



NOTE

Surgery

Bilateral renal abscessation and chronic active pyelonephritis in a male camel (*Camelus dromedarius*) caused by *Escherichia coli*

Mohamed THARWAT^{1,2)}, Madeh SADAN^{1,3)*}, El-Sayed EL-SHAFAEY^{1,4)},
El-Hassan SAEED⁵⁾ and Abdullah AL-HAWAS¹⁾

¹⁾Department of Veterinary Medicine, College of Agriculture and Veterinary Medicine, Qassim University, 51452 Buraydah, Qassim, Saudi Arabia

²⁾Department of Animal Medicine, Faculty Veterinary Medicine, Zagazig University, 44519 Zagazig, Egypt

³⁾Department of Surgery, Anaesthesiology and Radiology, Faculty of Veterinary Medicine, South Valley University, 83523 Qena, Egypt

⁴⁾Department of Surgery, Anaesthesiology and Radiology, Faculty of Veterinary Medicine, Mansoura University, 35516 Mansoura, Egypt

⁵⁾Department of Microbiology, Faculty of Veterinary Medicine, University of Khartoum, 51452 Khartoum, Sudan

ABSTRACT. This report summarizes the clinical, hematobiochemical, ultrasonographic, histopathological and bacteriological findings in a male Arabian camel (*Camelus dromedarius*) with bilateral renal abscessation and chronic active pyelonephritis. Owner complaint included a decreased appetite and loss of body condition with occasionally voiding red urine. In the right kidney, ultrasonographic changes included a hypoechoic fluid surrounding the renal parenchyma. Within the left kidney, a large volume of hypoechoic contents were imaged. Bacteriological examination yielded only *Escherichia coli*. To the authors' knowledge this is the first reported case of bilateral renal abscessation and chronic active pyelonephritis in dromedary camels. In conclusion, renal ultrasonography provides a precise and non-invasive technique for diagnosis and subsequent clinical decision making of renal abscessation and chronic pyelonephritis camels.

KEY WORDS: camel, *Escherichia coli*, pyelonephritis, renal abscessation, ultrasonography

J. Vet. Med. Sci.

80(5): 778–783, 2018

doi: 10.1292/jvms.17-0484

Received: 11 September 2017

Accepted: 24 February 2018

Published online in J-STAGE:
20 March 2018

Renal abscess and pyelonephritis are common renal diseases in ruminants, especially in cattle [2, 5, 12] but rarely reported in camels [1, 9]. In cattle, most pyelonephritis cases are caused by *Corynebacterium renale*, a common inhabitant of the lower urogenital tract of healthy cattle. Less common etiologies isolated from the urine of affected cattle include *Escherichia coli* and *Truiperella (arcanobacterium) pyogenes* [15, 18].

Urinary tract infection (UTI) exists when bacteria adhere, multiply, and persist in a portion of the urinary tract. Cystitis and urethritis are more common in the female camel because of a shorter urethra and the possibility of retrograde invasion by bacteria [7]. Like other species, urinary tract infection results in food animals most commonly from ascending infection of pathogenic bacteria normally inhabiting the genitourinary epithelium and gastrointestinal tract, or residing in the environment [11]. Seventy-five percent of pyelonephritis cases are seen almost exclusively in cows after abortion, dystocia or puerperal infection [2]. Catheterization of the bladder for urine collection can result in pyelonephritis [13], and natural breeding has been hypothesized to be another cause [13]. Rare cases may also have a hematogenous origin [12].

Diagnosis of pyelonephritis is based on the results of clinical examination as well as ultrasonographic findings [13]. The clinical signs in cattle with acute pyelonephritis may include fever and colic, and in chronic cases polyuria and gross hematuria or pyuria may occur. Rectal palpation may reveal an enlarged left kidney [15]. Results of ultrasonographic examination of cows with pyelonephritis include dilatation of the right or left ureter, cystic lesions in one or both kidneys and dilatation of the renal sinus [2]. In addition, [6] stated that, in cows with pyelonephritis, it was not possible to establish an accurate diagnosis and prognosis based upon clinical examination or laboratory tests alone.

The present report describes the clinical, hematobiochemical, ultrasonographic, histopathological and bacteriological findings in a male Arabian camel (*Camelus dromedarius*) with bilateral renal abscessation and chronic active pyelonephritis.

*Correspondence to: Sadan, M.: madehsadan@vet.svu.edu.eg

©2018 The Japanese Society of Veterinary Science



This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License. (CC-BY-NC-ND 4.0: <https://creativecommons.org/licenses/by-nc-nd/4.0/>)

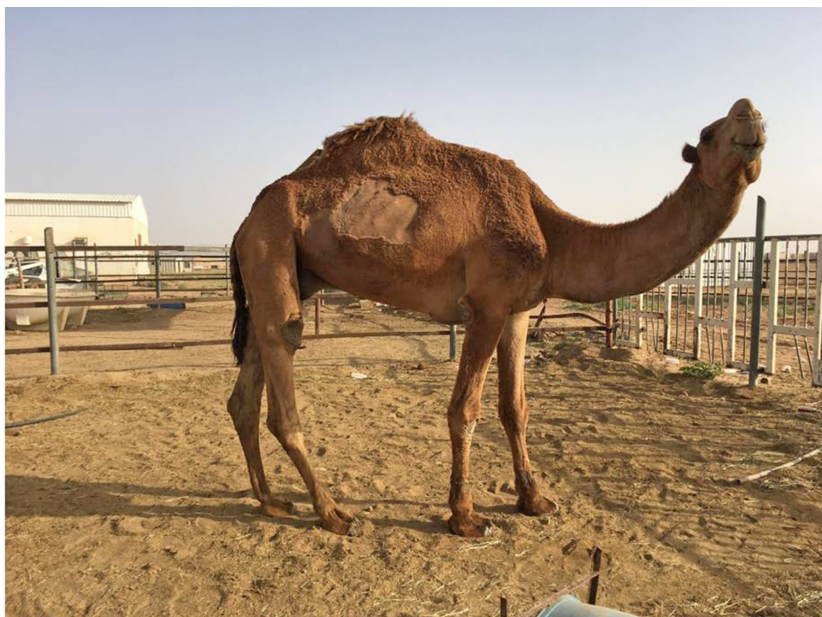


Fig. 1. A male Arabian camel with a history of decreased appetite and loss of body condition with occasional red urine.

A 12-year-old male camel was presented to the Veterinary Teaching Hospital, Qassim University, Saudi Arabia with a history of decreased appetite and loss of body condition. In another veterinary clinic, the camel was subjected to partial amputation of the rectal mucosa 18 months earlier because of extensively large and necrosed rectal prolapse. Following, the owner reported that the animal occasionally voided red colored urine during the last 4 months. Previous medications included intramuscular administration of only oxytetracycline 10 mg/kg body weight for 7 days. When first examined, the animal appeared emaciated with almost disappeared hump (Fig. 1). The animal underwent a thorough physical examination which included general behavior and condition, auscultation of the heart, lungs, rumen and intestine, measurement of heart rate, respiratory rate and rectal temperature, swinging auscultation, percussion auscultation of both sides of the abdomen and rectal examination [10]. Rectal examination was also carried out. The camel was maintained and treated according to the Laboratory Animal Control Guidelines of Qassim University, which basically conform to the Guide for the Care and Use of Laboratory Animals of the National Institutes of Health in the U.S.A. (NIH publications No. 86 to 23, revised 1996).

A complete blood count [total and differential leukocytic count, erythrocyte count (RBCs), hematocrit (HCT), hemoglobin, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC)] was carried out on the EDTA sample using the VetScan HM5, Abaxis, Union City, CA, U.S.A. An automated biochemical analyzer (VetScan VS2, Abaxis) was used to determine the serum concentrations of total protein (TP), albumin, globulin, glucose, blood urea nitrogen (BUN), creatinine, creatine kinase (CK), calcium, inorganic phosphorus, magnesium, aspartate aminotransferase (AST), γ -glutamyl transferase (GGT), alkaline phosphatase (ALP), sodium, potassium and chloride.

When the camel examined, it was dull, lethargic, anorexic and hypothermic (36.0°C ; normal 36.8°C). Auscultation of the heart and lungs did not reveal abnormalities. Rectal palpation showed pelvic mass that made examination difficult.

Hematobiochemical profiles revealed HCT 19.9% (reference range $28.9 \pm 2.7\%$), RBCs $8.78 \times 10^6 /\mu\text{l}$ (reference range $11.3 \pm 1.4 \times 10^6 /\mu\text{l}$), HGB 13.0 g/dl (reference range 16.0 ± 2.3 g/dl), MCV 23 fl (reference range 25.5 ± 1.5 fl), MCH 14.8 pg (reference range 14.7 ± 2.4 pg), MCHC 65.7 g/dl (reference range 57.6 ± 9.0 g/dl), WBCs 39,840 $/\mu\text{l}$ (reference range $169,000 \pm 2,700 /\mu\text{l}$), neutrophils 37,710 $/\mu\text{l}$ (reference range $9,800 \pm 3,000 /\mu\text{l}$), lymphocytes 1,410 $/\mu\text{l}$ (reference range $5,900 \pm 2,400 /\mu\text{l}$), TP 10.4 g/dl (reference range 7.9 ± 0.4 g/dl), albumin 3.9 g/dl (reference range 4.2 ± 0.4 g/dl), globulin 6.5 g/dl (reference range 3.7 ± 0.5 g/dl), glucose 151 mg/dl (reference range 61 ± 19 mg/dl), BUN 79 mg/dl (reference range 17 ± 10.0 mg/dl), creatinine 6.2 mg/dl, CK 419 U/l (reference range 139 ± 22 U/l), calcium 10.4 mg/dl (reference range 8.6 ± 0.7 mg/dl), AST 62 U/l (reference range 69 ± 44 U/l), GGT 604 U/l (reference range 12 ± 5.0 U/l), ALP 285 U/l (reference range 7 ± 3 U/l), inorganic phosphorus 4.7 mg/dl (reference range 2.6 ± 0.4 mg/dl), magnesium 1.0 mmol/l (reference range 0.26 ± 0.03 mmol/l), sodium 152 mmol/l (reference range 156.3 ± 2.9 mmol/l), potassium 4.8 mmol/l (reference range 3.9 ± 0.3 mmol/l). Using urine strips (Cambur 10 Urinary Test Strips, Roche), urine examination showed leukocytes +++++, protein ++, ketones ++, erythrocytes ++ and glucose +.

Ultrasonographic examination was carried out in sternal recumbency position using 3.5 MHz convex and 7.5 MHz linear transducers (SSD-500, Aloka, Tokyo, Japan). The animal was lightly sedated using intravenous 0.2 mg/kg xylazine HCl (Seton 2%, Laboratorios Calier, S.A., Barcelona, Spain). Both flanks were clipped and the skin shaved. After the application of transmission gel to the transducer, the right and left kidneys were examined at the upper right and caudal left paralumbar fossa. The transducer was directed perpendicularly when examining the right kidney and caudally when examining the left kidney. The left kidney was also imaged transrectally with the 7.5 MHz linear transducer. Transmission gel was applied to the transducer which was then

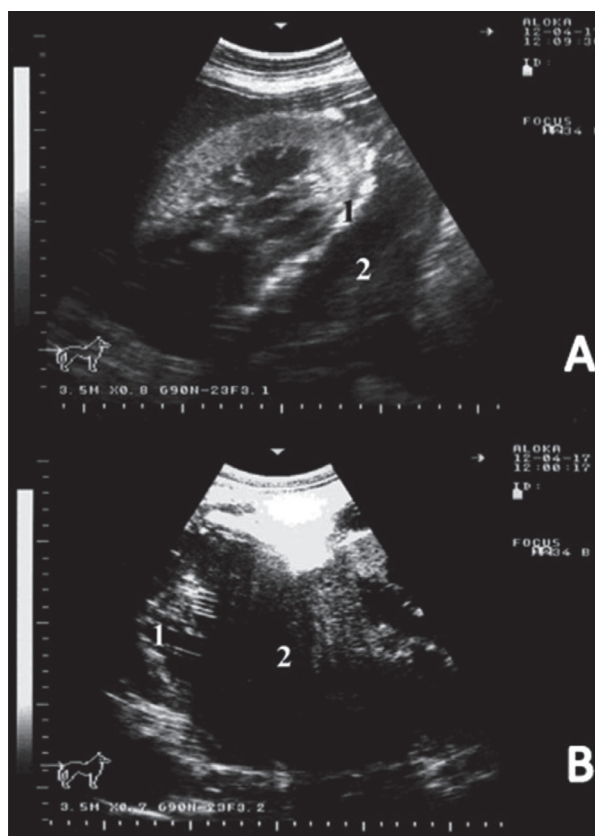


Fig. 2. Transabdominal ultrasonographic examination of the right kidney of the included male camel: (A) 1- The renal capsule was imaged hyperechoic with fibrin tags and the renal cortex appeared echogenic. 2- A hypoechoic fluid was imaged surrounding the kidney. (B) 1- Renal parenchyma; 2- Renal abscessation.

placed in a plastic rectal glove before being introduced into the rectum [16].

Transrectal ultrasonography revealed the presence of pelvic mass that occluded most of the pelvic inlet. During transcutaneous ultrasonography of the right abdomen, the mass was imaged in the lower right flank with a hyperechoic capsule and a hypoechoic contents. Aspiration of the mass yielded a pink colored pyogenic material. Directing the probe cranially, the right kidney was imaged located within the mass. Transabdominal ultrasonographic examination of the right kidney revealed a hyperechoic renal capsule with fibrin tags and echogenic renal cortex. A hypoechoic fluid was imaged surrounding the kidney from all sides and the kidney is floating within it (Fig. 2A). In the caudoventral left flank, the left kidney was imaged with a large volume of hypoechoic contents (Fig. 2B). No other abnormalities were detected by ultrasonography.

The animal was assigned for routine exploratory laparotomy of the mass. Feed was withheld for 12 hr prior to surgery. Preoperative antibiotic, penicillin-streptomycin (Pen & Strep, Norbrook Laboratories, Newry, U.K.) at a dose rate of 30,000 IU/kg for the penicillin and 10 mg/kg streptomycin and flunixin meglumine at 1.1 mg/kg were administered IV (Finadyin, Schering-Plough). Sedation was conducted via intravenous (IV) injection of xylazine Hcl (Seton 2%, Laboratorios Calier, S.A., Barcelona, Spain) at 0.3 mg/kg. Then, the incision site was anesthetized with linear infiltration local analgesia using 70 ml lidocaine Hcl (lidocaine hydrochloride 2% Norbrook Laboratories). The anesthetized camel was positioned in sternal recumbency. The left flank region was aseptically prepared for surgery. When the appropriate depth of anesthesia had been achieved, an 15 cm skin incision was made in relation to the site of left kidney. The incision was continued down with a combination of blunt and sharp dissection as required to gain access to the mass. Surgical exploration revealed a large mass with thick contents including the left kidney adhere to the parietal peritoneum. Hand manipulation of the right kidney revealed huge perinephric abscess. Such surgical findings indicated that the animal had grave prognosis. Therefore it was decided to euthanize the camel at this stage using Potassium chloride 10% solution I/V, and a post-mortem examination was carried out.

Postmortem examination revealed both kidneys were greatly affected. Huge perinephric abscess was observed in the right side together with pyelonephritis. Intranephric abscess (renal cortical and corticomedullary) was observed in the left kidney. Approximately 10.5 l of reddish pus was evacuated from the abscess surrounding the right kidney. The right kidney weighed 4.1 kg and the renal capsule was markedly thickened (Fig. 3A and 3B). The left kidney mass approximately weighed 18 kg. When opened, the center of the mass contained thick creamy pus (Fig. 3C and 3D). The renal pelvis had the capsulated abscess. The renal parenchyma suffered pressure atrophy (Fig. 4A).

Specimens from the right and left kidneys were immediately fixed in 10% neutral-buffered formalin. Following paraffin wax



Fig. 3. (A) Gross appearance of the right kidney revealed, thickened renal capsule with fibrin net. (B) Longitudinal section through the affected kidney where parts of the renal cortex appeared paler than the rest of the cortex. (C) Gross appearance of the left kidney showed, thick creamy pus evacuated from the affected left kidney weighting about 18 kg. (D) Longitudinal section through the left kidney after complete evacuation of the large abscess revealed thickening and dilatation of the renal pelvis in relation to the renal abscess.

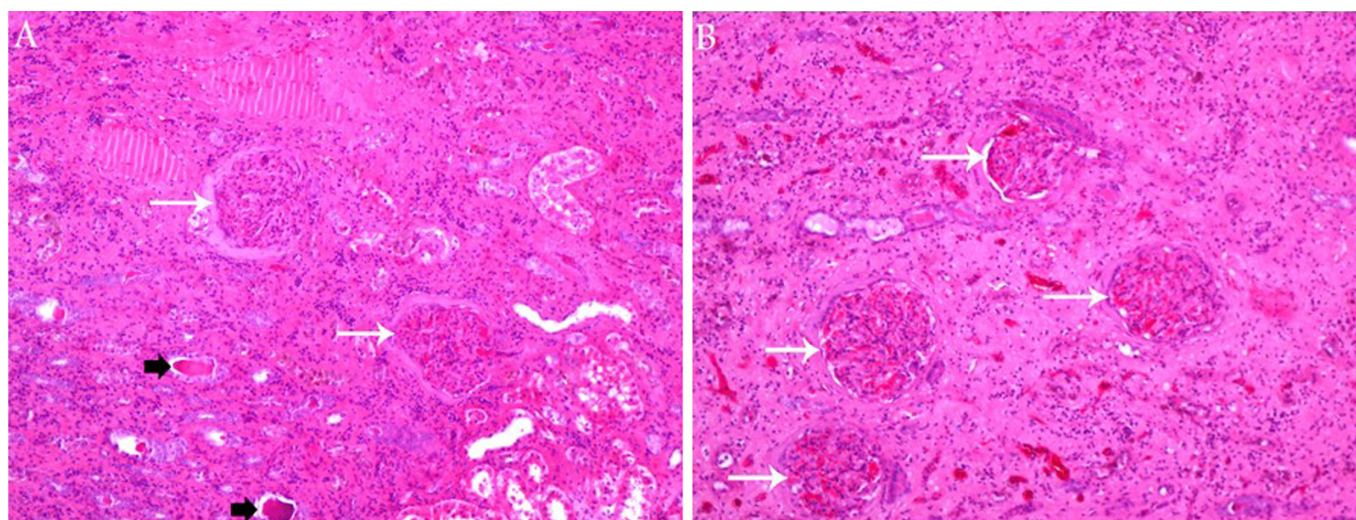


Fig. 4. Histopathological findings of renal specimen of the right (A) and left (B) kidney in a camel with bilateral chronic active pyelonephritis showing renal cortical and medullary tissue with congested glomeruli (white arrows) and tubules with colloid casts and a fibrous and granulation tissue part at the periphery (black arrows). The interstitial tissue shows active and chronic cells infiltrate (HE, $\times 100$).

embedding by using standard histological processing methods, all sections, cut at $4\ \mu\text{m}$ were stained with hematoxylin and eosin (HE) to be examined under light microscope. Histopathological examination of renal specimens showed renal cortical and medullary tissue with congested glomeruli and tubules with colloid casts and a fibrous and granulation tissue part at the periphery. The interstitial tissue shows active and chronic inflammatory cell infiltrates (Fig. 4B). A final diagnosis of bilateral chronic active pyelonephritis was then made.

During necropsy examination, kidney tissue and pus samples from renal and perirenal abscesses in sterile syringes were

Table 1. Susceptibility of the isolated *E. coli* to some antimicrobial agents

Antimicrobial	MIC	Interpretation	Antimicrobial	MIC	Interpretation
Ampicillin	≥32	R	Imipenem	≤0.25	S
Amoxicillin/Clavulanic acid	8	S	Meropenem	≤0.25	S
Piperacillin/Tazobactam	≤4	S	Amikacin	≤2	S
Cefalotin	32	R	Gentamicin	≤1	S
Cefoxitin	≤4	S	Ciprofloxacin	0.5	S
Ceftazidime	≤1	S	Tigecycline	≤0.5	S
Ceftriaxone	≤1	S	Nitrofurantoin	64	I
Cefepime	≤1	S	Trimethoprim/Sulfamethoxazole	≥320	R

S=sensitive, I=intermediate, R=resistant.

collected for bacteriological examination. The samples were streaked on Sheep Blood Agar and MacConkey Agar plates on the same day of collection and aerobically incubated overnight and for 48 hr at 37°C. Smears were prepared and examined by Gram's Method, directly from the tissue and pus samples and from growth on agar plates. Biochemical identification of pure bacterial growth and the susceptibility to some antibiotics were then carried out by VITEK 2 Compact system (bioMérieux, Craponne, France).

Gram-stained smears made directly from the collected samples and from colonies after growth showed only gram-negative short rods, which are abundant in tissue and red purulent fluid taken from inside the left kidney and scanty in the perinephric abscess. The colonial morphology and growth characteristics (fast growing lactose-fermenting) were suggestive of *E. coli*. A pure isolate was confirmed by VITEK 2 Compact system as *E. coli*, with probability of 98%. The isolate was found sensitive to most antimicrobial agents tested as shown in Table 1. Treatment of the animal was tried late in the course of infection using oxytetracycline, but failed. This failure of treatment might not be due to the bacterial resistance, especially the organism was found sensitive to tigecycline, a tetracycline derivative. It could be because the treatment was tried after renal abscess formation when the antibiotics may not reach the organism inside the abscess.

Renal pathologies such as abscess and pyelonephritis in camels are rarely reported compared to other animals [1, 9]. Out of 121 slaughterhouse-obtained renal lesions in dromedary camels, only 7.43% were pyelonephritis and no abscesses were found [9]. In contrast, renal abscess and pyelonephritis are common in other animals, especially in cattle [2, 5, 12]. In dogs and cats, perirenal abscesses typically are unilateral, and in cats perirenal abscessation develops, although infrequently, as a complication of chronic pyelonephritis [3, 19]. To the authors' knowledge, no previous report for bilateral renal abscessation and pyelonephritis were reported in camel. In this case report, chronic active pyelonephritis was obvious in both kidneys and the abscesses were very huge enclosing the left kidney and within the right kidney. These pathologies led to most severe illness and necessitated euthanasia. Renal pathologies in this case are most probably complications of ascending urinary tract infection caused by *E. coli* [11], which may be acquired from the environment, but mostly it found its way from the bowel to the urethra and via the urethra into the bladder and later upwards. This camel had a history of rectal prolapse, which could be the source of this bacterium.

In the present case report, bacteriological examination revealed *E. coli* as the causative agent. *E. coli* is mentioned in the literature as one of the most prevailing causative agents of pyelonephritis and renal abscess in animals [12, 15, 18] and humans [8]. *E. coli* is found in all cases (n=15) of chronic cystitis in dromedary camel [4].

Renal infections are mostly related to ascending route, but in rare cases, they may also have a hematogenous origin [12]. The case under investigation may be subjected to the ascending infection. The fast growing nature of *E. coli* and its high ability to adhere and colonize the host tissue [14] may justify the very huge sizes of renal abscessation, especially the perinephric one. The renal infection by *E. coli* may not be detected at the beginning of the disease course, because it may be asymptomatic [14]. Treatment failure may occur because antibiotics may not reach the organism inside the abscess.

Based on the complaint of occasional red urine, the urinary system was scanned and evaluated in this camel. The most important changes were found in the kidneys. In the right kidney, ultrasonographic changes included a hypoechoic fluid surrounding the renal parenchyma and the kidney is floating within it. The renal capsule appeared hyperechogenic with fibrin tags and echogenic renal cortex. Within the left kidney, a large volume of hypoechoic contents were imaged. Ultrasonographic findings in cows with pyelonephritis included dilatation of the right or left ureter, cystic lesions in one or both kidneys and dilatation of the renal sinus [2]. In cows with pyelonephritis, ultrasonographic changes included enlarged kidneys, echogenic material, and flocculent fluid within a dilated and deformed renal sinus and a poor cortical medullary differentiation [6].

Ultrasonographic examination of both kidneys in this case provided the first step in diagnosis of renal abscessation and pyelonephritis. Ultrasonography is a useful diagnostic and prognostic imaging tool for the evaluation of camels with different urinary affections [17], diagnosis of renal diseases in camels is difficult, and may be overlooked on many occasions; therefore, ultrasonography provides a means of detecting renal pathology more reliably in camels. Renal ultrasonography in camels is considered as an important tool for the diagnosis of renal disorders; it is a unique imaging modality for the non-invasive, patient-side evaluation of the renal cortex, medulla and sinus [16].

In conclusion, renal ultrasonography provides a precise, non-invasive and fast technique for the evaluation and subsequent clinical decision making of renal abscessation and chronic active pyelonephritis in dromedary camels caused by *E. coli*.

REFERENCES

1. Al-Ani, F. K. 2004. Camel Management and Diseases. 1st ed., Al-Sharq Printing Press, Amman.
2. Braun, U., Nuss, K., Wehbrink, D., Rauch, S. and Pospischil, A. 2008. Clinical and ultrasonographic findings, diagnosis and treatment of pyelonephritis in 17 cows. *Vet. J.* **175**: 240–248. [[Medline](#)] [[CrossRef](#)]
3. Cuypers, M. D., Grooters, A. M., Williams, J. and Partington, B. P. 1997. Renomegaly in dogs and cats. Part I. Differential diagnoses. *Comp. Cont. Educ. Pract.* **19**: 1019–1032.
4. El-Deeb, W. M., Al-Mujalli, A. M., Fouda, T. A. and Zabady, M. K. 2015. Clinical, biochemical and ultrasonographic investigation in chronic cystitis in dromedary camels. *J. Camel Pract. Res.* **22**: 227–230. [[CrossRef](#)]
5. Ertafi, H. B., Kilic, A., Özbey, G. and Muz, A. 2005. Isolation of Arcanobacterium (Actinomyces) pyogenes from abscessed cattle kidney and identification by PCR. *Turk. J. Vet. Anim. Sci.* **29**: 455–459.
6. Floeck, M. 2007. Sonographic application in the diagnosis of pyelonephritis in cattle. *Vet. Radiol. Ultrasound* **48**: 74–77. [[Medline](#)] [[CrossRef](#)]
7. Fowler, M. 1999. Medicine and Surgery of South American Camelids: Llama, Alpaca Vicuña Guanaco. 2nd ed., Wiley-Blackwell, Hoboken.
8. Kalra, O. P. and Raizada, A. 2009. Approach to a patient with urosepsis. *J. Glob. Infect. Dis.* **1**: 57–63. [[Medline](#)] [[CrossRef](#)]
9. Karmveer, S., Dadhich, H., Mathur, M. and Ashutosh, T. 2015. Histopathological studies on renal lesions in dromedary camel (*Camelus dromedarius*). *J. Camel Pract. Res.* **22**: 113–119. [[CrossRef](#)]
10. Köhler-Rollefson, I., Mundy, P. and Mathias, E. 2001. Managing and treating camels. pp. 1–67. In: A Field Manual of Camel Diseases: Traditional and Modern Healthcare for the Dromedary. ITDG Publishing, London.
11. Miesner, M. D. and Anderson, D. E. 2008. Unilateral nephrectomy of cattle. *Vet. Clin. North Am. Food Anim. Pract.* **24**: 497–500, vi. [[Medline](#)] [[CrossRef](#)]
12. Put, E., Valgaeren, B., Pardon, B., De Latthauwer, J., Valckenier, D. and Deprez, P. 2015. Surgical correction of pyelonephritis caused by multidrug-resistant *Escherichia coli* in a dairy cow. *Vlaams Diergeneesk. Tijdschr.* **84**: 94–100.
13. Radostits, O. M., Gay, C. C., Blood, D. C. and Hinchliff, K. W. 2000. Contagious bovine pyelonephritis. pp. 721–723. In: Veterinary Medicine. A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses, 9th ed. W.B. Saunders, London.
14. Roos, V., Nielsen, E. M. and Klemm, P. 2006. Asymptomatic bacteriuria *Escherichia coli* strains: adhesins, growth and competition. *FEMS Microbiol. Lett.* **262**: 22–30. [[Medline](#)] [[CrossRef](#)]
15. Rosenbaum, A., Guard, C. L., Njaa, B. L., McDonagh, P. L., Schultz, C. A., Warnick, L. D. and White, M. E. 2005. Slaughterhouse survey of pyelonephritis in dairy cows. *Vet. Rec.* **157**: 652–655. [[Medline](#)] [[CrossRef](#)]
16. Tharwat, M., Al-Sobayil, F., Ali, A. and Buczinski, S. 2012. Ultrasonography of the liver and kidneys of healthy camels (*Camelus dromedarius*). *Can. Vet. J.* **53**: 1273–1278. [[Medline](#)]
17. Tharwat, M. and Al-Sobayil, F. 2016. Ultrasonographic findings in camels (*Camelus dromedarius*) with different urinary affections. *J. Camel Pract. Res.* **23**: 301–308. [[CrossRef](#)]
18. Yeruham, I., Elad, D., Avidar, Y. and Goshen, T. 2006. A herd level analysis of urinary tract infection in dairy cattle. *Vet. J.* **171**: 172–176. [[Medline](#)] [[CrossRef](#)]
19. Zatelli, A. and D'Ippolito, P. 2004. Bilateral perirenal abscesses in a domestic neutered shorthair cat. *J. Vet. Intern. Med.* **18**: 902–903. [[Medline](#)] [[CrossRef](#)]