Dept. of Surgery,
Fact. Vet. Med., Assiut University.

CLINICAL STUDIES ON OBSTRUCTIVE UROLITHIASIS IN MALE CATTLE AND BUFFALOES

(With 5 Tables and 16 Figures)

By
N.A. MISK and *M.A. SEMIEKA*

(Received at 27/3/2003)

دراسات إكلينيكية على انسداد مجرى البول في ذكور الأبقار والجاموس

نبيل مسك ، محمد سميكة

تم إجراء هذا البحث على عدد ١١٩ حيوان من ذكور الأبقار و الجاموس الغير مخصية (٩٨ ذكور أبقار ، ٢١ ذكور جاموس) تعانى من انسداد فى مجرى البول. و قد تم تسجيل التاريخ المرضى و الأعراض الإكلينيكية لكل حالة. تم التأكد من التشخيص عن طريق إجراء الأشعة و بذل البطن. ثم تم تقسيم الحالات إلى انسداد مجرى البول فقط (٣٧ حالة) ، انسداد مجرى البول مع انفجار المثانة (٧٠ حالة) ،انسداد مجرى البول مع انفجار المبال (١٢ حالة). وتم إجراء العلاج الجراحي لكل الحالات و تسجيل نتائج العمليات ثم تم تجميع الحصوات و إجراء دراسات عليها.

SUMMARY

The present study was carried out on 119 non-castrated male cattle and buffalo calves (98 cattle calves and 21 buffalo calves) suffering from obstructive urolithiasis. Case history and clinical signs were recorded. Diagnosis was confirmed by abdominal paracentesis and survey radiography. Cases were classified into urethral obstruction only (37 cases), urethral obstruction with rupture of urinary bladder (70 cases), and urethral obstruction with rupture of penile urethra (12 cases). Surgical treatment was applied for all cases including penile transection with urethral fistulation in cases of urethral obstruction only, the same operation and laparocystorraphy in cases of bladder rupture, and performance of several skin incisions in urine infiltrated tissues in cases of urethral rupture. Results of the surgical operations were recorded. The calculi were collected and subjected to full study including; number, shape, weight, color, surface, and chemical composition.

Key words: *Clinical studies on obstructive urolithiasis in male cattle and buffaloes.*

INTRODUCTION

Urolithiasis is a common syndrome in male cattle (Abbas *et al.*, 1972; Sharma *et al.*, 1981; Tantawy, 1985; Gasthuys *et al.*, 1993; and Larson, 1996), male buffaloes (Rao and Unmack, 1973; Sinha and Lyer, 1975; and Singh *et al.*, 1983), rams (Lundvall, 1988; Noordsy, 1994; and Van Metre *et al.*, 1996) and fairly rare in horses and pigs (Lundvall, 1988 and Blood *et al.*, 1989).

The calculi are most often seen in the urinary bladder, although uroliths can occur in the renal pelvis and ureter. The distal portion of the sigmoid flexure of the urethra is the most common site of obstruction in cattle (Walker and Vanghan, 1980; Walker and Hull, 1984; Lundvall, 1988; and Noordsy, 1994).

The incidence of fatal urolithiasis in male cattle was estimated as 3% up to 10% or 50% when the condition got complicated by urethral or bladder rupture, respectively (Donecker and Bellamy, 1982).

Many factors are incorporated in the etiology of urolithiasis in domestic animals. These factors include geographical and seasonal influences, dietary factors, low water intake and infectious diseases of the urinary tract (Huntington and Emerick, 1984; Payne, 1989 and Lotfia *et al.*, 1999).

Urethral obstruction usually occurs alone or with rupture of the urinary bladder resulting in uroperitonium or rupture of the urethra with subcutaneous infiltration of urine (Gasthuys *et al.*, 1993).

Several surgical techniques were recommended to treat urethral obstruction which include; urethrotomy, urethrostomy, penile transection with urethral fistulation, cystorrhaphy and tube cystotomy (O'Connor, 1974; Singh *et al.*, 1983; Gasthuys *et al.*, 1993; Larson, 1996; and Van Metre *et al.*, 1996).

The aim of the present study is to throw a light on case history, clinical signs, diagnosis and treatment of different forms of urethral obstruction in buffalo and cattle calves with special regards to some studies on the physical features and chemical analysis of some collected stones.

MATERIALS and METHODS

The present study was carried out on a total number of 119 uncastrated male cattle and buffalo calves affected with urethral obstruction (98 cattle calves and 21 buffalo calves). Case history including age of animals, month of occurrence of urolithiasis and history

of anurea were registered. Clinical signs including posture of the animal, trials of urination, expression of pain and shape of the abdomen were recorded. Diagnosis was confirmed by abdominocentesis and radiography. Radiographic examination was available and performed in 98 cases only.

Cases were classified after diagnosis into urethral obstruction only (37 animals), urethral obstruction with rupture of urinary bladder (70 animals) and urethral obstruction with rupture of penile urethra (12 animals).

According to the type of urethral obstruction, the following operations were performed and evaluated:

1- Penile transection with urethral fistulation:

This technique was performed in all cases of obstructive urolithiasis. All animals were operated upon in lateral recumbency with the upper most hind limb extended forward. Xylazine Hcl as a tranquilizer at a dose rate of 0.05 mg/Kg b.w. was administered I/m. Analgesia of the surgical site was achieved by using local infiltration analgesia of 10 ml of 2% zylocaine Hcl. Area extending from the anus to the base of scrotum is clipped and prepared for aseptic surgery A midline incision, starting 5-10 cm above the scrotum and extending upward for 10-15 cm, is performed in the skin, and deepened through the subcutaneous tissues between the semitendinosus muscles until reach the dense white deep fascia. The later is incised and then blunt dissection is performed until the penis is identified and a loop is exteriorized from the incision. The dorsal vessels of the penis are bluntly dissected and preserved then the penis is transected at the distal part of the exteriorized loop. The distal penile stump is reduced. The urethra at the proximal stump is splitted with straight scissors for a 3 cm upward, and the edges of mucosal slit are sutured in both sides with the tunica albuginae of the penis by simple interrupted or continuous suture pattern. The proximal penile stump is then fixed 3-5 cm from its end to the lips of skin wound by one stitch with non-absorbable suture material. The skin incision is then sutured dorsal and ventral to the protruded proximal penile stump.

2- Removal of abdominal urine:

Removal of abdominal urine is performed in cases of obstructive urolithiasis with bladder rupture. A small area at the caudal ventro-lateral abdominal wall is prepared for aseptic surgery. A stab incision is performed in all layers of abdominal wall and the mouth of suction machine is introduced inside the abdominal cavity through this incision. Suction is started in a very slow rate with few minutes interval for

several times and the amount of uroperitonium is estimated. After evacuation of most of abdominal urine a Foley catheter is applied through the stab incision to provide adequate drainage. At the same time intravenous fluids are given by a rate of 50 ml/Kg b.w. of normal saline solution.

3- Cystorrhaphy via laparotomy:

The operation is performed in dorsal recumbency. A caudal paramedian incision is made through the abdominal wall taking into consideration all aseptic precautions. The urinary bladder is grasped and positioned into the incision then thoroughly inspected and the length of bladder rupture is measured and the seat is recorded. The edges of bladder wound are trimmed and the bladder wall is reconstructed with two layers inverting continuous suture pattern using chromic catgut or Dexon No. 1 with rounded a traumatic needle. The abdominal wall is sutured in a standard way. Cystorrhaphy was performed in 65 animals out of 70. In the rest of cases the seat of bladder rupture was detected has some sorts of healing and the bladder was observed has some urine. Thorough examination of bladder shows a weak area without opening at the dorsal aspect of the bladder wall.

4-Several skin incisions:

Several skin incisions are performed in cases of obstructive urolithiasis with rupture of the urethra. In addition to penile transection with urethral fistulation, a several skin small stab incisions were made with few cm distances between each others over the swelling at the ventral abdominal, preputeal and scrotal regions to facilitate drainage. A zinc oxide ointment is applied over healthy areas while magnesium-sulphate-glycerine paste or cod-liver oil are applied to the affected areas to help sloughing of necrotic tissues and facilitate healing.

Most of cases were followed up by questionnaire or re-examination up to three months.

Stone(s) were collected from 79 cases during operation. The number of stones in every case was calculated and a random sample of 20 stones was taken for physical analysis (shape, weight, color and surface) and chemical composition.

RESULTS

1- Case history:

Case history includes ages of affected animals, month of occurrence of urolithiasis and history of anurea (Tables 1, 2 & 3).

Table 1: Shows the number of affected animals in relation to age (months).

Age (Month)	2	3	4	5	6	7	8	9	10	12	15	18	24	Total
No. of Animals	1	10	16	13	16	7	15	6	3	16	2	10	4	119

Table 2: Shows the number of affected animals in relation to month of occurrence of urolithiasis.

Month of Occurrence	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
No. of animal	4	6	16	25	26	17	3	4	4	5	4	5	119

Table 3: Shows the number of affected animals in relation to number of days of anurea.

Days of anurea	1	2	3	4	5	6	7	8	9	10	Total
No. of animals	12	18	36	13	23	3	4	7	1	2	119

2- Clinical signs:

a) Urethral obstruction only:

Animal displays signs of short period of moderate colic including teeth grinding, rear leg stampling, and kicks at the abdomen. The animal assumes repeatedly the posture for urination and the tail may be seen move up and down with no urination or few droplets may result from these attempts. Lower intake of food or loss of appetite may also be detected. On rectal palpation, if the size of the animal will permit, the bladder was found distended and pelvic urethra was found pulsating. In most animals, body temperature, respiratory rate and pulse rate were within the normal ranges.

b) Urethral obstruction with rupture of urinary bladder (Figs. 1-3):

Within 48-72 hours after complete obstruction of the lower urinary tract a rupture of the urinary bladder or rupture of the penile urethra may occur. In bladder rupture, the appetite of the animal was progressively depressed but the signs of colic were ceases. Liberation of large volumes of urine into the abdominal cavity causes a marked distention of the ventral abdominal wall and results in a pear-shaped abdominal contour (water-belly). A fluid trill across the abdomen can be evidenced on percussion. On rectal palpation, the bladder feels empty and strangury ceases.

Abdominal paracentesis revealed copious quantities of clear yellowish fluid, which by its odour, was identified as urine. The amount of urine varies between 1-50 liters.

c- Urethral obstruction with rupture of penile urethra (Figs.4-8):

In cases of urethral rupture, the subcutaneous tissues at the ventral abdominal wall, preputial, scrotal and perineal regions become infiltrated with urine resulting in frog-belly shaped abdominal contour. Presence of a transverse line at the lateral abdominal wall is highly diagnostic and represents the line of separation between non-infiltrated and infiltrated tissues with urine. Violet discoloration of the skin at infiltrated areas appears first. Necrosis and sloughing of the skin, to a greater or lesser extent, occurs later according to the time elapsed from the beginning of urethral rupture.

3- Radiographic Examination (Fig. 9):

Lateral radiographs of the caudal abdomen and pelvic regions revealed presence of stone(s). In 79 animals out of 98 subjected to radiography the stone(s) were seen as rounded or oval radiopaque densities at a level of distal segment of the segmoid flexure just above the scrotum. However, when the obstruction was due to sandy stones or any radiolucent bodies, the seat of obstruction can not be differentiated radiographically.

4- Surgical treatment and observations (Figs.10-13):

The results of all operations performed for correction of urethral obstruction without or with rupture of the bladder or urethra were satisfactory (Table 4).

In most cases, the seat of obstruction by stone (s) was found at the level of the distal part of the segmoid flexure just behind the seat of insertion of retractor penis muscle. In two cases only, the stones were extracted from the penile urethra at the level of the proximal part of segmoid flexure. The dorsal aspect was the seat of bladder rupture in 35 cases out of 70 cases, the ventral aspect in 30 cases and in 5 cases the seat was detected as a week area at the dorsal aspect of the bladder. The length of the bladder wound at the time of operation varies between 1 and 10 cm (Table 5).

Table 4: Shows the results of operations in different types of urethral obstruction.

Type of obstruction	Recovered	Died	Not recorded	Total
Urethral obstruction only	34	3	-	37
Urethral obstruction With bladder rupture	59	10	1	70
Urethral obstruction With urethral rupture	8	2	2	12
Total	101	15	3	119

Table 5: Shows the length of the bladder wound in relation to number of the affected animals.

Length of bladder rupture (cm)	1	2	3	4	5	6	7	8	8 and up	weak area	Total
Number of animals	8	8	30	7	4	3	2	1	2	5	70

5- Physical and chemical analysis of urethral calculi (Figs. 14-16):

The number of stones caused urethral obstruction in each case varied between 1 and 4 stones. In 69 cases (87.3%) one stone was the cause, in 3 cases (3.8%) 2 stones, in 6 cases (7.6%) 3 stones, and in one case (1.3%) 4 stones. Sandy obstruction was detected in another 3 cases in which radiographic examination was negative. Most of stones were oval in shape, some were almost rounded and few numbers were cylindrical, quadrilateral or irregular. The majority of stones had rough surfaces while few numbers had smooth surfaces. In rare cases, the stones had clear projections. The weight varied between 0.1 and 0.5gm (average, 0.3gm). The color of stones was mostly pale gray, while some had yellow brown or even white color. Chemical analysis of the stones revealed presence of silicate, oxalate, carbonate and phosphate in variable levels in each stone.

DISCUSSION

Urolithiasis is the most common cause of urethral obstruction in male cattle and buffaloes. Other conditions that may result in urethral obstruction such as cystitis, which may produce enough cellular debris to block the urethra, paralysis of the bladder which favors the accumulation of stones, masses of cellular materials, ulcerative urethritis and external traumas can not be overlooked (Jenning, 1984).

Although the stones are usually formed in the bladder, they are insignificant until they pass and lodge in the urethra. In most cases of the present study when urolithiasis was the cause, the stone(s) was found obstructing the penile urethra at the distal part of the sigmoid flexure of the penis (Tyagi and Singh, 1996). The dilatation of penile urethra at this segment is restricted by the tunica albuginae surrounding the corpus cavernosum penis and corpus spongiosum urethrae. Moreover, the attachment of the retractor penis muscle at the ventral surface of the distal part of the sigmoid flexure causes an additional pressure over the urethra preventing its adequate dilatation to pass stones. Although castration has been shown to increase the incidence of urolithiasis (Khamis and Saleh, 1970; Gohar, 1978; Agag *et al.*, 1990; and Tyagi and Singh, 1996), all cases in the present study were uncastrated male calves.

Although, clear seasonal influences could not be detected in the present study, more than 70% of cases were recorded during March – June (spring and early summer) and the rest of cases were distributed all over the other months of the year. The higher incidence of urinary calculi in summer season could be due to insufficient carotene or vitamin A, heavy fluid loss and less water consumption which lead to concentration of urinary salts giving chance for formation of urinary calculi (Khamis and Saleh, 1970; Gohar, 1978 and Blood et al, 1989).

Also our results indicated that most affected calves are 3-8 months of age, however the condition was recorded in animals up to 24 months of age (Gasthuys *et al.*, 1993). In our region, no records of urolithiasis were observed in aged male cattle as most males above 2 years of age are slaughtered for human consumption. The small number of affected buffalo-male calves recorded in the present study may be due to the same reason. Young buffalo-male calves usually are slaughtered 2-4 months of age for human consumption.

History of anurea is considered to be one of the most important symptoms for diagnosis of urolithiasis. Animals can tolerate urolithiasis without rupture of urinary bladder or urethra up to five days but mostly after three days symptoms of strangurea subsides due to rupture of the bladder. Chronic urethral obstruction mostly may results in rupture of the urethra which occur considerably rare versus cases of bladder rupture (Smith, 1983 and Tyagi and Singh, 1996).

Rectal palpation and urethral pulsation were helpful for differential diagnosis between cases of urethral obstruction with or without bladder rupture. In addition, abdominocentesis is highly confirmative in cases of bladder rupture (Smith, 1983 and Tyagi and Singh, 1996). Urethral obstruction with urethral rupture is easily diagnosed by the shape of the abdominal contour (frog-belly) and presence of transverse line at the lateral abdominal wall. Discoloration of the skin and swelling of the perineal, inguinal, scrotal and preputeal regions are highly diagnostic.

Tyagi and Singh, (1996) stated that attempts to locate calculi by radiographic procedures were not successful. In contrast, in our present study, radiography was highly diagnostic in most cases of urethral obstruction. However, few cases of urethral obstruction could not be diagnosed radiographically.

Silica urolithiasis causes annual death losses in steers in Western North America range from 3-5% (Bailey, 1981 and Larson, 1996) and it is a primarily a problem of cattle grazing native range land grasses

(Bailey, 1981). Phosphatic urolithiasis were the cause of urolithiasis in 0.5% and 0.35% in two Colorado lamb feedlots and more common in ruminants consuming rations high in phosphorus such as cereal grain-based feedlot ration (Bushman *et al.*, 1965; Hoar *et al.*, 1970; McIntosh, 1978; and Hay, 1990). Carbonate and oxalate urolithiasis were also detected in animals grazing on clover pastures (Bailey, 1976 and Manning and Blaney, 1986).

The disturbance of minerals metabolism plays an important role in the induction of urolithiasis (Youssef and Ali, 1986). High level of dietary phosphorus results in significantly high serum and urine phosphorus value which in turn was suggested to cause renal tubular damage that leads to increased protein excretion, thus increasing the chance for calculi formation (Agag *et al.*, 1990 and Zabady, 1996). The imbalance between calcium and phosphorus in the concentrated ration increased the incidence of cystic and urethral calculi in castrated male calves (Gohar and Shokry, 1981; Smith, 1983; and Ahmed *et al.*, 1989).

In our present study, chemical analysis of 20 stones revealed presence of a mixture of silicate, phosphate, oxalate and carbonate with different levels in each stone. This may be due to unstanderdized rations offered to animals.

Different surgical procedures were adopted for treating cases of urolithiasis. In the present study, penile transection with urethral fistulation was found satisfactory for correction of cases of obstructive urolithiasis alone or with bladder or urethral rupture (Larson, 1996 and Van Metre, 1996). The percentage of success reaches up to 92% in cases of urolithiasis only and 85% in cases of urolithiasis with rupture of bladder taking in consideration that laparo-cystorrhaphy was done in due time. Spontaneous healing of bladder rupture stated by Walker and Vanghan (1980), from our point of view carries a great risk because it may only happened safely when the rupture is small and located at the dorsal aspect of the bladder. In our results 42.9% of bladder tears were found at the ventral aspect of the bladder and are most likely require surgical repair (Smith, 1983, Hooper and Taylor, 1995). Determination of a weak area at the dorsal aspect of the bladder in 5 cases may indicate spontaneous healing of the bladder wound.

In spite of the small number of cases of urolithiasis with urethral rupture recorded in the present study, the rate of success of treatment was considered satisfactory (66.6%). Urine-infiltrated tissues are looking disaster; however continuous management of cases after penile transection and urethral fistulation is obligatory until all necrotic tissues

sloughed down. Fluid therapy is important in such cases to counteract all metabolic disorders accompanied ureamia and dehydration.

REFERENCES

Abbas, F.; Angelo, S.J. and Das, S.C. (1972): Laparotomy with indwelling catheterization in buffalo. Indian J. Anim. Sci. 42(12): 1016-1020.

Agag, B.I.; Shoker, M.H.M; Bishara, M.V.; Mousa, S.M. and Hegazi, S.I. (1990): Report on field cases of obstructive urolithiasis in buffalo-calves. Egyptian J. of Comparative Pathology and Clinical Pathology 3, 2: 256-270.

Ahmed, A.S.; Amer, H.A. and Ibrahim, I.M. (1989): Influence of dietary mineral imbalance on the incidence of urolithiasis in Egyptian calves. Arch. Exper. Vet. Med. Leipzig 43: 73-77.

Bailey, C.B. (1976): Effects of ammonium chloride on formation of siliceous urinary calculi in calves. Can. J. Anim. Sci. 56: 359-360.

Bailey, C.B. (1981): Silica Metabolism and Silica urolithiasis in ruminants. A review, Can. J. Anim. Sci. 61: 219-235.

Blood, D.C.; Radostitis, O.M.; Henderson, J.A.; Arundel, J.H. and Gay, C.C. (1989): Veterinary Medicine, London, Bailliere Tindall, P. 348.

Bushman, D.H.; Emerick, R.J. and Embry, L.B. (1965): Experimentally induced ovine phosphatic urolithiasis: Relationships involving dietary calcium, phosphorus and magnesium, J. Nutri. 87: 499-504.

Donecker, J.M. and Bellamy, J.E.C. (1982): Blood chemical abnormalities in cattle with ruptured bladder and ruptured urethra. Canadian Veterinary Journal 23: 355.

Gasthuys, F.; Steenhaut, M.; De Moor, A. and Sercu, K. (1993): Surgical treatment of urethral obstruction due to urolithiasis in male cattle: a review of 85 cases. The veterinary record, 20: 522-526.

Gohar, H.M. (1978): Experimental studies on some factors leading to formation of urinary calculi in sheep and goats Ph.D. Thesis, Fac. Vet. Med., Cairo University.

Gohar, H.M. and Shokry, M. (1981): Efficacy of sodium chloride in prevention of sheep urolithiasis. Bulletin of animal health and reproduction in Africa, 29, 4: 321-324.

Hay, L. (1990): Prevention and treatment of urolithiasis in sheep. In practice 12: 87-91.

Hoar, D.W.; Emerick, R.J. and Embry, L.B. (1970): Potassium, phosphorus and calcium interrelationships influencing feedlot perfermance and phosphatic urolithiasis in Lambs. J. Anim. Sci. 30: 597-600.

Hooper, R.N. and Taylor, T.S. (1995): Urinary surgery. Vet. Clin. North. Am. 11(1); 95-121.

Huntington, G.B. and Emerick, R.J. (1984): Oxalate urinary calculi in beef steers. American Journal of Veterinary Research 45, No.1 180-182.

Jenning, P.B. (1984): The practice of large animal surgery. W.B. Saunders Company.1072-1080.

Khamis, Y. and Saleh, M. (1970): Urolithiasis syndrome in ruminants. Egypt. Vet. Med. J., 18: 242-248.

Larson, B.L. (1996): Identifying, treating and preventing bovine urolithiasis. Veterinary Medicine, 366-377.

Lotfia, S.F.; Khamis, Y.; Hegazy, A.A.; Gohar, H.M. and Shamaa, A.A. (1999): Effect of high dietary levels of calcium, phosphorus and magnesium on urolithiasis in sheep. Journal of Egyptian Veterinary Medical Association, 59, 213.

Lundvall, R.L.; Urinary system, in Oehme F.W. (1988): Textbook of large animal surgery Ed 2. Baltimore, Williams & Wilkins, PP. 501-510.

Manning, R.A. and Blaney, B.J. (1986): Epidemiological aspects of urolithiasis in domestic animals in queenland. Aust. Vet. J. 63: 423-424.

McIntosh, G.H. (1978): Urolithiasis in animals, Aust. Vet. J. 54: 267-271.

Noordsy, J.L. (1994): Food animal surgery, Ed 3. Trenton, N.J. Veterinary lerning systems, PP. 199-208.

O'Connor, J.P. (1974): Urethral obstruction and rupture of the urinary bladder in cattle. Irish Veterinary Journal 233-236, Dec. 1974.

Payne, J.M. (1989): Metabolic and nutritional diseases in cattle. Oxford, Blackwell Scientific Publications, P. 41.

Rao, S.V. and Unmack, A. (1973): Bovine urolithiasis in Andhra pradesh. Acta Vet. Scand. No. 14, 410-420.

Sharma, S.N.; Prasad, B. and Kohli, R.N. (1981): Clinical evaluation of uremia due to urethral obstruction in cattle. Bovine Practice Vol. 2, No. 3: 33-37.

Sinha, B.K. and Iyer, P.K.R. (1975): Pathological studies on nephrolithiasis in buffaloes. Indian Vet. J. 52: 682-685.

Singh, K.; Gera, K.L. and Nigam, J.M. (1983): Efficacy of peritoneal dialysis in urethral obstruction in buffalo-calves. Indian J. Vet. Surg. 4(2): 59-63.

Smith, J.A. (1983): Ruptured urinary bladder in a post-parturent cow. Cornell Vet. 73: 3-12.

Tantawy, M. (1985): A urethral calculus in a steer. Assiut Vet. Med J., 14(27)203

Tyagi, R.P.S. and Singh, J. (1996): Ruminant surgery. A textbook of surgical diseases of cattle, Buffaloes, Camels, Sheep and Goats. CBS publishers and Distributors.263-271.

Van Metre, D.C.; House, J.K.; Smith, B.P.; George, L.W.; Angelos, S.M. and Angelos, J.A. (1996): Obstructive urolithiasis in ruminants: Medical treatment and urethral surgery. The compendium. 317-327, March 1996.

Walker, D.F. and Hull, B.L. (1984): Urinary system surgery, in Jennings P.B.: The practice of large animal surgery. Vol. 2. Philadelphia. W.B. Saunders Co., PP. 1072-1080.

Walker, D.F. and Vanghan, J.T. (1980): Bovine and Equine urogenital surgery. Philadelphia. Lea & Febiger, PP/ 59-66.

Youssef, H.A. and Ali, M.A. (1986): Rupture of urethra in buffalo and cattle calves. Assiut Vet. Med. J. Vol. 16, 32: 335-340

Zabady, M.K. (1996): Studies on urolithiasis in ruminants. M.V.Sc. Thesis, Fac. Vet. Med., Cairo University.

LEGENDS OF FIGURES

Figs 1 & 2: Show pear-shaped contour of the abdomen (water-belly) in cases of urolithiasis with rupture of urinary bladder in a calf.

Fig. 3: Abdominal paracentesis in a calf with bladder rupture.

Fig. 4: A two-year-old calf has obstructive urolithiasis and rupture of the urethra. The transverse line at the lateral abdominal wall is clearly evident.

Fig. 5: Frog-belly abdominal contour in a calf with urethral rupture.

Figs. 6 & 7: Violet discoloration and swelling of the perineal, scrotal, preputeal and ventral abdominal wall in a buffalo calf with ruptured urethra.

Fig. 8: A 2-year-old mixed Friesian bull showing swelling at the ventral abdominal wall due to obstructive urolithiasis with urethral rupture.

Fig. 9: Lateral survey radiography showing a radiopaque oval stone at the level of the distal part of the sigmoid flexure in a buffalo-calf.

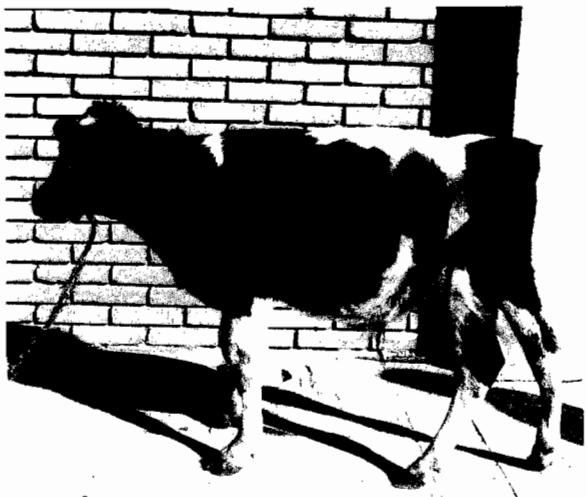
Fig. 10: Penile transection in a case of obstructive urolithiasis showing flow of urine from the proximal stump of the penis.

Fig. 11: A 13 cm long tear at the dorsal aspect of the bladder in a calf during laparotomy operation.

Fig. 12: Penile transection and urethral fistulation just after operation.

Fig. 13: Urination from the urethral fistula 5 months post operatively.

Figs. 14 – 16: Showing different varieties and shape of stones collected from cases of obstructive urolithiasis.



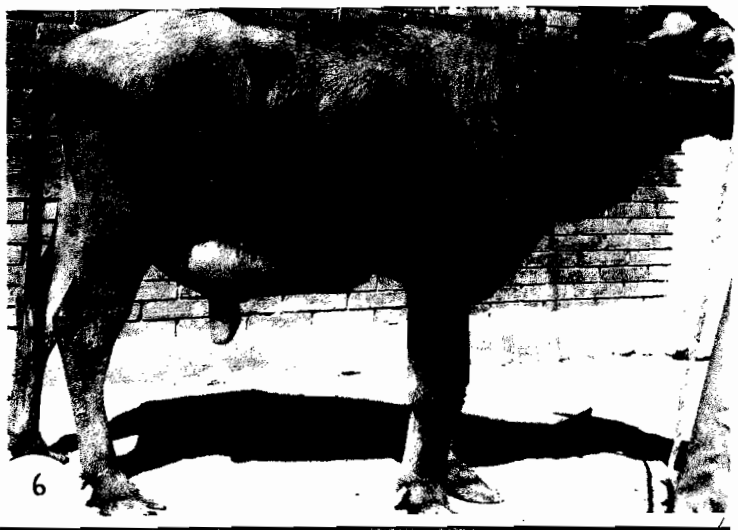
1

2

3

4

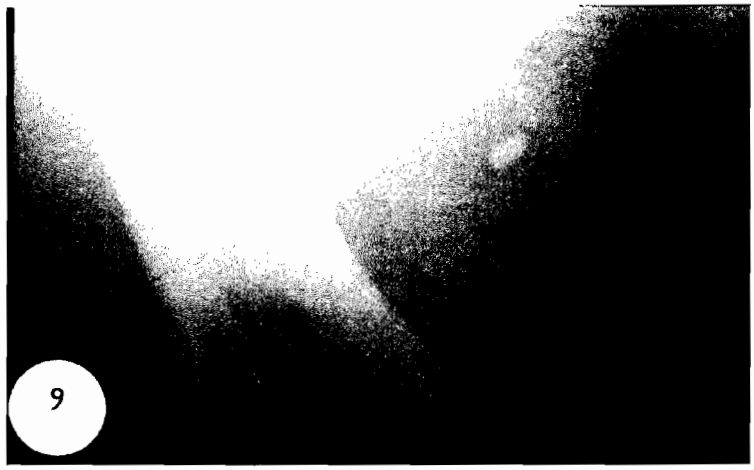
5



6

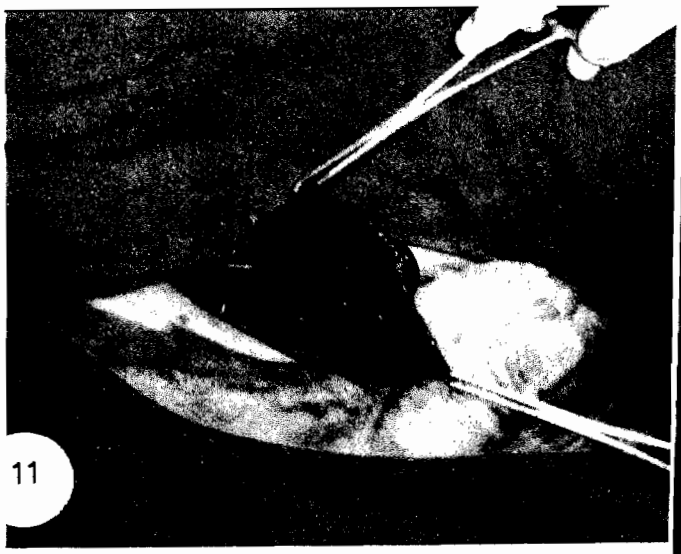
7

8

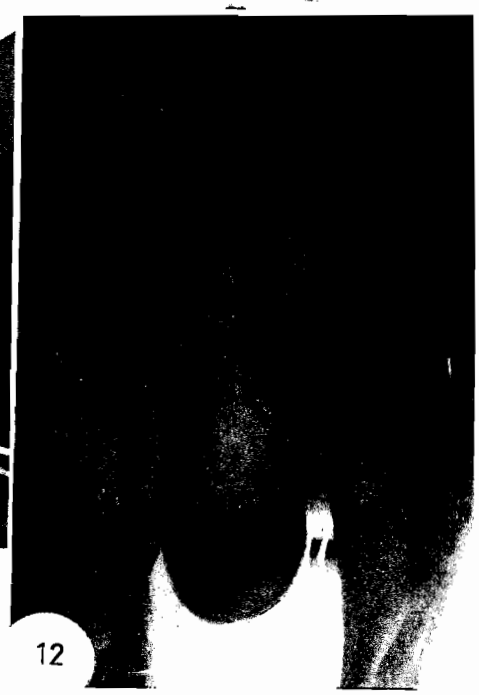


9

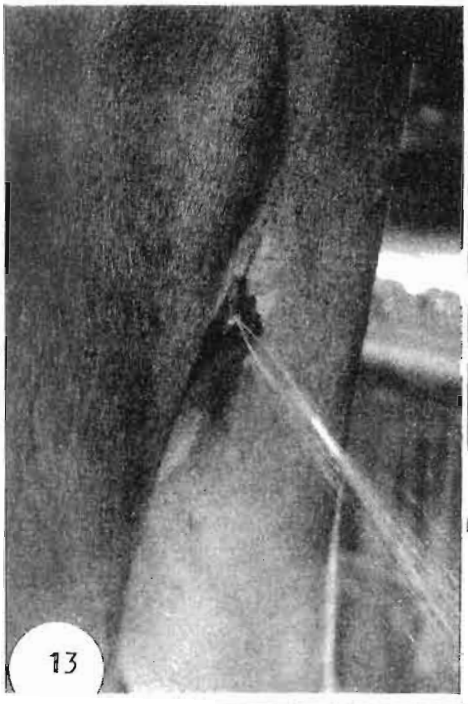
10



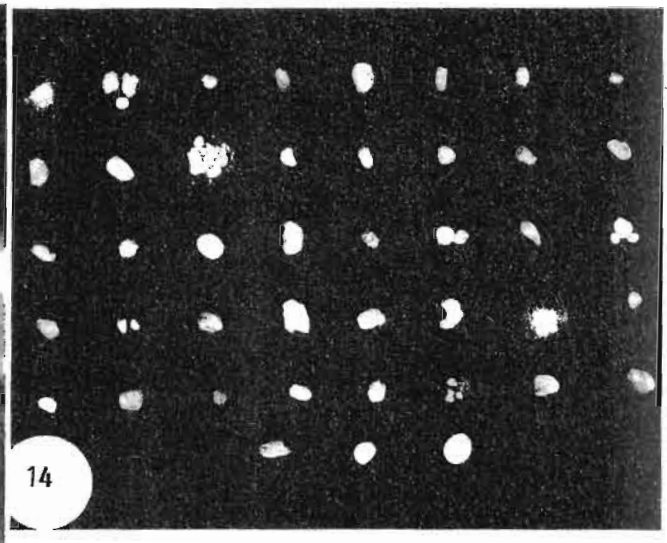
11



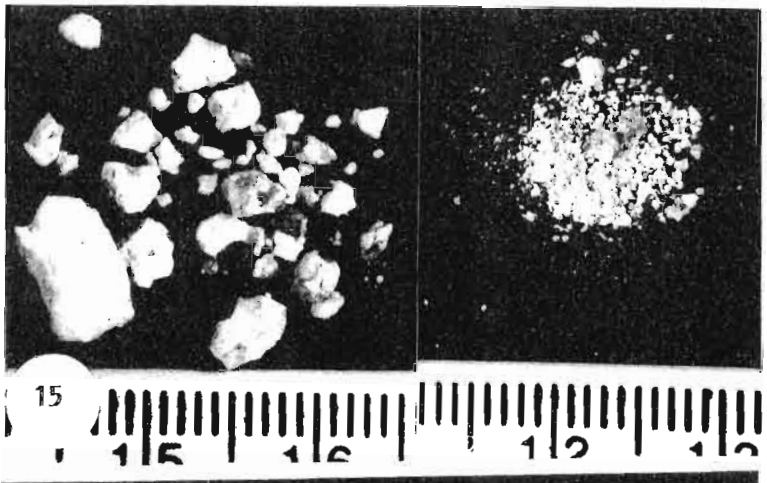
12



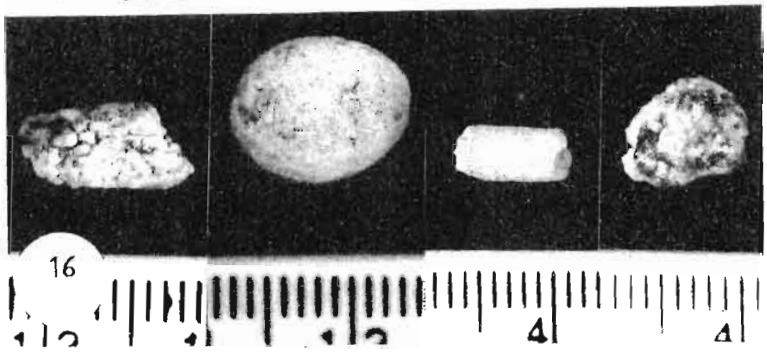
13



14



15



16