***Urolithiasis in ruminants***

- Urolithiasis is common as a subclinical conditions among ruminants raised in management systems where the ration is composed primarily of grain.

- Animals graze certain types of pasture.

- In these situations, 40-60% of animals may form calculi in their urinary tract.

- Urolithiasis becomes an important clinical disease of castrated male ruminants when calculi cause urinary tract obstruction, usually obstruction of the urethra.

- Urethral obstruction is characterized clinically by:-

 - Complete retention of the urine.

 -Frequent unsucceful attempts to urinate.

 - Distension of the bladder.

 - Urethral perforation and rupture of the

 bladder can be sequel.

* Mortality is high.
* Treatment is surgical.
* Prevention is important to limit losses from urolithiasis.

***Etiology:-***

-Urinary calculi or uroliths, form when inorganic and organic urinary solutes are precipitated out of solution.

- The precipitates occur as crystals or as amorphous deposits.

- calculi form over a long period by a gradual accumulation of precipitate around a nidus.

- An organic matrix is an integral part of most types of calculi.

- Several factors affect the rate of urolith formations including:-

 - The conditions that affect the concentration of

 specific solutes in urine.

 -The ease with which solutes are precipitated out of

 solution.

 -The provision of nidus.

 - The tendency to concretion of precipitates.

***Epidemiology;-***

-Urolithiasis occurs in all species but is of great economic importance in:-

 - Feeder steers and lambs being fed heavy concentrations.

 - Stock running at range in particular problem area.

- These range areas are associate- These range areas are associated with the presence of pasture plants containing large quantities of:-

 - Oxalate.

 - Estrogens.

 - Silica.

- When cattle graze pasture containing plants with high levels of silica, uroliths occur in animals of all ages and sexes.

- The prevalence of uroliths is about the same in cows, heifers, bulls and steers grazing the same pasture and they may even occur in newborn calves.

- Female and bulls usually pass the calculi and obstructive urolithiasis is primarily a problem in castrated male animals.

- There are three main groups of factors that contribute to urolithiasis;-

 - Those which favor the development of a nidus.

- Factors which facilitate precipitation of solutes on to the

 nidus.

 -Those which favor concretion by cementing precipitated

 salts to the developing calculus.

1. ***Nidus formation:-***

-A nidus favors the deposition of crystals about itself.

- In most cases, the nidus is believed to be a group of desquamated epithelial cells or necrotic tissue that may be formed as a result in occasional cases from local infection in the urinary tract.

- When large numbers of animals are affected it is probable that some other factors such as deficiency of vitamin A or the administration of estrogens (when stilbsterol was used as growth promotion) is the cause of excessive epithelial desquamation.

- Diets low in vitamin A have been suspected as a cause of urolithiasis but vitamin A deficiency does not appear to be a major causative factor.

***(B) Precipitation of solutes:-***

- Urine is a highly saturated solution containing a large number of solutes, many of them in higher concentrations than their individual solubility's permit in a simple solution.

- The reasons why the solutes remain in solution are improperly understood but several factors are known to be important:-

 - Probably the most important factor in preventing

 Precipitation is the presence of protective colloids which

 convert urine into a gel, these colloids are efficient up to

 a point, but their capacity to maintain the solution may

 be overcome by abnormalities in one or more of a number

 of other factors.

 -Even in normal animals crystals of a number of solutes

 may be present in the urine from time to time and urine

 must be considered to be an unstable solution.

 -The physical characteristic of urine.

 -The amount of solutes presented to the kidney for excretion.

 -The balance between water and solute in the urine.

- All influence the ease of calculus formation.

- In most cases these factors can also be influenced by management practices.

- The Ph of urine affects the solubility of some solutes.

- Mixed phosphate and carbonate calculi being more readily formed in an alkaline than in acid medium. Addition of ammonium chloride or phosphoric acid to the rations of steers increase the acidity of the urine and reduce the incidence of calculi.

- The mechanism is uncertain but is probably related to the effect of the ph on the stability of the urinary colloids.

- In contrast, variations in Ph between 1 and 8 have little influence on the solubility of silicic acid, the form of silica excreted in the urine of ruminants. As a result, dietary supplementation with ammonium chloride does not consistently prevent the formation of siliceous calculi.

- The amount of solutes presented to the kidney for excretion is influenced by the diet.

- Some pasture plants can contain up to 6% silica. Although ruminants grazing on these plants absorb only a small portion of the ingested silica, the kidney is the major route of excretion of absorbed silicic acid. The urine of these animals often becomes supersaturated with silicic acid. The urine of these animals often becomes supersaturated with silicic acid, which promoted the polymerization or precipitation of the silicic acid and calculus formation.

- Feeding of sodium chloride prevents the formation of silica calculi by reducing the concentration of silicic acid in the urine and maintain it below the saturated concentration.

- An excessive intake of minerals may occur on highly mineralized artesian water, or in diets containing high concentrations, particularly of phosphate on heavy concentrated diets.

- Sheep with a high dietary intake of phosphorus have an increased concentration of phosphorus in their urine and an increased development of calculi.

- In cattle, urolithiasis formation begins when concentrates have been fed for 2 months at the rate of 2.5% of the animal's body weight.

- Diets high in magnesium such a sore calf milk replacers have also been associated with an increasing incidence of obstructive urolithiasis.

- Supplemental calcium in the diet helps prevent calculus formation when phosphate or magnesium intake is high.

- Ingestion of plants with a high oxalic acid content can be risk factor for formation of calcium carbonate calculi in sheep.

- The process of formation of urinary calculi is more complex than a simple dietary excess.

- The concentration of urine is an important determinant of the concentration of individual solutes in the urine.

- Water deprivation can be exacerbated by heavy fluid loss by sweating in hot, arid climate.

***© Factors favoring concretion:-***

-Most calculi and particular siliceous calculi, are composed of organic matter as well as minerals.

- This organic component is mucoprotein, particularly its mucopolysaccharide fraction.

- it acts as cementing agent and favors the formation of calculi when precipitates are present.

- The mucoprotein content of urine of feeder steers and lambs is created by heavy concentrate-low roughage rations, even more so by implantation with diethylstilbestrol and, combined with a high dietary intake of phosphate, may be an important cause of urolithiasis in this class of livestock.

- These high levels of mucoprotein in turn may be the result of rapid turnover of supporting tissues in animals which are making rapid gains in weight.

***Miscellaneous factors in the development of urolithiasis:-***

-Stasis of urine favors precipitation of solutes.

- Virtue of the infection which commonly follows providing cellular material for a nidus.

- Certain feeds, including cottonseed meal and milo sorghum are credited with causing more urolithiasis than other feeds.

- Alfalfa is an indeterminate position, by some observers it is thought to cause the formation of calculi, by others to be valuable aid in preventing their formation.

- Pelleting appears to increase calculi formation if the ration already has this tendency.

- Natural cases most probably occur as a result of the interaction of several factors.

***Composition of calculi:-***

-The chemical composition of urolithiasis calculi varies and appears to depend largely on the dietary intake of individual elements.

- Obstruction is promoted by estrogenic stimulation of squamous metaplasia of the urethral epithelium, accessory sex glandular enlargement and mucus secretion.

- Feedlot lambs receiving a supplement of stilbstrol (1 mg/kg of feed or 2 mg per lamb daily) develops urethral obstruction believed to be caused primarily by plugs of mucoprotein. The accessory sex glands were also enlarged.

***Epidemiology of obstructive urolithiasis:-***

-The size of individual calculi and the amount of calculus material are both important in the development of urethral obstruction.

- Once calculi form, the most important factor contributing to the occurrence of obstruction is the bore size of the urethra.

- Wethers and steers are most commonly affected due to the relatively small diameter of the urethra in these animals.

- Castration has a significant impact on the bore size of the urethra in steers.

- Bulls were estimated to be able to pass calculi which were t were twice the size of those which could be passed by an early castrated steers.

- Urethral obstruction may occur at any site but is most common

- Bulls are not infrequently and a high incidence has been observed in rams.

- Urolithiasis is as common in females as in males, but obstruction rarely if ever occurs because of the shortness and large diameter of the urethra.

- Repeated attacks of obstructive urolithiasis are not uncommon in wethers and steers.

- In outbreaks it is probable that factors are present that favor the development of calculi.

***Pathogenesis:-***

-urinary calculi are commonly observed at necropsy in normal animals, and in many appear to cause little or no harm.

- Calculi may be present in kidney, ureters, bladder and urethra.

- In a few animals pyelonephritis, cystitis and urethral obstruction may occur.

- Obstruction of one ureter may cause unilateral hydronephrosis with compensation by the collateral kidney.

- The major clinical manifestation of urolithaisis is urethral obstruction, particularly in wethers and steers.

- This difference between urolithiasis and obstructive urolithiasis is an important one.

- Simple urolithiasis has little importance, but obstructive urolithiasis is a fatal disease unless the obstruction is relieved.

- Rupture of urethra or bladder occurs within 2-3 days if the obstruction is not relieved and the animal dies of uremia or secondary bacterial infection.

- Rupture of the bladder is more likely to occur with a spherical smooth calculus which cause complete obstruction of the urethra.

- Rupture of the urethra is more common with irregularly shaped stones which cause partial obstruction and pressure necrosis of the urethral wall.

***Clinical findings:-***

-Calculi in the renal pelvis or ureters are not usually diagnosed ante mortem although observation of the ureter may be detectable on rectal examination, especially it is accompanied by hydronephrosis.

- Occasionally the exit from the renal pelvis is blocked and the acute distension which results:-

 - May cause acute pain.

 - Stiffness of gait.

 - Pain on pressure over the loin.

- Calculi in the bladder may cause cystitis and are manifested by signs of that disease.

- Obstruction of the urethra by a calculus is a common occurrence in steers and wethers and cause a characteristic syndrome of:-

 - Abdominal pain:- kicking at the belly.

 -treading with the hind-fed/

 -switching of the tail

 -repeated twitching of the penis

 sufficient to shake the prepuce.

 -the animal may make strenuous

 efforts to urinate, accompanied by:-

 -straining grunting.

 -grating of teeth.

- But these result in the passage of only a few drops of blood-stained urine.

- On rectal examination the urethra and bladder are palpably distended and the urethra is painful and pulsates on manipulation.

- Heavy precipitate of crystals is often visible on the preputial hairs or on the inside of the thigh.

- The passage of a lead wire up the urethra, after relaxing the penis by epidural anesthesia or by administration an ataractic drug, may make it possible to locate the site of obstruction.

- Cattle with incomplete obstruction-dribblers- will pass small amounts of blood stained urine frequently.

- Occasionally a small stream of urine will be voided followed by a complete blockage.

- If the obstruction is not relieved perforation of the urethra or rupture of the bladder occurs in about 48 hours.

- If the perforation of the urethra the urine leaks into the connective tissue of the ventral abdominal wall and prepuce and causes an obvious fluid swelling which may spread as far as the thorax.

- The urine is often infected and severe cellulitis may occur with an attendant toxemia.

- In occasional animals an area of skin over the swelling sloughs, permitting drainage and the course is rather more protracted in these cases.

- When the bladder ruptures there is an immediate relief from discomfort but anorexia and depression develop as uremia appears.

- The abdomen soon becomes distended and a fluid thrill is detectable on tactile percussion.

- The animal may continue in this state for as long as 2-3 days.

- In occasional cases death occurs as soon after rupture of the bladder due to severe internal hemorrhage.

- In occasional cases calculi may form in the prepuce of steers may cause obstruction of the preputial orifice distension of the prepuce and infiltration of abdominal wall with urine. These cases may be mistaken for cases of urethral perforation.

***Clinical pathology:-***

-Laboratory examination may be useful in the diagnosis of the diagnosis of the disease in its early stages when the calculi are present in the kidney or bladder.

- The urine usually contains:- erythrocytes.

 - epithelial cells.

 -higher than normal number of crystals.

 -bacteria if secondary invasion.

- Blood urea will be increased before either urethral or bladder rupture occurs and will increase even further afterwards.

- Aspiration of fluid from abdominal cavity after rupture of bladder or from a subcutaneous aggregation. Warming the fluid may facilitate detection of the urine odor.

***Necropsy findings:-***

-Calculi may be found in the renal pelvis or bladder of normal animals or of those dying of other diseases.

- Unilateral urethral obstruction is usually accompanied by dilatation of the ureter and hydronephrosis.

- Bilateral obstruction causes fetal uremia.

- Calculi in the bladder are usually accompanied by varying degree of chronic cystitis.

- The urethra or urethral process may be obstructed.

- When rupture of urethra has occurred:-

 - The urethra is eroded at the site of obstruction.

 -Extensive cellulitis

 - Accumulation of urine are present in the ventral

 abdominal wall.

-When the bladder has ruptured:-

 - The peritoneal cavity is distended with the urine.

 - There is mild to moderate chemical peritonitis.

- In areas where urolithiasis is a problem it is an advantage to determine the chemical composition of the calculi.

***Diagnosis:-***

-Obstruction of the urethra in ruminant animals is rare unless the obstructive agent is a calculi.

- Non-obstructive urolithiasis may be confused with

 pyelonephritis or cystitis and obstructive urolithiasis in ureter.

-Differentiation may be possible only by rectal examinati:-on in the case of vesicle calculi or by radiographic examination in small animals.

-Ultrasonography may be useful to demonstrate hydronephrosis.

- The clinical signs associated with urethral obstruction in cattle and sheep are characteristic but if there is doubt a rectal examination should be carried out or the animal observed to see if the urine is passed.

***Treatment:-***

-The treatment of obstructive urolithiasis is primarily surgical.

- Fat cattle and lambs affected with urethral obstruction should be slaughtered for salvage, if the result of on ante mortem inspection is satisfactory.

- In general calculi cannot be dissolved by medical means.

- In early stages of the disease or in cases of incomplete obstruction, treatment with smooth muscle relaxants may be attempted to relax to urethral muscle and permit passage of the obstructive calculus.

- Animals treated medically should be observed closely to ensure that urination occurs and that obstruction does not recur.

- In small ruminants, amputation of the urethral process may restore the urine flow.

- If this is unsuccessful, perineal urothrostomy is indicated.

- In sheep, there is a high rate of recurrence of obstruction and as in cattle, the long-term prognosis is poor.

***Prevention:-***

-A number of agents and management procedures have been recommended in the prevention of urolithiasis in feeder lambs and steers.

- First, and probably most important, the diet should contain an adequate balance of calcium and phosphorus to avoid precipitation of excess phosphorus in the urine.

- Increase and maintain water intake in feeder steers.

- It is thought that supplementary feeding with sodium chloride help to prevent urolithiasis by decreasing the rate of deposition of magnesium and phosphate around the nidus of a calculus.

- Increased water intake promoted by salt supplementation.

- The feeding of ammonium chloride also has been found to be satisfactory in the prevention of urethraliasis due to phosphate calculi.

- Adequate intake of vitamin A should be ensured.

- Deferment of castration by permitting greater urethral dilatation, may reduce the incidence of obstructive urolithiasis.

***Urolithiasis in horses***

-Urolithiasis occurs sporadically in horses.

-The uroliths are usually present in the bladder, although they also occur in the renal pelvis, ureters and urethra.

- In most cases, there is a single discrete stone but a sandy sludge accumulates in cases of bladder paralysis.

- Almost all equine uroliths are composed of calcium carbonate.

- The factors that contribute to urolith formation in horses are unclear but there is a low rate of recurrence in treated cases.

- Nephrolithialiasis may arise as a sequel to degeneration or inflammatory processes in the kidney in which inflammatory debris serves as nidus for calculus formation.

- Cystic calculi present with a clinical picture of frequent painful urination with hematuria due to cystitis.

- The bladder wall may be thickened and large calculi may be palpable per rectum just as the hand enters the rectum.

- Large calculi may be observed on ultrasonography and cystoscopy.

- In males, urethral calculi may be present with signs of complete or partial obstruction that may confused with colic of gastrointestinal origin.

- Horses with urethral obstruction make frequent attempts to urinate but pass only small amounts of blood-tinged urine.

- Unless rupture has occurred, the bladder is grossly enlarged.

- The clculus can be located by palpation of the penile urethra and by passage of a lead wire or catheter.

- If a catheter leas wire is passed care should be taken to prevent damage to the urethral mucosa.

- Bladder rupture leads to an accumulation of fluid in the peritoneal cavity but if the rupture occurs at the neck of the bladder, urine may accumulate retroperitoneally and produce a large, diffuse, fluid swelling which palpable per rectum.

- When rupture occurs acute signs disappear and are replaced by:- Depression.

 -immobility.

 -Pain on palpation of the abdominal wall

 -The pulse rate rises rapidly.

 -The temperature falls to below normal.

- Nephrolithiasis frequently is bilateral and affected animals have often progressed to chronic renal failure by the time of diagnosis without having displaced signs of urinary tract obstruction.

- The major presentation is weight loss.

- Treatment is supportive as for all cases of chronic renal failure.

- Treatment is the surgical removal of the calculus and correction of any defect in the bladder.

- Some cystic calculi can be removed with the aid of electrohydraulic lithotripsy.