Radiosonographic study of the lower urinary tract in goat

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This study was conducted on 62 goats. The lower urinary tract was investigated in 50normal goats and 12 clinical cases suffered from lower urinary tract affections using ultrasonography and radiography.

The investigation included shape, position, anatomical architecture and dimensions of urinary bladder and urethra. Both urography and ultrasonography were used for diagnosis of cases suffering from urine retention, cystic calculi, cystitis, congenital urethral dilatation and congenital cystic diverticulum.

Nowadays, radiographic and ultrasonographic investigation of the urinary system plays an important role in the evaluation and assessment of function and condition of these structures in small animals. (Hagag, 2005).

Execratory and retrograde cystography of the normal goat have showed urinary bladder as an oval shaped shadow with smooth and sharp contour. The position of the urinary bladder differed according to filling state and when a pressing devise was used (Cegarra and Lewis, 1977; Weeren *et al.*, 1987 and Abu zaid, 1995). Sonographically, the normal urinary bladder appears as a flask or pear shaped in front of the pelvic cavity with echo free (anechoic) center that is circumscribed by a thin echogenic wall. Underneath it, there is an area of enhancement. The bladder neck and pelvic urethra can be easily demonstrated (Abuzaid, 1995).

Cystography of chronic cystitis cases revealed wall thickening, decreased capacity of distention, mucosal irregularity that might be associated with the presence of polyps (Kealy, 1987 and Scarvani *et al.*, 1998)). Ultrasonography of chronic (polypoid) cystitis, revealed wall thickening accompanied by multiple, small masses that project into the bladder lumen. Occasionally large polyps with a pedunculated base of attachment were seen (Nyland and Matton, 1995; Hafez and Elkhodary, 2001 and Scott *et al.*, 2001).

The radiopaque cystic calculi can be seen on plain radiographs (Kealy 1987and Charles 2003). The radiopaque or radiolucent calculi are detected ultrasonographically as hyperechoic focal echogenecities that shadow in the dependant portion of the bladder. (Nyland and Matton, 1995).

Bladder rupture in sheep and goat is associated with leakage of contrast material into the peritoneal cavity. (Abd El Hamid, 1976 and Kealy 1987). Ultrasonography reveals accumulation of urine in abdominal cavity represented by anechoic area (Hafez and Elkhodary, 2001).

Bladder diverticulum is defined as herniation of the bladder wall. These outpouchings may be singular or multiple and are thinner than the bladder wall (Sandra, 1998). The diverticulum is best demonstrated by positive contrast as an outpouching of the bladder wall, (Kealy, 1987). By ultrasonography, it appears as a membrane of varying size connecting the adjacent fluid filled structure to the bladder (Sandra, 1998). Urethral obstruction may result from fracture of the penis, catheter injury, foreign body, post inflammatory scar, trauma, tumor or urethral calculi. (Charles, 2003).

The radiopaque calculi can be seen on plain radiographs. Positive contrast urethrography is required to outline the radiolucent calculi. The radiolucent calculi appear as filling defect within the column of the contrast medium (Kealy, 1987). The diagnosis of urethral obstruction can not be made based on the ultrasonographic evaluation of full filled bladder as it also may be seen in healthy rams. The urethra appears dilated and the contents of the bladder appears as multiple uniformly distributed echoes (Hafez and Elkhodary, 2001)

A case of urethral dilatation was reported in a four days old male montaphon calf. On clinical examination, a fluctuating urine containing

swelling was noted beneath the anus in the middle of the upper perineum section. On ultrasonographic examination, the contents appeared anechoic in every direction (Geccelep and Alkan, 2000). Retrograde urethrography is the simplest and fastest means available to image the urethra, (Barry, 1988).

The aim of the present study is to determine the appearance of the lower urinary tract both radiographically and ultrasonographically and compare between radiography and ultrasonography in the diagnosis of some lower urinary tract affections.

Material and Methods

This study was conducted on a total number of 62 goats of both sexes, their age ranged from 6 months to 6.5 years, and of weight ranged from 10 to 50 kg. The lower urinary tract was investigated in fifty normal goats using ultrasonography (all ages) radiography (20 cases). Radiographic and ultrasonographic investigations were also conducted on 12 clinical cases suffering from affections of the lower urinary tract.

Radiographic Techniques. Twenty apparently healthy goats were subjected to radiographic investigation by intravenous pyelography and retrograde urethra cystography using urographin 76 %, with iodine content 7.4 gm / ampoule (Schering Co.). Animals were sedated using diazepam 2 mg/kg-body weight via intramuscular injection (Hall and Clarke, 1984). The most suitable radiographic potentials used were (50-80) Kv and (7-10) mAs and the focus film distance was 1 m. The radiographic projections used were either ventrodorsal or lateral views.

At the day of work, plain x-ray films were taken. Then excretory urography by intravenous injection of the contrast agent via the jugular vein was performed. Urographin in a dose rate 425 mg iodine / kg body weight (not exceed 35 gm iodine) was mixed with an equal volume of 5% glucose solution. Ten minutes after injection, radiographs were taken and repeated every ten minutes for visualization of the full bladder.

In retrograde positive contrast, urethrocystography technique, catheterization was performed in male after relaxation of penis (via pudendal nerve block) and trimming of urethral process. In female, vaginoscope was used to open the vulvar lips in order to locate the suburethral diverticulum. The catheter was lubricated by lignocaine 2% ointment and introduced through the external urethral orifice, urethra, (passing the urethral recess in male) and bladder. Urine was completely evacuated from the bladder and the bladder was slightly distended with contrast agent 5% iodine concentration w/v (6 ml / kg body weight) diluted with an equal amount of saline, then radiographic projections were taken.

Ultrasonographic technique. This part of study was conducted on 50 apparently normal goats The ultrasonographic examination was carried out using 3.5/5.0 MHz curved array electronic transducer (R40- 401665) and 6.0/8.0 MHz linear array probe (6 CM- 401663). High quality Sony printing paper type I (normal 110 mm x 20 m), Sony Co. Tokyo Japan was used.

Food and water were withheld for 12 hours. Examination was performed while animal in standing or recumbent position. The fluid filled bladder was examined using (6.0/8.0 MHz) trans-rectal linear array transducer. The transducer was covered by coupling gel, protected by rubber sac and lubricated by Vaseline then introduced into the rectum with the beam aimed ventrally. Dimensions of the bladder and internal urethral orifice were determined and the bladder wall, contents, and internal urethral orifice were visualized.

In case of young animals, the trans-rectal probe couldn't be used, as its size was larger than the diameter of the rectum that might injury the animal. Therefore, the urinary bladder was examined trans-abdominally via 3.5/5.0 MHz curved array or 6.0/8.0 MHz linear array transducer. The urinary bladder was examined in two planes (longitudinal and transverse views) from the ventral abdomen according to the method described by (Nyland and Matton, 1995).

The clinical cases required no special preparation except tranquilization by diazepam. Execretory urography and retrograde urethrocystography were done in all clinical cases except in case of urethral obstruction, only execretory urography was performed. All animals were subjected to routine ultrasonographic examination.

Results and Discussion

The radiographic and ultrasonographic anatomy of normal and diseased lower urinary tract were investigated the techniques used in urography and renosonography in goat were studies. Several radiographic and ultrasonographic techniques were used for evaluation of the urinary system. Full assessment of the

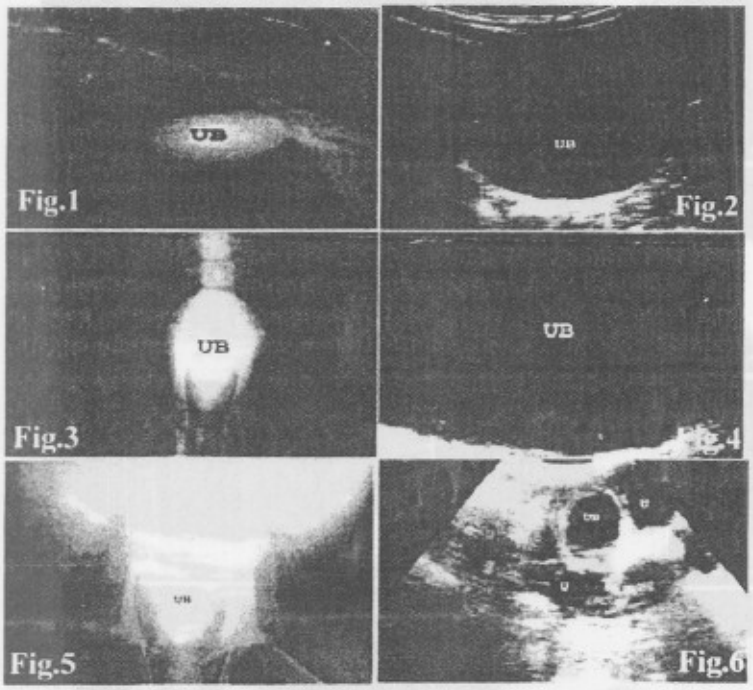

Fig. (1): Lateral cystogram showing the distended bladder with contrast material. UB (urinary bladder)

Fig.(2): Longitudinal plane through the urinary bladder. Using 6.0/8.0 MHz linear array transducer. UB (urinary bladder)

Fig. (3): Ventro-dorsal urogram showing over distended bladder with the contrast material. UB (urinary bladder)

Fig. (4): Transrectal longitudinal sonogram through the bladder showing over distension of the urinary bladder with anechoic content. UB (urinary bladder)

Fig. (5): Ventrodorsal urogram showing irregular shape of the bladder with leakage of contrast material out of the bladder lumen into the pelvic cavity. UB (urinary bladder)

Fig.(6): Transverse section through the bladder showing contracted bladder with anechoic content and the bladder floating in lake of urine. UB (urinary bladder) and U (urine)

bladder or urethra requires ultrasonography in combination with appropriate radiographic procedure. In many cases, the radiographic studies were required to define the location and extent of disease. However ultrasonography is often done prior to radiography because it is quicker in evaluating internal anatomy of abdominal organs and helps to select the most appropriate radiographic contrast procedure. Ultrasonography following radiographic studies is also valuable in answering any specific questions raised (Nyland and Matton, 1995).

The urinary bladder was opacified in all goats with varying size according to its filling status. It was detected 5 min. after the start of infusion as oval or globular radiopaque vesicle with smooth and sharp contour confined to the pelvic cavity and in front of the pubic bone at the end of infusion of the contrast solution, and protruded into the abdominal cavity by time (Fig.1). Maximum filling was reached 40 min. after the start of infusion. These findings were similar to those observed by (Cegarra and Lewis, 1977; Singh *et al*., 1983 and Abu Zaid, 1995). In the present study the time of maximum filling was lesser than that observed by (Abu Zaid, 1995).

The urinary bladder could be ultrasonographically visualized and was localized cranial to the pelvic rim (Fig. 2). The contents of the bladder were hypoechoic and the bladder wall was uniformly thick and smoothly demarcated inside and outside. Thickness of the bladder wall depends on the amount of urine in the bladder; it was thinnest when the bladder was full, as a fact that recorded by Konde *et al*., 1984; Wood and McCarthy 1990; Nyland and Mattoon 1995; Walter *et al*., 1987; Yamaga and Too 1984;

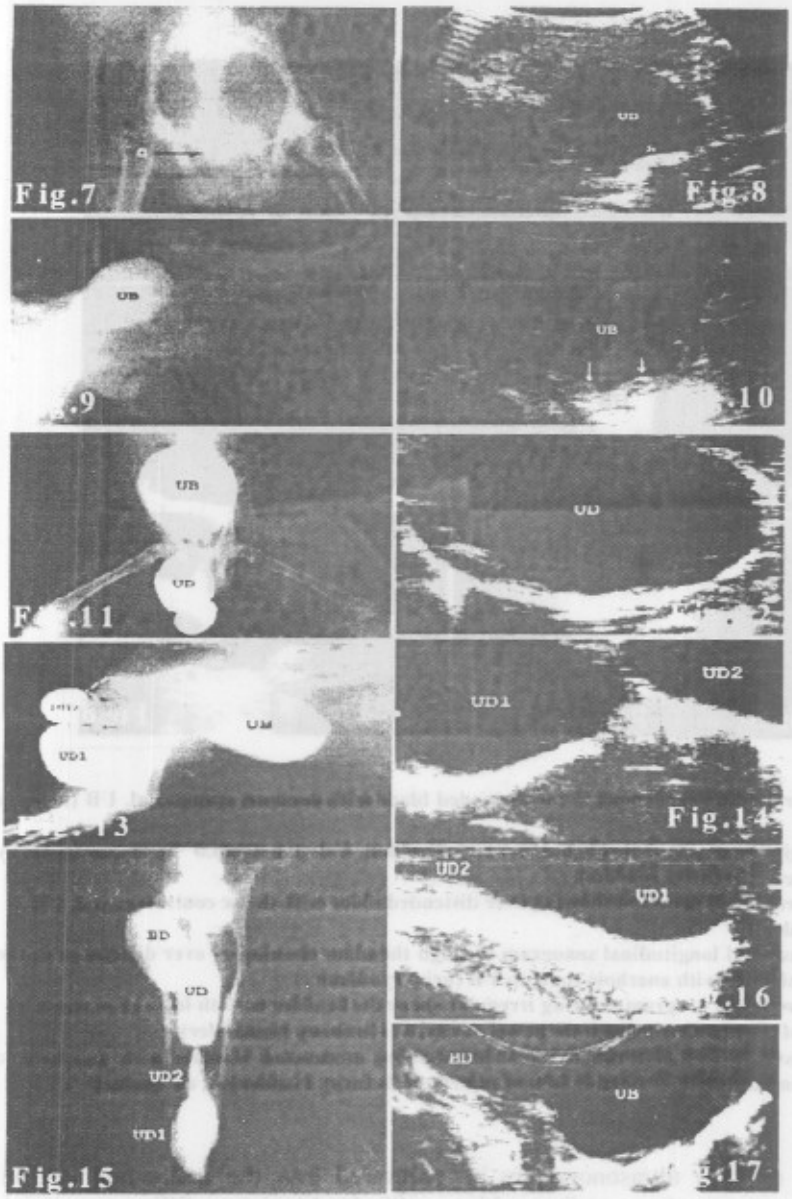

Fig. (7): Ventrodorsal survey radiograph showing radiopaque stones in the most dependant part of the pelvic cavity. S (stone)

Fig. (8): Transverse plane through the bladder showing anechoic content with hyperechoic stones in the most dependant part of the bladder and distal shadowing. S (stones) and UB (urinary bladder)

Fig. (9): Lateral cystogram showing irregular contour of the bladder. UB (urinary bladder)

Fig. (10): Transverse plane through the urinary bladder showing irregular mucosal lining (arrows) and anechoic turbid contents. UB (urinary bladder)

Fig. (11): Ventro-dorsal retrograde urethrocystography. UD (urethral dilatation), and UB (urinary bladder)

Fig. (12): Longitudinal sonogram through the urethral dilatation showing anechoic clear content. UD (urethral dilatation)

Fig. (13): Lateral retrograde urethrocystography. Arrows denoting the urethra. UD1 (urethral dilatation number one), UD2 (urethral dilatation number two), and UB (urinary bladder)

Fig. (14): Longitudinal plane through the swellings showing anechoic clear content. UD1 (urethral dilatation number one), and UD2 (urethral dilatation number two)

Fig. (15): Ventrodorsal retrograde urethrocystography. UB (urinary bladder), CD (cysticdiverticulum), UD1 (urethral dilatation number one), and UD2 (urethral dilatation number two)

Fig. (16): Longitudinal plane through the first and second urethral dilatations showing anechoic clear content. UD1 (urethral dilatation number one) and UD2 (urethral dilatation number two)

Fig. (17): Longitudinal plane through the bladder and the bladder diverticulum (BD). Urinary bladder (UB)

Braun *et al.*, 1992; Hafez and El Khodery 2001 and Abu Zaid 1995).

The mucosal margin of the urethra is best assessed by positive contrast urography, but ultrasonography offers complementary information such as urethral wall thickness. Ultrasonography of the urethra is quick, non invasive and does not require sedation or general anesthesia. In patients with complete urethral obstruction, ultrasonography may be the only way to image the urethra. (Jennifer and Amy, 1996).

All the diseased animals were subjected to both radiographic andultrasonographic investigations for reaching accurate diagnosis or to confirm clinical diagnosis. The clinical conditions recorded in this study were, cystitis, urine retention (with ruptured or intact bladder), bladder diverticulum and urethral dilatation.

In case of urine retention radiographic investigation showed intact bladder distended with opacified urine and extended beyond the limits of the pelvic cavity into the abdominal cavity (Fig.3) this may be due to urine accumulation and obstruction of the outflow. Similar findings were observed by (Abd El Hamid, 1976). While ultrasonographic examination in case of intact bladder, the kidneys appeared somewhat enlarged with signs of backpressure represented by dilatation of the pelvicalicyeal system. The urinary bladder was distended with urine and reached the abdominal cavity (Fig.4).

Radiographic investigation of cases suffered from ruptured bladder, showed that the shadow of the urinary bladder wasn't clearly identified and the area of the pelvic cavity was filled with the contrast material (Fig.5). This finding agrees with (Abd El Hamid, 1976 and Kealy, 1987). On the other hand, ultrasonographic investigation revealed contracted bladder with thickened hyperechoic wall floating in the anechoic urine filling the abdominal cavity (Fig 6). Similar findings were observed by (Hafez and El Khodery, 2001).

Radiopaque stones could be detected in the most dependant part of the pelvic cavity (Fig.7), which agreed with (Kealy, 1987). In the ultrasonographic investigation hyper echoic structures were seen with their shadow into the lumen of the bladder (Fig.8) that agreed with (Nyland and Matton, 1995 and Hafez and El Khodery, 2001). The mineral nature of the calculi reflected both x-ray and ultrasound beams thus it appeared as radiopaque on radiographic films and hyperechoic in ultrasound image. In cases suffering from cystitis, the bladder appeared radiopaque with irregular contour due to the absorption of the contrast materials by the bladder wall (Fig.9). Similar findings were observed by (Kealy, 1987 and Scarvani *et al.*, 1998). By ultrasonography, the bladder had thick hyperechoic wall, urine appeared anechoic with multiple, uniformly distributed tiny echoes. Blood and fibrin clots might be observed in the lumen of the bladder (Fig.10). Similar observ-ations were demonstrated by (Nyland and Matton, 1995; Hafez and Elkhodary, 2001 and Scott *et al.*, 2001). It was reported that urogenital system abnormalities are common in small than large animals and more frequent in goats than in sheep (Rossean and Ribble, 1988).

The differential diagnosis of perineal swelling should include haematoma, abscess, bladder retroflexion or hernia and congenital urethral diverticulum or dilatation (Geccelep and Alkan, 2000). Three cases of urethral dilatation were detected by physical examination .The first and third cases had only one swelling in the inguinal region while the second case had two swellings, one in the perineal region and the other one in the inguinal region. The first case had swelling as that was examined physically. In the second case, the observed two swellings by physical examination were detected by radiographic examination. Although the first and third cases appeared physically similar, they differed radiographically. The third case had two swellings other than the external swelling and they were connected to each other.

In the first case, the bladder appeared radiopaque in the pelvic cavity and distended with the contrast material (Fig. 11, 12). A radiopaque swelling was clearly recognized at the inguinal region. In the second case, two radiopaque swellings could be demonstrated at the neck of the bladder with normal diameter. The penile urethra showed increase in the diameter at the perineal region then returned to its normal diameter for a short distance then increased at the inguinal region and finally opened to exterior with normal diameter (Fig. 13,14). Similar results were detected by ultrasonography. In case of urethral dilatation, the diameter of the urethra was increased in the affected region and the contents of the swellings were clear and of anechoic nature indicating the presence of fluid. Similar case of urethral dilatation in a calf was recorded by (Geccelep and Alkan, 2000). In third case, contrast

radiography revealed the presence of multiple radiopaque swellings (Fig.15). The urinary bladder appeared radiopaque and elongated. A swelling that protruded into the abdominal cavity and connected to the urinary bladder (cystic diverticulum) was observed. On the other hand, the pelvic urethra appeared with increased diameter and connected to another swelling, (dilated penile urethra). Ultrasonography revealed elongated bladder connected toswelling (pouch) that was extended beyond the pelvic rim into the abdominal cavity (Fig.16, 17). Both the bladder and the pouch (diverticulum) contained clear fluid of anechoic nature (urine). On the other hand, there was dilatation in the pelvic and penile urethrae that were filled with clear anechoic urine.

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