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OBSTRUCTIVE UROLITHIASIS IN DROMEDARY CAMELS: CLINICAL, ULTRASONOGRAPHIC AND POSTMORTEM FINDINGS

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ABSTRACT

This article was written to evaluate camels with obstructive urolithiasis with special reference to the clinical, ultrasonographic and postmortem findings. Twenty male camels (*Camelus dromedarius*) with urolithiasis were examined. Of them, 18 had ruptured bladder and 2 had ruptured urethra. Main clinical findings included depression, anorexia and anuria. Ventral abdominal swelling was also detected in front of the penis with swelling of the prepuce. Exploratory laparotomy showed a massive amount of reddish uroperitoneum. In the camels with ruptured urethra, penile and ventral edema was detected in front of the penis with swelling of the prepuce. The urine penetrated the adjacent tissues that also yielded dark red urine on aspiration. The most important ultrasonographic findings included a collapsed urinary bladder in animals with ruptured bladder. Uroperitoneum was imaged easily where viscera were seen floating in the urine. Dilatation of the pelvic and penile urethra as a result of calculi was detected by ultrasonography. The urinary bladder wall was intact in cases before bladder perforation. Hydronephrosis with parenchymal pressure atrophy was also detected. The obstructing calculus was also seen within the penile urethra as a hyperechoic mass with distal acoustic shadowing. The perforated urinary bladder was also seen. In cases with ruptured urethra, the bladder wall was imaged intact and it contained hyperechoic sediment. Postmortem examination confirmed the ultrasonographic findings.

Key words: Camels, dromedary, imaging, ultrasonography, urolithiasis

Urinary calculi (urolithiasis, uroliths, nephrolith, bladder stone, cystolith) is common as a subclinical disorder among ruminants raised in management systems where the ration is composed primarily of grain, or where animals graze certain types of pasture (Radostits *et al,* 2007). In dromedary camels, the salt requirement is around 6–8 times than that of other domestic ruminants (Nigam, 1992). In addition, the urine of dromedaries can contain twice as much salt as sea water because of their extraordinary capacity for retention and concentration of fluids (Dorman, 1986). Therefore, small uroliths may enter the ureter or urethra and cause partial or complete obstruction of urine flow. Urinary calculi are formed in either the calices of the kidney, or more commonly in the urinary bladder. Small uroliths may enter the ureter or urethra and cause partial or complete obstruction of urine flow (Fowler, 1990; Fowler, 2000; Gutierrez *et al,* 2002; Fowler, 2008; Choudhary *et al,* 1995).

Urethral obstruction has been extensively reported in ruminant species; however, there is minimal information about its incidence in camelids. The etiology is unknown but is believed to parallel that for domestic ruminants (Smith, 1989). Previous reports of obstructive urolithiasis in llamas have suggested mineral imbalance, castration, and inflammation of the urinary tract as possible contributing factors (Kock and Fowler, 1982; Kock, 1985; McLaughlin and Evans, 1989). In two reports, the calculi contained a large proportion of calcium (Kock and Fowler, 1982; Kock, 1985), and in another report, the calculus contained necrotic inflammatory cells with no detectable mineral constituents (McLaughlin and Evans, 1989).

Rupture of the urinary bladder and subsequent uroperitoneum is a common problem in cattle, and in males, urolithiasis is the underlying cause in the majority of cases (Divers *et al,* 1982, Bertone and Smith, 1984). Uroperitoneum may be caused by trauma when the bladder is distended or from rupture of the bladder following urethral obstruction. Urine in the abdomen may not arise only from a

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single or multiple tears in the bladder wall, but also from seepage through the thinly stretched bladder wall in an over-distended bladder (Fowler, 2010). In camels, with ruptured urinary bladder, ultrasonographic examination of the abdomen simplifies the detection of either intact or perforated urinary bladder and the presence of uroperitoneum (Tharwat *et al,* 2012a; Tharwat and Al-Sobayil, 2016).

Bladder rupture leads to gradual development of ascites from uroperitoneum, ruminal stasis, constipation and depression. Finally, uraemia may take 1-2 weeks to develop to the point where euthanasia is necessary. Calculus may be identified ultrasonographically. However, it is impossible to pass a catheter in male camels because of the dorsal urethral recess and restrictive diameter of the urethra (Tharwat *et al,* 2012b; Tharwat and Al-Sobayil, 2016). A ruptured urethra has been reported in camels (Gahlot, 1992). This article reports obstructive urolithiasis in camels with special reference to the clinical, ultrasonographic and postmortem findings.

Materials and Methods

Twenty male camels (*Camelus dromedarius*) (age: 6 months until 12 years; weight 110 to 650 kg) were clinically examined at Veterinary Teaching Hospital, Qassim University, Saudi Arabia as per described procedure (Köhler-Rollefson *et al*, 2001). Animals were presented to the clinic for examination because of depression, anorexia, bloody urine and anuria. Camels were investigated during the period of 2012 to 2020. Animals were treated according to the regulations of the Laboratory *Animal Control Guidelines* of Qassim University.

Ultrasonography of the urinary tract and postmortem examination

The urinary tract was scanned by ultrasonography as recently reported (Tharwat *et al,* 2012c). The right kidney was visualised in camels at the level of the 10^{th} and 11^{th} intercostal spaces and the upper right flank. The left kidney was imaged from the caudal left flank. Differentiation between the renal cortex and medulla was visible; the renal cortex was relatively hyperechoic compared to the renal medulla and the renal sinus was hyperechogenic and more differentiated than the cortex and medulla. The right and left renal parenchyma were less echogenic than the neighboring hepatic and splenic parenchyma, respectively. The renal hilus was seen when the transducer was placed in the paralumbar fossa and rotated about its longitudinal axis. Ultrasonography via the so-called hepatic and splenic windows also results in good images of the right and left kidneys, respectively. The left kidney was also accessible transrectal where the entire left kidney and the cranial pole can be reached. The urinary bladder and the pelvic urethra were imaged transrectally while the penile urethra was examined transcutaneously (Tharwat *et al,* 2012b). Of the 20 male camels, 7 were euthanised and thoroughly examined at postmortem.

Results

Of the 20 male camels, 18 (90%) had ruptured bladder and the remaining 2 (10%) had ruptured urethra. One of the camels with ruptured bladder was admitted firstly with intact bladder that was ruptured 2 days later. Depression, anorexia and anuria were seen in this case. Ventral abdominal swelling was detected in front of the penis with swelling of the prepuce (Fig 1). All animals with ruptured bladder were admitted with a history of anuria. Exploratory laparotomy showed a massive amount of reddish urine (Fig 2). Fig 3 shows a male camel with anuria for the past 15 days. Abdominal paracentesis revealed blood tinged urine. Centrifugation of the abdominal fluid yielded sediment. In this camel, 2 calculi were detected within the penile body. In the two male camels with ruptured urethra, ventral abdominal subcutaneous infiltration of urine was detected in front of the penis with swelling of the prepuce (Fig 4). Fig 5 shows ruptured urethra in a male camel where severe edematous swelling at sheath was observed that yielded a massive amount of red urine on exploratory puncture. The urine also invaded gluteal muscles that also yielded dark red urine on exploratory puncture.

Ultrasonographic examination of the male camels with ruptured urinary bladder showed a collapsed urinary bladder that contained blood clots. Uroperitoneum resulted from rupture of the urinary bladder revealed floating of intestines (Fig 6). Figs 7 and 8 are showing dilated pelvic and penile urethra in a male camel with long-standing urine retention. Fig 9 was taken from a male camel with a history of cessation of micturition where transrectal ultrasonography showed distended bladder and urethra. Transcutaneous ultrasonographic examination of right kidney in the same case showed dilated renal pelvis and pressure atrophy of the renal parenchyma. A hyperechoic calculus located within the penile urethra with distal acoustic shadowing and a perforated bladder is seen in Fig 10. In cases with ruptured urethra, the bladder was imaged with intact wall and it contained hyperechoic sediment (Fig 11).

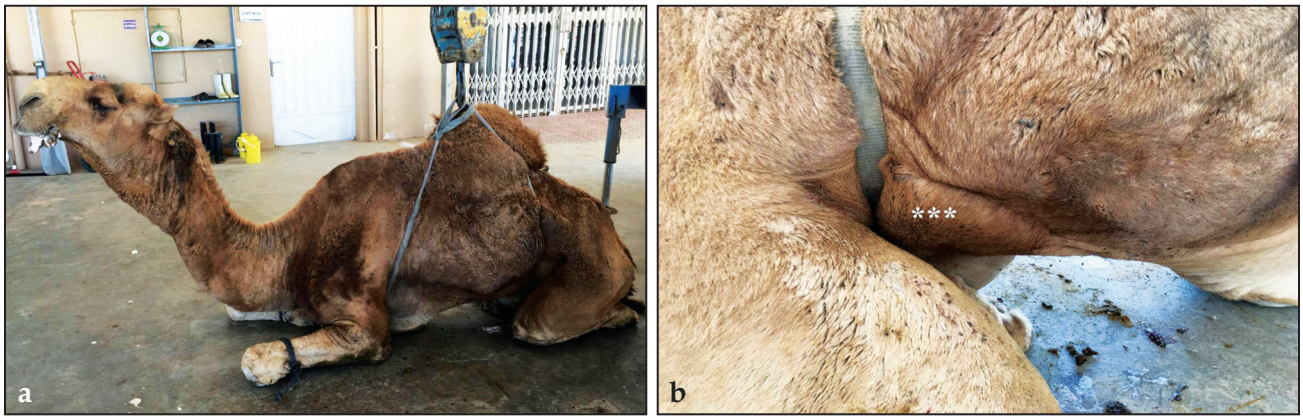

Fig 1. Ventral abdominal swelling extending up to penile sheath **(a)** and close-up view of the penile sheath and ventral swelling (stars) **(b)** in a case of retention of urine.

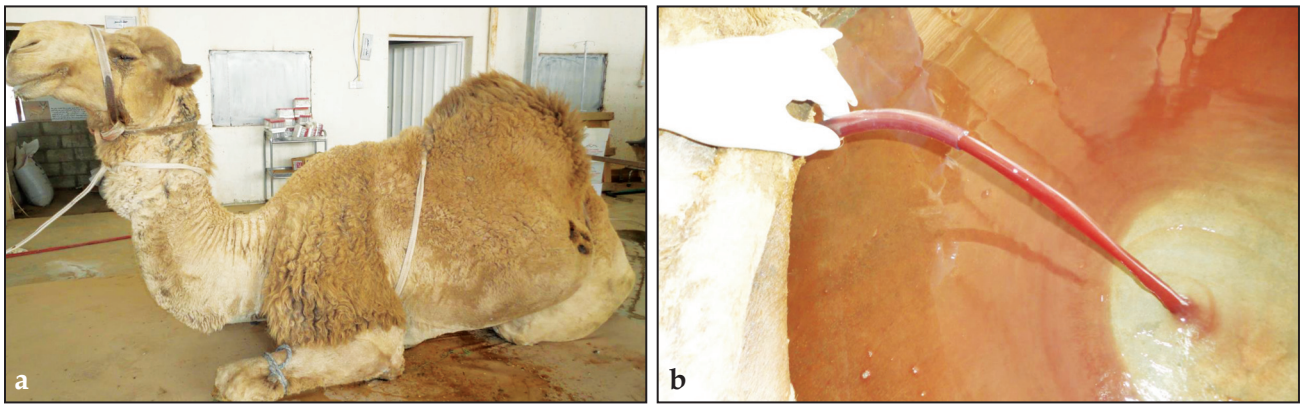

Fig 2. Depressed and dehydrated camel (**a**) and uroperitoneum was evidenced by aspirating out blood tinged urine (**b**) following exploratory laparotomy in camel with obstructive urolithiasis.

Fig 3. Abdominal paracentesis (**a**) revealed blood tinged fluid (**b**). Centrifugation of the abdominal fluid yielded sediment **(c)**. Two calculi were detected within the penile body (**d**) in a camel with anuria since last 2 weeks.

Necropsy findings of a camel with ruptured bladder revealed collapsed and ruptured wall (Fig 12). The bladder contained a reddish-brown deposit that represented blood clot and it contained a rough stone. The penile body contained 4 rough stones. A 6-month old male camel calf swith ruptured urinary bladder (15 days before) had distended abdomen. Postmortem examination showed uroperitoneum, congested and haemorrhagic bladder serosa and perforated bladder (Fig 13).

Discussion

Urolithiasis appears to be more common in temperate climates, it occurs in both females and male, castrated or intact, and there appears to be no age predisposition (Kock, 1985). The diameter of the female urethra generally allows free passage of a calculus that may enter the urethra; thus, obstructive urolithiasis is rare in the female. Urolithiasis has been associated with a diet high in concentrated feeds, such as are often used in zoos. Cattle pastured on grasses

Fig 4. Ruptured urethra in a 6-month-old male camel calf. Ventral abdominal swelling was detected in front of the penile sheath (**a**) and a close-up view of the penile sheath swelling (**b**).

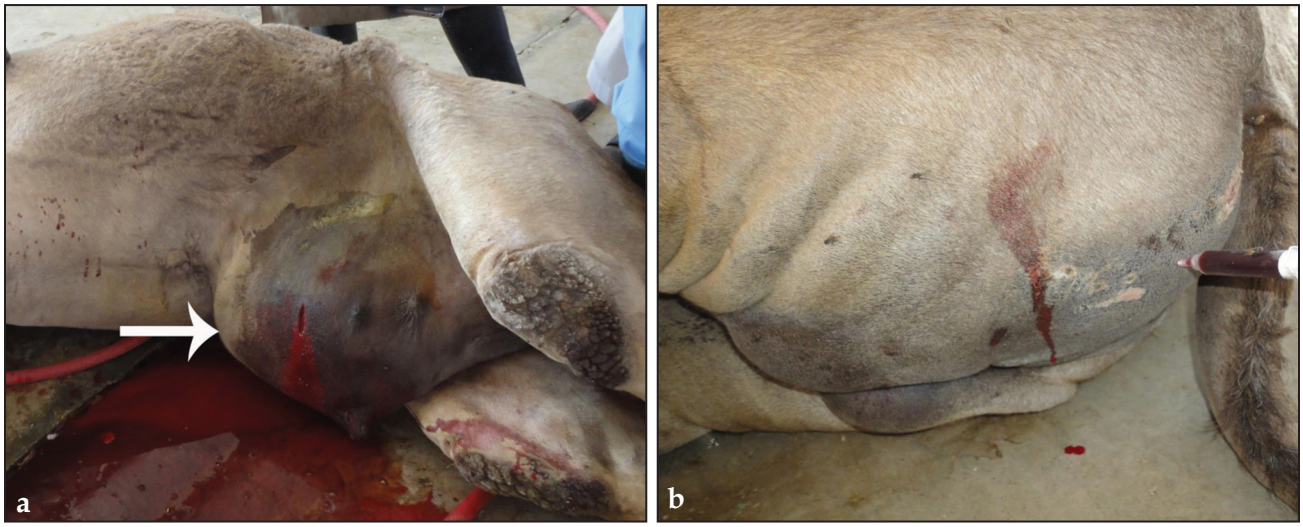

Fig 5. Ruptured urethra in a male camel. Severe sheath swelling was observed due to subcutaneous infiltration of urine which was confirmed by exploratory puncture (**a**; arrow). The urine was also infiltrated at medial thigh muscles; dark red urine on exploratory functure (**b**).

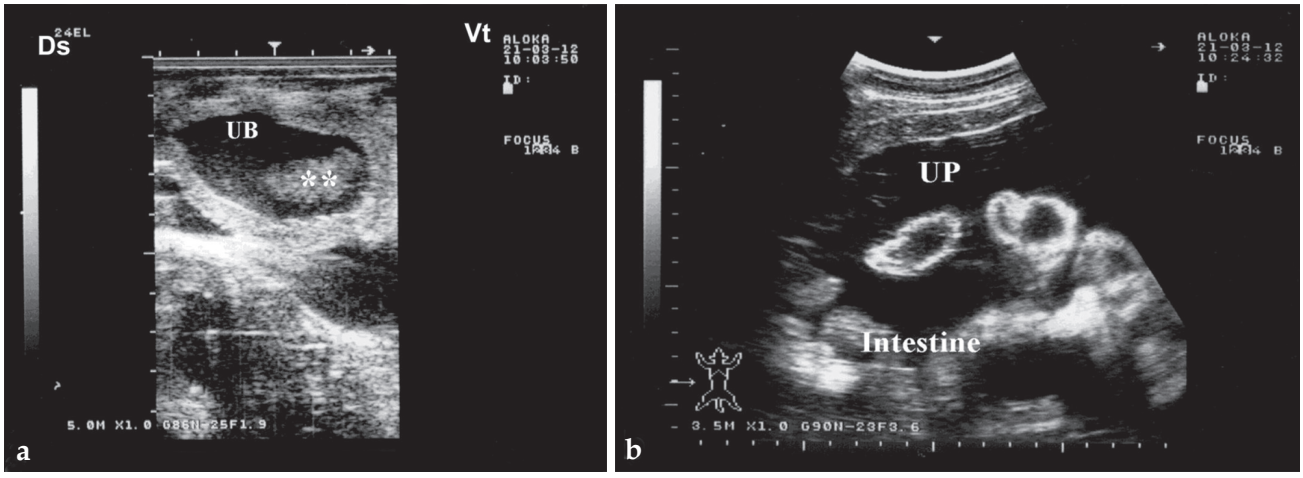

Fig 6. Ultrasonogram of a male camel with ruptured urinary bladder showing a collapsed urinary bladder (UB) and blood clot (stars) (**a**) and uroperitoneum (UP) with floating intestines (**b**).

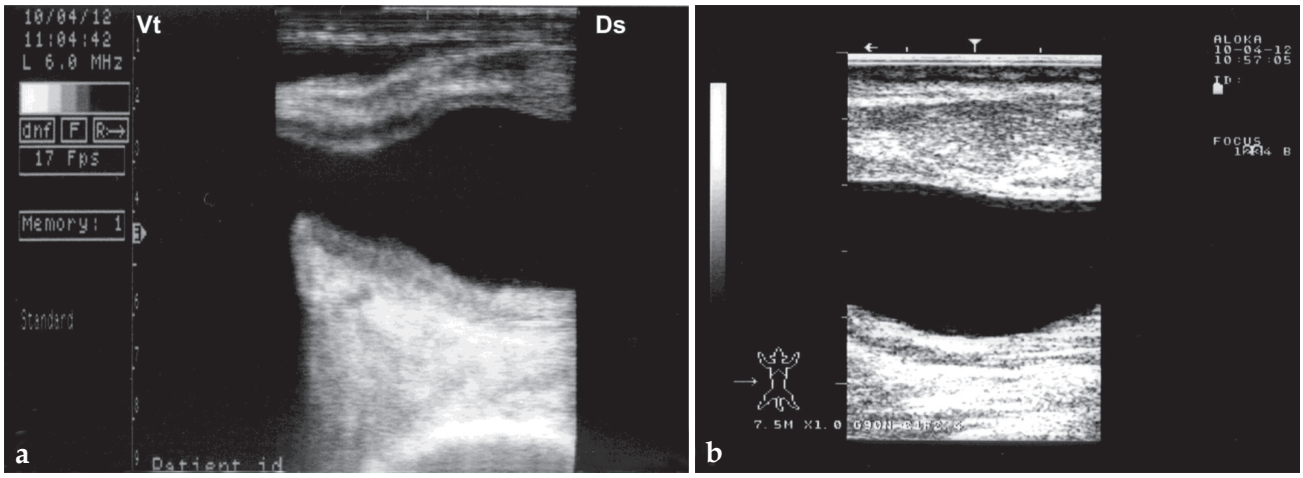

Fig 7. Ultrasonogram revealed dilated pelvic (a) and penile (b) urethra in a male camel with long-standing urine retention.

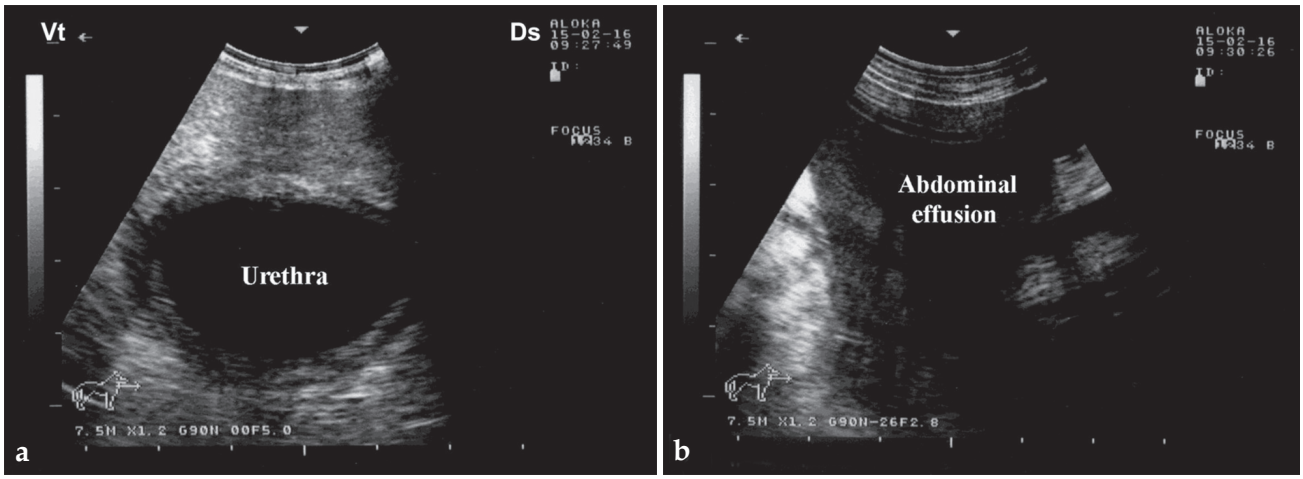

Fig 8. Ultrasonogram of the male camel with urine retention revealed dilated pelvic urethra (**a**) and uroperitoneum (**b)**.

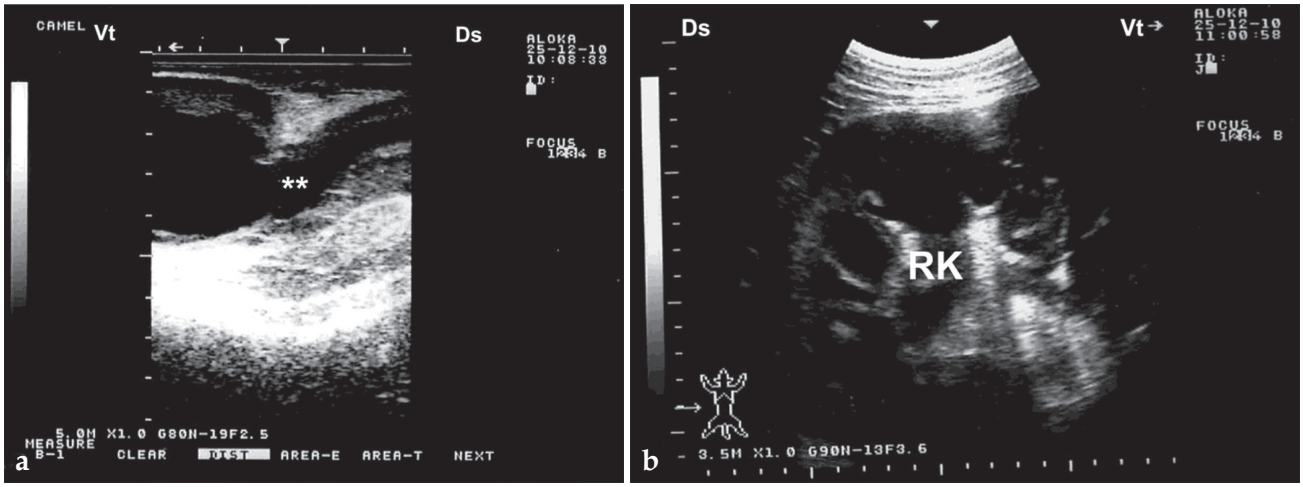

Fig 9. Transrectal ultrasonography showed distended bladder and urethra (**a**) of the male camel with a history of anuria.. Transcutaneous ultrasonographic on of right kidney (RK) showed dilated renal pelvis and pressure atrophy of the renal parenchyma (b).

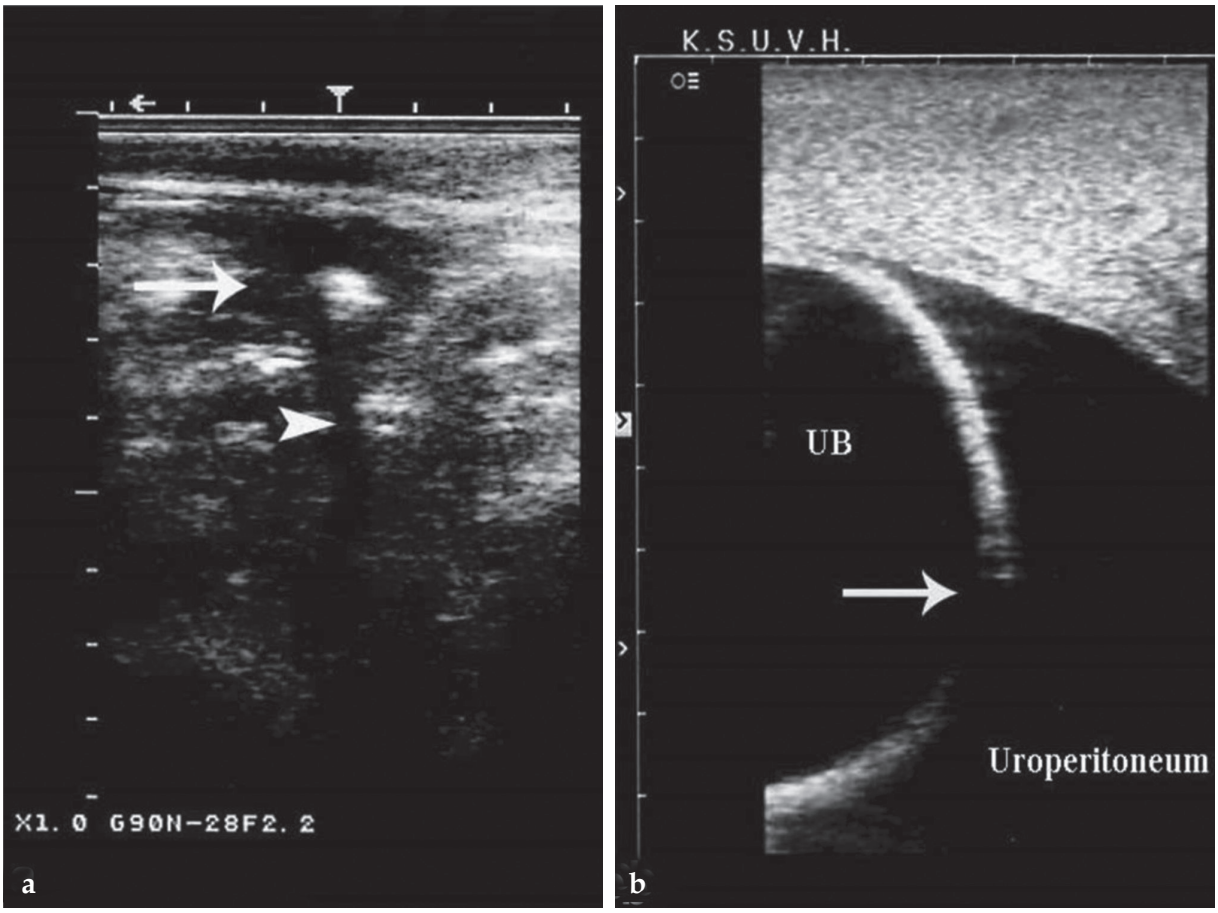

Fig 10. Ultrasonogram of a six-month old camel-calf with ruptured urinary bladder showed urinary calculi within the urethra (white arrow) with acoustic shadowing (arrowhead) (**a**) and perforated urinary bladder wall (UB) (white arrow) (**b**).

containing high levels of silicates may sometimes develop silicate urolithiasis, and presumably camelids grazing on such pastures may also be at risk (Fowler, 2010). In this study camels with urinary calculi were managed on a high concentrate feeding.

A basic understanding of the camelid urethra is required to locate sites of possible obstruction and develop approaches to management. The pelvic urethra is expansive, but at the reflection around the ischium, only a tiny orifice allows passage of urine beyond this point. The anatomy of this area is further complicated by a dorsal urethral recess, which precludes any possibility of passing a catheter into the bladder from the tip of the penis. Whereas the sigmoid flexure is the probable site of the majority of bovine urethral obstructions, this is not the case in camelids. The orifice from the pelvic urethra into the penile urethra is a common site of obstruction; another is where the penile urethra narrows as it enters the glans penis (Fowler, 2010). The penis of the camel is of the fibro-elastic type and depends primarily on its elasticity for erection and extension.

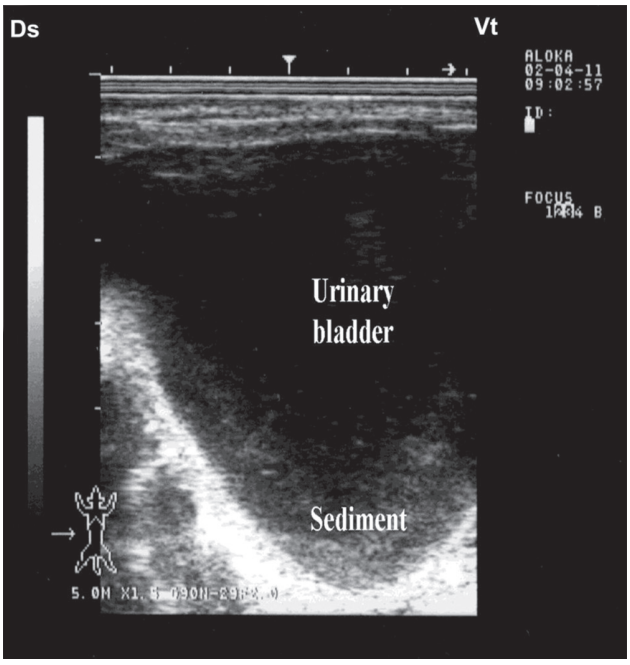

Fig 11. Ultrasonogram of a male camel calf with ruptured urethra. The bladder had an intact wall and it contained hyperechoic sediment.

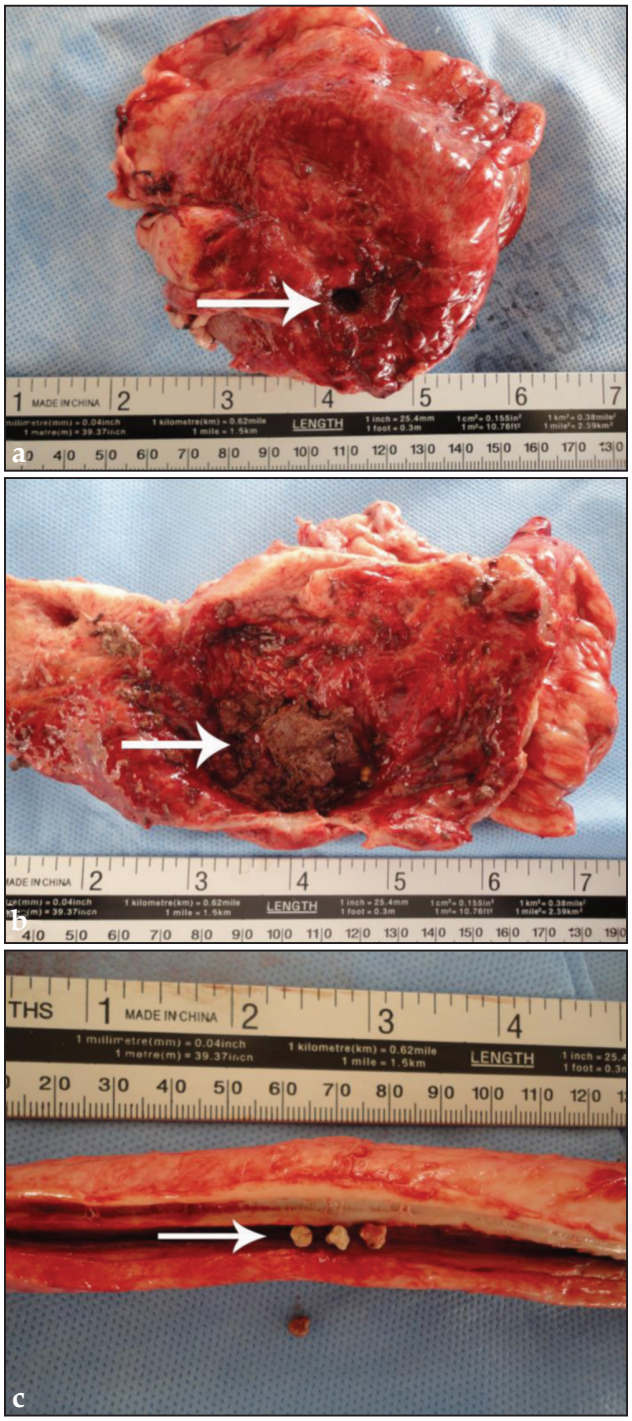

Fig 12. Necropsy findings of the camel with ruptured bladder. The bladder was collapsed and its wall was perforated (**a**). The bladder contained a reddish-brown deposit that represented blood clot and it contained a rough stone (**b**). The penile body contained rough stones (**c**).

In the absence of an erection, the penis is retracted into its sheath via a pre-scrotal sigmoid flexure not a post-scrotal sigmoid flexure, as is the case of bulls (Ali *et al*, 1996). The glans penis is curved along its vertical plane giving it a hook-shape with a definite neck between the glans and body of the penis (Mobarak *et al*, 1990; Belloa and Umarub, 2013). The penile urethra is extremely narrow and its opening is minute and the glans penis is represented by the urethral process (Smuts and Bezuidenhout, 1987).

Clinical signs of obstructive urolithiasis prior to bladder rupture include colic, straining stance to urinate, dribbling urine, blood - tinged urine, anuria, distended bladder, and possible pulsation of the urethra. Signs after bladder rupture include absence of colic, depression, anorexia, anuria, and uroperitoneum, with possible distention of the abdomen and uremia. Uroperitoneum may be caused by trauma when the bladder is distended or from rupture of the bladder following urethral obstruction. Urine in the abdomen may arise from a single or multiple tears in the bladder wall but also from seepage through the stretched - thin bladder wall (Fowler, 2010). A ruptured urethra has been reported in camels (Gahlot, 1992). Results of this study agree with these findings where depression, anorexia and anuria were the common clinical signs. Ventral abdominal swelling was also detected in penile sheath with swelling of the prepuce. Exploratory laparotomy showed a massive amount of reddish uroperitoneum that by centrifugation yielded red sediment. In the camels with ruptured urethra, penile sheath edema with ventral abdominal edema was detected. The urine in the later cases infiltrated the adjacent tissues that also yielded dark red urine on aspiration.

In this study, ultrasonographic examination of male camels with obstructive urolithiasis was valuable in evaluating diseased camels and in determining their prognosis. The most important findings included a collapsed urinary bladder in animals with ruptured bladder. Accumulation of urine within the peritoneum was also imaged easily where viscera were seen floating in the urine. Dilatation of the pelvic and penile urethra as a result of calculi was detected by ultrasonography. The urinary bladder wall was imaged intact in cases before bladder perforation. Unilateral or bilateral hydronephrosis with parenchymal pressure atrophy was also seen in camels with obstruction of the urinary tract. The obstructing calculus was also seen within the penile urethra as a hyperechoic mass with distal acoustic shadowing, and the perforated bladder was also seen. In cases with ruptured urethra, the bladder wall was imaged intact and it contained hyperechoic sediment. Postmortem examination of camels with ruptured bladder confirmed the

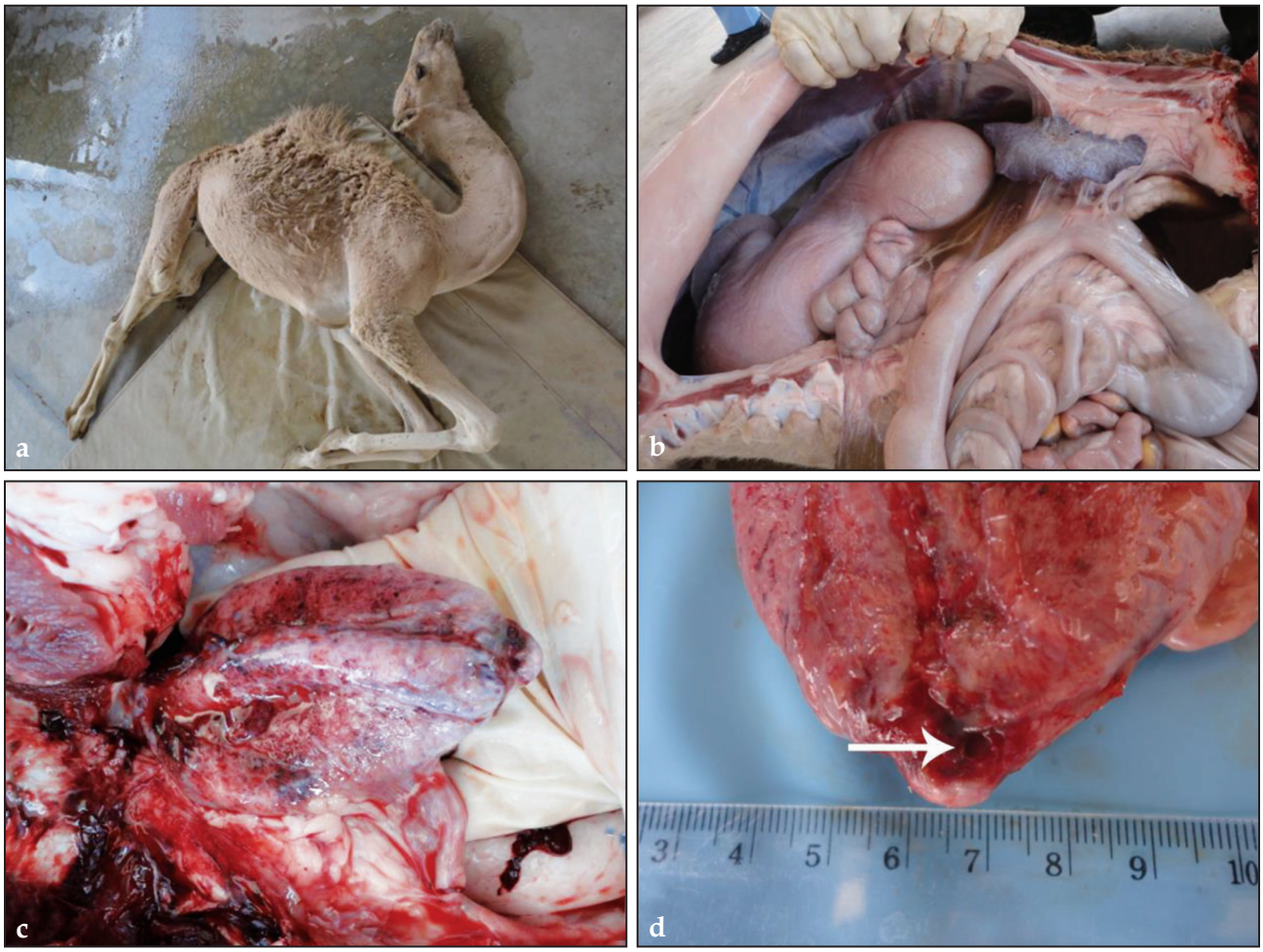

Fig 13. A 10-month old male camel calf with ruptured urinary bladder had distended abdomen (**a**). Postmortem examination showed uroperitoneum (**b**), congested and haemorrhagic bladder serosa (**c**) and perforated bladder (white arrow) (**d**).

ultrasonographic findings where the bladder was found collapsed and its wall was perforated. The bladder was found to contain blood clots and the urethra contained stones. Massive amount of uroperitoneum was detected and the bladder serosa was congested and hemorrhagic.

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