needle should be inserted with acute angle through the skin to prevent eversion of the skin. Finally the two free ends of silk are knotted. The four points of entrance and exit form rectangle.

Regarding continuous pattern, only one knot is created at the beginning of the wound by simple interrupted stitch then the same mentioned technique is performed from one side to the other in zigzag manner with creation of another knot at the end of the wound.

Advantages: -

1-It can be used in areas where much tension is placed on the skin

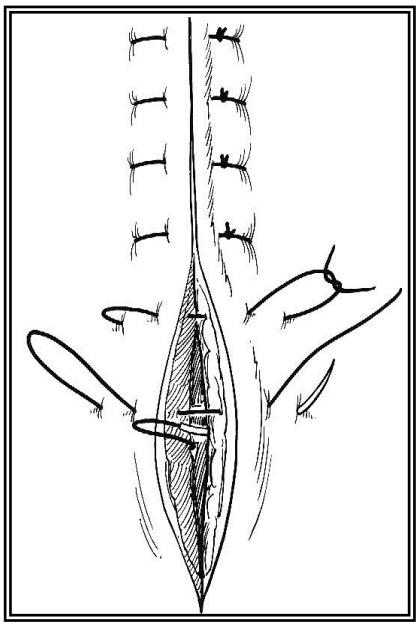
2-Interrupted manner has advantages of interrupted pattern in relation to continuous patter, i.e. cutting of one stitch will not affect the other stitches etc, and continuous pattern has advantages of continuous pattern at lesser time and suture materials consumption etc

Disadvantages: -

1-The main disadvantage of that pattern is that it interferes with blood supply to the skin and interferes with healing as the suture material is perpendicular to the blood supply

2-Other disadvantages are the same general disadvantages of interrupted and continuous patterns

E-Vertical mattress suture



Technique: -

In this type of suture pattern, the needle is inserted at point number one at considerable distance from the edge of the wound (according to the species) and passes through the wound to exit at point number two at the same distance from the wound edge but on the other side of the wound.

Then the needle is reinserted at the same level at point number three that lies medial to point number two (midway between the wound edge and point number two), passes through the wound and exits at point number four medial to point number one and midway between point number one and wound edge.

Finally the two free ends of the suture material are knotted to form the stitch with two suture material lines presented perpendicular on the suture line, one on each side of the wound, at the same time the four points of entrance and exit presented at the same level. This type of suture can be used in areas where much tension is placed on the skin.

Advantages: -

1-The main advantage of that pattern than horizontal mattress pattern is that it doesn't interfere with blood supply of the skin like horizontal type as the stitch is parallel to blood supply

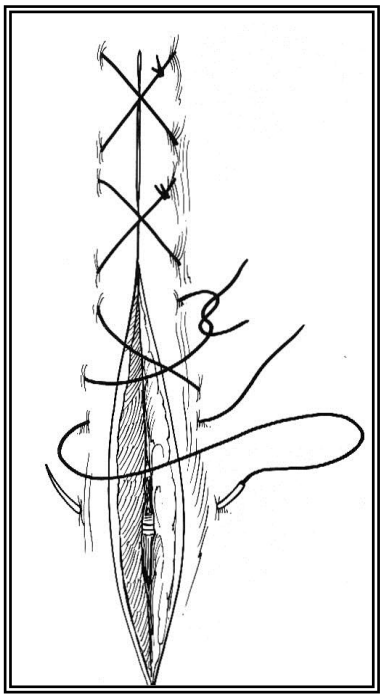
2-It has the same general advantages of interrupted pattern

Disadvantages: -

1-It has the same general disadvantages of interrupted patter as consumption of much suture material and more time.

2-It causes much more eversion of the wound lips

F-Cruciate suture (Cross mattress)



Technique: -

In this type of suture, the needle is inserted at point number one at one side of the wound at considerable distance from the wound edge, passes through the wound to exit through point number two in the same manner as simple interrupted.

Then the needle is inserted at point number three at the same side of point number one and at lower level, passes through the wound and exits from point number four at the other side of the wound and at lower level than point number two but at the same level of point three.

Finally the two free ends of the suture materials are knotted. The four points of entrance and exit create rectangle and two lines of suture materials can be seen on the surface of the wound. These two lines make X or cross over the two lips of the wound and prevent eversion.

Advantages: -

1-The main advantage of that pattern than other mattress patterns is that it doesn't interfere with blood supply nor it causes much eversion

2-It has the same general advantages of interrupted pattern

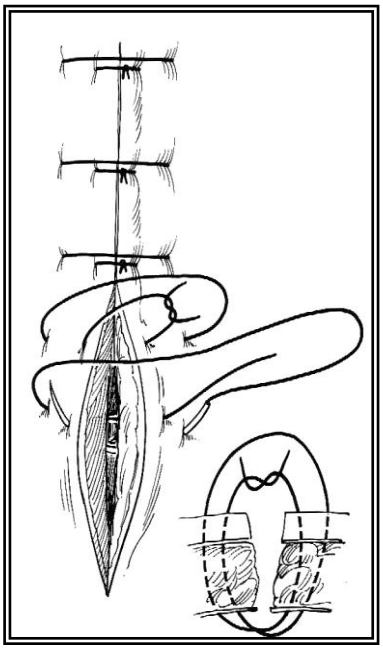
Disadvantages: -

It has the same general disadvantages of interrupted patter as consumption of much suture material and more time

G-Near-far-far-near suture

Technique: -

This type is a mixture of cross mattress and vertical mattress sutures. The needle is inserted at point number one at considerable distance from the wound edge, passes through the wound and exits at point number two at the other side of the wound but at higher level and much more far from the wound edge.



Then the needle is inserted at point number three at the same level of point number two and far from the wound edge with a distance similar to that of point number two, passes through the wound and exit at point number four at the other side of the wound, at the same level of point number one and far from the wound edge with a distance equal to that between point number one and wound edge. Finally the two free ends of the suture materials are knotted and the four points of entrance and exit creates trapezoidal shape with two unequal suture material lines that are perpendicular at the wound and parallel to each other, can be seen on the surface of the wound.

Advantages: -

1-The main advantage of that technique is that it mainly used for linea alba of horse as it is a good tension suture

2-It has the general advantages of interrupted pattern

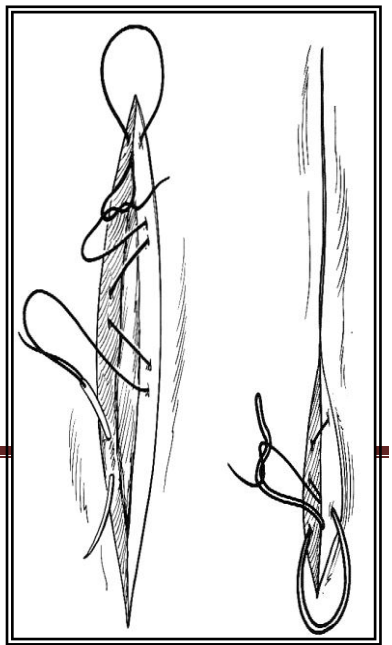
3-It doesn't interfere with blood supply of the wound

Disadvantages: -

It has the same general disadvantages of interrupted pattern as time and suture materials consuming pattern.

H-Subcuticular suture

Technique: -



This type of suture is used to avoid the small scars produced around suture holes in other patterns. The needle is inserted into the subcutaneous tissue in the apex of the wound and passes to the other side and a knots is tied subcutaneously, then the suture is advanced like

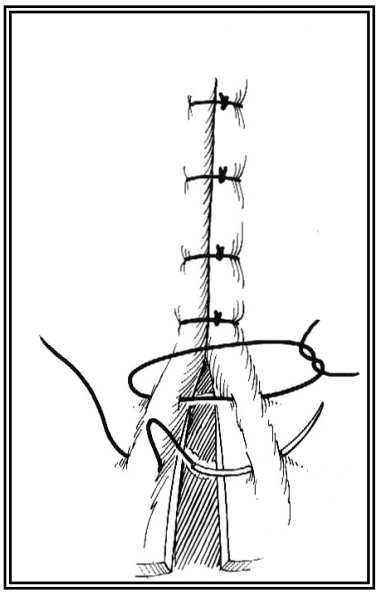
continuous horizontal mattress, but the needle is inserted in one side and exits at lower level in the same side, then it is advanced to the other side and inserted then drawn at lower level till the end of the wound. At the end of the wound the suture material is knotted subcuticular and no suture materials can be seen after suturing of the wound as the knots are subcutaneous.

2-Suture Patterns for Hollow Organs

These patterns are either opposing or inverting patterns and can be applied in as single or double rows. Single row patterns have high incidence of leakage, dehiscence, adhesion and peritonitis, while double row patterns associated with high incidence of stenosis. Whither single row or double row is the best, it stills questionable.

A-Lambert suture

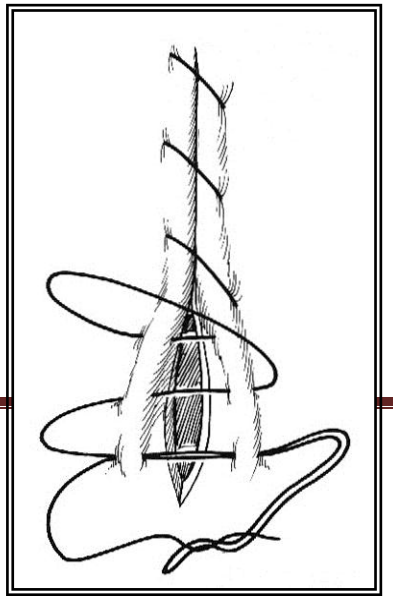
Technique: -



This pattern can be used in an interrupted or continuous manner. The needle passes through the serosa, muscularis and submucosa but it doesn't involve the mucosa.

The needle is inserted at point number one in a perpendicular manner on the wound at one side of the wound and passes the mentioned layers then it is exit at point number two that is nearer to the wound edge and at the same level of point number one and at the same side.

Then after the needle is inserted at point number three at the same level with the other two points and with a distance from the wound edge similar to that between point number two and the wound, passes the mentioned layers and exit at point number four at the same level of the other three points and far from the wound lips with same distance between point number one and the wound.



The four points exist at the same level, and after knotting the stitch, only one line of the suture material can be seen perpendicular on the wound.

Regarding the continuous manner, only two knots are created at the beginning and at the end of the wound and the only parts that can be seen after completing the pattern, are oblique and parallel lines that are perpendicular on the wound edge.

Advantages: -

1-It is the simplest pattern for the internal organs

2-It is relatively rapidly performed

3-It inverts lips of the wound, and never involves the mucosa so the possibility of contamination is low

4-The interrupted manner has the same general advantages of interrupted manner and the continuous manner has the same general advantages of continuous manner.

Disadvantages: -

1-It produces slight stenosis of the bowel

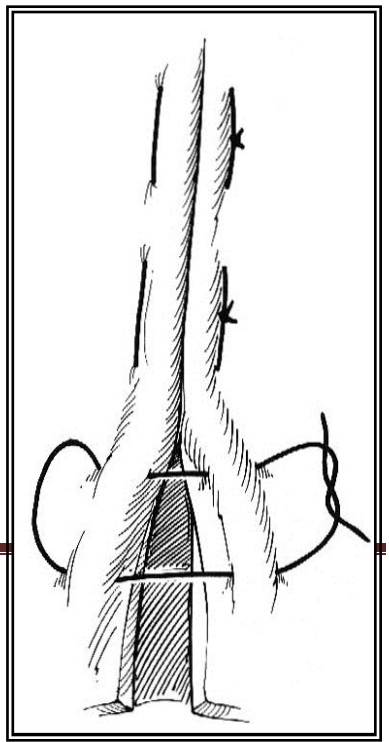
2-Interrupted Lambert has the same general disadvantages of interrupted manner and continuous Lambert has the same general disadvantages of continuous manner

3-It cause retardation of healing when it is applied perpendicular on blood supply

B-Halsted suture (interrupted Quilt)

Technique: -

It is a modification of Lambert pattern that has 8 points of entrance and exit divided on two lines (four points for each line) and can be performed either in interrupted or continuous manners. The needle passes through the serosa, muscularis and submucosa but it doesn't involve the mucosa. The needle is inserted at point number one in a perpendicular manner on the wound at one side of the wound and passes the mentioned layers then it is exit at point number two that is nearer to the wound edge and at the same level of point number one and at the same side.



Then after the needle is inserted at point number three at the same level with the other two points and with a distance from the wound edge similar

to that between point number two and the wound, passes the mentioned layers and exit at point number four at the same level of the other three points and far from the wound lips with same distance between point number one and the wound. Then the needle inserted at point number five at a level lower to that of point number four and advanced to exit through the point number six at one side of the wound then advanced to point number seven at the 1st side of the wound to exit through point number 8. The two free ends at point number one and number 8 are knotted so that only two lines of suture material can be seen parallel to the wound (one on each side).

Advantages: -

1-It inverts lips of the wound, and never involves the mucosa so the possibility of contamination is low

2-The interrupted manner has the same general advantages of interrupted manner and the continuous manner has the same general advantages of continuous manner

Disadvantages: -

1-It produces slight stenosis of the bowel

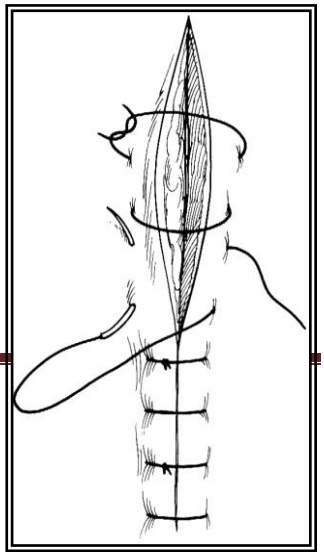
2-Interrupted type has the same general disadvantages of interrupted manner and continuous type has the same general disadvantages of continuous manner

3-It cause retardation of healing as it will be always perpendicular on blood supply

C-Interrupting inverting mattress suture

Technique: -

This pattern is similar to the horizontal mattress suture pattern but the bites of the stitch are parallel to the edges to the wound. The needle is inserted at point number one at one side of the wound at considerable distance from the wound edges and advanced parallel to the wound to exit at the same side of the wound but at lower level.



Then the needle advanced to the other side and inserted at point number three at the same level of point number two and advanced parallel to wound to exit from point number four.

The four points of entrance and exit form rectangle, and after knotting the two free ends at point number one and four, only two lines of suture material can be seen perpendicular on the wound, parallel to each other's and of the same length.

The technique should be performed in interrupted manner and it causes inversion of the wound edges. The mucosa may be or not involved during suturing.

Advantages: -

1-It inverts lips of the wound, that lowers the possibility of contamination and if doesn't involve the mucosa, the possibility of contamination is maintained at minimal level

2-It has the same general advantages of interrupted manner

Disadvantages: -

1-It produces slight stenosis of the bowel

2-It has the same general disadvantages of interrupted manner

3-It causes retardation of healing (it is perpendicular on blood supply)

D-Cushing suture

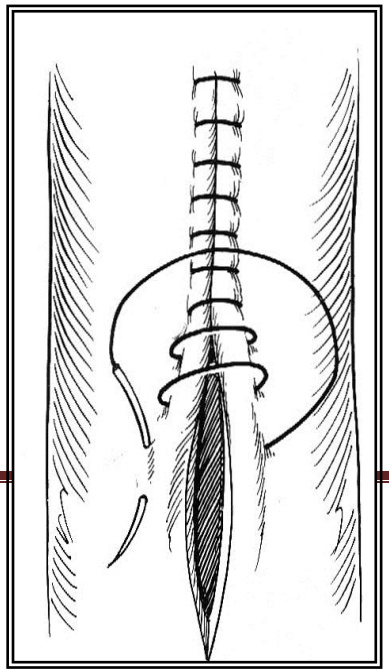
Technique: -

It resembles inverting mattress suture but it is performed in *continuous* manner, and the *mucosa* is not involved.

Following creation of the knot at the beginning of the wound, the needle is inserted at one side of the wound at point number one and advanced parallel to the wound without penetrating the mucosa then it exits from point number two at the same side of the wound.

Then after the needle is advanced to the other side of the wound and inserted at point number three at the same level of point number two, and advanced without penetrating mucosa to exit through point number four that has level lower than that of point number three.

The final shape of the pattern shows lines of the suture material that parallel each other and perpendicular on the wound.



Advantages: -

1-It inverts lips of the wound and doesn't involve the mucosa that lowers the possibility of contamination

2-It has the same general advantages of continuous manner

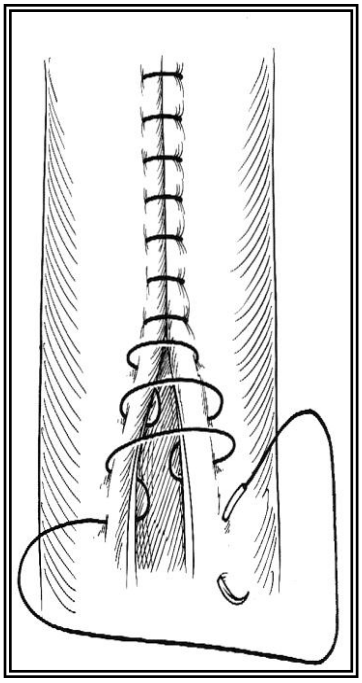
Disadvantages: -

1-It produces slight stenosis of the bowel

2-It has the same general disadvantages of continuous manner

3-It cause retardation of healing as it will be always perpendicular on blood supply

E-Connell suture



Technique: -

It resembles cushing suture pattern, but the needle passes all intestinal layers, so the possibility of contamination is higher.

Advantages: -

1-It inverts lips of the wound, that lowers the possibility of contamination but it involves the mucosa, the increases possibility of contamination

2-It has the same general advantages of continuous manner

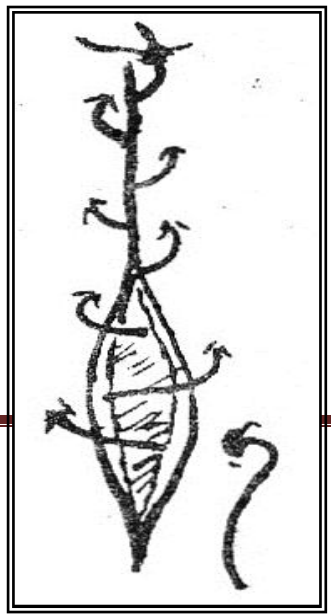
Disadvantages: -

1-It produces slight stenosis of the bowel

2-It has the same general disadvantages of continuous manner

3-It cause retardation of healing as it will be always perpendicular on blood supply

4-It has higher possibility of contamination when compared with techniques that don't involve the mucosa



F-Schemieden's suture

Technique: -

It is an inverting suture pattern that doesn't involve the mucosa. Stitches are brought through from inside the gut into the muscularis and drawn from the serosa

Advantages: -

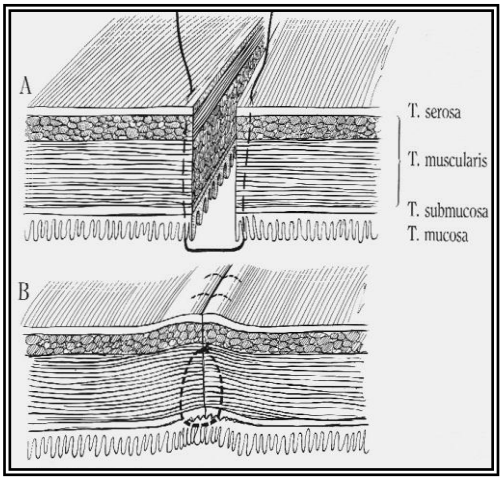
It has the same general advantages of continuous pattern (rapid and consumes lesser amount of suture materials)

Disadvantages: -

1-It has higher probability of infection as the mucosa is involved and the two serosal surfaces are not permitted to come in contact as they are separated by the suture material

2-It has the same general disadvantages of continuous pattern

G-Simple interrupted suture



Technique: -

It involves the mucosa and can be performed in two manners, either simple interrupted that doesn't interfere with circulation, or crushing manner that interferes with blood supply.

Advantages: -

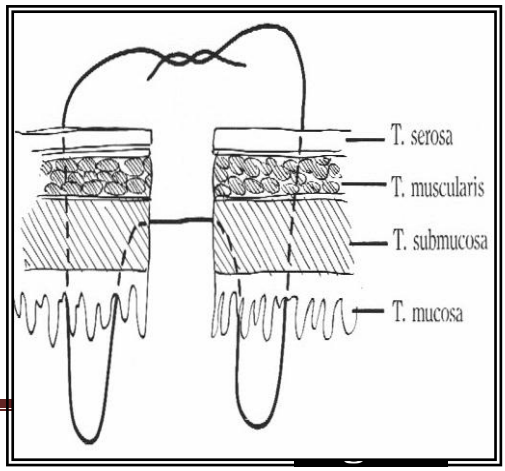
It has the same general advantages of interrupted pattern

Disadvantages: -

It has the same general disadvantages of interrupted pattern

H-Gambee suture

Technique: -



It is an interrupted pattern in which the needle is inserted in a perpendicular manner into the serosa of one side of the wound at considerable distance from the wound edge, exits from the mucosa and reinserted through the mucosa to exit from the submucosa. Then it passes to the submucosa of the other side, exits from

the mucosa, reinserted through the mucosa to exit through the serosa

Advantages: -

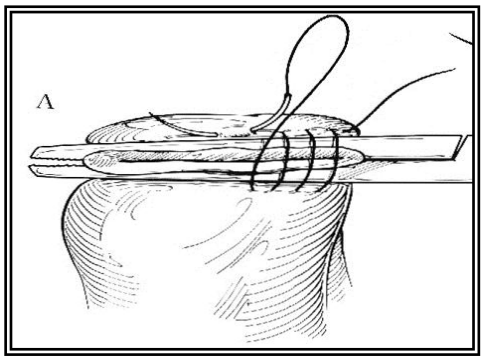
1-It has the same general advantages of interrupted pattern

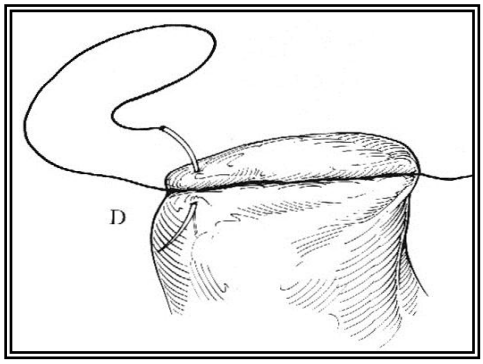
Disadvantages: -

1-Less simple than other technique

2-It has the same general disadvantages of interrupted pattern

I-Parker-Kerr oversew





Technique: -

It is a mixture of cushing over which another Lambert pattern is performed. A hemostatic forceps is applied perpendicular on the hollow organ, and then the organ is severed

The 1st layer of cushing is applied after which the forceps is removed and a Lambert pattern is applied

Advantages: -

1-It has the same general advantages of continuous pattern

2-It has lower possibility of contamination

Disadvantages: -

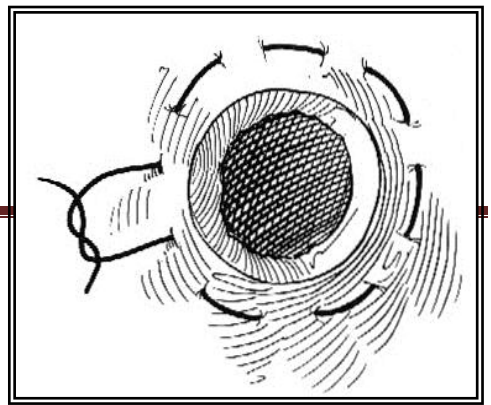
1-It has the same general disadvantages of continuous pattern

2-It is associated with higher possibility of retardation of healing

J-Purse string suture

Technique: -

This pattern can be used to close small holes that evacuate gas from the bowel or to keep cannulae in situ, but it is mostly used with anus to retain rectum during rectal prolapse.



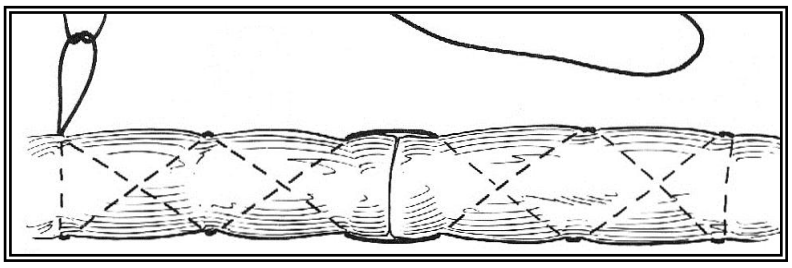
The needle is inserted parallel to the anal opening, 1.5 cm far, and advances subcutaneously for 1.5 cm then drawn,

then reinserted with the direction of watch 360 degree, then the two ends of the suture material are tied in special manner that facilitates untying and retying for frequent evacuation of rectal contents.

3-Suture Patterns for Severed Tendons

A-Bunnell suture

Technique: -



Most of suture materials are kept inside the tendon to maintain the gliding function of the outer surface of the tendon and the suture material presented parallel to the tendon.

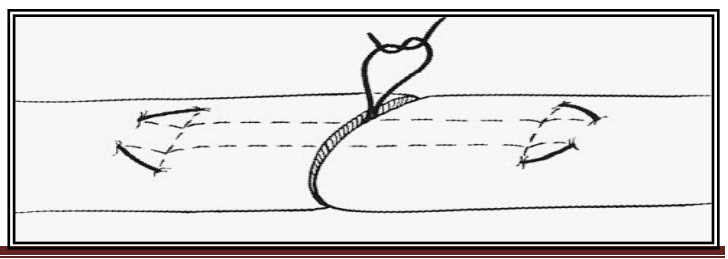
Double round needle suture materials are used in this pattern. Starting at the right side, one needle is inserted at considerable distance from the edge of the severed tendon at right angle, and then the needle is reinserted 0.2 cm far to this site in diagonal or oblique direction toward the other surface of the tendon and exits at a point about 40% of the remaining distance. The same needle is reinserted 0.2 cm far and diagonally to exit at about 80% of the whole distance to the original surface.

The other needle is advanced in the same manner, so finally an eight figure is formed inside one end of the tendon. In the other side of the severed tendon, the two needles are advanced from the end of the tendon and in the same mentioned manner.

All we can see are seven 0.2 cm long suture materials parallel to the tendon, two longer lines (one on each surface of the tendonn), and a knot. They all constitute 10 points.

B-Locking-loop tendon suture

Technique: -



The needle is inserted through the cut surface of the tendon and advanced in the tendon to a considerable distance then

drawn from one surface, at a point 0.3 cm lower and lateral to the point of puling of the needle, the needle is reinserted and passes perpendicular on the tendon, exits through the same surface, reinserted 0.3 cm higher and medial to the point of drawing, and then advanced parallel to the tendon and drawn from the cut edge at the same level of the 1st bite. The needle is advanced in the other side of the severed tendon in the same manner and the knot is made in the cut surface of the tendon.

INFLAMMATION

Definition: -

Inflammation is a complicated *vascular* and *cellular* reaction of an individual to an irritant that is not strong enough to cause death of tissue. The objects of inflammation are to destroy and remove the irritant, and to help in repair of the damage induced by this irritating agent.

Causes: -

I-MECHANICAL CAUSES

Like trauma, blow, or sprain, all of these causes lead to rupture of certain cells and change of its phospholipids wall to arachidonic acid with subsequent induction of inflammation.

II-PHYSICAL CAUSES

Excessive cold or heat predispose to rupture of cells with induction of inflammation

III-CHEMICAL CAUSES

Acid, alkaline, or caustic substances have destructive effect on cells and induce inflammation

IV-BIOLOGICAL CAUSES

Bacteria, virus, parasites, or mycotic destroy tissue and induce inflammation; however inflammation due to microorganisms is more serious than that caused by other causes owing to;

1-The destructive local effect

2-The serious general effects of the toxins of many bacteria

Cardinal Signs of Inflammation

I-REDNESS (RUBOR)

It can be seen in non-pigmented skin as a result of;

1-Hyperemia of the inflamed area

2-Extra-vasation of blood

II-SWELLING

The swelling varies according to the nature of the inflammation (plasma in acute form and fibrous tissue in chronic form), and it is more marked in vascular than in non-vascular structures, and in loose tissues than in hard tissues, however enlargement of inflamed area is due to;

1-Hyperemia and increased blood volume in the affected part

2-Exudation

III-HEAT (KALOR)

Heat associated with inflammation is readily detected in extremities but it is more difficult to be detected in internal organs due to rapid dissipation of heat to surrounding organs. Generally this increase in the temperature of an inflamed area is due to;

1-Increased blood flow

2-Increased metabolic rate

Abnormal heat can be recognized by;

1-Palpation

2-Comparing the temperature of the affected part with that of a corresponding place on the other side of the body or with the normal temperature of the region

IV-PAIN (DOLAR)

The pain varies according to;

1-The severity of the inflammation

2-The degree of nerve supply of the region

3-The tenseness and hardness of the overlying tissue

Pain occurs as a result of;

1-Injury and neuritis to the nerve endings by accumulated metabolic waste products or toxins

2-Stretching and compression of nerve terminals due to accumulation of exudates

V-IMPAIRED FUNCTION (FUNCTION LAESA)

The animal reluctant to move, and specific organ functions (like excretion, secretion, and motility) can't take place, this phenomena ensues as a result of;

1-Swelling

2-Pain

3-Tissue destruction

Changes of the Tissue during Inflammation

I-DEGENERATIVE CHANGES

It varies from cloudy swelling to necrosis

II-VASCULAR CHANGES

Its benefits include;

1-Bringing more of body defenses (blood cells and antibodies) for destruction of irritating agent

2-Bringing more nutrients and oxygen for repair of damaged tissue

1-Changes in Blood Vessels

Momentary constriction of blood vessels occurs directly after the application of the irritant. This is followed by vasodilatation due to vasodilator nerve impulses and local vaso-dilatory action of substances like histamine (chemical mediators). Finally, an increased vascular permeability occur leading to escape of the blood (plasma, leucocytes, and erythrocytes) through the wall of the vessel to the surrounding tissue.

2-Changes in the Rate of Blood Flow

Temporary acceleration of the rate of blood flow ensues as a result of vasodilatation and this is followed by retardation of the rate of blood flow due to;

1-Increasing the capillary bed

2-Margination of the leucocytes

3-Swelling of the endothelial cells lining the capillaries

4-Hemoconcentration

5-Stasis of blood flow

3-Changes in the Blood Stream

1-Redistribution of the cellular elements of the blood stream

2-Margination of leucocytes by leukotaxine

4-Exudation of Plasma

Exudation of plasma ensues as a result of;

1-Increased osmotic pressure due to;

a-Accumulated catabolic products

b-Tissue acidosis

c-Changes in colloids crystalloids

2-Increased capillary permeability due to histamine release

5-Migration of Leukocytes

6-Diapedesis of Erythrocytes

Classification of Inflammation

I-ACCORDING TO CONSTITUENT OF EXUDATES

1-Serous

2-Catarrhal

3-Fibrinous

4-Suppurative (purulent)

5-Hemorrhagic

6-Lymophocytic

II-ACCORDING TO DURATION

1-Per-acute Inflammation

It has very short course and the animal die soon (few hours) after exposure to the causative agent

2-Acute Inflammation

It is an inflammation that has rapid onset and short duration, with prominent vascular and cellular changes (mainly neutrophils, eosinophils, and lymphocytes)

3-Sub-acute Inflammation

It is an inflammation that is caused by mild irritant with less prominent vascular and cellular changes (neutrophils decrease and macrophages increase)

4-Chronic Inflammation

It is an inflammation that occurs within months of exposure to the causative agent and lasts for a long time. The circulatory and cellular changes are difficult to be seen in the area, neutrophils are very few in number, macrophages are numerous, and granuloma usually formed by proliferating fibroblasts and mature fibrocytes.

III-ACCORDING TO FATE OF INFLAMMATION

1-Hyperplastic Inflammation

It is characterized by increased tissue size as a result of increased number of the cells

2-Hypertrophic Inflammation

It is characterized by increased tissue size as a result of increased size of the cells

3-Atrophic Inflammation

It is characterized by decreased tissue size

4-Fibrous Inflammation

It is characterized by excessive fibrous tissue formation

5-Adhesive Inflammation

It is characterized by organization of the exudates with fibrous tissue formation leading to adhesion

VI-ACCORDING TO THE CAUSE

1-Mechanical Inflammation

It ensues as a result of trauma, blow, kick, or sprain

2-Physical Inflammation

It ensues as a result of heat, cold, electricity, or radiation

3-Chemical Inflammation

It ensues as a result of alkali, acid, or caustic

4-Biological Inflammation

It ensues as a result of bacteria (it has direct effect on affected tissue and indirect effect by circulating toxin), viruses, or parasites

Termination of Inflammation

I-DELITESCENCE

It means that the inflammation suddenly subsides (as the causative agent is slight or very mild)

II-RESOLUTION

After the process has been completed the inflammatory exudate is reabsorbed, the damaged tissue is repaired by formation of fibrous tissue, and the affected part apparently resumes its normal condition, although histologically it is not the same as it was before the onset of the injury.

III-SUPPURATION

In this case pyogenic organisms produce an abscess or other form of suppuration, and the condition usually ends with resolution

IV-GANGRENE

This is often spoken of as a termination of inflammation, when the causative agent is strong enough to cause death of tissue

V-INDURATION

Usually it results from chronic inflammation with excessive formation of fibrous connective tissue that undergoes maturation and the tissue subsequently resumes hard appearance

Prognosis of Inflammation

It depends on;

1-Nature of inflammation

2-The affected organ

3-The virulence of the causative organisms

Treatment of Acute Inflammation

I-REMOVAL OF THE CAUSE AND REST

The main treatment of an inflammation is the suppression of its cause and rest of both the animal and the affected part. These simple steps have marked and rapid effect on treatment, as they prevent spreading or dissemination of bacteria and give the tissue the chance for repair. Aside from this, the treatment should be directed towards alleviating the pain

and functional disturbance, and restoration of normal function of injured organ.

II-PHYSICAL THERAPY

It helps restoration of normal physiologic function by promotion of healing through assisting normal physiologic processes and affecting vascular supply

1-Cold application, Astringents, and Anodyne

It can be used for treatment of *acute* or *sub-acute* non-infectious inflammation, and mild inflammation when tissues are not devitalized. It causes vasoconstriction of blood vessels and prevents exudation, but its prolonged use may cause vasodilation either as a reflex during use or directly after application, so it must be used with pressure bandage and rest.

It can be used alone 24-48 hours post injury (for 20-40 minutes and repeated every hour), or as alternating heat and cold after 24 hours.

Anodyne like iodoform ointment can be used for treatment of painful lesion. It can be used for treatment of injury of muscles, tendons, ligaments, or joints, or for burns in order to;

1-Relieve pain (via induction of some analgesia)

2-Lower tissue metabolism

3-Shorten recovery period

4-Prevent edema and tissue swelling (via vasoconstriction)

A-Running cold water or moist therapy

It should be used for an hour at least, and it is contraindicated in presence of open wounds

B-Ice bags

It can be used even through bandage, but it shouldn't be used for tissues that are threatened with death as it may cause vasoconstriction and aggravate the condition

C-Astringent

Lead acetate can be used for induction of

vasoconstriction

2-Heat Application or Thermotherapy

It can be used for promotion of resorption of noninfectious inflammatory swelling, caused by blood or serum 24-48 hours post injury

It improves circulation and prevents death of injured tissue, but it should be used under control of antibiotic as it predisposes to deeper spread of bacteria and toxin.

Aim of use: -

1-It increases metabolism, number of phagocytes, lymph flow, and oxygen supply.

2-It causes vasodilatation with increased permeability and rising of temperature. This may lead to increased absorption of toxin, and increased swelling after application, so it must be followed by active or passive action either manually or by exercise.

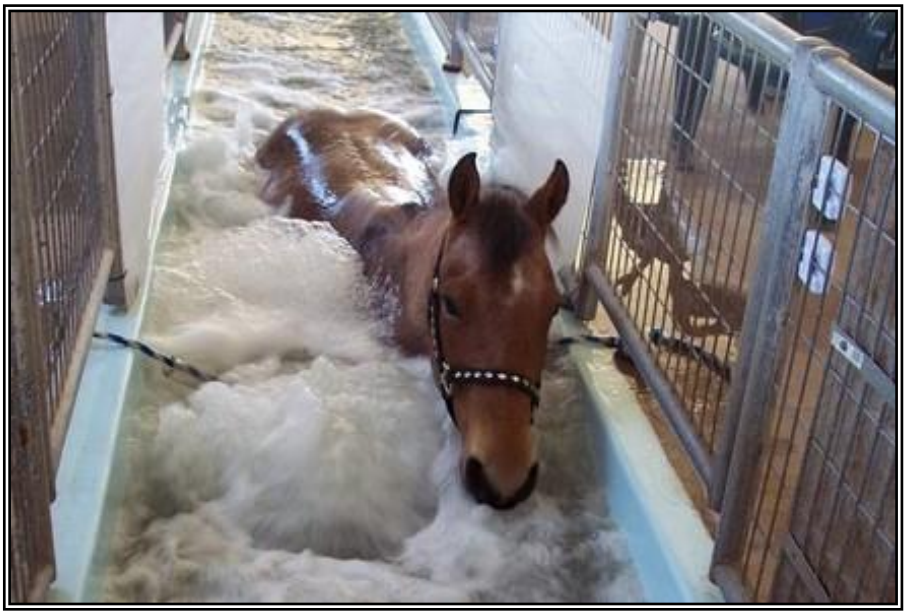
Heat is applied in the form of:-

A-Superficial heat

It causes superficial inflammation that doesn't extend far beneath skin

1-Conductive heat (superficial penetration): -

a-Moist heat: -



It should be associated with massage during application, and massage after application using alcohol, liniment, or mild rubefacient to aid massage and to induce erythema, and antiseptic solution can be added in case of septic inflammation

1-Hot water poultice

2-Hot fomentation, turbulator, or whirlpool (induces passive massage)

b-Dry heat: -

1-Hot water bottle

2-Electric heating pad

3-Ultra violet light

2-Radiant heat of deeper penetration (Infra-red light): -

It is either luminous or non-luminous (metal coil and has no danger of bulb breakage). It is used for frost bites or pointing of abscess, for 20-40 minutes, repeated every hour, and kept 45 cm far from the animal to avoid burns that have no pain initially but thermal burns appear later on.

B-Deep heat

1-Conversive heat: -

Heat ensues as a result of tissue resistance to energy

a-Ultra-short wave diathermy: -

It is ultra-short wave diathermy, shock wave or high frequency electrical energy. Heat penetrates 5 cm deep, and it can be used twice daily. It has direct relationship with water contents of tissue, but metal objects like bone nails can be heated high enough to cause

bone necrosis.

b-Sound waves or Ultra-sound: -

It can be used 48-72 post injury (to avoid hematoma and seroma), for 5-10 minutes to produce micro-massage and heat (41˚C) that penetrates 8-12 cm (as deep as bone and may cause demineralization), and it help for function restoring by relief of pain. The head should be kept in motion and contact over the shaved skin using coupling agent (mineral oil). It can be used for treatment of soft tissue injury with no bone affection, even in presence of metal objects, like muscles, tendons, bursa, trauma, nerve damage, or scar of contracted tissues, either alone or associated with corticoid.

Contraindications: -

1-In presence of bone injury, cancer (to avoid dissemination), or local analgesia

2-Prior to radiotherapy (10 days) and post radiotherapy (up to 2 months) as radiotherapy produces prolonged inflammatory reaction

3-Massage and Compression

It is used for sub-acute or chronic inflammation, combined with liniment to aid massage. Massage promotes re-sorption of swelling and prevents skin adhesion to the underlying tissues, while compression warms tissue, supports affected area, and reduces swelling. Massage should be done in direction of venous and lymphatic drainage for 5: 10 minutes but as it has transient effect, it should be repeated several times a day.

4-Faradic current

It induces muscular contraction and relaxation so it can be used for treatment of muscle strain and joint sprain via prevention of adhesion and muscular atrophy, promotion of joint mobilization, and re-sorption of inflammatory swelling and hematoma.

5-Exercise

It strengthens the limb and rehabilitates the horse after injury as it removes swelling during sub-acute or chronic inflammation like puncture wound of the limb, midline incision, or castration. It can be used as hand lead with massage using liniment, or swimming.

III-SCARIFICATION

Scarification can be used to relieve tension and pain from affected area via release of fluid infiltrated the tissue, but it may cause infection of affected area

IV-IMMOBILIZATION

It is used for acute inflammation to reduce movement, prevent spread of inflammation, reduce swelling, permit healing, minimize scar formation, and to support damaged structures.

1-Plaster cast

Use: -

1-Allow healing of bone or tendon

2-Immobilize wound

3-Support the limb to prevent contraction of tendons or overstress

2-Compression bandage

Types: -

1-Ace bandage

2-Cotton bandage

3-Nylon bandage

Contraindications: -

1-It shouldn't be used for infectious inflammation unless antibiotic is used, as it tends to spread bacteria and toxins deeper into tissues

2-It shouldn't be left for more than 3 days without changing to avoid skin necrosis and sloughing

3-Strong liniment shouldn’t be used under it to avoid severe blistering

V-POULTICES, CATAPLASMS, OR ANTIPHLOGISTICS

They work through high osmotic tension to draw fluid from tissue toward the surface. It can be used for infectious and noninfectious inflammatory conditions even over puncture wound. It can be used under plastic sheet and bandage. It can be left in position for 12-48 hours.

Example: -

1-Unna's paste (Zinc oxide 15 gm, gelatine 15 gm, glycerine 35 gm, and water 35 ml)

2-Magnesium sulfate paste

3-Boric acid paste

4-Kaolin poultice (Kaolin, glycerine, aconite, and water)

5-Anti-phlogestics like icthyol

VI-ANTI-INFLAMMATORY

1-Steroids

They are drugs used for *acute noninfectious* inflammatory conditions to relief pain and swelling, and to reduce fibrosis

Uses: -

1-Relief of post-surgical pain and swelling, in combination with antibiotics as they lower immunity

2-Relief of pain due to tenosynovitis, splint, or bucked shin, by local injection

3-Relief of pain and swelling, and lower fibrosis, when injected parenterally, in combination with cast for treatment of tendosynovitis

4-Relief of pain during acute arthritis by intra articular injection, in combination with hyaluronic acid, and must be preceded by radiographs to ensure absence of chip fracture. This must be performed under aseptic condition and with compression. It acts on synovial membrane, allowing recovery of cellular function, reduction of synovial volume, and increasing its viscosity.

Side effects: -

1-Lowering immunity and predisposes to infection, so it must be used with antibiotics

2-Destruction of articular cartilage

3-It masks signs of inflammation

4-It causes rapid relief of pain leading to early forcing of the animal to work and destruction of affected joint, so it should be associated with rest

Contraindications: -

1-It shouldn't be during degenerative arthritis or reparable fracture of the joint

2-Injection of long acting corticoid (for joint only) into soft tissue as it causes tissue calcification

3-Infection

4-It shouldn't be used in adjunction with counter irritation

5-It shouldn't be used with chip fracture of joint as it masks signs of inflammation, relieves pain, and causes more destruction of the joint by demineralization of bone fragment and erosion of the cartilage, and increases incidence of post-surgical infection.

2-Non-steroidal Anti-inflammatory

a-Acetyl salicylic acid (aspirin)

b-Diclophinac sodium

c-Indomethacine

d-Flunixin meglumin

Treatment of Chronic Inflammation

I-RUBEFACIENTS & COUNTER IRRITANTS

It is used to change sub-acute or chronic inflammatory process to a more acute form in the hope that resolution will occur when the acute inflammation heals. This occurs via induction of local hyperemia, increasing blood supply, with subsequent attraction of more oxygen, nutrition, and WBCs for repair of inflamed area, and resorption of exudates.

They increase circulation leading to redness and mild heat, and it should be repeated once or twice daily as it has temporary relief. It can be used

to relief pain during muscular or joint soreness. It has many terms like iodine ointment, icthyol, liniments, tightener, brace, and sweat, with very little difference among them.

1-Iodine ointment

Iodine ointment 5-10 % can be used over affected area and the remaining vaseline should be removed every new application to prevent isolation of the newly applied ointment from coming in contact with skin. Application should be associated with massage in one direction (the heart direction usually).

2-Liniment

Liniments contain one or more of essential (volatile) oils, their use on limbs can produce considerable edema and skin soreness, their blistering effect increases when applied under bandage, and if the reaction is severe or neglected scars and denuded areas can result

Example: -

i-Camphor and cottonseed oil

ii-Camphor and soap liniment

iii-Turpentine oil

iv-Chloroform liniment

3-Tightner

It is any combination of drugs used to aid removal of edema or synovia of a joint capsule or tendon sheath, so that the tendons are more palpable. The effect is related to massage and bandage rather than being related to the drug itself. It shouldn't be applied over skin soreness, and should be applied daily and covered with cotton and bandage for 5 days.

Example: -

Tincture of belladonna 4oz, tannic acid powder 2oz, menthol crystals 2oz, camphor crystals 1oz, and alcohol q.s.1qt.

4-Sweat

It is drug used to induce accumulation of moister over skin, and most products that have alcohol can induce such effect. It must be used under plastic wrapping, oiled silk, or waxed paper

Example: -

i-Alcohol

ii-Alcohol and glycerin

5-Brace

It is a mixture of drugs that used routinely following workouts (at night), with massage and compression bandage, to prevent filling of joint capsule or tendon sheath

II-BLISTERS or VESICANTS

It is used for sub-acute or chronic inflammation to produce blistering and inflammation down the subcutaneous tissue. Generally it is ineffective painful method, especially for bone conditions like exostosis

1-Red iodide (Bin-iodide) of mercury & Cantharides (Spanish fly)

Uses: -

1-Chronic inflammation of joints

2-Chronic bone conditions

3-Tendonitis, synovitis, or tendosynovitis

4-Pointing of abscess

General roles of application: -

1-Clipping hair

2-Rubbing for 5 minutes

3-Should be removed after 8-24 hours.

4-Application of petroleum jelly at the periphery

Precautions: -

1-Cross tying to prevent licking

2-Don’t use it for young animals.

3-Shouldn't be used on medial aspect of the thigh

4-Iodide interferes with interpretation of radiographs.

Contraindications: -

1-Acute inflammatory conditions

2-Open wound

3-Flexor surfaces except fetlock.

4-Near mucous membranes

5-Emaciation

6-Injection of corticoid (up to 30 days)

III-PUSTULANTS

Seton in the form of gauze impregnated in turpentine oil and inserted subcutaneously from one opening to a ventral one, and it should be kept in situ for 14 days

IV-THERAPEUTIC CAUTERY or FIRING

It changes sub-acute or chronic inflammation into acute form in hope that it will undergo resolution.

Indications: -

1-Soft tissue damage (around joints, tendons, and ligaments)

2-Carpitis (popped knees) especially if there is no periosteal new bone growth

3-Chronic arthritis

4-Tendonitis and tendosynovitis

5-Osselets, with no periosteal new bone growth

6-Sesamoiditis, bone spavin, or splints

Contraindications: -

1-Near open wound, area of dermatitis, or infection

2-Acute inflammation

3-Healthy tissue

4-Flexor surface of joint

5-Young or emaciated animals

6-Active new bone growths

7-When corticoid has been used (up to 30 days)

Types: -

1-Point firing

It can be applied either as block or diagonal pattern and it can be used as superficial (no skin penetration) or deep point firing (the skin is penetrated)

Induction: -

1-Clipping

2-Scrubbing with soap and antiseptic

3-Induction of local analgesia

Considerations: -

1-Holes shouldn't be closer than 1 cm

2-Iron should be heated to cherry red

3-Don't fire for too long time to avoid necrosis and sloughing

4-Don't apply excessive pressure to avoid penetration of synovial structures or bone

5-Avoid sudden movements of the horse

6-Avoid penetration of blood vessels

2-Line firing

It can be used as transverse, oblique, or tree manner and it shouldn't penetrate skin. It can be used over volar surface of tendons or the long axis of stifle joint and generally the edge of the instrument shouldn't be more than 3 mm wide. It is not recommended and doesn't cause any more irritation than blistering

3-Needle point firing

It penetrates deep and reaches bone or ligament but it is not recommended to be used near joint or tendon to avoid infection of these structures

Aftercare of firing: -

1-Blistering for 21 days by 2 parts Tr. Iodine 7%, 1 part glycerine, and 1 part liquid phenol. It acts as germicidal and local anesthetic and it produces prolonged irritation.

2-Rest for 6 months

Complications: -

1-Sloughing of skin

2-Wound infection and septicemia

3-Laminitis

4-Suppurative arthritis and synovitis

NECROSIS AND GANGRENE

Definition: -

Necrosis is a collective term means localized death of cells or tissue within the body as a result of loss of nutrition, injury, disease, or other pathologic state.

Sloughing means necrosis or death of soft tissue that is followed by casting off, and the dead area is called ***slough***.

Sequestration means that a fragment of dead bone separated from healthy bone as a result of injury or disease or it is necrosis of bone and the dead fragment is called ***sequestrum***.

Necrobiosis means aseptic necrosis of tissue as a result of occlusion of its blood supply (infarction).

Cells that die due to necrosis do not usually send the same chemical signals to the immune system that cells undergoing apoptosis (natural death of cells) do. This prevents nearby phagocytes from locating and engulfing the dead cells, leading to a build-up of dead tissue and cell debris at or near the site of the cell death. For this reason, it is often necessary to remove necrotic tissue surgically, a process known as debridement. In addition necrosis can release harmful chemicals into the surrounding tissue. In particular, cells contain small organelles called lysosomes, which are capable of digesting cellular material. Damage to the lysosome membrane can trigger release of the contained enzymes, destroying other parts of the cell. Worse, when these enzymes are released from the non-dead cell, they can trigger a chain reaction of further cell death. If a sufficient amount of contiguous tissue necrotizes, it is termed gangrene. Proper care and treatment of wounds or animal bites plays a key role in preventing this type of widespread necrosis. During a surgical biopsy, this necrosis chain-reaction is halted by fixation or freezing

Necrosis typically begins with cell swelling, chromatin digestion, and disruption of the plasma membrane and organelle membranes. Late necrosis is characterized by extensive DNA hydrolysis, vacuolation of the endoplasmic reticulum, organelle breakdown, and cell lysis. The release of intracellular content after plasma membrane rupture is the cause of inflammation in necrosis.

Gangrene means death and decay of body tissue or local death and putrefaction of a tissue while being attached to the living body usually caused by impaired or absent blood supply. Gangrene can occur as a result of arterial or serious venous damage. The effect of gangrene can be disastrous, leading to loss of limbs. It can also cause the products of tissue breakdown to enter the bloodstream causing blood poisoning and threatening life.

Causes of necrosis: -

Cellular necrosis can be induced by a number of external sources, including injury, infection, cancer, infarction, poisons, and inflammation. For example, an infarction (blockage of blood flow to muscular tissue) causes necrosis of muscle tissue due to lack of oxygen to the affected cell, such as occurs in a myocardial infarction. Certain spider and snake venoms can cause necrosis of the tissue near the bite wound, as can a group A streptococcus infection (one of the "flesh-eating" bacteria).

Treatment: -

Treatment of necrosis typically involves two distinct processes. Usually, the underlying *cause* of the necrosis must be treated before the dead tissue itself can be dealt with. For example, a snake or spider bite victim will receive anti-venom to halt the spread of the toxins, while an infected patient will receive antibiotics.

Even after the initial cause of the necrosis has been halted, the necrotic tissue will remain in the body. The body's immune response to apoptosis, the automatic breaking down and recycling of the cell material, is not triggered by necrotic cell death.

The standard therapy of necrosis (wounds, bedsores, burns, etc.) is *surgical removal* of necrotic tissue. Depending on the severity of the necrosis, this may range from removal of small patches of skin, to complete amputation of affected limbs or organs. Chemical removal, via an enzymatic debridement agent, is another option. In selected cases, special maggot therapy has been utilized with good results.

Causes of gangrene: -

I-DIRECT INJURY OF THE TISSUE (primary gangrene)

1-Mechanical or traumatic injury to tissue, crushing of blood supply, or prolonged pressure (by harness as sit fast or against bony prominence as bed sore)

2-Physical causes as burns or frostbite

3-Chemical causes like acids, alkalis, caustic substances, or even natural body fluids in aberrant location (subcutaneous urine in case of ruptured urethra)

4-Infectious cause like bacterial infection with production of toxins

II-INDIRECT CAUSES (secondary gangrene)

1-Vascular causes like arteriosclerosis, arterial spasm (by drugs as ergot), or embolism; or venous thrombosis or phlebitis. Mechanical prolonged closure of blood supply by tourniquet, tight bandage, pressure of displaced bone fragment, or strangulation

2-Bacterial toxins

Classification

I-PRIMARY or SECONDARY GANGRENE

1-Primary Gangrene

It is the result of invasion of the tissue by gangrene-producing organism like black quarter in sheep and cattle, malignant edema in horse, and gangrenous udder due to Staph and Strept.

2-Secondary Gangrene

It is the result of tissue death due to disturbance in blood supply, followed by invasion by putrefactive bacteria.

II-DRY or MOIST GANGRENE

1-Dry Gangrene (death mummification)

This type of gangrene occurs in tissues that have reduction of blood flow through the arteries with adequate venous drainage. The usual cause is chronic arterial obstruction as arterial sclerosis or calcification of the terminal end of the arteries (sit-fast), accordingly it appears gradually and progresses slowly. Affected tissue becomes cold, hard, dry, shrunken, and dark brown to black, and eventually sloughs off but no putrefaction can be observed as the affected part does not become infected.

2-Moist gangrene

This type is observed in tissues that are rich in fluid and have inadequate venous drainage. It usually occurs as a result of venous obstruction followed by sudden arterial obstruction, and the affected tissue become swollen, disintegrated and liquefied by the action of putrefactive bacteria with production of blood stained foetid fluid and toxins.

Wet or moist gangrene also develops as a complication of an untreated infected wound. Swelling resulting from the bacterial infection causes a sudden cessation of blood flow that facilitates invasion of the muscles by the bacteria and multiplication of the bacteria because disease-fighting cells (white blood cells) cannot reach the affected part.

Gas gangrene is a type of wet gangrene caused by the bacteria known as Clostridia. Clostridia are a type of infection-causing bacteria that grow only in the absence of oxygen. As Clostridia grow, they produce poisonous toxins and gas; therefore, the condition is called gas gangrene.

Signs of death of tissues

1-Loss of arterial pulsation

2-Loss of sensation as a result of death of nerve endings

3-Pain due to irritation of the healthy nerve endings

4-Loss of function

5-Loss of heat (cold in palpation)

6-Changes in color

Symptoms of gangrene

I-LOCAL SYMPTOMS

1-Period of Death

In case of ***dry gangrene***, the dead part becomes hard, dry, shrunken, dimensioned in volume (adequate venous drainage), dark color, and the hair become dry and erected.

In case of ***moist gangrene***, the volume of the affected tissue increases (as a result of inadequate tissue drainage), the color changed into green or black color, epithelium can be scraped from the skin, the affected organ becomes cold, and offensive odor discharge comes out from the affected tissue.

2-Period of Separation of the Slough

An inflammatory line of demarcation separates the affected tissue from the healthy one. The dead area cast off indicating that toxemia wasn't sufficient to kill the animal. During this period, many complications can occur, like secondary hemorrhage as a result of sloughing of blood vessels, septic arthritis as a result of opening of a joint, or synovitis as a result of opening of tendon sheath.

3-Period of Cicatrisation

Once the slough has separated, healing ensues, except the parts of hard necrotic tissues like cartilage or bone that separated slowly.

II-CONSTITUTIONAL or GENERAL SYMPTOMS

These symptoms ensue mostly as a result of absorption of toxins, and these symptoms include fever, rapid pulsation, and hurried respiration, loss of appetite, exhaustion, and death.

Diagnosis: -

1-History

2-Symptoms

3-Clinical examination

Prognosis: -

Prognosis depends up on the nature of the lesion. When toxemia is severe, the case is dangerous as in moist gangrene and death may occur within few days as with gangrenous mastitis or even within hours as with strangulating intestinal obstruction.

Treatment:

1-Local Treatment

It must be directed toward prevention of extension of gangrene and stimulate fast separation of the slough.

1-Removal of the cause

2-Excision of the mummified part in case of dry gangrene

3-Application of irritants at the periphery of the dead tissue to enhance separation

4-Application of warm antiseptics dressing if intense inflammation is present in the vicinity

5-In case of moist gangrene, surgical debridement (removal of dead tissue), scarification of the lesion, or even puncture with hot iron must be performed (permitting the escape of toxic liquids, and to irrigate the tissue with antiseptic solution)

6-Stimulation of granulation and healing

7-If the case is hopeless, amputation of the affected appendages or organ can be performed to save the life of the animal

2-Treatment of Constitutional Symptom

1-Administration of easily digestible food

2-Administration of systemic antibiotic

3-Administration of vitamins, minerals, tonics and stimulants

4-Administration of analgesics for controlling the pain

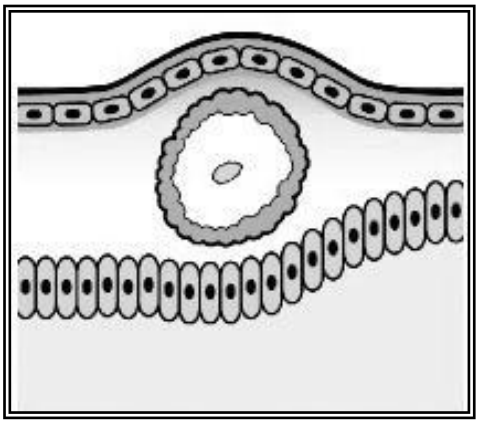
Regarding gas gangrene, the condition needs to be treated aggressively because of the threat of the infection rapidly spreading via the bloodstream and damaging vital organs. The wound requires immediate debridement and antibiotics are administered to the affected animal.

SWELLING

I-ABSCESS

Definition: -

Abscess is defined as a circumscribed swelling containing pus (localized collection of pus) surrounded by an inflamed area. It is formed by destructive effect of pyogenic micro-organisms on a tissue. Abscesses can be caused by a wide range of bacterial and fungal infections.



An abscess is different from cellulitis in that it has a defined edge and shape.

Characteristics:

1-Raised skin surface

2-Localized heat

3-Tenderness and pain

4-Redness of the skin (in white people)

5-Pus formation

6-Foul smell if it has begun to discharge

Predilection seats: -

Abscesses can be formed at any part of the animal body. In *equines, sheep and goats* it is predominant in the parotid region and inter-mandibular space while in *cattle* it is formed in left chest region behind elbow joint, in the front of udder and at the umbilicus.

Etiology: -

Occasionally it ensues as a result of entrance of microorganisms through a break down in the skin or mucous membrane through:

1-Foreign body as nail, needle, sharp piece of bone, wood or glass.... etc.

2-Injuries, accidents and skin wounds

3-During injection, as the wide bore needle that may drive a piece of skin or hair into the muscle or the improper sterile technique of injection

Pathogenesis: -

Abscess is the last stage of a tissue infection that begins with inflammation. Initially, the invading germ activates the body's immune system that causes increase in the temperature of the affected area due to the increased blood flow, swelling due to the accumulation of water, blood, and other liquids, redness and pain due to the irritation from the swelling and the chemical activity. These four signs (heat, swelling, redness, and pain) characterize inflammation. As the process progresses, the tissue begins to liquefy, and an abscess forms. As the chemical digestion liquefies more and more tissue, the abscess increases in size

and spreads following the path of least resistance tissues that are easily digested.

A good example is an abscess just beneath the skin that continues beneath the skin rather than working its way through the skin. The contents of abscess leak into the circulation and produce symptoms like any other infection including chills, fever, aching, and general discomfort. Sterile abscesses are a milder and does not caused by germs but by nonliving irritants such as drugs. If an injected drug like penicillin is not absorbed, it stays in place and may causing irritation to generate a sterile abscess (sterile because there is no infection involved). In general, sterile abscesses are likely to become hard as they scar rather than remaining as pockets of pus. Although there are sterile abscesses, most abscesses are caused by bacterial infections that produce large amounts of pus in the tissues. Abscesses commonly develop after bite wounds, scratches, or when objects penetrate the skin and then the skin heals over. Since the infection cannot drain, pus builds up under the skin and an abscess develops. As the pus continues to build, the skin over the abscess undergoes necrosis by the infection and the abscess will eventually rupture. Unfortunately, unless the abscess is treated correctly, the skin will heal over again and the abscess will redevelop.

Classification: -

There are two types of abscesses, septic and sterile. Most abscesses are septic, which means that they are the result of an infection. Septic abscesses can occur anywhere in the body and only a germ and the body's immune response are involved in such process. In response to the invading germ, the white blood cells gather at the infected site and produce enzymes which attack and digest the germ. These enzymes act like acid, killing and breaking down the germs into small pieces that can be picked up by the circulation and eliminated from the body. Unfortunately, these enzymes also digest body tissues and in most cases, the germ produces similar chemicals resulting in thick, yellow, liquid pus containing digested germs and tissues, white blood cells and enzymes.

Abscesses are classified according to the clinical features into;

a-Acute or hot abscess of rapid evolution and it may be superficial or deep

b-Chronic or cold abscess of slow evolution and it may be hard or soft

Each of the above types may be distinguished as;

a-Idiopathic

b-Symptomatic

c-Metastatic (there are multiple foci)

d-Critical when it resulted from grave disease or develops in connection with vital organ

I-ACUTE or HOT ABSCESS

Formation and structure of an acute abscess: -

1-An acute abscess is formed within 3-5 days after entrance of the pyogenic micro-organism.

2-It is composed of wall (*pyogenic membrane*) and contents (*pus*)

3-The character of the pus varies according to tissue involved and causative agent.

4-The germs, which gained access to the tissues, multiply and produce toxins that diffuse into surrounding structures causing acute inflammation, vasodilatation, accelerating blood stream (but finally retarding the blood stream), thrombosis and leucocytic emigration and microscopically, the lesion shows two well differentiated zones;

a-Central area of dead tissues that have lost their staining properties and contain the causative pyogenic bacteria

b-Peripheral zone of acute inflammation which is highly infiltrated with leucocytes and fades gradually into the surrounding healthy tissues

Fate of pus: -

1-Usually the pus directed to the external body surface, but if it is unable to escape superficially due to tissue resistance, as horn of the hoof, it extends in the direction of the least resistance until it finds a means of escape.

2-An abscess in vicinity of joint or visceral cavity may open into it leading to serious consequences.

3-Abscess formation on ligament, tendon or bone may cause necrosis of these structures and interferes with healing even after the abscess burst.

4-Retained pus in an abscess cavity for a long time, without evacuation, causes resorption of the liquid part of the abscess, inspissation, caseation, and finally calcification.

Symptoms: -

Generally, there is no specific clinical signs except presence of lump or swelling, reduced appetite, and increased water intake or fever.

1-Acute Superficial Abscess

General signs of acute inflammation (swelling, redness, hotness and pain). It starts as a very painful firm circumscribed inflammatory swelling. The center of such swelling gradually becomes softer while its periphery remains firm, and gradually the wall becomes thin and the abscess appears to be fluctuated. Later on, it points at the skin surface, forming a shining hairless patch at its center which is thin on palpation giving a sensation of softening combined with elasticity. At the end it burst allowing escape of pus through the orifice.

2-Acute Deep Abscess

As a result of the deep position of that abscess, local manifestations can't be noticed except slight edema in its vicinity. Deep abscess is first indicated by febrile condition of the animal due to absorption of toxins. It may interfere with normal function of surrounding organs like pharynx or larynx. When the pus reaches near the surface, features of a superficial abscess may be detected.

Diagnosis: -

Diagnosis of superficial abscess is always easy by symptoms while deep one may present some difficulties as a result of absence of local manifestation. The common findings of inflammation (heat, redness, swelling, and pain) easily identify superficial abscesses. Deep abscess is indicated only by generalized symptoms such as fever and discomfort. *Pain* and tenderness on *physical examination* are common findings. Sometimes a deep abscess will eat a small channel (sinus) to the surface and begin leaking pus. Generally, edema at the vicinity, interference with normal function of surrounding organs and febrile condition may be helpful. A sterile abscess may cause only a painful lump deep in the buttock where a shot was given.

1-History

2-Clinical signs

3-Exploratory puncturing

Differential diagnosis: -

Abscess may be confused with hematoma, cyst, hernia, bursitis or tumor.

1-Hematoma: -

1-It appears directly after severe trauma, and immediately fluctuating beneath intact skin

2-It causes transient inflammatory reactions that can be seen for few days then disappear, but generally pain is not as severe as in abscess

3-Crepitation ensues when coagulation occurs

4-It never points as the abscess

2-Cyst: -

1-It is uniformly fluctuating and lined with epithelium or endothelium

2-It is either congenital or it takes longer time to develop

3-Hernia: -

1-Presence of hernial ring, and reducibility of contents in case of reducible hernias

2-Absence of inflammatory reaction except when it is recent and traumatic

4-Tumor: -

1-It is abnormal benign or malignant overgrowth of tissue

2-Benign tumors are firm, grow slowly, single or multiple, remains localized and with a regular and well-defined borders without any sign of inflammation. In some cases it may be subjected to friction leading to ulceration and infection.

5-Bursitis: -

An inflammatory swelling of the bursae (known from anatomical positions)

Treatment: -

General Considerations

1-The hair must be clipped off the area

2-If the mature abscess has not ruptured, it can be surgically lanced. Lancing is a lot better for healing than allowing the abscess to rupture without surgery.

3-Thus, the pus must be drained from the abscess. The surgeon determines when the abscess is ready for drainage and opens a path to the outside, allowing the pus to escape. Ordinarily, the body handles the remaining infection, sometimes with the help of antibiotics or other drugs.

4-The sooner the mature abscess is lanced, the less tissue damage will occur and the quicker that healing will occur.

5-After the abscess is lanced, flushing of the pocket with sterile fluids is critical to prevent the abscess from recurring.

6-Keeping the incision opened for 7 to 10 days is required to flush out all of the infection and sometimes the surgeon may leave a drain (a piece of cloth or rubber) in the abscess cavity to prevent it from closing before all the pus has drained out.

7-If the incision closes too quickly, the infection will recur and possibly the infection could spread and infect bones in the area. Since skin is very resistant to the spread of infection, it acts as a barrier, often keeping the toxic chemicals of an abscess from escaping the body on their own.

1-Conservative Treatment

1-Systemic antibiotic for control of septicemia and bacteremia and it should be continued even after evacuation of abscess

2-Anti pyretic or anti-inflammatory according to need

3-Fluid therapy if the animal refuses to eat as a result of toxemia

2-Ripening or Maturation

It is a process aims at faster maturation of the abscess to come close to the skin surface, become fluctuating and the pus lies within a thin wall cavity beneath a thin circle of skin, and inflammation of the surrounding tissues subsides.

Ripening can be done by using;

1-Fomentation and/or poultices

2-Antiphlogistic preparations such as icthyol ointment

3-Iodine ointment

4-Blister like bin-iodide of mercury ointment

3-Evacuation and Drainage

It is a process of incising of the mature abscess for evacuation of pus and drainage. The incision must be wide enough to prevent re-accumulation and it should be made at a suitable level for good drainage (lowest point).

Technique of evacuation: -

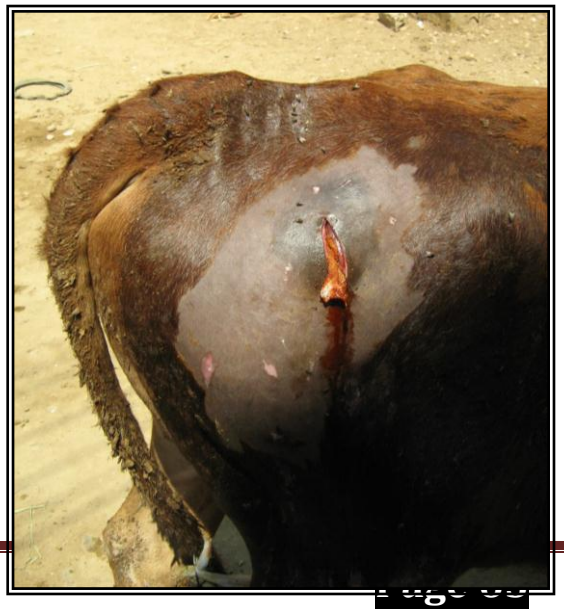
1-The area should be shaved, washed with soap and water, dried, and suitable antiseptic like Tr. Iodine is applied prior to incision.

2-Generally speaking it is not advised to open an abscess which is not fully ripe or mature to avoid secondary abscess formation, although abscesses that situated close to a joint or peritoneum should be opened before they are fully mature and this in fact is made to avoid rupture of the abscess into the joint or the peritoneal cavity.

3-Incision should be performed by using sterilized abscess knife or scalpel that incises the abscess from its point and downward so that drainage occurs by gravity when the animal stands in normal position.

4-Sometimes it is necessary to make another opening to provide drainage and it is called a counter-opening.

5-After evacuating the pus, the cavity should be irrigated with antiseptic solution like hydrogen peroxide, to promote the complete evacuation and removal of the contents then after the abscess cavity should be explored for the presence of foreign body.



6-After opening the abscess and its irrigation, it should be packed with gauze moisten with Tr. iodine to destroy infection and to stimulate the healing process. The gauze packs are removed after 24 hour and then the abscess cavity is irrigated with diluted solution of mild antiseptic solution like acriflavin, potassium

permanganate, dettol, savlon, or povidone iodine.

7-The abscess cavity should be dressed daily and drain should be changed till the healthy granulations are seen filling its gap.

The actual functions of the gauze: -

1-To carry the antiseptic solution (Tr. iodine)

2-To maintain the opening of the abscess and prevention of its closure

3-To bring exudates out of the abscess progression or retardation of healing

4-To induce mild irritation that stimulates granulation formation

The average period required for the complete healing of an abscess is about three weeks and it should be obliterated from inward to outward, otherwise, secondary abscess is formed. However, the persistent discharge from an opened abscess indicates; inadequate drainage due to either small orifice; retention of dead tissue as sequestrum or foreign body; or persistence of suppuration as a result of secondary infection or the use of ineffective antiseptics. The use of systemic antibiotics may be indicated in some cases.

Critical Abscesses

Critical abscess found in vicinity of serious area (has great blood vessels, nerves) or vital organs such as parotid region or sub-pharyngeal region. Treatment of such abscess should be performed over the skin only without deep puncturing by using blunt instrument (artery forceps or blunt scissors) that is inserted through the underlying tissues to reach the abscess cavity and when the two jaws are inside the abscess cavity, the jaws of the instrument are opened without sharp cutting to widen the abscess opening bluntly. However the rest steps of treatment are the same adopted for treatment of abscess and mentioned before including evacuation, washing with antiseptics and insertion of drain.

Abscess in mucous cavity like pharynx, rectum or vagina may be opened by; thrusting the finger into its thin wall, using a concealed knife, trocar

and canula, or an ordinary pointed scalpel guarded or enveloped in gauze or cotton wool just up to its point.

II-CHRONIC or COLD ABSCESS

These abscesses grow very slowly and show very slight inflammatory reactions, therefore pain in these cases is either very slight or absent.

Etiology: -

Repeated simple wounds as those induced by the saddle, leading to wounds of the bony prominences as the ribs or the pelvic bones.

Types: -

1-Cold Soft Abscess

An abscess of soft surface and contains a large amount of pus

2-Cold Hard Abscess

An abscess that is surrounded by fibrous tissues and the pus contents are small in quantity.

Symptoms: -

1-Absence of inflammatory symptoms or presence of only mild inflammation

2-The abscess appears as cyst in cold soft abscess or fibroma in cold hard one

Diagnosis: -

1-History

2-Clinical examination and exploratory puncturing

Treatment: -

The same treatment adopted in case of hot abscesses by maturation and evacuation, however blister may be applied to change the cold abscess into acute one and bring the pus near to the surface before opening it.

When pus is inspessiated, curetting of the abscess cavity is necessary that is followed by application of a drain immersed in Tr. Iodine, and a counter opening for drainage may be necessary in some cases.

Encapsulated abscess can be excised surgically within its intact capsule then the skin wound is sutured

Special forms of abscesses: -

I-ACNE, FURUNCLE or BOIL

Acne, furuncle or boil is an abscess involving the sebaceous gland affecting all domestic animals but it is common in the horse and dog. In the dog it is more common in short haired breeds in the region rich in sebaceous glands like nose, lips ... etc.

Etiology: -

Local irritation from any cause (e.g. friction of saddle or collar) predisposes to the infection (mainly staphylococci)

Symptoms: -

The lesion appears as a single or multiple pustules that have the size of a pea that release grayish white pus. At the same time, grayish white core of necrotic tissue comes out when the pustule is compressed between fingers.

Treatment: -

1-Wash thoroughly with soap and warm water and apply an antiseptic and salicylic acid ointment

2-Some pustules must be incised to remove the necrotic core and then swapped with Tr. iodine

3-Topical and systemic antibiotics are very effective

II-PHLEGMON

It is a diffuse inflammatory swelling which fades gradually into the surrounding structures without any definite demarcation

Types: -

1-Septic

It is either caused by bacterial invasion or infiltration of the tissues by one of the body excretions as urine or feces

2-Aseptic

It is caused by infiltration of the subcutaneous tissues by an irritant sterile material as turpentine oil, chloral hydrate or concentrated saline solution

Symptoms: -

1-Formation of local diffuse swelling which fades gradually in the surrounding structures

2-Local tenderness and hotness

3-The lymphatic glands draining the area are usually inflamed

4-The body temperature rises and sharply fluctuates

Causes: -

1-Trauma followed by infection by microorganisms.

2-Infiltration of the tissues by body excretions or an irritant material

3-Secondary to local suppurated lesion as abscess, lymphadenitis or arthritis

Treatment: -

1-Keep the affected part in complete rest

2-Apply warm antiseptic fomentation with compression, antiphlogestic poultices and bandage if practicable

3-If the phlegmon is so voluminous, incise it several times (scarification) to provide drainage then dress it as septic wound

4-Administration of systemic antibiotics

5-Administration of anti-titanic serum for animals susceptible to tetanus

III-FISTULA and SINUS

It will be discussed at topic sinus and fistula

II-CYST

Definition: -

It is a congenital or acquired circumscribed non inflammatory hollow swelling or tumor like structure with secretory lining membrane and it contains fluid, semi-fluid, or solid structures like hair or teeth, or they are movable "bags" of liquid or semisolid material that are surrounded by a membrane wrapping. Cysts can sometimes remain at their same size during months or even years. Cysts can be classified into congenital and acquired; and into epithelial, retention, exudative, parasitic, or degenerative.

Classification: -

I-ACCORDING TO HEREDITY

1-Congenital

It is a cyst that presented at birth and it is of embryonic origin formed as a result of failure of embryonic cavity to obliterate or misplacement of certain embryonic tissue.

A-Dermoid cyst

Commonly, it is a subcutaneous cyst that is rarely observed in internal organs (ovary, testicle, or brain). An example of this type is the dermoid that frequently observed in the cornea or conjunctiva of farm animals and sometimes it contain hairs.

i-Simple form: -

It is lined with epithelium and contains mucoid fluid

ii-Compound form: -

It is a Teratoma like cyst that affects calves mainly

Location: -

The neck, Entrance of larynx, Posterior part of lower maxilla

Characteristic : -

Wall is similar to skin (has hair follicle and sebaceous gland)

iii-Follicular cyst: -

Location: -

Bony alveoli, especially the first molar teeth

Characteristics: -

It usually affects foal and increases in size at age of one year

B-Dentigerous cyst

Location: -

At the temporal bone as a sinus opening anterior to ear base

Characteristics: -

It usually affects foal and contain

tooth. Thick exudates comes out from the opening of the sinus and when it is probed, the probe will strike the tooth

2-Acquired

It is cysts that are acquired along the life of the animal as a result of certain pathological processes

II-ACCORDING TO CAUSE AND ORIGIN

1-Epithelial cyst

It is a type of cysts that has embryonic origin

A-Dermoid cyst

As mentioned before

B-Tongue base, pharyngeal, or epiglottis cyst

Location: -

Tongue base, entrance of pharynx or larynx, or epiglottis

Characteristics: -

It usually affects calves and foals, and has mucoid contents. It is either pedunculated or not, large round cyst that may interfere with mastication or cause dyspnea and asphyxia

C-Umbilical cyst

Location: -

Umbilical region

Characteristics: -

It usually affects calves and foals and contains mucoid contents with size varies from hen's egg to hand fist size

D-Traumatic epithelial cyst

Contents: -

Grey yellowish mucoid fluid

Characteristics: -

Caused by trauma or fire shooting with sequestration of piece of skin or foreign body at wound base with superficial healing of the wound

2-Retention cyst

It is an acquired cyst formed as a result of obstruction of secretory duct of glands

A-Atheroma

It usually affects horse

Contents: -

Sebaceous

Characteristics: -

It affects sebaceous gland of false nostril leading to stenosis of nasal passage and respiratory noise

B-Mucous membrane cyst

Contents: -

Clear viscid mucoid fluid

Characteristics: -

It is spherical or oval shape cyst formed due to obstruction of mucoid gland

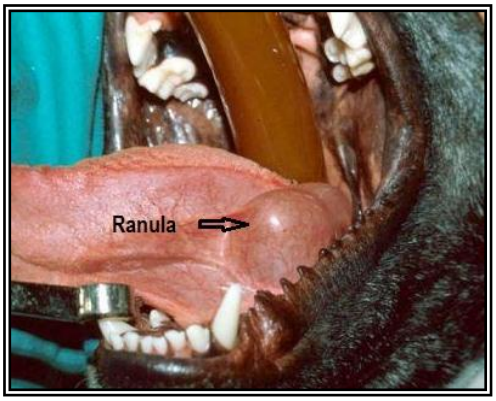
Location: -

1-Inner aspect of the lower lip or sublingual mucous membrane in cattle and horse

2-Rectal mucous membrane of the horse

3-Vaginal mucous membrane of the cow (bartholin gland)

C-Salivary cyst (neck cyst, brachial cyst, ranula, or honey cyst)



Contents: -

Honey like thick yellowish saliva (so it is called honey cyst)

Characteristics: -

It usually affects dog or other animals and formed as a result of obstruction of duct of sublingual or mandibular salivary gland. It is round or oval swelling with thin wall formed beside fraenum linguae or tongue (so it is called mouth cavity cyst or ranula), or under larynx or upper part of neck (so it is called neck cyst)

3-Exudation cyst

It is formed as a result of accumulation of exudates in pre-existing cavity as in case of accumulation of fluid in tunica vaginalis after castration or ovarian cyst

4-Parasitic cyst (pseudo-cyst)

It is formed as a result of irritation of tissue by growing parasite with formation of pseudo-cyst surrounded by fibrous tissue

Examples: -

Coenurus cerebralis	**Brain of sheep and cattle**
Echinococcus cyst (Hydatid)	**Kidney, liver, lung, spleen, and bone**
Taenia cyst	**Masseter muscle and heart in cattle and pigs**

5-Degenerative cyst

It associates tumors like cysto-carcinoma, cysto-sarcoma, or cysto-fibroma

Symptoms: -

1-Localized swelling containing fluid (fluctuating), semi-fluid, or solid structures like teeth or hair (dentigerous or dermoid cyst respectively)

2-Slow growth rate and *absence of inflammatory* signs

3-Well defined periphery with absence of pathological lesion in skin covering the cyst

4-Symptoms are confirmed by exploratory puncturing

5-Radiography diagnoses and confirms bone cyst

Diagnosis: -

1-History 2-Clinical signs

3-Exploratory puncturing 4-Differential diagnosis

5-Radiography

Treatment: -

1-Aspiration of contents by needle or trocar and cannula with injection of irritants like Tr. Iodine or 5% Carbolic acid to destroy secretory lining and to stimulate granulation tissue for obliteration of the cavity or

2-Surgical incision at lowest point and swap with Tr. Iodine to stimulate granulation tissue formation and obliteration or

3-Seton may be used to stimulate granulation tissue formation and obliteration

4-Surgical excision

5-Pedunculated cysts of the base of tongue, vagina, or abdominal cavity can be removed by ecraseur to avoid bleeding or

6-Ovariectomy or castration for removal of ovarian or testicular cyst o

7-Hydrocele can be treated by evacuation of fluid that is followed by castration

8-Dentigerous cyst can be treated by surgical excision, curetting, cauterization of the sinus, then closure of the wound with establishment of an opening at the lowest point for drainage

III-BURSA AND BURSITIS

Definition: -

Bursa is a closed sac lined with membrane similar to synovial membrane, located at boney prominence or between moving parts to permit gliding and prevents friction.

Bursitis: -

Bursitis is an inflammatory reaction within a bursa that can range from mild inflammation to sepsis. It is more common and important in horses. It can be classified as true (congenital) or acquired (false). True bursitis is inflammation in a *congenital* or natural bursa (deeper than the deep fascia),

as trochanteric bursitis and supra-spinous bursitis (fistulous withers). *Acquired* bursitis affects subcutaneous bursa that was not previously present or affects superficial bursa as capped elbow over the olecranon process, shoe boil over the point of the elbow, and capped hock over the tuber calcaneus.

Bursitis may manifest as an acute or chronic inflammation. Examples of acute bursitis include bicipital bursitis and trochanteric bursitis in the early stages. It is generally characterized by swelling, local heat, and pain. Chronic bursitis usually develops in association with repeated trauma, fibrosis, and other chronic changes (as capped elbow, capped hock, and carpal hygroma). Excess bursal fluid accumulates, and the wall of the bursa is thickened by fibrous tissue. Fibrous bands or a septum may form within the bursal cavity, and generalized subcutaneous thickening usually develops. These bursal enlargements develop as cold, painless swellings and, unless greatly enlarged, do not severely interfere with function. Septic bursitis is more serious and is associated with pain and lameness. Infection of a bursa may be hematogenous or follow direct penetration

Classification of bursa: -

I-ACCORDING TO POSITION

1-Subcutaneous

2-Sub-fascial

3-Sub-muscular

4-Sub-tendinous

II-ACCORDING TO HEREDITARY

1-Congenital (True, deep or typical)

They develop before birth and located in fixed position. Usually they associated the deep structures like deep fascia, tendons or muscles.

2-Acquired (False, Subcutaneous or atypical)

They develop after birth subcutaneously over bony prominence. Usually they grew as a result of mechanical effects as movement of the skin with

subsequent tearing of SC connective tissue with gap formation that is filled with fluid and encapsulated with fibrous tissue.

Classification of bursitis: -

I-ACUTE BURSITIS

1-Aseptic bursitis

1-Dry

2-Serous

Causes: -

Usually it is traumatic in origin and an example is acquired bursitis of olecranon bursa (capped elbow), capped hock (calcaneal bursitis), and capped knee (pre-carpal bursitis)

Signs: -

1-Pain during extension and flexion of the joint at early stages but distension is not clear (dry bursitis)

2-Pronounced exudation and distension at late stages (serous bursitis)

Treatment: -

1-Remove the cause

2-Rest of the animal and the organ

3-Cold application at early stage to prevent effusion and swelling

4-Systemic anti inflammatory

5-Local injection of steroids and penicillin but repeated injections may result in infection

2-Septic bursitis

Causes: -

The main cause of that type of bursitis is infection either via contaminated penetrating object or via circulation. Septic navicular bursitis may ensue after picked up nail while fistulous withers may ensue as a result of infection of the bursa by brucella.

Signs: -

1-General signs of inflammation over the distended bursa

2-Certain bursae may show draining as fistulous withers

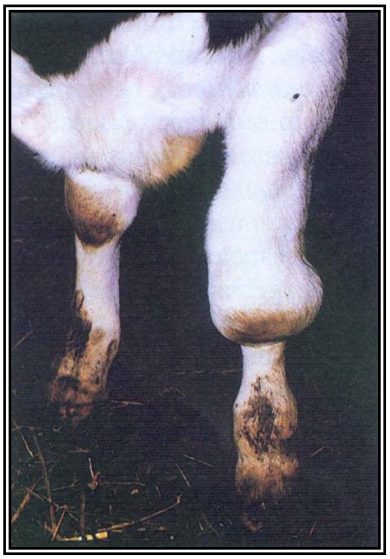
3-Lameness may be evident

Treatment: -

1-Surgical drainage with removal of necrotic tissue

2-Control of infection

II-CHRONIC BURSITIS



It ensues as a result of mild repeat trauma or as a squalled of acute infectious bursitis. The bursa shows swelling but pain is not marked as a result of chronicity. Usually it causes mechanical interference.

1-Cystic

This form characterized by cyst formation that has variable quantity of viscid fluid that may contain cartilaginous materials and a thick fibrous wall

2-Proliferative

The inner surface of the bursa contains vegetative papillae extend into the lumen of the bursa may with presence of cartilaginous materials

3-Fibrous

This type of bursitis characterized by presence of high amount of fibrous tissue and low amount of fluid and it appears as fibroma

4-Hemorrhagic

This form is characterized by presence of extra-vasated blood in the lumen of the bursa indicating the severity of the trauma

Treatment: -

1-Remove the cause

2-Topical application of absorbent (iodine ointment), counter irritant, or firing or

3-Aspirate its contents in case of cystic bursae with injection of irritants like Tr. Iodine or carbolic acid to destroy the epithelial lining and stimulate granulation to obliterate the cavity, this is performed in conjunction with application of bandage or

4-Application of seton or

5-Incision of the bursa with swapping the lining with irritant to stimulate granulation or

6-Surgical excision

IV-TUMORS

Definition: -

Tumors or neoplasm are those benign or malignant over growths that can be observed anywhere over the body of the animal. *Malignant* tumors usually affect elder animals (squamous cell carcinoma) while *benign* tumors affect younger animals (warts).

Classification and characters: -

Tumors are classified into benign or malignant, and solitary or multiple tumors

BENIGN TUMOR	MALIGNANT TUMOR
Capsulated	**Not capsulated**
Doesn't recur after excision	**Recur after excision**
Slower in growth rate	**Develops rapidly**
Doesn't show ulceration	**Shows ulceration**
Localized tumor, doesn't infiltrate or invade surrounding tissue	**Invade surrounding tissue**
Have definite shape	**Have no definite shape**
Doesn't adhere to the skin	**Adhere to skin**
Has no metastasis	**Metastatic**
Example ***Connective tissue:*** **Fibroma, lipoma, myoma, or osteoma** ***Epithelial tissue:*** **Papilloma** ***Endothelial tissue:*** **Angioma, or lymphangioma**	***Connective tissue:*** **Sarcoma** ***Epithelial tissue:*** **Carcinoma** ***Pigment cells:*** **Melanoma**

Diagnosis: -

1-History

2-Clinical signs and involvement of LN

3-Clinical examination

4-Histopathologic examination confirms diagnosis and determines nature of the tumor

Treatment: -

1-Benign Tumor

A-Ligature

Pedunculated tumors can be removed by ligation with elastic or rubbery materials and the induced wound is dressed with antiseptic solution. The aim of use of ligature is to close the blood supply of the tumor and to hasten its separation and sloughing.

B-Hot red iron

It controls bleeding, and causes necrosis and sloughing of the stump of the tumor.

C-Ecraseur

The skin is incised and the chain is applied on the incision.

D-Wart enucleator

It is a forceps with excavated jaws and sharp borders used for removal of warts

E-Potential caustics

Like arsenal paste, nitric acid, acetic acid, salicylic acid, or liquor of potassae

F-Surgical excision

2-Malignant Tumor

Generally, the success rate of treatment of malignant tumors is very low

A-Radiotherapy

The aim of use of this method is the destruction of malignant cells by gamma radiation. Anyway this technique is better to be used in adjunction with surgical de-bulking.

B-Cryotherapy

It depends up on two cycles of freezing and thawing. Freezing predisposes to ice crystals formation within the cell, and the volume of these crystals is larger than the volume of water leading to rupture of cells.

C-Immunotherapy

By using BCG that is injected 1 ml/cm3 once a week for 4 weeks. Severe reaction and necrosis of the tissue occurs. This technique is used for treatment of sarcoma in equine.

D-Surgical Excision

Alone, it is of no value as there is high probability of recurrence of the tumor

V-SINUSA

ND FISTULA

Definition: -

Fistula is an abnormal tract connecting between two cavities (as the recto-vaginal fistula) or between a cavity and the outer surface (as fistulous withers) or between a canal and the exterior (as milk and salivary fistulae). When the end of the tract is closed (has one opening), it is called a sinus which is a blind purulent tract showing no tendency to heal.

Classification: -

I-CONGENITAL or ACQUIRED

1-Hereditary (congenital)

The urachus is an example of congenital fistula, in such affection the umbilical cord is closed except the urachus from which the urine comes out from it as well as from the natural external urethral orifice in the penis in males and in the vagina in females, or recto vaginal fistula that sometimes seen in female sheep suffered from atresia ani.

2-Pathologic (acquired)

This fistula results from a pathological condition as a dental fistula, (caused by a diseased tooth) or quittor (caused by necrosis of the lateral cartilage of the hoof).

A-Purulent

It is a fistula discharging pus, like quitter that frequently seen on the coronet corresponding to the lateral cartilage in equine hoof

B-Non-purulent fistula (specific)

It is a fistula discharging any secretion rather than pus and these non-purulent fistulae are subdivided into;

i-Excretory fistula: -

As intestinal fistula, anal fistula and urethral fistula

ii-Secretory fistula: -

As milk and salivary fistulae

iii-Specific fistula: -

A fistula caused by a specific infection as actinomycotic fistula and botryomycotic fistula

II-ACCORDING TO NUMBER OF OPENINGS

1-Complete fistula

It has two openings

2-Incomplete or blind fistula

It has one opening (sinus)

Etiology: -

1-Improper drainage of the pus that predisposes to accumulation of pus in the bottom of the abscess preventing its healing. The presence of a foreign body or necrotic tissue at the depth of the fistula

2-Specific affections as actinomycosis and carcinomas

3-Abscesses of the parotid region and parotid duct

4-Faulty incision of an abscess either via incising it from its upper part or insufficient draining

5- Movement of the wall of the sinus prevents healing and predisposes to fistula formation

Signs:-

1-Presence of an opening that varies greatly in diameter and varies in number

2-The orifice of recent fistula is surrounded by granulation tissue while elder ones has hard fibrous borders

3-Long standing fistulae undergo cicatrisation and excessive fibrosis and contraction so that the opening of the fistula presented as if it is in depression

4-Presence of cicatrized spots representing old opening that closed following the formation of new one

5-Probing the duct may or not permits reaching to the cavity of the sinus according to the course of the duct (strait or tortuous), and may indicates presence of more than one sinus communicating by many ducts

6-Injection of fluid into the sinus indicates its volume and whether the orifices communicating or not

Composition of fistula: -

The fistula is composed of an *opening*, a *canal* and a *depth*. Typical *opening* is a small opening that is usually small in size denuded from hair and discharging pus of bad odor or discharging non-purulent exudates (according to the type of the fistula), and this opening is surrounded by an unhealthy granulation tissue. The skin around the opening epithelializes gradually until the opening is closed by a scar (presence of several scars around the fistula opening is an indication that the fistula is old), sooner or later pus accumulates in the depth forming a new abscess which bursts by a new opening beside the old one and in many cases more than one opening may be present. Some inflammatory reactions may accompany the fistula.

The *canal* connects the fistulous opening with the depth and it may be straight and short (as in cases of quittor or picked-up nail) or long and tortuous (as in cases of fistulous withers). Insertion of a probe from the opening of the fistula can detect the depth of the fistula and whether there are collateral canals or not.

The *depth* usually contains the real cause of the fistula which may be a foreign body, as a nail, suture material, piece of gauze, a necrotic tendon or a necrotic piece of bone (sequestrum).

Diagnosis: -

1-History

2-Signs and clinical examination

3-Radiography

Treatment: -

In fistulae with short canals, it is enough to curette the canal and its depth but when it is impossible, an incision is made including the whole tract, then irrigate the wound with antiseptic solution and the foreign body is extracted from the depth if present, while fistulae with long canals are treated by

1-Providing for good drainage when improper drainage is the main cause of formation of fistula. This can be adopted via incising the fistula in down ward direction or via creating counter opening

2-The interior of the fistula can be swapped with caustic substance (silver nitrate or copper sulfate) to facilitate sloughing of its lining that permits faster healing via widening of the lumen of the duct and elimination of

necrotic tissue at the depth. However this procedure is not recommended to be used near joint to avoid the possibility of sloughing into the joint

3-Inserting hot iron, in the form of a rod heated till it becomes red, inside the fistula to stimulate separation of necrotic tissues

4-Surgical opening of the fistula through its the whole length till its depth with curetting and removal of necrotic parts and foreign bodies. When the depth of the fistula can't be reached surgically, it is enough to perform curetting and washing with antiseptics

5. Surgical excision of the fistula (fistulectomy)

6-Some secretory fistulae can be treated either by a *purse string suture* after freshening the lips or when they have small orifice, *injection of some drugs* which have the power to enhance connective tissue formation may be useful. This can be performed by injection of 0.1 cc at 6 places around the orifice, subcutaneously and 2 injections inside the fistula orifice under the mucous membrane.

7-Cases of secretory fistula which do not respond to one of the previous treatments as parotid fistula must be treated by preventing salivary secretion by injecting Tr. iodine or paraffin (heated up to 40°C) inside the parotid duct 3-4 times.

Recto-vaginal or Recto-vestibular Fistula

Congenital recto-vaginal fistula is characterized by the communication between the dorsal wall of the vagina and the ventral portion of the rectum, so that the vulva functions as a common opening to the urogenital and gastrointestinal tracts. Usually, the abnormality is associated with a rectum that ends as a blind pouch immediately cranial to the imperforated anus.

Clinical signs: -

1-Passage of feces through the vulva, with vulvar irritation and tenesmus

2-Cystitis

3-Mega-colon

4-Pneumo-vagina that results from stretched, ruptured, deformed and horizontal vulva which may introduce fecal material, urine and air into the vagina (particularly in older cows) leading to vaginitis, cervicitis, endometritis

5-Failure of conception and repeated breeding

Otherwise the condition occurs as an acquired event in mares (wind. sucking, gill-flirter) because of the precipitate nature of the equine birth process. Perforation of the recto-vaginal shelf occurs at foaling. The lesion does not extend to include the perineum and feces accumulate in the rectum, more over chronic vaginitis ensues.

Diagnosis of such condition radiographically can be performed by retrograde infusion of the rectum with barium sulfate and if the animal suffers from atresia ani, the infusion can be conducted via the vagina.

The condition can be aggravated when the animal couldn't evacuate the rectum leading to mega-colon, however the condition is treated surgically by restoring the lumen of both the rectum and the vagina via linear incision along the median raphe just ventral to the anal sphincter extending to the dorsal vulva then after the fistula is located and isolated by blunt dissection. The dorsal communication with the rectum is ligated with absorbable suture placed around the fistula and the fistula is incised. Then the dorsal ligature subjected to over-sewing to ensure tight seal. The tract is also severed where it joins the vagina and the stoma is sutured with absorbable suture material in a line perpendicular on that created at the rectal side to make cross like.

Treatment: -

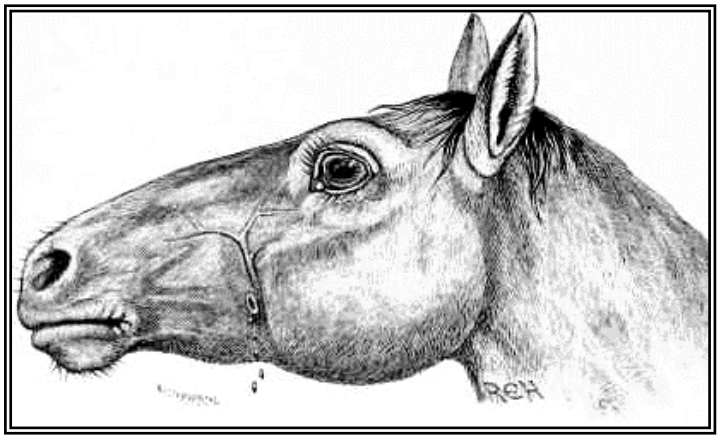
Two surgical techniques are frequently used in the treatment of recto-vaginal fistula and atresia ani

1-The fistula is isolated, transected, and the rectum and vulvae defects are closed separately, followed by reconstruction of the anus or

2-The rectum is transected cranial to the fistulous opening, the affected segment is removed, and the terminal part of the rectum is sutured to the anus. Closing the recto-vaginal fistula by numerous purse-string sutures along its length

Fistula of the Parotid Duct

The parotid duct, or duct of Stenson, is the vessel or canal by which saliva is conveyed from the salivary gland into the mouth. On leaving the gland the parotid duct passes along the inner surface of the lower jaw, and then winds round its lower border in front of the great muscle of the cheek in company with the inferior maxillary artery and vein, and finally opens into the mouth opposite to the junction of the second with the third molar tooth of the upper jaw in the horse. In its course round the jaw-



bone and along the side of the face it becomes exposed to injury, and as the result of blows from the kicks of horses and other mishaps as well as from the ulcerating effects of calculi (stones) which sometimes form within it, an opening is made through its walls at the seat of injury by which the saliva is allowed to escape instead of passing into the mouth. The duct may be completely divided, as sometimes occurs from external violence, in which case one portion of the vessel is separated from the other, or it may only be punctured. Obviously the former condition is the more serious of the two, since the divided ends draw away from each other and are with difficulty brought together under the most favorable circumstances; and if allowed to remain apart for any length of time that portion connected with the mouth closes up, owing partly to no saliva being able to enter it, but more immediately as the result of inflammation excited in it by the accident. Fistula of the parotid duct may also result from the formation of an abscess in some part of its course giving rise to ulceration of its walls.

Symptoms: -

The existence of this disease is known when a watery fluid is found to discharge through an opening in the skin at or near the lower border of the jaw. The quantity will depend a good deal upon the size of the opening and also upon the act of mastication. When feeding, the secretion of saliva is most active and the flow is very considerable, but becomes comparatively slight when food ceases to be taken.

Treatment: -

The indications here are to close the external wound promptly, so the saliva will flow along its proper channel. Success will greatly depend upon:

1-Whether the vessel is partially or completely divided

2-Upon the period of time which is allowed to elapse between the injury and recourse to treatment

3-The state of the duct itself

When the duct is cut through, or its walls are involved in an ulcerative condition, the prospects of cure are remote; when, however, the duct is simply perforated it is more favorable. Whatever treatment is undertaken, solid food must be altogether withheld for three or four days, or more if necessary, and the patient supported on liquid aliment such as thin oatmeal and maltmeal gruel mixed with eggs, beef-tea, and milk alternately, the object being to keep the jaws at rest and the secretion of the saliva as far as possible in abeyance.

The hair must now be removed from about the wound and the part thoroughly cleansed with soap and water and afterwards freely irrigated with a solution of carbolic acid. With a small needle and catgut-thread the lips of the wound are then to be carefully and completely drawn together, in doing which a sufficient hold should be taken of the skin to guard against tearing out. The part is then to be covered by a thick dressing of styptic-colloid and covered with a thick pad of antiseptic wool or absorbent lint.

When necessary both should be renewed but not otherwise, and the animal is to be so secured that he may not rub or otherwise disturb the application. By some, closure of the wound is attempted to be brought about by the production of a scab, and for this purpose it is freely dressed with caustic, such as nitrate of silver, nitric acid, or the hot iron.

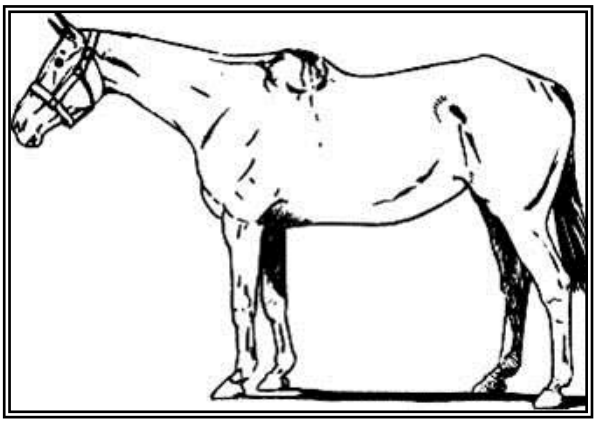
In old-standing cases, where the wound has become callous and that part of the duct near the mouth closed up and impermeable, the salivary gland should be destroyed, and the formation and discharge of saliva from it altogether arrested. This is accomplished by injecting some irritant along the duct into the gland. For this purpose a solution of one of the following drugs is employed, silver nitrate, caustic ammonia, or tincture of iodine. The immediate effect of this course is to cause inflammation and swelling of the gland, sometimes also the production of an abscess; the ultimate result, however, is that the organ is spoiled, ceases to secrete saliva, and wastes away. Defect in mastication will be observed for a short time, and it may cause indigestion, but with care in feeding and management this will soon cease.

Fistulous Withers

This is an abscess above the vertebrae, at the withers, which extends down between the shoulder blades. It is caused by a blow, a bite from another horse, or an ill-fitting collar or saddle.

Symptoms: -

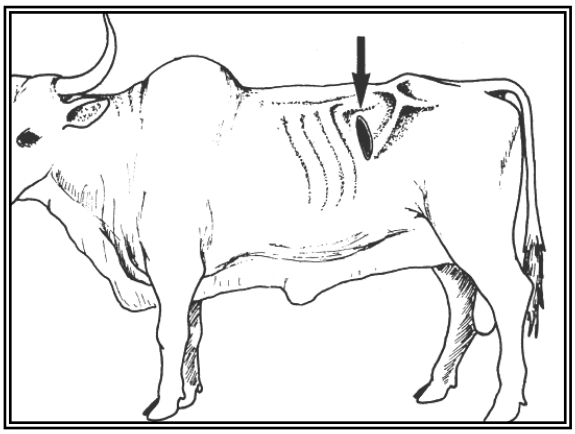
The first symptom is pain over the withers, followed by a swelling which may assume a large dimension. In most cases the swelling bursts, but in a few cases it will subside. If the swelling bursts, the skin may heal after the discharge has ceased, but this will be only temporary, and the abscess is sure to recur. Owing to the position of the abscess, it is extremely difficult to secure drainage, and the ligaments above the vertebrae are apt to be affected by the poison from the pus in the abscess.



Treatment: -

Fistulous withers is a very serious condition, and the veterinary surgeon should be called in immediately. He may be able to remove all diseased tissue by operation. Neglected cases are often impossible to cure. The external application of poultices or blisters is useless.

Ruminal Fistula



However mot all types of fistula are disease condition and require treatment, even sometimes we induce fistula for treatment of the animal. An example of such condition is the ruminal fistula that is created for treatment of cases of diaphragmatic hernia in pregnant animals to avoid fatal tympany during pregnancy, after which the animal can be slaughtered.

The condition is not only recommended in pregnant animals having diaphragmatic hernia, but also in chronic recurrent ruminal tympany that

usually occurs in calves of 3-9 months. It causes unthriftiness resulting from reduced feed intake. Fistula affords symptomatic relief and is rapidly produced. Alternatively, self-retaining disposable calf trocar may be used for a few days, but requires to be cleaned regularly with metallic trocar to avoid blockage.

Technique: -

Once the site has been cleaned and disinfected, and the local anesthetic injected, an incision about 5 cm for sheep and about 10 cm for cattle is made in the ventro-caudal direction through the skin, following the line identified previously.

The underlying abdominal muscles and peritoneum are separated by blunt dissection to form an opening in the abdominal wall. This requires considerable physical strength with large animals such as buffaloes and the bold use of the scalpel to cut to the peritoneum is less traumatic to the animal.

On reaching the peritoneum, this is cut and the rumen wall which lies immediately below is drawn to the exterior to form a fold and held with two "Alice" forceps. The brass clamp is applied and the screws tightened. Sutures should be placed through the skin and under the clamp and are tied to the clamp at both ends. These sutures hold the clamp to the skin and also prevent accidents which can occur if the rods catch on the sides of the pen. Stitching the skin is one of the most difficult aspects of the operation, particularly with buffaloes, and a sharp cutting needle is needed.

In ten to fourteen days the rumen fold held by the clamps will slough off and can be removed quite easily. A flexible rubber cannula or rigid cannula prepared is inserted and clamped into position.

VI-HERNIA

It will be discussed at special surgery the next year

AFFECTIONS OF BLOOD VESSELS

I-AFFECTIONS OF ARTERIES

1-Wounds

A-Contusions

It is non-significant injury as a result of elasticity and vitality of the artery. When an artery is severed by contusion, the inner and middle coats contract and retract within the outer coat, and this promotes thrombus formation.

B-Open Wounds

Classification: -

i-Penetrating or non-penetrating: -

Non-penetrating wound causes weakness of the vessels wall predisposing to aneurism while penetrating one causes hemorrhage. Severity of hemorrhage depends on size of injured artery.

ii-Punctured, incised, contused, or lacerated: -

a-Punctured wound: -

It may be caused by sharp pointed objects, a piece of bone during fracture, or during surgery (neurectomy or phlebotomy) and gravity of the wound depends up on;

1-The nature of the causative object

2- The size of the puncture

3-The location and the size of the artery

b-Incised wound: -

1- Incised - Complete severing: -

Complete severing of large vessel may cause fatal hemorrhage, while those with smaller caliber, deeply situated, and associated with narrow wound in the overlaying tissue, may be followed by natural hemostasis with thrombus formation that is organized 40 days later.

Before organization of the thrombus, hemorrhage may recur if the wound is subjected to violence or the blood pressure increased.

2- Incised - Partial severing: -

Partial severing of the vessel may be *oblique*, *transverse,* or *longitudinal*. If the oblique or transverse sections are small, spontaneous hemostasis may occur as in case of punctured wound. If more than half the circumference of the vessel is involved, the wound retracts due to the elasticity of the wall and the constant force of the blood stream prevents the formation of thrombus. On the other hand, longitudinal wounds are less gaping, and so it is not so dangerous.

When an artery is torn, the inner layers recoil and covered by the outer layer that promotes coagulation, and this is the main idea of hemostasis by torsion or ecraseur.

Characteristics of arterial hemorrhage: -

1-The blood escapes in jets that coordinate with the ventricular contraction, but if the artery is so deep, the pulsatile movement may be not clear.

2-The blood is bright red

3-The bleeding is dimensioned or arrested by pressing the cardiac side of the wound, and when bleeding continues, it may be due to anastomosis with another artery at the distal portion.

Varieties of hemorrhage:-

1-Primary or immediate hemorrhage

2-Recurrent or intermediary or reactionary hemorrhage

3-Secondary hemorrhage

Prognosis of arterial wounds: -

Prognosis depends up on the size of the wound, the species of the animal (hemostasis occurs faster in dog, ox, sheep, and horse respectively), and the nature of the injury (complete severing is better than partial severing of the artery, as the inner wall retract in the former controversial to the later).

Treatment: -

Treatment of arterial wounds directed towards;

1-General treatment of the associating wound by suturing …..etc

2-Control of infection and stimulation of healing by using antibiotic and vitamins

3-Control of hemorrhage

2-Ulceration of Artery

The wall of an artery can be subjected to ulceration by the pyogenic microorganisms as with abscess formation and fatal bleeding can occur depending up on the caliber of the vessel.

Treatment: -

1-Treatment of the associating cause (The abscess)

2-Control of hemorrhage

3-Rupture of Artery

Artery may rupture as a result of laceration by fractured bone or violent effort as struggling or jumping.

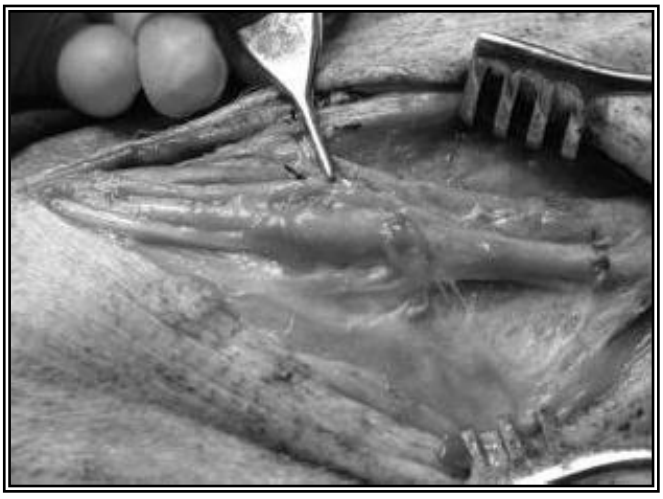
Symptoms: -

When a superficial artery ruptures, subcutaneous pulsating hematoma beneath the skin ensues (diffuse aneurism), but when a large internal artery ruptured, death may occur within few minutes to hours according to the size of the artery.

Treatment: -

Small superficial ruptures treated as hematoma, while internal ruptures are usually out of treatment.

4-Aneurysm



Aneurysm is seen frequently in horses as a result of strongylus vulgaris. External aneurism is distinguished as a pulsating swelling on the course of an artery that expands at each pulsation. The main complication of an aneurism is rupturing with fatal hemorrhage.

Treatment: -

Ligation of the artery above and below the aneurysm and extirpation of the aneurysm after ligation

5-Arteritis and Arterial Thrombus

Arteritis always precedes thrombosis. It ensues as a result of irritation of the endothelium by bacteria or parasite, or by violent over stretching of the endothelium. The rough surface of the artery permits thrombus formation that starts small and later on increases in size and extends to the first collateral branch and causes complete occlusion.

Partial thrombus affects the need of the tissue to blood and oxygen, even if the animal doesn't suffer any clinical signs, but when the animal is active, the blood supply becomes relatively insufficient and signs of reduced blood supply to that organ appear clearly.

An example of this theory is the colic seen in equine after feeding them coarser roughages while they have mesenteric thrombus due to strongylus vulgaris. These animals will suffer from colic as the blood supply of the intestine is relatively insufficient during digestion of coarse roughages that require relatively much more intestinal motility and subsequently much more blood supply.

Symptoms of aortic and ileac thrombosis: -

The symptoms of thrombosis at bifurcation of the aorta are characteristic, the horse is quite normal at rest, but after exercise, he stops and shows symptoms of distress and even the animal may lying down. If the case is unilateral, the affected limb may be cold and has no prominent veins like the health leg, and the condition is called *intermittent claudication*. On rectal examination, the location of the thrombus can be detected. The prognosis is grave because the case is usually incurable.

Treatment: -

There is no satisfactory treatment of the condition, and the following measures are tried without definite success;

1-Administration of potassium iodide, fibrinolytic enzymes, or heparin

2-Massage of the aorta per rectum although fragmentation of the thrombus may cause embolism and death of the animal

3-Rest of the animal that is followed by gradual exercise

II-AFFECTIONS OF VEINS

1-Open Wounds

Wounds of the vein are much more common than arterial ones as a result of the superficial location of veins, and they usually give rise to hemorrhage of various degrees according to the size of the vein wound, aside from the hemorrhage, infection of the vein and phlebitis may ensue according to the nature of the causative agent.

Treatment: -

As arterial one

2-Air Embolism

When a vein is opened near the chest, air can enter the vein leading to air embolism, that may affect the coronary artery, pulmonary artery, or it cause heart failure when it is large enough.

Treatment: -

Massage over the injured vein to permit escape of air with blood

3-Phlebitis

Definition: -

Phlebitis is irritation of the smooth inner lining of a vein (tunica intima) and associated with roughening of the vein lining that can encourage the formation of clots. All veins are susceptible for phlebitis, however, the jugular and umbilical veins are usually at greater risk of developing phlebitis.

General signs: -

The vein is reddened or inflamed and can sometimes be felt as a thick cord beneath the skin.

Causes: -

1-Peri-vascular infiltration by irritant drug like chloral hydrate or thiopental

2-Lack of aseptic precautions during IV injection

3-Extension of infection from other sites, septic wounds over the vein, or toxins

4-Infection of umbilicus

Types: -

A-Adhesive phlebitis

The vein appears as hard resistant cord due to roughening of the endothelium with thrombus formation that adheres to the wall of the vein occluding its lumen partially or completely. The peri-venous tissue seems edematous and pain is evident along the course of the vein.

Treatment: -

Treatment includes resting, antibiotics and anti-inflammatory drugs

1-Keeping the affected area at rest to avoid extension of the inflammation or disintegration of the thrombus and embolism

2-Application of antiseptic for the wound of the affected vein

3-Providing for drainage of the wound

4-Application of counter irritant after the thrombus organized, to stimulate collateral circulation and to remove edema from the parts drained by the vein

B-Purulent phlebitis

Inflammatory symptoms are much more acute, and abscesses may be formed over the vein that may form fistula discharging hemorrhagic pus. Probing of the fistula may cause the probe to enter the vein.

Treatment: -

1-Opening abscess after maturation and enlarging the fistulous orifice for removal of the necrotic tissue

2-Irrigation of the lesion by antiseptics

3-Otherwise, extirpation of the purulent vein can be performed

C-Hemorrhagic phlebitis

It is a complication of one of the fore-mentioned types of phlebitis that ensues due to disturbance of the clot or the thrombus of the vessels either mechanically or as a result of infection. It is characterized by repeated hemorrhage.

Treatment: -

1-Plugging of the wound with antiseptic gauze to arrest bleeding

2-Ligation of the vein

4-Varicose

It is uncommon in veterinary practice. Usually it is observed on the ventral aspect of the abdomen or the lower part of the leg.

Treatment: -

1-Compression

2-Firing the skin over the vein to act as a sort of permanent bandage

3-Obliteration of the vein by injection with certain substances

4-Ligation of the vein above and below the swelling and excision can be applied

FLUID THERAPY

The principle goals of fluid and electrolyte therapy are the restoration and maintenance of homeostasis by restoring cellular perfusion, normal cellular functions, fluid volume, electrolyte and acid-base balance.

In order to understand the need of an animal to fluid therapy, three basic body changes must be kept in mind, these changes are; hydration status of the body, electrolytes changes, and changes of the acid-base balance.

I-HYDRATION STATE OF THE ANIMAL

Water constitutes more than 70% of the animal's body; 50% intra-cellular fluid and 20% extra-cellular fluid. The 20 % extra-cellular fluid is classified into 15% (in the interstitial space and in the body cavities like GIT and peritoneal cavity etc…) and the other 5% is intra-vascular.

Body of the animal

<table>
<tr><td>30%
Solids</td><td colspan="3">70%
Water</td></tr>
<tr><td></td><td colspan="2">50%
Intra-cellular</td><td>20%
Extra-cellular</td></tr>
<tr><td></td><td></td><td>15%
Interstitial</td><td>5%
Intra</td></tr>
</table>

The animal suffers from dehydration when the animal losses large amount of water outside the body as during severe diarrhea, severe vomiting, hot weather with water withheld, etc… all the previously mentioned condition cause direct loss of body water and the final result is called dehydration. Dehydration doesn't only mean loss of water outside the body, but the animal may also suffer from dehydration without loss of water outside the body. This occurs when the ratio between the mentioned body fluids disturbed, and an example of this is the sequestration of the body fluid in the rumen or the intestine as a result of obstruction of the bowel.

Severity of dehydration	**Mild**	**Moderate**	**Severe**
Body weight deficit %	**5-7 %**	**8-10 %**	**> 10 %**

Dehydration up to 5% is clinically inapparent, but over 5% is clear and the other signs of dehydration are clear, and over 12-15% dehydration, it

is said that the animal suffers from shock. Detection of the dehydration can be done either clinically by using skin fold test or laboratory by detection of the PCV in the light of total plasma proteins (TPP), hemoglobin concentration, and kidney function tests. The skin fold test is performed over sides of the neck by picking up and pinching of a skin fold. It is used as a rough guide for degree of dehydration.

In good hydration state the skin fold should flatten within 1-2 sec and percentage of dehydration measured with the consumed seconds for flattening of the skin fold. On reaching 7 seconds (7% dehydration) the animal will be so dehydrated that the eyes seem sunken. The major problem with dehydration is the adverse effect on the cardiovascular system with consequent reduction of tissue perfusion.

This finally will lead to, oliguria, low blood pressure, absence of hemorrhage at surgery site, tachycardia, cellular ischemia and acidosis as a result of glycolysis.

II-ELECTROLYTES

It is a group of extra and intra cellular cations (+) and anions (-). Water in the body never moves freely, but it usually moves with electrolytes. The loss or sequestration of water in the body is usually associated with disturbances in electrolytes, and if these disturbances are not corrected, the animal will die.

Na^+	**131-147 mEq/L**	**Cl^-**	**94-113**
K^+	**1.7-4.93**	**HCo^-_3**	**20**
Ca^{++}	**5.3**	**HPO^-_4**	**1.6**
Mg++	**1.8**	**SO-4**	**2**
Cations column		**Organic acids**	**10**
		Proteins	**14.5**
		Anions column	

1-Sodium

It is the major extra-cellular cation, responsible for half the plasma osmolarity, plays an important role in maintaining normal distribution of water, and controls osmotic pressure of extra-cellular fluid. The plasma sodium level in normal horses is 131-147 mEq /L.

2-Potassium

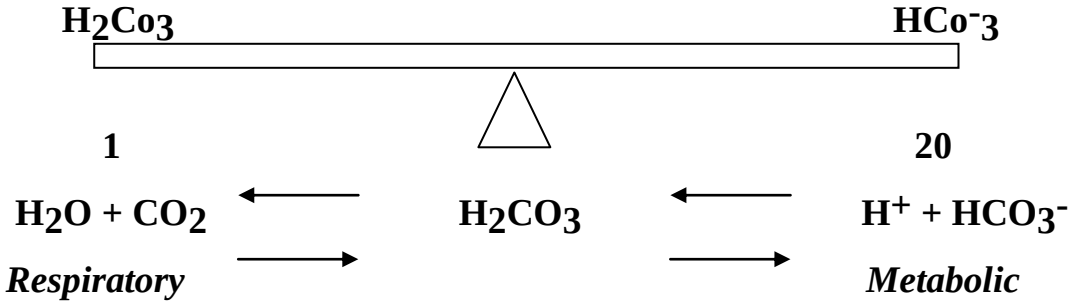
It is the major intra-cellular cation and the extra-cellular level is very low. Red blood cells and muscles contain high amount of potassium, so hemolysis and muscular activity elevate the serum level of potassium. The plasma potassium level in normal horses is 1.7-4.93 mEq/L.

3-Chloride

It is the major extra-cellular anion. The plasma chloride level in normal horses is 94-113 mEq/L.

III-ACID-BASE BALANCE

Acid-base balance is carefully regulated with normal blood pH ranging from 7.36-7.44. Blood pH is determined by the concentration of free hydrogen ions and the animal suffers from acidosis when pH lowered than 7.35 and pH values less than 7.2 are life threatening, but significant alkalosis is uncommon in surgical patients. The state of acid-base balance or imbalance of the extra-cellular fluid depends upon the relative quantities of carbonic acid and base bicarbonate present in the extra-cellular fluid. Normally they are present in the ratio of 1part carbonic acid: 20 parts bicarbonate. When the pH increases over 7.8 or decreases than 6.8, the animal dies. Alteration in the acid-base balance is either respiratory or metabolic in origin.



1-Respiratory acidosis

It is a condition where the CO_2 is retained as a result of hypoventilation leading to respiratory distress, depression of the CNS, weakness,

cyanosis, and finally coma. The condition is characterized by retention of CO_2 and H_2CO_3 and excess H^+. The compensatory mechanism of the kidney is the retention of HCO_3^- and secretion of H^+. Laboratory analysis of the blood and urine will reveal dropping in the pH. Treatment of this affection is directed toward proper ventilation and using of alkalizing solution like sodium bicarbonate, lactate or acetate.

2-Respiratory alkalosis

It is a condition of loss of high amount of H_2CO_3 and in turn H^+, with retention of HCO_3^- as a result of hyperventilation. Clinical signs include hyperpnea, hyperactive tendon reflexes, and CNS stimulation or excitation with convulsion. The pathogenesis is excessive release of CO_2 and the compensatory mechanism of the kidney is to excrete HCO_3^- with retention of H^+. Laboratory analyses of the urine and blood will reveal rising of the urine pH. Treatment of such affection includes administration of acidifying solutions like NaCl.

3-Metabolic acidosis

It is a state of retention of H^+ with loss of HCO_3^-, it occurs as a result of excess acid production or excess loss of base. Clinical signs are characterized by depression of the CNS with hyperpnea. The pathogenesis is that ketones and excess Cl^- replace HCO_3^-, thus lowering pH while the compensatory mechanism includes hyperactive respiration to remove H_2CO_3 and the kidneys save HCO_3^- and excrete H^+. Laboratory analysis will reveal low urine pH, blood pH, serum HCO_3^-, and rising of the serum K^+. Treatment of such condition includes administration of alkalizing agents like sodium bicarbonate, lactate or acetate.

4-Metabolic alkalosis

It is a condition of excessive retention of HCO_3^- with reduction of the H^+. Clinical signs include CNS excitation like tetany and convulsion and muscular hyper-tonicity with dyspnea. The pathogenesis is the depletion of Cl^- with subsequent rising of the HCO_3^- and blood pH, while the compensatory mechanism includes rising of the ability of the kidney to

excrete HCO_3^- with retention of H^+. Laboratory analysis reveals elevation of the HCO_3^- and lowered Cl^- and K^+. Treatment is directed toward administration of acidifying solution like NaCl.

Acid-base imbalance directly affects the electrolytes, when acidosis ensues, the high level of extra-cellular H^+ shifts intra-cellular and exchanges with intra-cellular K^+. On the other hand, alkalosis causes the extra-cellular K^+ to shift intra-cellular and exchanges with intra-cellular H^+ so in cases of acidosis, the high extra-cellular K^+ is false and the animal may suffer from reduction of the total amount of K^+.

How to use fluid therapy?

On using fluid therapy, three basic questions must be kept in mind; what is the *type* of fluid therapy to be used? what is the *amount* of fluid therapy to be used?, and what is the *rate of injection*?

The fluid plan can be made without knowledge of laboratory result by using the anticipated alterations of the disease and isotonic polyionic fluid as Ringer's which is suitable for this stage, and later on the plan can be remodeled on knowing the laboratory results. The fluid should be used at the same body temperature.

Most of animals admitted to your clinic affected with acidosis. The state of acidosis ensues as a result of anaerobic glycolysis, and these animals suffer from hyperglycemia. Accordingly, incorporation of glucose in the fluid therapy is contraindicated unless the laboratory results revealed the need of the animal to glucose. Improper use of glucose may aggravate the condition of dehydration by stimulating renal excretion.

The amount of fluid therapy can be classified into *replacement* dose and *maintenance* dose. Priority must be given to the volume of replacement (degree of dehydration X animal weight) injected in a *rate* of 10-20ml/kg/hour, while the maintenance requirements are 50ml/kg/day and injected in a *rate* of 2-4ml/kg/hour.

Ringer's solutions, containing lactate or acetate as bicarbonate precursors, closely resemble plasma composition. Lactate, acetate, and gluconate are used commonly as base sources because bicarbonate solutions are unstable and calcium carbonate precipitates in calcium-containing solutions. Lactate and gluconate induce alkalinization only after hepatic metabolism whereas acetate metabolism occurs in tissues and muscles.

Fluid therapy should be used cautiously in patients with CNS edema, congestive heart failure, or severe respiratory diseases as intensive fluid therapy can exacerbate the problem of fluid accumulation, and administration of sodium rich solutions should be avoided in patients with cardiac diseases to avoid volume overload.

The rapid rate of intravenous fluid administration is not hazardous in adult horses, however, the rapid expansion of circulating volume may cause diuresis before diffusion into ECF compartment, but in foals, this rapid injection rate can result in pulmonary and or cerebral edema. Generally, 10-20 ml/kg/hour for rapid replacement and 2-4-ml/kg/hour maintenance injection rate can be tolerated by animals.

EXAMPLE: -

A horse of 400 kg admitted to your clinic and suffers from strangulating obstruction of the large colon and 9% dehydration. Mention the type, amount, and rate of injection of fluid therapy.

Replacement dose should be injected to the animal at the 1st day then the maintenance dose is injected, however, the next day the animal is injected with maintenance dose only and this is repeated until the animal become able of taking reasonable amount of food and fluids orally, at this point the animal should be assessed to determine if fluid therapy should be continued or not.

Type: Ringer's lactate		
Amount	**Rate of injection**	**Hours**
Replacement **0.09X400** **= 36 L**	**10-20 ml/kg/hr** **(4-8 L/ hr)**	**4.5-9 hr**
Maintenance **50 X 400** **=20000 ml** **= 20 L**	**2-4 ml/kg/hr** **(0.8-1.6 L/hr)**	**12.5-25 hr**

SKIN AFFECTIONS

I-BURNS AND SCALDS

Definition: -

It is an injury of the skin and underlying tissues as a result of exposure to high temperature or corrosive chemical substances. Burns appear to be fairly uncommon pets. The commonest cause is friction injuries where the animal is hit by a car then dragged along the road or falling from an auto and being dragged behind it. When the etiology of burn is hot liquid or steam, the condition is called *scald*. Degree of injury depends up on temperature of object and duration of contact with the body. Generally, sudden increase in the tissue temperature causes coagulation of tissue protein and cellular death.

Etiology: -

1-Heat

2-Chimicals (acidic or alkaline)

3-Various forms of energy (light, ultraviolet rays, radiation, or electrical current)

Classification of Burns

I-ACCORDING TO THE DEPTH (CLASS I)

Burn depth has been classified according the degrees of injury. *Superficial or first degree* involves the epidermis layer, *partial-thickness or second degree* involves the epidermis and mid to deep amount of dermis, and the *full-thickness or third degree* there is complete destruction of the skin and compromise structures of the subcutaneous

1-Burns grade I

First-degree burns result in some redness and swelling of the injured part, without necrosis of any tissue or the formation of blisters. This type of burns is characterized by injury of the superficial layers of the epidermis, burning pain, marked hyperemia or erythema, and moderate edema of the skin. An example is the mild sunburn, and healing is completed in a few days without scarring as the superficial layers desquamate and replaced by the deeper germinal layers.

2-Burns grade II (Partial thickness)

Second-degree burns show a variable destruction of parts of the epidermis so that blistering occurs. Healing by regeneration in such superficial burns does not necessitate skin grafting, unless secondary infections ensue; no scarring results. This type of burns is characterized by;

1-Injury of the partial thickness of the skin including the whole epidermal layer and parts of the papillary layer of the skin

2-Burns that are caused by hot fluids or steam (in carnivorous animals) are characterized by formation of blisters or vesicles of variable sizes filled with serous exudates. On the other hand, burns as a result of flame (in large animals) never show blisters, but it is associated with edema of the subcutaneous fat.

3-Due to complete loss of epidermis, healing occurs by cells located in the dermis

4-Dilatation of the blood vessels in affected area with exudation of plasma and migration of leucocytes via affected blood vessels

5-Edema of subcutaneous tissue

3-Burns grade III (Full thickness)

Third-degree burns are marked by complete destruction of the epidermis of a region, including the necrosis of accessory skin structures like hair and sweat glands. A brownish-black eschar (a piece of dead tissues)

marks the destroyed tissue. This is sloughed off and that defect becomes filled with granulation tissue that later consolidates and changes to form a dense, thick scar. Complications may occur without adequate care, and grafting is not unusual, sometimes being required because of contracture of the scar tissue. This type is characterized by;

1-Injury of the epidermis and papillary layer, the epidermis undergoes total charring, and the papillary layer undergoes coagulative necrosis, leading to transformation of the entire skin into homogenous coagulated mass under the effect of heat and the formed eschar appears leathery and dark brown in color and the skin acquires rubber consistency.

2-Superficial subcutaneous blood vessels undergo thrombosis while deeper ones become progressively permeable leading to edema of the subcutaneous fat

3-Loss of sensation at affected area due to destruction of nerve endings

4-Damaged tissue undergo necrosis and gangrene

5-Healing ensues slowly, unless grafting performed, as the necrotized tissue slowly rejected leaving shallow ulcers, but later on, it is slowly covered by epithelium from wound edges

4-Burns grade IV

This type of burns is characterized by;

1-Total charring of the superficial layers of the skin

2-Coagulative necrosis of the skin through its depth

3-Necrosis of fascia, subcutaneous fat (with massive edema), and even the superficial muscular layers

4-The skin acquires shell appearance

5-Burns grade V

This type of burn is characterized by charring and blackness of all soft tissues and even of the bone.

II-ACCORDING TO EXTENT

Affected surface can be approached by burned body segments. Each forelimb means 9% each rear limb means 18%, head and neck 9%, Trunk and abdomen 18%.

1-Minor burn

It affects less than 15% of the body surface

2-Intermediate burn

It affects 30% of the body surface

3-Major burn

It affects more than 30% of body surface

Pathogenesis

I-LOCAL LESION

Burns grade I and II are manifested by serous or serofibrinous exudation and epithelial regeneration. While burns grade III to V are characterized by inflammatory reaction of purulent nature.

1-Stage of destruction

Skin destruction either occurs as a result of direct cellular damage via protein denaturation, or delayed injury via progressive dermal ischemia, necrosis, and gangrene. Affected area has three zones;

1-Central zone of coagulation contains eschar

2-Intermediate zone contains viable tissue that may die over the next 24 hours after burn

3-Outer hyperemic zone contains inflammatory mediators (prostaglandins and histamine) with edema formation and usually it recovers within 7-10 days unless infection ensues

2-Stage of inflammation

This stage is characterized by vasodilatation, plasma exudation on affected skin, and infection

3-Stage of healing

A-Partial thickness burn

Crust is formed to lower evaporation and to act as a dam against infection, then it separate after 3-4 weeks to leave a fully epithelialized healthy skin.

B-Full thickness burn

All the skin undergo burning with formation of thick layer called eschar that separates after 4 weeks exposing underlying granulation tissue that start epithelialization of the affected are from the periphery to the center. Healing is slow generally and associated with marked scaring that appears thin, shining, and hairless.

II-CONSTITUTIONAL EFFECT

Few hours after extensive burn, disturbance in circulation of parenchymatous organs, especially kidney, liver and lung, occurs. This disturbance might be due to vasodilatation of the peripheral blood vessels and increased permeability leading to edema and hypovolemia. The injured tissue easily invaded by bacteria leading to suppurative dermatitis. Finally, sepsis, toxemia, or shock (hypovolumic or toxic) ensues. Systemic reactions involve;

1-Kidney function as a result of hypovolemia and absorption of toxins

2-Liver function

3-Pulmonary function as a result of inhalation of smokes or steam

4-Hemoconcentration and disturbance of blood protein, electrolytes, and acid base balance as a result of fluid and blood loss via skin

5-Shock and septicemia

Treatment: -

Burns affect primarily the skin, and the degrees of injury are related to the depth and extension surface affected. The skin has many different roles in the normal physiology of the body. It is the primary barrier against invasive infection, helps to maintain the body temperature controlling the evaporation of fluids, adapts to aggressions or changes in the environment like pain, cold and heat. All these functions are impaired in burned animals and have been related as secondary cause of death.

First degree burns usually don't require any medical treatment, since the fur of your dog or cat will have protected it more than likely from being burned. *Second degree* burns need to be checked by a veterinarian if they exceed an area of more than two fists. The blisters that usually occur with second degree burns should be left alone if they look normal.

The skin will start healing on its own underneath the blister. The function of the blister is to protect the new skin from infections and further damage. The only thing you can do is applying light gauze to the blister.

Then, once the blister bursts it is important to gently remove the dead skin, for example by washing it off the affected area. The new skin that formed under the blister lays open now and needs to be protected. The best way to treat the wound is applying a wound dressing under sterile gauzes.

The major goal in treating burns in your dog, horse or cat is to relieve the pain and heal the burn without infection or major scarring. Aims of treatment are;

1-Relieve of pain 2-Correction of circulatory disturbance

3-Control of bacterial infection 4-Application of healing stimulants

1-Local treatment

Run cold water over the affected area or apply cold packs for up to 15 minutes or until the body part has returned to normal temperature. Do not overcool the animal. If the animal is starting to shiver then stop applying the cold water.

Thorough washing if the cause of burn is corrosive chemical substance. Chemical burns break down the protein in the skin. Pour milk over the burn or paint the area with egg white. This gives the substance something else to break down instead of your animals flesh.

Removal of charred or necrotic tissue as it is good media for bacterial growth and to facilitate contact between the topically applied dressing solutions and healthy skin.

Evacuation of vesicles to allow escaping of its contents and to relieve pain caused by pressure

Electrical burns tend not to damage the superficial skin so there may be little to see while the deep structures can be badly damaged. Be careful of any live wires and turn off power if possible, then remove yourself and the animal from danger, and finally cool the burnt area under running water. The surface of burn can be swapped with

1-Tincture of iodine (antiseptic)

2-Saturated solution of picric acid (analgesic and antiseptic)

3-Tannic acid 2% in the form of jelly (astringent)

4-Anodyne antiseptic ointments like cocainised vaseline or iodeform ointment

5-Topical antibacterial agents like dyes (gention violet), sulfa, or antibiotic preparations can be used for control of infection. Systemic antibiotics do not penetrate eschar, so topical therapy is always indicated with antibiotic ointments and creams. Gentamycin, Polymyxin, Neomycin, and bacitracin are very effective against the contaminant flora in burn wounds, as well as fluoroquinolones.

6-Solcoseryl or panthenol ointment, or cod liver oil can be used to stimulate healing

2-Systemic treatment

1-Stimulants (hypodermic caffeine) to counteract the effect of toxemia and depression

2-Antihistaminic (Avil®) to counteract the effect of histamine

3-Analgesics like cortisone (for its analgesic, anti-inflammatory and antihistaminic effect aside from rising blood pressure), however, cortisone has side effects like immuno-suppresion and delayed healing. One of the best analgesics anti-inflammatory to be used is Flunixine meglumine

4-Bronchodilator can be used like minophyline, if the animal exposed to high amount of smokes, and signs of respiratory distress are present, even tracheotomy is indicated if the dyspnea is so severe

5-Antibiotic for control of infection

6-Vitamin and minerals to stimulate healing

7-Administration of fluid therapy for correcting the hypovolemia, the best fluid therapy to be used is Ringer solution. The dose and the rate of infusion are very important; the doses that can be used depend up on the degree of dehydration that can be determined by measuring PCV in the light of total protein

Dehydration	Light	Moderate	Severe	Rate of infusion
Replacement dose	5%	8%	10%	10-20 ml/ kg/ hour
Maintenance dose	50 ml/ kg			2-4 ml/ kg/ hour

Prognosis: -

It depends on the extent of injury rather than the degree of burn, shock may ensue when more than 40% of skin involved, however, prognosis is

unfavorable when more than 50% of the skin is affected. First-degree burns may last 10 days for healing, while second and third degrees need 4 weeks or more for healing.

II-ULCERATION AND ULCERS

Definition: -

Ulcération is the loss of superficial epithelial tissues leading to exposure of sub-epithelial of skin or mucous membrane with formation of wound has no tendency to heal. It differs from gangrene in that the latter term denotes the simultaneous loss of vitality of a considerable portion of tissue.

Causes: -

1-Trauma 2-Infection

3-Neoplasm

4-Repeat irritation of a wound (dog's ear, tip of the tail and angles of flexion**)**

5-Presence of foreign body or necrotic tissue that causes infection and prevents healing

6-Loss of innervation 7-Poor blood supply

Classification: -

1-Traumatic ulcer due to trauma

2-Specific ulcer due to infection as in ulcerative lymphangitis, glanders, or T.B.

3-Malignant ulcer as rodent ulcer, epithelioma, and fungating ulcer due to streptococcus farciminosus

Symptoms: -

1-More or less rounded breach on the surface and varying in depth

2-The center of the lesion may be flat or concave and show necrotic spots

3-The borders may be hard or soft, and of the same level of the surroundings or higher

4-Usually it has serous, purulent, bloody, or grayish discharge

5-Old ulcer is surrounded by fibrous tissue and the edges are cut perpendicular and hard (*callus ulcer*).

6-If gangrene occurs at the level of the ulcer and extends rapidly in its depth due to bacterial destruction, the ulcer is called *phagedenic ulcer*

Diagnosis: -

1-History 2-Clinical signs 3-Clinical examination

Treatment of ulcers:

1-Remove the cause

2-Apply antiseptic fomentation with moderate pressure bandage to promote healing or

3-Astringent, thermo-cautery, or caustic applications can be used if the granulations are excessive or unhealthy, or for callus ulcer or

4-Excision of the ulcer then suturing of the wound is the best treatment

5-Specific treatment for specific ulcers

SURGICAL AFFECTIONS OF THE BONE

Structure of bone:

Bone is composed of three types of osseous tissue: the outer layer of compact bone or cortex, the middle layer of cancellous bone, and the medullary bone. The medullary bone is the connective tissue found in the interspace of cancellous bone as well as in the marrow cavity. The medullary bone give support to the bone marrow and the blood vessels.

The compact bone (cortex) contain longitudinal channels called Haversian canals. Surrounding each Haversian canal are thin ring-like bone called lamellae. Spaces between these rings are called lacunae containing osteocytes. The lacunae are interconnected by microscopic channels called canaliculi. Haversian canals are occupied by small arterioles derived from the periosteal and medullary arteries. Since hard bone is incapable of expansion, the collection of inflammatory exudates in these canals cause obliteration of the vessels due to pressure, and causes necrosis of the area of bone involved.

The cancellous bone is composed of bony tissue arranged in the form of trabeculae. Cancellous bone does not have Haversian system.

Inflammation of the cancellous tissue and marrow differs from that of compact bone. In cancellous bone, the blood vessels are not so readily occluded and this necrosis is less likely to result.

The proportion of cortical and cancellous bones varies greatly in different bones. In flat bone, the outer compact layers form two plates between which lies a small amount of cancellous tissue. In short bones, a thin layer of compact bone is found covering a disproportionally large amount of cancellous tissue. The long bones are made up of a shaft, which is composed of a tube of compact bone known as diaphysis joined to either end by a cartilage known as epiphyseal cartilage.

Blood supply of the bone is from the periosteum lining the outer surface of the bone, from the endosteum lining the inner surface, and metaphyseal arteries. In case of long bone, additional nutrient artery which enters the bone through the shaft. The nutrient artery breaks up into small branches in the endosteum and also enter Haversian systems to anastomose with branches from periosteal vessels.

Nerve supply to bone: the periosteum and endosteum are supplied with sensory nerve endings.

General affections of the bone

A) Congenital defects and deformities:

1-Absence of a part
2-Defect of a part
3-Supernumerary parts

B) Affections due to nutritional factors

The growth and maintenance of the bone depend on a balanced intake of minerals and vitamins. Defects in this respect are manifested in bone by retarded growth deformities and fragility.

Rickets: it is a disease of young animals in which newly formed bone matrix continues to grow but fails to calcify. It is generally related to low calcium and inorganic phosphate in blood plasma due to deficiency of Vit.D. Treatment by putting the animal on a balanced diet with adequate Vit.D.

Osteomalacia: this is the adult form of rickets affecting the adult animals. The condition is due to lack of vit. D and deficiency of calcium

and phosphorus. Radiographically, there is a generalized osteoporosis, which results in fragile bones and increased chance of bone fracture.

C) Inflammation of the bone (Ostitis)

Ostitis is usually due to concussion or sprain of the ligament at their point of insertion. The inflammation may be of the periosteum (periostitis), or periosteum and bone (osteoperiostitis). Osteomyelitis is inflammation involving chiefly the bone marrow. Ostitis may be acute, chronic or suppurative.

Ostitis cause rarefaction of the bone due to increased vascularity which predisposes it to fracture. Rarefaction or depletion of the mineral matter of the bone (de-calcification) seen in initial stages of inflammation is followed by increased mineral deposition when the vascularity decreases. This mineralization may proceed beyond the replacement of the loss from the initial decalcification, resulting in exostosis or condensation of the bone filling up the cancellous bone and Haversian canals as seen in chronic ostitis.

Symptoms:

General signs are of acute or chronic inflammation as the case may be. In chronic cases, the chief sign noticed is the presence of osseous deposits (Exostosis). Lameness is not marked unless the exostosis interferes with the movement of the joint or tendons.

Purulent osteomyelitis is characterized by multiple abscess formation in the bone. If infection is due to punctured wound injury, pus has direct route to escape externally through the wound (forming sinus).

Prognosis:

Aseptic inflammation usually terminates in resolution. Prognosis in septic inflammation is guarded as it depends on the virulence of the organism and the early treatment. Prognosis of chronic ostitis depends on the tissue involved (specially joints) and the location of exostosis (intra or extra articular).

Treatment:

Aseptic ostitis & osteoperiostitis: the aim of treatment is to limit exudation and control the developing exostosis. This can be achieved by cold application, pressure bandage, and application of counter irritant after inflammatory symptoms subside.

Purulent ostitis & osteoperiostitis:

Locally: comprises surgical drainage under general anesthesia. The opening of the purulent sinus is enlarged and the pus is evacuated and all necrotic tissue and bone removed. Local application of antibiotic or sulfonamides after wound irrigation and then bandage the area.

Generally: systemic antibiotic injection, parenteral tonics and stimulant are administered.

Chronic ostitis & osteoperiostitis: treatment is about curetting of exostosis and pressure bandage.

Local affections of the bone

A) Tumor:

Tumors of the skeletal system are most commonly seen in dogs, less in horses and cats. They may be benign or malignant.

Benign tumors: osteoma in compact or cancellous bone, chondroma in cartilage.

Malignant tumors: as osteosarcoma which is commonly seen in dogs and treated by limb amputation or limb sparing surgery.

B) Necrosis (osteosis), Avascular Bone Necrosis, or Cyst:

Definition: -

It is septic or aseptic necrosis of piece of bone. Septic necrosis occurs in some cases of sequestra or osteomyelitis, while aseptic necrosis occurs as a result of trauma, irradiation, or infarcts, and sometimes it is idiopathic.

Etiology:

Trauma leads to fracture and sequestrum is resulted.

Inadequate blood supply of a portion of bone causing ischemia and necrosis due to general or local circulatory diseases or specific infection.

Symptoms:

Local: sinus formation with inflammatory swelling.

General: disturbance may be observed depending on the part affected

Treatment:

Surgical treatment of the sinus.

Removal of sequestrum.

Irrigation of the wound and application of antibiotics and protective bandage.

Systemic antibiotic, tonics, and stimulants.

C) Traumatic injuries of the bone:

Injuries of the bone constitutes contusions and fractures.

1- Contusions:

It is a lesion produced by an applied violence to the bone as a result of which there is a varying amount of damage without a break in the continuity of the bone.

Symptoms:

If the contusion is limited to the periosteum, it causes exudation and extravasation beneath this membrane with a marked degree of pain.

When the bone is severely contused, this leads to hemorrhagic centers in its substance and perhaps infiltration of the medulla with blood. Acute ostitis result with acute local inflammation and febrile disturbances may be observed.

Symptoms of lameness may appear in different degrees according to the severity of the lesion and the part affected.

Treatment:

Complete rest of the patient.

Cold astringent application to the affected part in case of recent lesions.

Hot fomentations or counter irritation in old cases.

Pressure bandages.

2-Fractures:

Definition: -

Fracture is a partial or complete disruption or break down of bone continuity.

Causes: -

I-Predisposing (Indirect) Causes:
1-Anatomical

Anatomical factors include shape and position of the bone. Long bones are relatively exposed bones and are more prone to fracture than the short compact bones. Also, the superficially located bones are more susceptible to trauma and fracture than those deeply situated.

2-Age

The incidence of fracture is higher in young and senile animals

3-Sex

During sexual intercourse, females are more susceptible to pelvic fracture, while males are more susceptible to fracture of hind limb

4-Nutritional

Low calcium and phosphorus, high vitamin A, high fluorine, and high carbohydrate with obesity are all predisposing causes to osteoporosis and fracture.

5-Hormonal

Hyperthyroidism increases blood Ca and P and reduces them in bone, while low estrogen level in females predisposes them to osteoporosis (human)

6-Aim of Animal Use

Galloping, jumping, and drafting horses are more susceptible to fracture than show horses

7-Nature of Land

Fracture is less frequent on soft land and its incidence increases on slippery or hard lands

8-Animal Temper

Fracture is less frequent in calm animals and more frequent in vicious animals

9-Animal condition and diseases (Pathological)

Cancer or chronic depilating diseases predispose to fracture. The mechanical strength of the bone may be reduced locally by bone tumor formation or generally by diseases caused by dietary imbalance (osteoporosis) rendering the bone more fragile so that even minor trauma causes fracture. This is called a pathological fracture (abnormal bone that fractures with minimal trauma).

II-Exiting (Direct) Causes:

1-Extrinsic forces

A-Direct violence: -

Like falling from high places, car accidents, or violent beating of an animal with strong stick. The fracture occurs at or near the point of impact.

B-Indirect violence: -

The site of trauma is far from the site of fracture as falling on leg with fracture of the back (compression) or pelvic bones, or when twisting of hand causes fracture of shoulder bones

2-Intrinsic forces

A-Severe muscular traction during racing

Severe traction of muscle may exert enough stress on one or more bones causes its fracture

Classification of fractures: -

I-ACCORDING TO DEGREE OF DAMAGE (Extent of bone damage)

1-Incomplete fracture
2-Complete fracture

1-Incomplete Fracture

It is a type of fracture that doesn't extend throughout the full thickness of the bone.

A-Green stick fracture: -

It is a type of fracture affects long bones of young animals especially those suffer from rickets. The increased pressure over the convex surface of the affected bone predisposes to fracture and the injured bone looks like bent green stick.

Characteristics:

1-Affected bone has convex fractured surface and concave surface

2-It affects young animals only

B-Fissure cracks or fissure lines (Fissured Fracture): -

The fissures are formed in one cortex of the bone and are covered by an intact periosteum. This type of fractures occurs in adults.

Characteristics:

1. Presence of single or multiple fractures lines that are parallel or not, of different directions (transverse, longitudinal, or oblique)

2. It causes no bone displacement

C-Splint fracture (Splintered Fracture): -

It affects flat or long bone, as a result of direct violence as gun fire.

Characteristics:

1. The bone still intact & the hole of the fire arms sometimes has cracks around it.

2. Piece of bone separated from the main bone

D-Deferred fracture: -

It occurs as a result of neglecting incomplete fracture for a long period. Separation of fractured fragments occurs considerable period after the accident as a result of subsequent violence, strain or concussion. E.g.: some cases of broken back in horses.

E-Star fracture: -

It is a type of incomplete fracture characterized by radiation of fissures from a central point giving star shape appearance.

2-Complete Fracture

Complete fracture denotes complete disruption of bone continuity and the bone fragments may undergo displacement.

II-ACCORDING TO FRACTURE LINE

Fracture line is subdivided according to:

1-Number of fracture line

2-Site of fracture line

3-Direction of fracture line

1-According to Number of Fracture Lines

A-Single fracture: -

It is a fracture that divides the bone into two pieces (bone broken in one place).

B-Double fracture: -

It is a fracture that divides the bone into three pieces due to presence of two fractures in the affected bone

C-Multiple fracture (Comminuted): -

It is a fracture type where the bone is divided into more than two pieces with presence of more than one fracture line.

2-According to Site of Fracture Line

A-According to the location of fracture line on the bone & joint involvement: -

Fracture can be classified into epiphyseal, metaphyseal, or diaphyseal.

Epiphyseal fracture: affecting proximal or distal epiphysis.

Metaphyseal fracture: affecting metaphysis (which is the connection between epiphysis and diaphysis).

Diaphyseal fracture: affecting the shaft (diaphysis).

According to joint involvement, it is divided into:

Periarticular fracture: when the bone is fractured close to the articulating extremity without extending into the joint.

Articular fracture (Joint fracture): fracture involving the articular surface of a bone.

B-According to the name of the fractured piece of bone: -

Fracture can be classified into condylar, supracondylar, trochanteric, or inter condylar.

Supracondylar fracture: fracture above the condyle e.g. supracondylar fracture of the humerus.

Condylar fracture: fracture in which small fragments including condyle is separated from the bone. e.g. condylar fracture of femur or humerus.

Transcondylar fracture: a fracture of the humerus or femur in which the fracture line is at the level of the condyles

Intercondylar fracture: fracture between the condyles of the humerus. An intercondylar and transcondylar fractures may coexist making T-shaped fracture.

Trochanteric fracture: fracture of the femur passing thorough the greater trochanter.

3-According to the Direction of Fracture Line

A-Longitudinal: -

Usually it affects short bones. The fracture extends in a longitudinal direction. e.g. split pastern in horse where there is a longitudinal fracture of the second phalanx

B-Transverse: -

Usually it affects long bones. The fracture line is at a right angle to the longitudinal axis of the bone.

C-Oblique: -

The fracture line exists in an angle with the longitudinal direction of the bone

D-Spiral fracture: -

The fracture line passes through spiral pass around the long axis of the bone

III-ACCORDING TO FRACTURED FRAGMENTS

1-According to Displacement of Fractured Fragments

2-According to Stability of Fractured Fragment

1-According to Displacement of Fractured Fragments

A-Overlapped fracture (Riding or over-riding fracture): -

It is a fracture in which the two fragments overlap each other and presented side by side and it can be observed in case of oblique fracture leading to shortening of the bone

B-Angled or angulated fracture: -

It is a fracture characterized by angle formation between the two bone fragments, and this causes deformity of the shape of affected bone

C-Lateral fracture: -

It is a fracture type in which the two edges of the fractured bone exist lateral to each other

D- Torsion fracture: -

It is a fracture type characterized by rotation (twisting) of one bone fragment around its long axis

E-Wedged or Impacted fracture: -

It is a fracture characterized by displacement with impaction of one fractured fragment into the other fragment like wedge. The affected bone undergoes shortening. The fracture ends are driven into one another.

F-Depressed fracture: -

It is a traumatic fracture of flat bone over a cavity leading to displacement of a disc of bone into this cavity, like frontal bone (fracture of the skull in which the affected bone is pushed in giving a concave deformity as the fragment is depressed below the surface)

G-Compressed fracture: -

It is a fracture with shortening and thickening of the bone as those affecting vertebrae (cancellous bone) where compressive forces has resulted in reduction in the size of the bone.

H-Distracted fracture (Avulsion fracture): -

Fracture characterized by wide separation of the bone fragments due to pulling action of ligament or tendon. e.g. fracture of olecranon or avulsion of the tibial crest.

I-Dentate fracture: -

It is a fracture type that is characterized by presence of toothed interlocked two ends of the fractured bone

2-According to Stability of Fracture Fragment

A-Stable fracture: -

It is a fracture characterized by interlocking of the fractured fragments after reduction and they resist shortening forces, and the only fixation required in such fracture is to prevent angular deformity (like transverse fractures and greenstick fractures). A cast can be used when this type of fracture occurs below elbow or stifle while intramedullary pin is often effective when the fracture involves the humerus or the femur.

B-Unstable fracture: -

It is an oblique, spiral, or comminuted fracture as the fragments don't interlock after reduction and there is no resistance to shortening. Accordingly, the fixation is needed to maintain the length, alignment, and to prevent rotation. Intramedullary pinning provides poor resistance against these forces unless used in combination with cerclage wire in oblique or spiral fractures. The ideal method for this group of unstable fractures is to use lag screws in combination with a plate (*neutralization plate*).

IV-ACCORDING TO COMPLICATIONS

1-Simple fracture (Closed fracture)

It is pure bone fracture with no complications or wounds of the skin (the overlying skin remain intact).

2-Compound fracture (Open fracture)

It is fracture with skin injury (wound) i.e., there is a communication between the fracture site and skin wound.

According to the time of wound occurrence, this type of fracture is furtherly divided into:

a-Primary compound fracture: in which the wound occurs at the time of the fracture either from the external violence or from internal forcing of the point ends of the bone fragments which penetrate the tissue and skin.
b-Secondary compound fracture: in which the wound occurs after a period of the fracture time and it may be due to sloughing of the tissue over the fracture site.

3-Complicated fracture

It is fracture associated with injury to nerve (like radial paralysis), artery or vein, opening of a joint, or opening of a body cavity (like chest)

Symptoms: -

I-LOCAL SIGNS

1-Dysfunction

Dysfunction in case of limb fracture is most commonly exemplified by lameness. In the orthopedic examination the focal site of the lameness must be found and the diagnosis pursued. Dysfunction may also include paralysis with spinal fracture, unconsciousness accompanied by cranial fracture, or masticatory dysfunction with mandibular fracture.

Impairment or loss of function is a constant sign of complete fracture and is the result of pain or loss of mechanical support. Only in cases of incomplete or impacted fracture may some weight be borne by the bone.

2-Pain

Pain over the site of fracture is common. Pain is evidenced especially when the fragments is moved. Pain is less in impacted fracture. In incomplete fractures this may be the only clinical indication. Direct tenderness can be misleading, since it may be due to a contusion or other soft tissue damage caused by a blow. Indirect tenderness is a more accurate sign of fracture. It is produced by pressure in the long axis of the

bone exerted at its two extremities. If there is a break in the continuity of the shaft, such pressure will cause pain at the fracture site that is quite distinct from the pain of injured soft tissue parts. If an animal is examined during the state of local tissue shock, that is, within 20 to 30 minutes after the accident, pain may not be a conspicuous sign.

The initial pain exhibited at time of fracture vanishes after few minutes and there is a short period of no pain at the seat of the fracture (*period of numbness*) which last for 20 minutes. During this period of numbness there is also muscular relaxation and therefore reduction of fracture is easy. The period of numbness is again followed by pain and muscular contraction.

3-Local Swelling

Examination of the area around a fracture may demonstrate swelling, hematoma, contusion, or laceration if the fracture is open. Often because of extreme swelling, the examiner will be unable to palpate crepitation. Local swelling, although present in many other conditions, is one of the most constant signs of a fracture. Immediately after injury the swelling may be sharply outlined as a result of bleeding from the bone and the soft parts. An indistinctly outlined swelling that occurs later is caused by edematous infiltration. Generally, the swelling increases for 24 to 48 hours then gradually subsides (particularly under treatment). When applying bandages and splints immediately following fracture, it is important to bear in mind that swelling will subside.

4-Abnormal Posture or Limb Positioning (Deformity)

Abnormalities of positioning, when of acute onset associated with trauma, usually reflect a fracture. Deformity, a deviation from the normal anatomical structure, may be caused by displacement of the bony framework as in a fracture or dislocation, but it may also be caused by changes in configuration due to a neoplasm. Local swelling in the site of fracture may also cause some deformity. The displacement of bone fragments that produces deformity in a fracture may be angular, longitudinal, or rotational. Longitudinal displacements may cause shortening, referred to as overriding, or may result in separation of the fragments; termed distraction (e.g., fractures of the olecranon). In most cases the primary displacement is determined by the direction and force of an injury and is maintained and often increased by the contraction of muscles. If in doubt about positioning, comparison with the opposite limb or side of the body part is advised.

5-Crepitus (Crepitation)

Crepitus (coarse grating sound) is a sign of fracture that is considered pathognomonic. Bony crepitus is the gritting sensation transmitted to the palpating fingers by the contact of the broken bone ends on each other. There are other forms of crepitus (pseudo-crepitus or soft crepitus) such as occurs in some cases of arthritis, partial luxations of the patella, or luxation of the coxofemoral joint.

The absence of crepitus does not necessarily indicate the absence of a fracture. The interposition of a piece of soft tissue between the fragments will prevent crepitus. It is also absent when the ends of the bones are so far apart that they cannot be brought into contact, or when they are impacted.

Crepitation should be elicited with the utmost precaution because of the danger of causing further damage to bony fragments and surrounding soft tissue. Vigorous palpation, which may turn a routine closed fracture into a contaminated open one, should be avoided.

6-Abnormal Mobility

A false point of motion is also pathognomonic. It is the ability to move the affected part at a point or in a direction in which the movement is not normally possible. It occurs if there is a complete fracture of the shaft of a long bone; it does not occur in an incomplete or impacted fracture.

Mobility near a joint may be difficult to differentiate from normal or abnormal mobility of the joint itself. In order to avoid additional trauma, the same precaution should be taken in eliciting this symptom as in eliciting crepitus.

7-Radiographic Picture

Fracture, either diagnosed or suspected, should be documented by radiography. At least two views including the joints above and below the fracture are needed. Fracture of joints or special anatomical locations may require additional radiographs or special positioning. Radiographs should be read on a well illuminated flat surface. If questions about anatomical structures exist, the opposite limb or side of the body may be radiographed for comparison. The specific radiographic signs of fracture include those listed below: A break in the continuity of a bone; A line of radiolucency when the fragments are distracted; A line of radiopacity when the fragments are compressed or superimposed.

II-SYSTEMIC SIGNS

Although all of the above signs do not always occur in all fractures, combinations of these signs are always present. As time elapses between the time of the trauma and the time of treatment, symptoms change in accordance with the changes at the fracture site. Miscellaneous signs associated with fracture include the following:

1-Fever

Elevated temperatures are seen routinely 24 to 48 hours following a fracture and reflect the response to breakdown of the hematoma.

2-Anemia

Medullary arteries are high pressure vessels, and significant hemorrhage can occur with fracture. Large dogs may lose 200 ml to 300 ml of blood into the hematoma. Animals with multiple bone fractures can lose this amount of blood into each hematoma.

3-Shock

Hypovolemic shock can readily occur with severe fracture or concomitant vascular lacerations. Shock may lead to death following severe blood loss into a fracture site.

4-Nerve Injury

Depending on the location of the fracture or its severity, peripheral nerves can be involved.

5-Necrosis or Gangrene

In instances of fracture and simultaneous vascular laceration or occlusion, necrosis of distal extremities may occur. This usually occurs several days following fracture.

6-Fat in synovial fluid

This sign may indicate presence of an articular fracture; however, any trauma to a joint may result in fat in the synovial fluid. If fat is found and the animal remains lame, further studies may be needed to pursue the diagnosis of fracture.

Diagnosis: -

1-History

2-Clinical examination (local symptoms and crepitation)

3-Radiography for small animals or appendages of large animals

Prognosis:

The prognosis of fracture varies and depend on different factors:

1-Type of fracture: compound fractures are always serious than simple ones owing to the possibility of infection which can lead to osteomyelitis with bone necrosis and sinus formation.
2-Soft tissue damage: lacerated muscles may be interposed between the ends of the bone fragments thus rendering the proper reduction.
3-Age: healing rate is slow in old animals due to senile osteoporosis.
4-Temperament of the animal: docile animals have more favorable prognosis.
5-Size of the animal: small animal fractures are prognostically favorable.
6-Delay treatment.

Healing of fracture: -

Bone heals by regeneration of new bone. The reparative bone tissue is identical to the original bone. This is in contrast to the healing of the other tissues whereby the defect is repaired by fibrous connective tissue.

I-Pathologic Classification

1-Soft callous

1-Stage of hematoma (1-3 days)

2-Stage of tissue granulation (5 days)

3-Stage of ostoid tissue formation (5-7 days)

2-Hard callous

1-Stage of consolidation (3- 5 weeks)

2-Stage of osseous tissue formation (6 months)

3-Stage of remodeling

II-Clinical Classification

1-Temporary Callous

2-Soft Callous

Bleeding occurs during fracture with accumulation of inflammatory exudates leading to swelling. The fluid is reabsorbed, and blood under goes clotting with fibrin net formation. Later on angioblasts and fibroblasts appear for granulation tissue formation from the periphery toward the center. This process is associated with chondrogenic changes

(formation of cartilage) and ostoid tissue formation by osteoblasts with calcium deposition.

3-Hard Callous

It starts with consolidation and characterized by calcium deposition under control of blood calcium level, and gypsona can be removed 3-5 weeks later. Osseous tissue formation and remodeling occur during this stage with union of the bone fragments, conversion of ostoid tissue to osseous tissue, and formation of haversian system (it lasts 6 months). Osteoclasts lyses the external and internal callous with precipitation of calcium form outer to inner parts of the intra-fragmental callous.

It is important to note that callus formation can be minimized or eliminated by achieving complete stability at the fracture site. This may occur in an incomplete fracture or by utilizing methods of rigid internal fixation. The healing of rigidly fixed bone fragments by direct bone formation without callus formation and without multistage differentiation has been termed *primary bone healing*. This type of bone healing can occur in areas of direct bone contact or across small gaps.

Primary bone healing in areas of direct contact occurs by Haversian remodeling across the fracture site and leads to simultaneous union and reconstruction of the fragment ends.

Factors Affecting Fracture Healing:

The rate of fracture healing is influenced by many factors which may operate individually or collectively. The following factors are the most important to be considered.

1-Age

The younger the age the faster the healing (2-3 weeks in young and 3-5 weeks in old animals).

2-Individual variations

Certain individuals show faster healing of fractures than others of the same species and breed and this might be related to the general health condition of that individual.

3-Nutrition

Qualitative or quantitative reduction in food ingredients prolongs healing time. Low dietary levels of calcium, phosphorus, or vitamin D predisposes to delayed healing of the fracture.

4-Cause

Traumatic injuries are characterized by temporary hematoma followed by rapid healing, while infection of fracture site causes destruction of the granulation tissue with prolongation of healing time.

5-Site of fracture (type of bone involved)

Epiphyseal fracture of spongy bone heals faster than fracture of compact bone. Cancellous bone has an abundant blood supply and heals more rapidly than compact bone. Consequently, fractures involving metaphysis or epiphysis heals faster than those of diaphysis.

6-Shape of fracture

Single smooth fracture is better than multiple fragmented fracture. Comminuted fractures tend to heal more slowly because of inherent instability and disruption of the blood supply to the fragments. Fracture healing is also delayed by the presence of infection.

7- Kind of fixation:

Fractures fixed with internal pins heals more rapidly than with other types of fixation.

8- Diseases:

Some conditions causing change in bone structure necessary alter the healing time such as rickets, osteomyelitis, and bone tumors.

Treatment of fracture: -

I-Supportive treatment

II-Definitive treatment

III-Restoration of normal muscles, tendons, and joints function.

I-PRIMARY (SUPPORTIVE) TREATMENT

1-Prevention of shock due to pain by analgesics

2-Prevention of further damage due to movement

3-Prevention of change of simple fracture to compound due to movement

II-SECONDARY (DEFINITIVE) TREATMENT:

The basic principles of fracture treatment are reduction, fixation and restoration of the function.

A-Reduction of Fractured Bone to Approximate Normal Position

Reduction means correction of displaced fractured ends of bone into normal alignment and position

Types of reduction: -

1-Closed Reduction

It is performed with the skin closed (intact skin). These steps should be done after good straining of the animal with application of epidural analgesia (in hind limb fracture) or under effect of general anesthesia. The aim of anesthesia is to relieve pain, and induction of muscular relaxation. Later on extension (traction) of the lower fragment and counter extension of the upper fragment in the opposite direction by an assistant should be done to bring the bone fragments in one level. Finally, X-ray should be done to ensure the normal positioning of bone fragments.

2-Open Reduction

The fracture site is exposed surgically and reduction is performed under direct vision.

Open reduction is indicated in the following cases:

1-When soft tissue is interposed between fractured ends

2-Late unreducable or untreated fractures

3-Articular fractures where accurate anatomical reduction is essential

4-Growth plate fractures

5-Avultion fractures

6-When internal fixation is needed

7- Unstable fracture (oblique and spiral fractures)

B-Fixation & Immobilization till Complete Union of Bone

Holding the fractured bone segments so that they are stable or motionless as near its normal state as possible after their reduction. The fixation should rigid and uninterrupted during the healing process until clinical union is denoted via absence of pain on manipulation, stable fracture site, and palpable callus according to method of fracture fixation. The bone fragments and the joints upper and lower to the fractured bone should be fixed till complete union of fracture.

Types of fixation:

1-External Fixation

This method is usually used in association with closed reduction. External fixation is most effective for fractures with inherent stability (especially for transverse fractures). The joints located dorsal and ventral to the fracture should be fixed therefore this method is usually applied to fractures below the elbow and stifle, and sometimes all the limb is fixed.

Advantages: -

1-Cheap and easy method

2-It doesn't need high experience or complicated equipment

3-There is no possibility of infection

Disadvantages: -

1-Pressure necrosis

2-Joint problems and stiffness, and muscular atrophy due to prolonged fixation

A-Ordinary splints or coaptation splints: -

Splints must be light weight, malleable, sufficiently rigid to support the weight of the animal, ends are rounded and guarded by pad of cotton and has length greater than the distance between the two joints, like metal, wood, leather, or even cartoon in birds or pets. At least two splints (medial and lateral) are needed for proper fixation.

Application: -

The joints above and below the fracture should be involved and fixed, and sometimes the entire limb is fixed. Enough cotton padding should be applied to avoid direct pressure on skin and subsequent necrosis and gangrene, and to make the animal more comfortable, but very thick padding decreases the fixation.

Cotton should be inserted between claws or fingers, and should be at levels beyond the splint. Splints are applied medial and lateral to the limb then a gauze tapping should be applied over the splints.

B-Coaptation casts: -

Example of casts is the Gypsona or plaster of paris bandage. Other types of casts are plastic or fiberglass casts and they are stronger and not affected by moisture but they have no pores leading to heat stasis and sweat stasis with final maceration of the skin.

Advantages: -

1-Cheap

2-Easily applied

3-Has no local complications

Disadvantages: -

1-Affected by moisture

2-It needs long time to reach its maximum hardness (24 hours)

Application: -

Application of bandage by padding with cotton and tapping with gauze as mentioned before, and then the gypsona is applied and left for 30 mins to undergo hardening

Postoperative care: -

The cast should be observed for cracking, presence of discharge (color), odor, and swelling.

C-Thomas tube (Thomas extension splint): -

It is a metal tube of two rings (upper wide with a diameter 1 inch more than the thigh, and lower narrow), and two lateral splints longer than the limb. A modified Thomas tube with bent side splints is used for the hind limb. This splint is useful both for traction and fixation of fracture. It is usually used in dogs and cats, where prolonged extension of the limb has to be maintained and where the seat of fracture is higher as in humerus and femur.

D-External skeletal pin fixation (percutaneous pin fixation), External Skeletal Fixation (ESF): -

This method is a mixture of external and internal methods of fixation. It is suitable fixation method for compound or infected fractures, and it is not applied directly on bone, and the bone itself is fixed externally without incising the skin by using pins that pass per-cutaneous from bone cortex to the opposite cortex and the pins are fixed outside by frame (external bar). Generally, the splint is placed in the craniolateral surface of the humerus, the craniomedial surface of the radius, the lateral surface of the femur and the medial surface of the tibia.

The pins should be sterile, and of non-corrosive or ionized substances like stainless steel, platen, or cobalt nickel. The purpose of an external skeletal fixation frame is to immobilize the fracture so that healing can take place.

This method is called *Kirschner splint.* Again, it is ideal for treatment of compound or infected fracture as the pins can be inserted into healthy bone at some distance from the fracture site.

Types of external fixation device: -

i-Half pins: The pins pass through the skin once.

ii-Full pins: The pins pass through the skin twice.

However, all fixation pins should pass through two bone cortices

i-Half-pins: -

Although adequate in most small animal fractures, they are the weakest and least stable method of external skeletal fixation. Full-pin fixation or through-and-through pinning with connecting bars on both sides of the fracture increases the strength of the fixation approximately fourfold. To ensure correct placement of the pins when using a half-pins splint, the proximal and distal pins are positioned as far away from the fracture site as possible, and the middle pins (near the fracture site) should be positioned as close to the fracture site as possible as determined by the quality of the soft tissues and the bone itself. The stability of the half- and full-pins devices is related to the pin diameter that penetrates the bone and the distance from the bone that the connecting bar is applied; the larger the pin diameter (up to approximately 30% of the diameter of the bone), the stronger the fixation. The greater the distance the connecting bars are applied away from the bone, the less rigid the fixation becomes.

ii-Full-pins: -

Splinting with connecting bars on both sides of the leg. The ultimate strength of the external fixation device can be influenced by the number of pins in each fracture fragment. There seems to be an increase in stability up when including four pins in each fragment.

In all situations, the most proximal and distal pins are the most highly stressed. Again, when using full-pin splinting, it is important to place the pins as far from and as near to the fracture as possible. If the bones are sufficiently long, three or four may be used in each fracture fragment.

Advantages: -

1-No joint fixation thus it avoids complications the affect joint and muscles

2-No hindrance of circulation

Disadvantages: -

1-High incidence of infection

2-Possibility of traumatization of the frame

Application: -

Under aseptic condition, the pins are driven percutaneously into muscles, periosteum, and the two cortexes of the bone. It is better to drive the pins in two different angels for better fixation.

2-Internal Fixation (Osteosynthesis)

Direct fixation applied to the bone itself. Osteosynthesis means healing of the bone through surgical intervention with implantable device.

Internal fixation should be performed under complete aseptic precautions whereas open incision is made on the seat of the fracture to perform open reduction of the fragments and uniting them by any method of fixation.

The methods of internal fixation (*osteosynthesis*) include:

1-Intramedullary pins.
2-Wire: A- suture B- cerclage C- Tension band
3-Bone plates and screw.
4-Lag Screw.

Advantages: -

1-Better method because it fixes the bone itself without involvement of the joint

2-It produces accurate reduction as the skin and muscles are opened

3-It has no circulatory hindrance or pressure atrophy

Disadvantages: -

1-High incidence of infection and inflammation, and destruction of bone marrow

2-Pressure of the plate on bone

Used materials: -

1-From clinical point of view it should be of high strength, non-corrosive, not rusting, and not ionizing

2-From economic point of view it should be cheap like stainless steel (it is the best), ceramic, nickel, or cobalt

The principles, instruments, and operative techniques of internal fixation are regulated according to AO/ASIF studies. ASIF stands for association for the study of internal fixation.

The aim of the AO/ASIF techniques is a rapid return to full function by the portion of the skeleton involved. This achieved by:

1-Anatomical reduction of the fracture fragments especially articular surface in joint fractures.
2-Preserving the blood supply to the bone fragments and soft tissue by delicate atraumatic surgery.
3-Stable internal fixation satisfying the biomechanical requirements.
4-Early active pain-free movement and full weight-bearing of the traumatized limb, avoiding the *fracture disease*.

Internal fixation could be divided into extra-medullary & intramedullary.

A-Extra-medullary: -

i-Screw pin fixation or Lag screw: -

Interfragmental compression is a method of internal fixation of two fragments of bone together using the lag screw principles. The optimal position of a lag screw is perpendicular to the fracture line.

Indications: -

Fractured extremities, head of bone (femoral head), neck, or condyles (condylar fractures of femur and humerus).

Technique: -

1-Control of the animal

2-General anesthesia and aseptic precautions

3-Open reduction of fractured bone

4-Drilling of bone fragments and screw pining through the entire thickness of the fractured fragments

5-Closure of wound in layers

6-Removal of the screw after complete healing

ii- Orthopedic wire:

A) Wire suture:

Wire sutures may be used as the sole method of fixation particularly in fractures of the mandible. Simple interrupted sutures are used to retain fragments in place.

B) Tension band wire:

This method is used for treatment of avulsion fractures of the olecranon, greater trochanter, tibial crest, and os calcis.

C) Cerclage:

Cerclage wire is frequently used in combination with intramedullary pin for fracture fixation.

The cerclage wire for internal fixation is used mainly in oblique fractures in 360 cerclage (Full) or hemicerclage techniques.

Full cerclage wiring can be performed in the dog by large heavy-gauge wire of 18- or 20- gauge diameter and some method of adequately molding the wire to the bone (surrounding the whole contour of the bone). This technique has come to be used as a definitive method of fracture fixation in small animals and seems not to pull apart as one might suspect. The other technique is to use heavy- gauge wire and twist the wire in a fashion that allows the wire to tighten over the cortex. With this technique a wire twister or pair of pliers may be used.

Full cerclage wires can be used in long oblique fractures, spiral fractures, or in fractures that have longitudinal cracks. The wires are used most easily in mid-diaphyseal locations where the diameter of the bone is most constant.

Hemicerclage wiring has been advocated by many in combination with intra-medullary Steinmann pinning. In this technique a large 18- or 20-gauge wire is used to hold fracture fragments or cracks together. The wire is effective in reinforcing longitudinal cracks in the cortex and often in preventing rotation and overriding of oblique fracture fragments.

The wire is passed through a small hole in one fracture fragment, passes across the fracture site, and comes out through a small hole in the opposite fracture fragment. The wire is twisted together in the same manner as described in full cerclage wiring and may or may not be bent over in place, depending on its application.

Sometimes the wire is also placed around the intra-medullary device so that the pin is incorporated with the wire in bone-fracture fixation. Many patterns and applications of hemicerclage wiring have been reported in

the veterinary literature. They are a definite adjunct in any fracture that is handled with the single Steinmann pin when rotation of the fragments is a possibility or if overriding of the fracture is a complication.

Technique: -

1-Control of the animal

2-General anesthesia and aseptic precautions

3-Open reduction of fractured bone

4-Drilling of bone fragments with suturing of fragments with simple interrupted wiring by stainless steel wire

5-Closure of wound in layers

6-Removal of wire after complete healing

iii-Bone plating: -

This method can be applied by using metal plate that has the same bone convexity and fixed with 4-6 screw pins.

Indication: -

Diaphyseal fracture of long bones

Disadvantages: -

1-Exposure of large area of the bone and tissue that predisposes to infection

2-The plate is applied directly on the bone that predisposes to necrosis

Technique:

1-Control and general anesthesia

2-Aseptic technique guide

3-Open reduction of the bone fragments, exposure, and fixation by plate and pins

4-Closure of the wound in layers

B-Intra-medullary pinning: -

Fixation is made here through the medullary cavity of the bone. It can be applied to diaphyseal fractures of long bones but metaphyseal fractures are treated by screw pins.

Primary bone union should occur when the pin tightly impacts the medullary cavity and completely immobilizes the fracture.

The criteria for intramedullary fixation are:

a-Shaft fractures of long bone such as femur which are relatively straight.
b-Relatively transverse fracture which will impact under weight bearing.

Advantages: -

1-Proper reduction and fixation of the bone fragments

2-Joint, muscles, and blood supply are not affected

3- Ease and speed of insertion and removal of the pin

4- Low cost.

5- a pin which crosses an epiphyseal plate causes minimal disturbance in bone growth when compared with other methods of internal fixation.

Disadvantages: -

1-Bone marrow destruction

2-Higher probability of infection and osteomyelitis

Types of pins: -

1-Steinmann pin:

The Steinmann pin is the pin most frequently used in veterinary orthopedics and little specialist equipment is needed for its insertion. It is straight and round in cross section with pointed end and considered as the best type of pins. Intra-medullary pinning with a single Steinmann pin may be indicated in fractures throughout the length of a long bone. It is best for transverse and short oblique fractures of the middle third of long bones (like femur).

It can be applied in conjunction with cerclage and hemicerclage wiring. Single or multiple Steinmann pins together with cerclage and hemicerclage wiring may be adapted for all types of fracture fixation. The Steinmann pin is the most commonly used intra-medullary device in veterinary medicine and because it is placed in the medullary cavity, it resists bending in all directions. Its strength is related to its diameter, and its ability to restrict motion of the fracture fragment is related to its contact with the surrounding bony cortex. A small diameter intra-medullary pin in a large medullary cavity has been shown to producing non-unions.

Complications of intra-medullary pinning with Steinmann pins can often be traced to mechanical factors such as pin migration, or bending. Since

the medullary cavities of most bones in the dog vary widely in diameter, the Steinmann pin is usually used in three-point fixation. It is anchored at the point of introduction, has contact with the fractured surfaces and/or the isthmus of the medullary canal, and is impacted into the distal cancellous bone. In general, when an intra-medullary Steinmann pin is placed alone for reduction and stability of a fractured long bone, it should contact as much of the medullary cortex as possible in order to provide some torsional stability. If intra-medullary fixation does not present adequate stability against rotation, either multiple pinning, cerclage wiring, hemicerclage wiring, or external fixation must be used in conjunction with the pinning. Intramedullary devices provide no longitudinal support; the fracture fixation is dependent upon the stability of the fracture fragments themselves. Therefore, when comminution or cracks exist, there is a definite possibility for further collapse and telescoping of the fracture fragments over the Steinmann pin.

2-Kuntscher nails (V and "cloverleaf" shaped)

It is straight and V-shape in cross section. Kuntscher nailing is indicated for middle third, transverse, or short oblique fractures of the humerus, tibia, and femur when no longitudinal cracks or fissures of the bony cortex are present. The Kuntscher nail is designed to stabilize the bony fragments by filling the marrow cavity and contacting as much of the cortical bony surface as possible. In humans this contact surface is increased by intra-medullary reaming. In the dog, intra-medullary reaming is contraindicated because the cortices are relatively thin and the diameter of the marrow cavity changes markedly throughout the length of the diaphysis. Therefore, in the dog the Kuntscher nail is usually used as a three-point fixation device. The initial point of fixation is the penetration of the nail through the proximal portion of the bone. The nail is then stabilized in the central portion of the fracture site, usually at the area of the isthmus of the marrow cavity, and distally is anchored in the cancellous portion of the bone of the distal diaphysis.

The concept of the triangular or cloverleaf shape of the Kuntscher nail allows contact to be made along the marrow cavity in at least these three places. This is the one advantage of the Kuntscher nail over a firm-fitting round intra-medullary pin of the Steinmann type. The Kuntscher nail allows point contact on the inner medullary surface of the cortex, which will help prevent rotation of the bone fragments. The nail itself is a relatively weak appliance when subjected to torsional forces. The fact that it never breaks in canine application is due to that large torsional

forces are not usually present or that the nail does not fit tightly enough in the medullary cavity to prevent bony rotation.

3-Rush pin

It has curvature along its axis and it is bent near its wide end. Rush pins indicated when used in pairs for fractures of the distal humerus and distal femur (*supracondylar fractures of both femur and humerus*) or fractures of the central third of the diaphysis of both the humerus and femur in dogs.

They can be inserted individually, but this technique has not been popularly embraced in veterinary surgery. Steinmann pins are usually preferred than single Rush pins. The Rush pin is a specially tempered, round intra-medullary device that is supposed to be quite springy. It has a hooked end that is used to drive and seat the pin into the bone and a tapered end that should bounce off the inner cortex of the bone as it is inserted so that it fits snugly against the inner wall of the medullary cavity. It is through the elastic bending of this intra-medullary pin that the rigid fixation is accomplished.

Since each pin usually gives two points of fixation, Rush pins are most commonly used in pairs. It is important that the pins themselves bend elastically during their insertion, rather than cause a change in the axis of the bone.

Indications: -

Fractured long bones, but can't be used for comminuted fractures, multiple fractures, infected fractured, or metaphyseal fractures

Technique: -

1-Control and general anesthesia

2-Aseptic technique guide

3-Open reduction of the bone fragments

4-Insertion of the pin along the bone through medulla, and the excess length is removed by saw, or the pin is inserted in retrograde manner.

Osteotomy (Corrective Osteotomy):

Osteotomy is an elective surgical procedure whereby bone is cut (surgical division of the bone) to correct an abnormality which resulted from trauma or disease. Osteotomy is used for several specific indications:

1-Variation in growth of paired bones.
2-Diaphyseal angulation due to growth abnormalities (*Angular limb deformity, ALD*) or malunion fractures.
3-Torsional deformity.
4-Cranial cruciate ligament rupture in canines which is treated by TPLO (Tibial Plateau Leveling Osteotomy).
5-Limb length discrepancy.

Arthrodesis (Assisted fusion of the joint):

Arthrodesis is an elective surgical procedure for elimination of the motion in a joint by providing a bony fusion. This procedure is used for several indications:

1-End stage osteoarthritis.
2-To relieve pain.
3-To provide stability as in chronic loss of ligamentous support.
4-To halt advancing disease as in severe degenerative arthritis.

To accomplish arthrodesis of a joint, all cartilage must be removed to a level of bleeding cancellous subchondral bone. If bone ends are sclerotic due to the disease process, they must be removed. Since bony union is the desired end result, it is best to use rigid fixation, applied using the same considerations as for internal fixation of fractures. Cancellous bone graft must be applied around the contact areas of bone.

In small animal, arthrodesis can be indicated in most of joints, but in horses mainly in the distal interphalangeal joints (Pastern joint is the commonest).

Bone grafting (Bone Transplantation)

Bone grafts promote bone healing through osteogenesis, and osteoinduction, or bridge and replace cortical defects. Cancellous autografts are the most osteogenic and the most commonly used bone grafts in veterinary surgery. Whether an autograft (from the same animal) or an allograft (from the same species) is transplanted depends upon the quantity of bone needed and its availability.

Bone grafting is indicated in case of:

1-Comminuted fractures.
2-Cortical defects.
3-Nonunion.
4-Additional bone strength.

5-Arthrodesis.
6-Bridging larger defects.

I-Autogenous Bone Grafting (Autograft):

A piece of spongy bone is removed for healthy bone of an individual, fragmented, and transplanted to the fracture site of the same individual, it means that tissue transferred from one person or animal from one portion of the body to another.

II-Isografting:

The isograft is material that is taken from one individual and transplanted into another genetically identical individual, such as an identical twin. In this case the donor and the recipient must have the same genotype.

III-Allografting (formerly known as a homograft):

The allograft (formerly called a homograft) is tissue that is transferred from one individual to another individual of the same species.

Fresh allografts elicit an immune response resulting in death and phagocytosis of the grafted osteoblasts. Suppression of this immunological properties can be achieved by freezing for 48 hours or longer. Use of frozen allografts results in some initial delay in new bone formation (approximately 2-3 weeks) by the host, which is not seen in autografts. However, at 6-8 weeks, clinical and radiographic response from both sources appear nearly identical.

IV-Xenografting (formerly known as a heterograft):

It is tissue that is taken from one individual and transferred to another individual of a different species.

Treatment of Compound Fractures

The principle here is to treat the fracture and the wound as soon as possible with control of infection. Fixation, internal and direct skeletal fixations have no problem for the wound, while external fixation interferes with monitoring of the wound, so 8-Figure gypsona should be applied to leave a window for wound monitoring. The wound is treated as usual through the **window** in the gypsona.

III-Restoration of normal muscle, tendons & joint function:

Gradual exercise should be performed after union of the fracture to preserve the normal function of the joint, the muscle and the tendons.

Complications of fracture treatment:

The common complications of fracture healing include fracture disease, delayed union, nonunion, malunion, growth disturbances, osteomyelitis, pressure sores, and failure of implants.

Other complications include pressure necrosis, muscular atrophy, joint stiffness due to pressure of the fractured fragments, damage of artery or vein due to movement of splint, and improper reduction and fixation.

1- Facture disease:

It is used to describe the syndrome of muscle wasting, joint stiffness, and osteoporosis which results from prolonged immobilization of a limb during the healing of a fracture. One of the important advantages of rigid internal fixation of a fracture is that early pain free immobilization is possible and fracture disease is avoided. Physical rehabilitation should be performed to reduce the risk of *fracture disease*.

2- Growth disturbance

Trauma to the growth plate with or without fracture may cause premature closure and result in shortening of the limb or angular deformity.

3- Osteomyelitis:

Normal periosteum provides the bone with an adequate defense against invading microorganisms, but when this protection is removed as a result of a fracture or surgery then the bone becomes extremely susceptible to infection.

Bone infection occur more frequently as a result of open fractures than as a result of fracture repair. But the incidence of the latter can be high when internal fixation is used.

The ideal treatment of compound fractures should be aimed at restoring the continuity of the periosteum and protecting it so that it may in turn defend the bone against infection, this can be achieved by perfect open reduction, rigid internal fixation, debridement and wide excision of the wound, followed by primary closure of the soft tissue.

4- Pressure sores:

Fracture patients sustain minor pressure sores and abrasions from friction when encumbered with a cast or splint. Providing the fracture heals adequately, minor sores are of no consequence.

However, severe pressure sores that develop early or midway in the healing period will significantly limit the period of immobilization or the possibility for reapplication of another cast.

5- Failure of implants:

The large size of many patients, and consequently the extreme forces placed on the implants cause many implants to fail prior to completion of bone healing.

6- Malunion (Improper union):

Malunion is defined as a fracture that has healed or healing in an abnormal position. Causes include improper reduction and/or immobilization during healing.

7- Delayed union (Retarded) and nonunion (Pseudoarthrosis):

A frequent complication of fracture healing is delayed union. This means that the fracture has not healed in the time normally expected for that type of fracture (prolongation of the time for fracture healing).

In the state of nonunion (unsuccessful), the fracture healing stops and union will not occur without surgical intervention (failure of fracture to progress to osteosynthesis).

The clinical signs of nonunion (*Pseudoarthrosis* or *false joint*) include painful motion at the fracture site, progressive deformity, disuse of the limb, and muscle atrophy. The formation of *false joint* is due to failure of callus formation, the two ends of the bone fragments being united by fibrous connective tissue or being covered by cartilage and provided with a synovial membrane like true joint.

The causes of delayed and non-union are the same and are listed below:

1-Imperfect reduction and inadequate immobilization of the fracture.
2-Infection or osteomyelitis.
3-Gaping between bone fragments due to soft tissue interposition (such as muscle, tendon, or aponeurotic tissue) or distraction of the fragments.
4-Loss of blood supply by damage to the nutrient vessels to the bone or severe comminution.
5-Some diseases (rickets or osteomalacia)
6-General factors which delay wound healing.

Pseudoarthrosis can be treated by removal of fibrous connective tissue, soft tissue, and cartilage, refresh the bone surfaces by scraping, then make proper fixation.

8-Gangrene

It occurs due to direct pressure of splint on skin or tissue, impairment of circulation, or thrombi of the main blood supply. Signs of gangrene appear 24-48 hours later on in the form of local signs (Bad odor, swelling, and greenish discharge) and systemic reaction (fever and anorexia)

Treatment should be applied as soon as possible by removal of splint and application of hot antiseptic fomentations to enhance circulation, but if gangrene appeared, amputation will be the main treatment.

9- Formation of large callus:

If a fracture is improperly reduced leads to the formation of a large callus and deformity of the limb. The bone should be refractured via osteotomy and the excessive callus is removed and the fractured ends are set in the correct position then immobilized efficiently.

If a nerve is compressed by a large callus causing paralysis or pain, the enlargement may be removed if it is in an accessible situation.

Biological Osteosynthesis:

Due to complications associated with traditional open reduction techniques, a shift has occurred from establishing absolute rigid fixation to creating an environment more conducive to fracture healing.

Biological osteosynthesis is founded upon the theory that less precise reconstruction and less rigid fixation will reduce iatrogenic trauma to the fracture site and encourage early formation of callus with rapid secondary bone healing.

The principles of biological osteosynthesis:

(1) Indirect fracture reduction using limited surgical approaches with minimal disturbance of the fracture hematoma.

(2) Limited reliance on secondary implants such as cerclage wires.

(3) limited use of bone grafts.

These principles may be implemented through the use of an "open but do not touch" technique or by using various minimally invasive surgical techniques collectively referred to as *minimally invasive osteosynthesis (MIO).*

The evolution of surgical approaches from traditional "open reduction and internal fixation" (ORIF) to "open but do not touch" technique (OBDNT), and current "minimally invasive osteosynthesis" (MIO): -

1- Open Reduction and Internal Fixation (ORIF):

Early open reduction and internal fixation principles included anatomic reduction and stabilization of the bone fragments with rigid fixation using interfragmentary compression. Large incisions facilitate direct fracture visualization, manipulations of bone fragments, and direct reduction.

2- Open But Do Not Touch (OBDNT):

Open but do not touch techniques were devised as a logical next step toward optimizing bone healing. This technique involves an open approach for direct observation, the fracture site is not disturbed and alignment is restored via manipulation of the major bone fragments at positions away from the fracture site.

Distraction and alignment of the segments are facilitated by the use of bone-holding forceps. The "open but do not touch" technique, however, may result in damage to the vasculature and other soft tissues.

3- Minimally Invasive Osteosynthesis (MIO):

Further reduction of the surgeon's footprint may be achieved through implementation of MIO techniques, which involve indirect fracture reduction techniques and remote access to the fracture site.

Typically, two small incisions are made in the epiphyseal/metaphyseal regions (remote from the fracture site) and serve as portals through which the implant can be inserted into an epiperiosteal tunnel over the fracture once proper alignment is restored. Toothed reduction handles, commonly known as "*joysticks*" are used for reduction maneuvers. Joysticks are used mostly in pairs. A *tunneler* is used to create an epiperiosteal space within which the plate will be inserted. The tunneler features a blunt, spade-shaped tip designed to limit iatrogenic trauma to the periosteum. Plates anchored to the bone via only a limited number of screws at each extremity. MIO is commonly indicated for fractures of diaphysis.

With minimally invasive osteosynthesis, open exposure of the fracture is not performed, and only small incisions remote from the fracture site are used to achieve closed reduction and fixation. Minimally invasive osteosynthesis most effectively preserves an optimal biologic environment for fracture healing via limiting iatrogenic surgical trauma to the soft tissues and vascular supply surrounding the fracture. In another words, a key factor in the success of minimally invasive

osteosynthesis is the preservation of the early fracture hematoma as well as blood supply to the fracture site.

However, in part because of the lack of direct observation of fracture segments, proper implementation of minimally invasive osteosynthesis techniques is associated with a steep learning curve. The unique conformation and large surrounding muscle mass of some bones can make closed reduction particularly challenging. A comprehensive knowledge of the local and regional anatomy is required to achieve successful surgical outcome.

Preoperative radiographs and a normal bone specimen can be used for reference during surgery; however, specialized training and regular practice are essential for proficiency.

To avoid potentially devastating iatrogenic complications, intraoperative *fluoroscopy* (C-arms) is highly recommended for assessing fracture reduction (limb alignment and fracture fragment apposition), as well as for ensuring proper positioning of the implants.

Although critical for the reduction of articular and metaphyseal fractures, intraoperative imaging for diaphyseal fractures is considered beneficial. The concepts and techniques of minimally invasive osteosynthesis are progressively gaining acceptance as an alternative to previously described methods of repair.

Complications of MIO:

With minimally invasive osteosynthesis, the emphasis is placed on the biological rather than the mechanical component of fracture repair. As a result, complications such as infection, delayed union, and nonunion, seen with open reduction and internal fixation (ORIF), have substantially subsided.

Conversely, limited exposure of the fracture site during minimally invasive osteosynthesis has made implant application and restoration of alignment more challenging. Consequently, postoperative malalignment has become more prevalent with minimally invasive osteosynthesis (MIO) compared to open reduction and internal fixation (ORIF).

1- Malalignment:

Malalignment is the most significant challenge that orthopedic surgeons have to overcome with minimally invasive osteosynthesis.

2- Joint Space Violation:

Bridging plate osteosynthesis is routinely recommended in minimally invasive osteosynthesis in order to achieve optimal stability rather than absolute rigidity. Bone screws located at the plate ends are in close proximity to joint spaces, which in turn could result in placement of a screw through the joint surface and into the joint space if correcting measures are not implemented intraoperatively.

3- Neurovascular Injuries:

Iatrogenic lesions to neurovascular structures may occur with minimally invasive plate osteosynthesis. Postoperative identification of neurological deficits should warrant immediate revision, exploration of the affected nerve.

Conversion to open techniques:

Fracture reduction using minimally invasive osteosynthesis techniques can prove challenging or impossible in some cases.

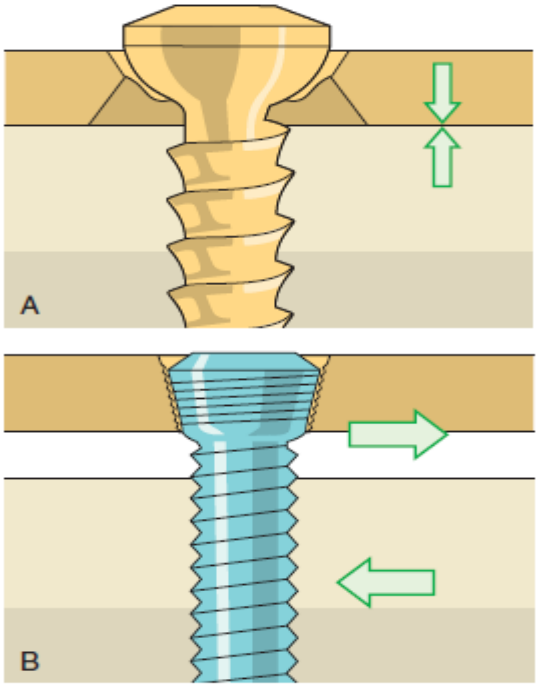
An important factor to consider when planning minimally invasive osteosynthesis is the time between trauma and repair. Lengthy delays result in muscle contraction, organization of the fracture hematoma, deposition of a fibrous intervening network, and formation of an immature callus. As a result, proper reduction may not be achievable. In these cases, the surgeon should revert to open reduction and internal fixation techniques (ORIF) to optimize fracture reduction and fixation.

Conversion to open approaches should be considered in the following cases:

1-If assessment of alignment is impossible or hazardous, conversion to open methods might become necessary.
2-If closed techniques fail to provide satisfactory reduction (failure to restore limb alignment or articular surface anatomy), conversion to open reduction must be performed.
3-Conversion to an open approach should be considered in cases in which adequate, atraumatic restoration of alignment cannot be completed within an appropriate amount of time with minimally invasive osteosynthesis techniques.

Plates and Screws:

Screws

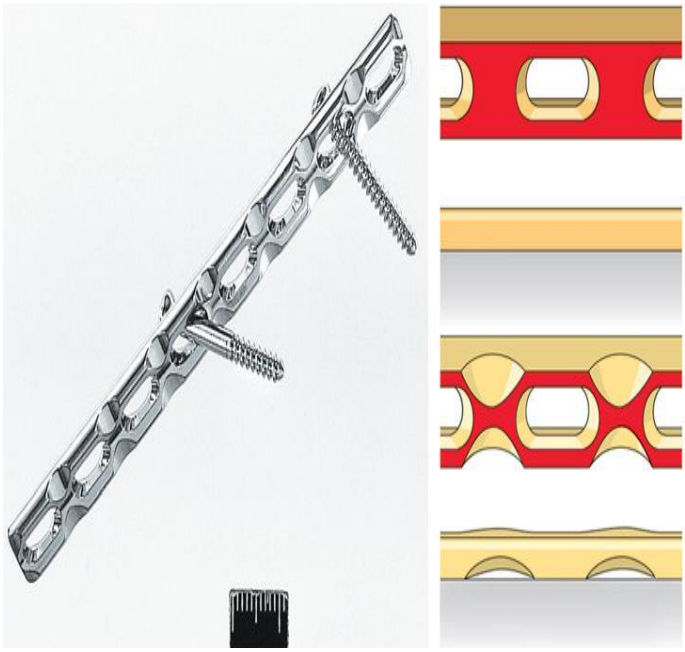


Different types of screws are available for use in bone. The distinctions are based on shaft thread type and whether the head is smooth or threaded for locking into a plate. Cortical and cancellous bone screws are made from stainless steel or titanium. Standard sizes for cortical or cancellous screws are 1.5, 2.0, 2.4, 2.7, 3.5, 4.0, 4.5, 5.5, and 6.5 mm in diameter. For optimal compression, place the screw perpendicular to the fracture.

Plates:

Bone plates are made primarily from stainless steel or titanium. Plates are available in many sizes and shapes, depending on their intended site of application and the strength required.

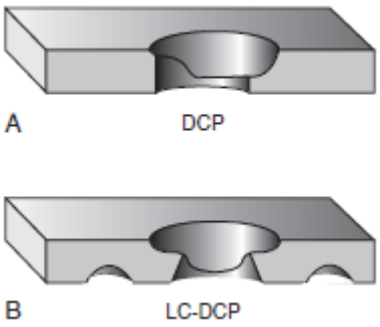
1- Dynamic Compression Plate (DCP):



The primary bone plate system is the dynamic compression plate. This name derives from the design of the screw hole, which, when used correctly and in the appropriate situation, results in compression of the fracture fragments. The dynamic compression plate (DCP) is made so that tightening the screws drives the bone ends together. This further stabilizes the fracture and allows primary bone healing. Plates with 6 to 12 holes are used most frequently.

2- Limited Contact Dynamic Compression Plate (LC-DCP):

The limited contact dynamic compression plate (LC-DCP) was developed to address two issues associated with the dynamic compression plate (DCP).



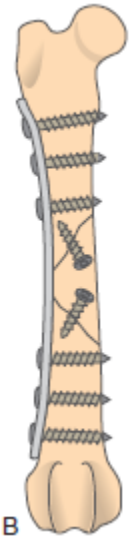
The contour of the solid portion of the plate is scalloped on the underside so that stress is not concentrated at the screw hole. Scalloping (undercutting) of the underside of the plate reduces the area in direct contact with the bone; it therefore has less effect on vascularity of the bone beneath it than does a dynamic compression plate and results in a more even stress distribution within the plate. The undersurface of each hole is also more rounded so that plate screws may be angled to a greater degree than with a dynamic compression plate.

Neutralization Plates:

A neutralization plate neutralizes physiologic forces acting on a section of bone that has been anatomically reconstructed and stabilized with lag screws and/or cerclage wire. In neutralization mode, the plate acts to neutralize forces which were not wholly addressed by the initial implants. Indications for a neutralization plate include reducible oblique fractures in which the fracture line exceeds 45 degrees.

If the fracture plane is oblique, applying compression with the plate causes fragments to shear. In these cases, compression of the fracture line is best achieved with screws used in lag fashion. However, alone, screws used in lag fashion are never sufficient to resist the bending forces on a weight bearing bone, so a plate is always applied. A plate used in this manner is termed a *neutralization plate*.

Image shows ***neutralization plate*** which addresses the physiologic forces acting on anatomically reconstructed oblique fracture with lag screws.



AFFECTIONS OF MUSCLES

Muscle is a tissue composed of bundles of elongated cells capable of contraction and relaxation to produce movement in an organ and it gives the body its general shape. It is called striated because it appears striped, in alternating bands of light and dark, when viewed under a microscope, and animals have conscious control over most of their striate muscles.

The normal anatomy and histology of the muscle revealed that its fibers, which are of elastic nature, run parallel to the long axis of the muscle with which the blood and nerve supply pass in the same direction. The muscle is an organ rich in blood supply and regenerates well but the regenerated tissue is usually of fibrous nature that has lesser elasticity than the original muscular tissue. The main function of the muscle is motion accordingly it is usually in a state of more or less contraction and its origin and insertion is usually tendon or ligament. Viable muscle contracts and bleeds when injured but due to its high contents of glycogen, it poorly hold suture material.

It is concluded that suturing of muscle require induction of muscular relaxation, and severing of muscle during surgery should be made parallel to the fibers as possible (grid technique) to minimize bleeding and fibrous tissue formation.

I-OPEN WOUNDS OF MUSCLES

It should be treated either it is recent or old wound, although the muscle usually unable to hold the suture material well.

II-RUPTURE OF MUSCLES

Muscle frequently subjected to ruptures that are either partial or complete, or at its middle or near insertion. Generally, rupture of muscle is not as common as that of tendons.

Causes: -

1-Severe contraction of the muscle

2-It occurs in the relaxed muscle by severe contraction of the corresponding muscle

Symptoms: -

1-General symptoms of inflammation or hematoma

2-Lameness if the muscle involved in motion

3-Hernia if the muscle is abdominal one

Prognosis: -

*Slight rupture heals spontaneously and signs of inflammation and functional disturbance subside

*Severe rupture is incurable as the muscle heals with formation of fibrous tissue that interferes with the normal function of the muscle

Treatment: -

1-Applying rest to the animal

2-Applying the usual remedies for treatment of of traumatic inflammation or hematoma

III-MUSCULAR ATROPHY

It ensues as a result of

1-Disuse of muscle (during fracture)

2-Paralysis (injury of nerve) 3-After myositis

4-Senility or poor nutrition (usually generalized)

Signs: -

The size of the affected muscle is smaller than that of the healthy side, and when the affection is bilateral, the size of the affected muscle will be smaller than that of another healthy animal of the same size.

Treatment: -

1-Remove the cause

2-Massage of the muscle to preserve its tone and stimulate blood supply

3-Application of counter irritants for stimulate nerve

4-Exercise for stimulation of the muscle

5-Administration of nerve tonics

IV-MUSCULAR SPASM (CRAMP)

A muscle spasm or cramp is an involuntary contraction of muscle that occurs suddenly, usually resolves quickly, and is often painful.

Muscular spasms are either;

1-Tonic (continuous) like tetanus

Tonic spasm of the muscle may occur as a result of severe muscular exertion and it may be related to irritation of the nerve endings by the product of the fatigued muscle.

2-Colonic (intermittent) like strychnine toxicity

Colonic spasm is an intermittent form of spasm like that observed with strychnine toxicity

Symptoms: -

The symptoms of muscle spasm depend upon the muscle involved and the circumstances leading up to the spasm. Skeletal muscle spasm usually involves muscles that perform excessive work. There is acute onset of pain as the muscle contracts. A bulging muscle may be seen or felt rigid underneath the skin where the muscle is located. Most often, the spasm resolves spontaneously after a few seconds though it may last many minutes or longer. Usually, the patient will feel the need to stretch the involved muscle, thus relieving the spasm and resolving the episode. Affected hind limbs are directed caudally like patellar luxation.

Treatment: -

Applying cold douches and massage

V-MYOSITIS

1-Acute Myositis

A-Traumatic myositis

It ensues as a result of trauma or bacterial infection

i-Simple myositis: -

It ensues after minor muscular injuries without breaking the skin like trauma or injection of irritant drugs. The affected muscle is hard, thick and painful, and may contain hematoma or sterile abscess, and lameness appears if the limb is involved. During healing, the formed exudates are resorbed, and the damaged fibers regenerate.

Treatment: -

1-Rest

2-Cold application

3-Antiphlogistic application

4-Treatment of large abscess or hematoma

ii-Bacterial myositis: -

It ensues due to extension of bacterial infection from phlegmon or cellulites or directly invade muscle with contaminated penetrating object (the skin is opened). The most common cause of that type of myositis is clostridia.

Affected area is painful on palpation, with firm swelling of variable size. Animal may show systemic reaction according to the causative organism, like fever. Lameness is clear when one or more limbs are affected.

Treatment:

1. Local treatment of infected area

2. Systemic treatment

B-Rheumatic Myositis (rheumatism)

It is observed in winter in neck, back, and limbs, and the affected muscles are tense, contracted, and painful, and pain is recurrent.

Treatment:

1. Anti-inflammatory (steroidal or non-steroidal)

2. Local antiphlogistine

3. Massage

2-Chronic Myositis

A-Chronic Fibrous Myositis

It is an extension of acute form and it is characterized by reduced signs of pain and lameness

B-Eosinophilic Myositis

This type was recorded in certain breeds of dog, and characterized by wide opening of the mouth with enlargement of mastication muscles that appears hard in touch, and later on it shows atrophy leading to changes in the shape of the face, but signs of pain or systemic reaction (fever) are usually absent. The eyeball shows bulging and the 3rd eyelid protrudes to cover about 50% of the eye, and finally the cornea becomes dry and ulcerated that may lead to blindness.

The affection is recurrent with weeks of interval during which the animal appears normal but as it reoccur, the disease takes the chronic nature. Examination of blood sample reveals state of eosinophilia.

Treatment: -

1-Steroidal anti-inflammatory

2-Antihistaminic

3-Local treatment of the eye

C-Chronic Myositis Ossificans: -

It occurs after trauma or inflammation of the muscle and characterized by calcification or deposition of calcium slat in the muscle and its connective tissue.

VI-TUMORS

It is mentioned before under the topic tumor

VII-PARALYSIS

It is mentioned before under the topic nerve affections

AFFECTIONS OF THE NERVES

I-COMPRESSION

It is a process through which the nerve is compressed against blunt hard objects for a period long enough to cause paralysis of the innervated organs. Clear example of that is compression of radial nerve during casting of the animal on lateral recumbency for long period during surgery leading to paralysis of the extensors of corresponding limb.

Causes: -

Pressure is the main cause (as with radial or facial nerve)

Symptoms: -

Paralysis of the innervated muscles if the nerve is motor and loss of sensation if the nerve is sensory

Treatment: -

1-Application of counter irritants and massage over the nerve course

2-Supportive treatment (bandaging the limb)

3-Injection of nerve tonics (Vit B12, Strychnine, or arsenical preparations)

4-Treatment of the affected muscle to avoid atrophy

II-CONTUSIONS

Contusions usually affect superficial nerves

Cause: -

Mainly trauma

Symptoms: -

1-General symptoms of contusion and inflammation

2-Paralysis of muscles (motor nerves) and loss of sensation (sensory nerves)

3-Pain at the nerve

Treatment: -

1-Promoting absorption of inflammatory exudates

2-Analgesics

3-Treatment of the paralyzed nerve and muscles as mentioned before

III-OPEN WOUND

Nerves may be subjected to different types of wounds either by external objects or by internal exciting causes like bone fragment during fracture. These wounds may lead to partial or complete severing of the nerve.

Treatment: -

Most nerves undergo regeneration following injury by swelling of the stump of the nerve with formation of neuroma, however suturing of the nerve and injection of nerve tonics promote healing of regenerative nerves.

IV-NEURITIS AND NEURALGIA

Neuritis is an inflammation of a nerve or group of nerves, characterized by pain over the nerve, loss of reflexes, and atrophy of the affected muscles.

Neuralgia is a chronic pain of *unknown* cause, and without inflammation, in the area covered by a peripheral *sensory* nerve. It appears as attacks of severe shooting pain along the nerve with weeks or months apart, but over time they become more frequent. Analgesics help, but permanent cure requires surgery.

Neuritis and neuralgia affect the peripheral nerves (the nerves that link the brain and spinal cord with the muscles, skin, organs, and all other parts of the body). These nerves usually carry both sensory and motor fibers; hence both pain and some paralysis may result.

Cause: -

The cause of neuritis may be mechanical, vascular, allergic, toxic, metabolic, or viral, while neuralgia has no definite cause.

Symptoms: -

Affection of *sensory* nerves causes tingling, burning, or stabbing pains while affection of *motor* nerves causes weakness to paralysis of the muscle that is usually confined to the part of the body served by the inflamed nerve.

Treatment: -

1-Once the underlying cause is treated, recovery is usually rapid but may be incomplete in severe cases, with residual motor and sensory disturbances

2-Analgesics can relieve the pain

3-Treatment of the wound if present

However with neuralgia, it is often difficult to diagnose, and most treatments show little or no effectiveness. Neuralgia is more difficult to treat than other types of pain because it does not respond well to normal pain medications.

V-PARALYSIS

The primary lesion may be in the brain, spinal cord or peripheral nerve. When the affected nerve is motor nerve, the innervated muscle has no ability to contract, and when the affected nerve is sensory nerve, the innervated region suffers from permanent analgesia.

Treatment: -

1-Nerve tonics

2-Counter irritants over the nerve and massage

3-Application of usual remedies to the innervated muscles

VI-TUMORS

It is discussed under the topic tumor

AFFECTION OF THE JOINTS

Anatomical Consideration

The joint is an articulation between two or more bones. According to their normal range of motion, joints are most often classified into three main groups:

1-Synarthrosis (fibrous joints)

They are immovable joints as in the skull, where bone plates are held firmly to each other by fibrous elements.

2-Amphiarthrosis (cartilaginous joint)

They are slightly movable joints as articulation between the vertebrae where a flattened disc of fibrocartilage connecting the articulating surfaces with a fibrous capsule invests the entire structure.

3-Diarthrosis (synovial joints)

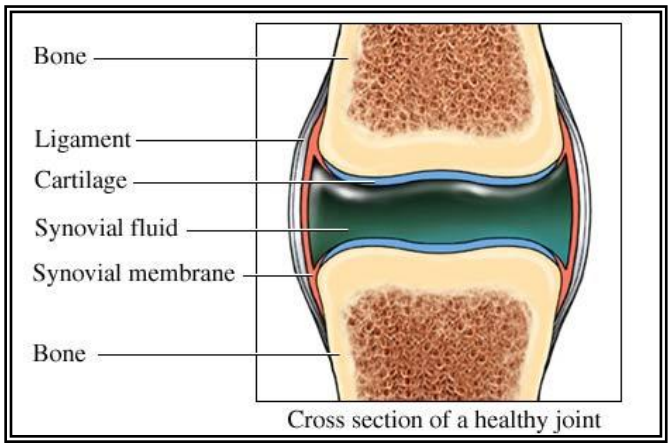
They are movable joints. Synovial, or true joints, vary with regards to the number of bones composing the joint, the amount and kind of mobility in them and the form of the joint surfaces. Synovial joints characterized by presence of articular cartilage, joint cavity and joint capsule lined by synovial membrane. Joints are held together by ligaments which can be extracapsular, intracapsular or be part of the joint capsule. Some joints include intra-articular plates of fibrocartilage between the articular surfaces. They form congruent articular surfaces, allow greater range of movement and diminish concussion. Examples are the menisci in the stifle joint or the articular disc dividing the temporomandibular joint. Intraarticular fat pads are located in some joints for protection.

Synovial joints consist of

1-Articular Cartilage

The articular cartilage forms a covering over the articular surface of the epiphyseal subchondral bone. The articular cartilage is avascular structure and has no nerve supply. It receives nutrition from the synovial fluid and subchondral bone. The collagen fibers of the matrix of the articular cartilage are orientated to withstand maximum stress and strain. Hyaline cartilage diminishes the effects of concussion and greatly reduces friction.

2-Joint Capsule



Cross section of a healthy joint

The Joint capsule consists of two layers, the outer fibrous layer which is thickened in parts to form ligaments and the inner layer or synovial membrane which is responsible for secretion and absorption of synovial fluid. The synovial membrane has a rich supply of arteries, lymphatics and nerves. Its inner surface is covered with fine villi. The synovial membrane covers all structures within the joint except the articular cartilages and menisci.

3-Synovial Fluid

Synovial fluid is an ultra-filtrate of blood plasma that contains hyaluronic acid, proteoglycans, protein, white blood cells and other biomedical mediators. The main function of synovial fluid is to lubricate the joint and provide nutrition to the hyaline cartilage. Synovial fluid is normally clear, colorless to yellow, viscid, free from blood and does not clot after standing. It contains a few cells and present inside the joint in low amount according to the volume and type of joint. The quality of the synovial fluid deteriorates with joint injury and inflammation. Synovial fluid analysis is valuable in diagnosis of joint diseases.

4-Ligaments

Joints are held in place by intra-capsular, capsular or extra-capsular joint ligaments.

AFFECTIONS OF THE JOINTS

I-ARTHRITIS

Definition: -

Arthritis can be defined as inflammation of the joint. This inflammation may involve any or all of the components of the joint, which include the bones forming the joint, the articular cartilages, the joint capsule and associated ligaments.

Types: -

1-Traumatic arthritis (serous arthritis)

2-Osteoarthritis (degenerative joint disease, DJD)

3-Septic arthritis (Infectious arthritis)

1-Traumatic Arthritis (serous arthritis)

It is characterized by non-infectious inflammation of the synovial membrane and increased synovial fluid, with subsequent increased capsular pressure and swelling.

Causes: -

Direct trauma is the main cause of serious arthritis. Also trauma due to poor conformation which causes constant stress on certain joint may lead to serious arthritis.

Clinical Signs: -

1-Signs of acute inflammation at the region of the joint such as swelling, pain and heat

2-Distention of the joint capsule by synovial fluid

3-Aspirated synovial fluid appears to be normal

4-Radiographically the bony structure of the joint appears to be normal

5-Serious arthritis may resolute leaving normal joint or develop into osteoarthritis if it persist for long time

Treatment: -

1-Rest and immobilization: -

1-Until the joint has returned to normal function

2-Bandage support may also assist healing of an acutely damaged joint (however, prolonged immobilization may lead to muscle atrophy and adhesion formation within the joint)

3-Casting is only appropriate in cases of ligamentous damage.

2-Physical therapy: -

Hydrotherapy may be useful immediately after a traumatic joint injury. It is reasonable to assume that cold hydrotherapy is indicated in the acute stage of joint injury to retard the inflammatory processes of exudation and diapedesis and reduce edema. The application of ice is extremely

beneficial as a primary treatment for the most acute joint injuries. After 48 hours hot hydrotherapy may be indicated to relieve pain and reduce tension in inflamed tissue. The vasodilatory effect can aid in both fluid resorption as well as providing phagocytic cells.

3-Intra-articular injection of corticosteroids:

Aspiration of the excessive synovial fluid and intra-articular injection of anti-inflammatory drug with a prophylactic dose of antibiotics, then apply pressure bandage.

2-Osteoarthritis (degenerative joint disease, DJD)

Osteoarthritis is a chronic disorder of synovial joints characterized by progressive deterioration of articular cartilage, in some cases resulting in a readily detectable radiographic loss in joint space, and by reactive changes in the joint margin and joint capsule.

Causes: -

1-Primary condition occurs in joint with no known previous trauma or disease. The primary condition is best exemplified by the joint changes seen in older animals. Primary osteoarthritis is generally regarded as an aging phenomenon in which deterioration of the articular cartilage occur leading to the characteristic joint changes.

2-Secondary osteoarthritis is the result of some insults to the affected joint. Usually it is a local phenomenon rather than a systemic disease, although some systemic diseases that affect joints may ultimately lead to osteoarthritis. Osteoarthritis may follow serious arthritis, trauma, or due to poor conformation.

Clinical signs: -

The clinical signs will vary with the type and degree of osteoarthritis as well as with the degree of acute inflammation. In high motion joints with acute inflammation, there will be lameness, heat, swelling of the joint (synovial effusion) and pain on flexion. In more chronic cases joint enlargement is associated with fibrous tissue deposition (some bony enlargement may also be present), but acute inflammatory signs may persist to various degrees. There will be decreased motion.

The characteristic radiographic features of osteoarthritis include: -

1-Narrowing of the joint space and deformity of the joint space due to the loss of significant amounts of articular cartilage, allowing sub-chondral bone (which is more radio-opaque than articular cartilage) to come in closer contact, therefore giving the appearance of a narrow joint space

2-The joint capsule may be undergoing fibrotic change and sometimes calcification.

3-Osteophyte formation which appear as periarticular new bone growth arising from the margins of the articular surface where the joint capsule attaches

4-Sclerosis of sub-chondral bone is seen in more chronic cases of osteoarthritis and suggested that bone beneath the cartilage is being subjected to increased stress that normally is born by articular cartilage.

The changes vary according to the severity of osteoarthritis. Although, radiography is one of the diagnostic tools, joints appear free of radiographic changes does not mean it is free of articular disease.

Treatment: -

The choice of treatment and its effectiveness will depend on the stage of the disease and the degree of active inflammation present. The principles of treatment of osteoarthritis can be divided into three areas

1-The first is the prevention or treatment of any primary cause.

2-The second principle is the treatment of active soft tissue disease contributing to articular cartilage degeneration. This includes rest, physical therapy, anti-inflammatory drugs and joint lavage.

3-The third principle is the treatment of cartilage degeneration. This includes articular cartilage curettage, osteophyte removal, radiation therapy and surgical arthrodesis.

The specific treatment methods are: -

1-Rest

2-Joint lavage

3-Intra-articular corticosteroids are useful for the treatment of soft tissue inflammation and the inhibition of enzymatic damage.

4-Surgical curettage of diseased articular cartilage

5-Surgical arthrodesis: for many cases of end stage osteoarthritis, the only methods available for pain relief are total joint replacement or

arthrodesis. Arthrodesis is satisfactory in low motion joints as the pastern joint.

3-Septic arthritis (Infectious arthritis)

Septic or infectious arthritis means inflammation of the joint as a result of bacterial infection in the joint.

Causes: -

1-Hematogenous infection: -

Hematogenous septic arthritis is most commonly observed in young animals associated with umbilical infection (joint ill). Septic arthritis may be associated with pneumonia, entritis, metritis, suppurative mastitis, or any other form of systemic infection. Intrauterine infection can occur.

2-Traumatic injury with local introduction of infection: -

Direct trauma is a common cause of septic arthritis in older animals. Direct penetration of the joint is not essential; tissue destruction and cellulitis in the region of the joint can lead to an open joint and septic arthritis.

3-Iatrogenic infection: -

It is associated with joint aspiration, injection, or arthrotomy.

Clinical signs: -

In young animal with hematogenous infection, the disease is commonly polyarticular with the larger joints, mainly hock, stifle, carpus and fetlock primarily involved. In addition to the typical localizing signs of infectious arthritis, the problem may also be accompanied by osteomyelitis.

Localizing signs in septic arthritis include lameness which may be slight in the early stages but usually progresses rapidly to a nonweight-bearing type of lameness. There will be swelling and heat of the involved joint. Both periarticular soft tissue swelling and synovial effusion are components to the joint swelling. Periarticular swelling ranges from edema and cellulitis in the acute case to fibrosis in the more chronic case with bony enlargement being seen at a later stage. A low grade fever may be present in adults with infectious arthritis. Foals with polyarthritis generally tend to have increased temperatures.

Traumatically induced infectious arthritis in adult tends to be associated with more diffuse soft tissue swelling. In some instances, animal presented with open drainage from the joint.

Radiograph should be performed immediately to eliminate traumatic damage to the bone or osteomylitis. Marked effusion is often apparent by observing an increased joint space on radiographic examination. Sequential radiographs are important to assess the degree of destruction. Lytic change in the bone can develop very quickly. As the disease progresses, radiographic changes include periosteal proliferation and narrowing of the joint space due to destruction of articular cartilage. Rather than diffuse narrowing of the joint space, punctuate areas of lysis may be seen. With further progression, generalized osteomyelitis develops in the subchondral bone, and the joint space widens again as bone is destroyed. The combination of osteomyelitis and marked periosteal proliferation may cause eventual ankylosis.

Synovial fluid analysis is the most definitive way of confirming the existence of infectious arthritis.

Treatment: -

Treatment of infectious arthritis is designed to eliminate the causative organism and remove the harmful enzymes and proteinaceous material that can damage the articular cartilage.

1-Systemic administration of broad spectrum antibiotics

2-Intra-articular injection of broad spectrum antibiotics

3-Needle drainage by application of a wide needle and aspiration of all contents then injection of antibiotics

4-Through and through lavage by application one needle above and a second needle below then a large amount of normal saline solution is injected from above and drained from below.

5-Distension irrigation technique is performed by injection of normal saline solution inside the joint cavity and left for short time then removed.

6-Arthrotomy and surgical debridement with partial synovectomy may be necessary to eradicate the infection.

7-Arthrodesis of the joint

8-Amputation of the limb in complicated cases of small animal

Prognosis: -

The prognosis for any case of infectious arthritis is never good because lack of response to treatment can occur. Even with early and correct treatment, problems can still develop. In general, response to treatment in neonated polyarthritis seems better than in adult animal but the success is certainly not completely.

II-OSTEOCHONDRITIS DISSECANS (OCD)

Definition: -

It is a degenerative disease of young horses due to vascular changes (ischemia) and demineralization of bone. The lesion involves articulation and may cause fracture of articular cartilage. The chance of healing decreases as the cartilage doesn't remain intact (separates and allows necrotic bones to be free).

Signs: -

1-Distension of joint capsule

2-Radiographic irregularity in the outline of the bone followed by demineralization and fragmentation.

3-Complete destruction of the articular cartilage at late stages.

Treatment: -

OCD lesions are usually treated by surgical excision of the cartilage flap and curettage of the subchondral bone to stimulate bleeding and fibrocartilage filling of the bone defect.

III-DISLOCATION OR LUXATION OF THE JOINT

The joint is dislocated when the two articular extremities forming it are displaced from perfect contact with one another.

Types: -

1-Complete dislocation or luxation: The articular surfaces become in no part in contact with one another

2-Incomplete dislocation or subluxation: the articular surfaces are still partially in contact with one another

Causes: -

1-Severe violence as motor-car accident

2-Congenital as secondary to hip dysplasia

3-Pathological as in cases of paralysis of some muscles or in cases of arthritis

Clinical signs: -

1-Immobility of the affected joint. This is due to mechanical impossibility of the free movement of the articular extremities on account of their displacement.

2-Deformity is due to displacement of the bone extremities. A prominence is seen in one side and a depression may be seen in the other side. The limb takes abnormal direction.

3-A large inflammatory swelling may be seen in deep situated dislocation and tends to conceal the characteristic features of the condition.

4-A rocking sound or crepitation may be obtained on manipulation of the bones due to knocking of the articular ends against each other

5-Severe pain during passive manipulation of the joint

6-Muscular atrophy in chronic cases

Treatment: -

1-Closed reduction and fixation in recent cases within the first 24 hours

2-Open reduction and fixation in old cases

The treatment depends on the type of affected joint and is more successful in small animals than large animals.

AFFECTIONS OF THE TENDON, LIGAMENT AND TENDON SHEATH

Tendon structure

A tendon is a dens band of fibrous connective tissue that acts as an intermediary in the attachment of muscle to bone. The chief constituents of the tendons are thick, closely packed parallel bundles of longitudinally oriented collagen. Fibroblasts (tenoblasts) are arranged in long parallel rows in the spaces between the collagenous bundles.

Gliding function of the tendon is facilitated by the presence of tendon sheath, bursa and paratenon. In areas where the tendon makes an abrupt change in course as where it crosses a joint, a tendon sheath is present. A tendon sheath is composed of parietal and visceral connective tissue layers lined with synovial cells. It forms a cavity around the tendon containing synovial fluid. A bursa is similar to a tendon sheath except that it is covers only part of the tendon circumference. Bursae are interposed between tendons and bony prominences. Paratenon is a loosely arranged areolar tissue surrounding the tendon in areas does not require a tendon sheath. This tissue is elastic and allows gliding function where sheath are not present.

Tendon repair

The process of tendon repair consists of four overlapping phases; injury, inflammation, repair and remodeling. Numerous factors influence healing, including the nature of the injury, the tendon injured, the type of tissue surrounding the tendon at the site of the injury and the treatment. However, the result of tendon healing is a connective tissue scar rather than restoration of normal tendineous tissue. Although this scar may restore tendon continuity, the repair process does not restore normal tensile strength and elasticity. Furthermore adhesions may develop during healing and prevent gliding of injured tendon.

AFFECTIONS OF THE TENDONS AND LIGAMENTS

I-TENDONITIS & DESMITIS

Definition: -

Tendonitis means inflammation of the tendon while desmitis means inflammation of the ligament.

The following tendons and ligament are usually affected:

1-Superficial digital flexor tendon

2-Deep digital flexor tendon

3-Suspensory ligament

4-Common digital extensor tendon

Tendonitis of the superficial digital flexor tendon and suspensory ligament are common in riding and race horses. The deep digital flexor tendon is mostly affected in working animal.

Causes: -

1-Predisposing factors

1-Bad conformation such as weak tendons and upright pastern

2-Bad shoeing such as short shoe

3-Improper trimming of the hoof and long toe

4-Uneven and slippery ground

5-Muddy or sandy tracks

6-Putting of animal in work too early

7-Calcium-phosphorus imbalance

8-Nature of the tendon and its function

The superficial digital flexor tendons of the forelimbs are most commonly affected. This may be related to smaller cross-sectional area of the tendon and the greater stress placed on it during hyperextension of the fetlock joint as compared to the deep digital flexor tendon.

2-Exciting causes

1-Overstretching of the tendons

2-Excessive load associated with falls, jumps, stumbles and sustained heavy work.

3-Parasitic infestation with onchocerca reticulata

Clinical signs: -

Tendonitis may be acute or chronic.

1-Acute Tendonitis

1-Moderate to severe lameness and the limb is held in a flexed position

2-During rest the animal points the affected limb in front the sound one with flexion of the fetlock and knee joints

3-During walking, the animal walks on the toe of the affected limb

4-Pulsation of the metacarpal or metatarsal arteries

5-Local swelling is detected along the whole length of the metacarpus/ metatarsus in cases of the superficial digital flexor tendon and is known as bowed tendon

6-In case of inflammation of the deep digital flexor tendon, a circumscribed swelling is visible on the palmar surface in the proximal third of the metacarpal region

7-In case of desmitis of the suspensory ligament the swelling is located behind the fetlock joint

8-The swollen area is hot, tender to touch and firm

2-Chronic Tendonitis

1-Slight and often intermittent lameness

2-Uniform or nodular thickening at the back of the cannon region

3-Chronic tendonitis of the deep digital flexor tendon in which the inferior check ligament is involved, a circumscribed swelling is visible on the palmar surface in the proximal third of the metacarpal region. This swelling is hard and tender to touch, and knuckling over may be acquired.

Diagnosis: -

1-Clinical signs

2-High palmar or planter nerve block

3-Ultrasonography

Treatment: -

1-Acute tendonitis

1-Cold packs applied to the tendons (cold hydrotherapy)

2-Parenteral administration of non-steroidal anti-inflammatory drugs

3-Peritendinous injection of corticosteroid is used to minimize adhesion

4-Prolonged rest following treatment is still regarding the most important ingredient of successful tendon repair

2-Chronic Tendonitis

1-Application of blister (biniodide of mercury) that is rubbed for 2-5 minutes on a clipped skin then covered by absorbent bandage

2-Firing and blistering and a line firing pattern is generally used with extensive lesion and point firing when changes are circumscribed. After firing a blister is applied and rubbed then absorbent bandage is applied and left for 2 weeks.

3-Radiation therapy using ultraviolet rays short waves and microwaves.

4-Tendon splitting: the aim of the operation is to stimulate the formation of vascularized granulation tissue into what is thought to be ischemic, degenerated core of tendon. The tendon splitting knife is inserted through the skin. With the blade held parallel to the longitudinal axis of the tendon, the tip of the knife is moved up and down in a fanlike split, perforating the peritendinous tissue on the opposite side.

5-Carbon fibers implantation: The aim of the implanted carbon fiber is not to provide mechanical strength but to provide a physical scaffold for the invading fibroblasts to grow along. Thus the subsequent collagen fibers are aligned in a manner similar to that of normal tendon rather than the haphazard organization that occurs in scar tissue following injury.

Prognosis: -

Acute cases can recover well. Chronic cases require adequate rest after treatment followed by optimum training program (about 12 months), to be improved, but normal soundness can't be obtained

II-TENDON WOUND (Severed tendon)

It is fully discussed under topic wound

Causes: -

Wire cut, or any sharp object comes in contact with the flexor tendons or tendon Achillis

Clinical signs: -

Open wound at the level of the tendons with mostly severe hemorrhage. The tendon stumps can be seen with flexion and extension of the joints.

Treatment: -

1-In fresh cases suturing should be tried

2-Cast is essential

3-Old cases are nearly hopeless

AFFECTION OF THE TENDON SHEATH

The most important tendons with tendon sheaths are

1-At the level of the carpal joint

1-Tendon of extensor carpi radialis with its sheath

2-Tendon of extensor digitorum communis with its sheath

3-Tendon of extensor digitorum lateralis with its sheath

4-Tendon of ulnaris lateralis with its sheath

5-Tendon of extensor carpi obliques with its sheath

6-Tendon of flexor carpi radialis with its sheath

2-At the level of the fetlock and pastern joints

1-Superficial and deep digital flexor tendon with their sheath

2-Common digital extensor tendon with its sheath

TENOSYNOVITIS (Tendovaginitis)

Definition: -

Tenosynovitis means inflammation of the synovial membranes of the tendon sheath, the fibrous layer of the tendon sheath is usually incorporated as well

Types: -

1-Idiopathic tenosynovitis

Synovial effusion was detected without any other signs of inflammation, pain or lameness. The cause of the condition is unknown. The most common sites are tarsal synovial sheath, digital flexor tendon sheath and extensor tendon sheath. Treatment is restricted to aspiration of the

synovial fluid and injection of corticosteroid then a pressure bandage is applied.

2-Acute tenosynovitis

It is characterized by rapid developing of synovial effusion of the tendon sheath accompanied by signs of inflammation including hotness, pain, swelling and lameness. A marked elongated, warm, markedly fluctuating swelling appears at the palmar aspect of the fetlock joint medial and lateral to the digital flexors. Direct trauma appears to be the direct cause of the condition.

Treatment:-

1-Rest 2-Cold hydrotherapy or cold packs

3-Aspiration, injection of corticosteroids, and pressure bandage

4-Parentral injection of non-steroidal anti-inflammatory

3-Chronic tenosynovitis

It is characterized by presence of synovial effusion with fibrous tissue thickening of the tendon sheath. The condition usually follows the acute form.

Treatment: -

1-Aspiration and injection of corticosteroids?

2-Blistering and firing sometime is recommended

4-Septic or infectious tenosynovitis

This type occurs as a result of haematogenous infection and seen during the course of some infectious diseases. Also, punctured wound of the tendon sheath from picked up nail in the foot may be a cause.

Clinical signs: -

1-Diffuse, hot and painful swelling is seen behind the fetlock joint.

2-Severe degree of lameness

3-Increased body temperature and general bad condition of the animal

4-Multiple abscesses may be formed at the level of the swelling

Treatment: -

1-Parentral injection of broad spectrum antibiotics

2-Aspiration of the infected synovial fluid and irrigation with antiseptic solution

3-Through and through technique is used for irrigation of the synovial sheath. Medial and lateral vertical skin incisions are performed on the palmar aspect of the fetlock joint. Another third incision is performed at the midline on the palmar aspect at the level of the pastern joint. The incisions are extended inside the tendon sheath. The contents are evacuated and the cavity is irrigated with mild antiseptic solution then local antibiotic solution is injected.