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Suppurative Pyelonephritis in a Caprine Buck: Clinical, Laboratory, Ultrasonographic and Pathologic Findings

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ABSTRACT

This report emphasizes the clinical presentation, hematological and biochemical changes, and ultrasonographic and pathologic findings in a caprine buck with bilateral suppurative pyelonephritis. A 9-month-old male caprine buck was referred for examination. Two blood samples were collected on EDTA and heparin. The main clinical presentation of the case under investigation included anorexia, diarrhea, abdominal distension, and intermittent dribbling of discolored urine during the last three weeks. The buck has been admitted in a depressed state, head lowering, and abdomen distended. Voided urine was centrifuged, and hematuria was proved upon getting urine sedimentation. Results of acid-base balance and blood gases included metabolic acidosis. The PO_2, BE, HCO_3, TCO_2, and sO_2 were low while the Anion Gap was high compared to reference ranges. The tested hematological parameters red blood cells, hematocrit, hemoglobin, mean corpuscular volume and mean corpuscular hemoglobin were low while total white blood cells and neutrophils were high, and lymphocytes were low. The most important biochemical findings included hyperproteinemia, hyperglobulinemia, hyperglycemia, and marked elevation in blood urea nitrogen and creatinine concentrations. During abdominal ultrasonography, a massive amount of peritoneal effusion was found in the peritoneal cavity and the urinary bladder appeared severely distended with echogenic urine. Renal scanning revealed the kidney architecture was misshaped, the renal pelvis was dilated, and the cortex and medulla could be differentiated. All these findings were confirmed postmortem. On histological examination of renal specimens, the renal cortex, and medulla showed diffuse suppurative pyelonephritis. Conclusively, ultrasound was very useful in the verification of pyelonephritis in the buck. It was especially helpful in scanning the renal parenchyma and detecting the abnormal architecture and misshaping of the kidneys. It also revealed severe urinary bladder distension with echogenic urine sediments as well as considerable amounts of peritoneal effusions. In spite of all these results, the histological examination of the kidneys remains the final and decisive diagnosis in such cases.

Key words: Animals, Diagnostic imaging, Goat, Pyelonephritis, Ultrasound.

INTRODUCTION

Diseases and disorders of the urinary system in small ruminants are numerous. Of them discolored urine, renal failure, cystitis, pyelonephritis, ruptured urethra, ruptured urinary bladder, hydronephrosis, paralysis of the bladder wall and urolithiasis (Kimberling and Arnold 1983; Braun et al. 1992; Tharwat 2021a; Almundarij and Tharwat 2023). *Corynebacterium renale* (*C. renale*) has been documented to cause pyelonephritis in sheep and goats (Higgins and Weaver 1981; Elias et al. 1991). The condition of pyelonephritis is commonly detected in cows (Taghipur-Bazargani et al. 2015) and equines (Parveen et al. 2020). However, in sheep and goats, it is rarely reported. The sonographic picture of pyelonephritis concurrent with obstructive urolithiasis and cystitis has been documented only in 2 reports in sheep and goats (Morin and Badertscher 1990; Kose et al. 2018). A case report of unilateral pyelonephritis with an abscess in brain in a ram was also reported (Sriraman et al. 1979). This report describes in detail the clinical, acid-base, blood gases, hematobiochemical, ultrasonographic and pathologic findings in a caprine buck with suppurative pyelonephritis.

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MATERIALS AND METHODS

Case Report

A 9-month-old male caprine buck was referred to the University Hospital of the University of Qassim, Saudi Arabia, with a history of depression, off food, diarrhea, and abdominal distension. Intermittent dribbling of discolored urine was informed during the last three weeks. Previous medications during the last 2 weeks included a five-day course of antibiotics comprising of penicillin/streptomycin combination, a non-steroidal anti-inflammatory drug, and fluid therapy. The buck underwent a full clinical examination that included measuring of rectal temperature, pulse and respiratory rates, mucus membranes, and cardiopulmonary and digestive systems. Special attention was paid to the examination of the kidneys, urinary bladder, urethra, and penile body (Tharwat 2021a). Two blood samples were collected: 1) EDTA sample for complete blood count assay and 2) heparin sample for acid-base, blood gases, and biochemical measurements.

Determination of the Hematobiochemical and Blood Gas Variables

The complete blood count panels including total white blood cells (WBCs), lymphocytes, neutrophils, red blood cell counts (RBCs), hematocrit (HCT), hemoglobin (Hg), and RBCs indices were measured in EDTA samples by a veterinary analyzer (VetScan HM5, Abaxis, California, USA). Different biochemical parameters and electrolytes including albumin, total protein, globulin, creatinine, blood urea nitrogen (BUN), glucose, and calcium were evaluated using a veterinary analyzer (VetScan VS2, Abaxis, California, USA). The activity of aspartate aminotransferase (AST), creatine kinase (CK), and γ-glutamyl transferase (GGT) was also determined using a Large Animal Profile VetScan VS2 Rotor (VetScan VS2, Abaxis, California, USA). Complete acid-base and blood gas panel was measured immediately after the heparinized sample collection by a portable veterinary analyzer (I-STAT®, Abaxis, California, USA). This panel included (1) pH (2) oxygen partial pressure (PO_2) (3) carbon dioxide partial pressure (PCO_2) (4) total carbon dioxide (TCO_2) (5) excess of base (BE) (6) oxygen saturation (sO_2) (7) bicarbonate (HCO_3) (8) anion gap (AG) and (9) lactate (Tharwat and Al-Sobayil 2014; Tharwat 2021b).

Ultrasonographic and Postmortem Examinations

Sonographic imaging of the urinary system was carried out using 3.5, 5.0, and 7.5 MHz transducers (SonoScape, Sonoscape Medical Corp., China). The right kidney was scanned either in the upper part of the right flank or in the 1th and 12th intercostal spaces high on the right side. The left kidney was imaged both from the caudal region of the left flank or transrectal. The urinary bladder was imaged transrectally, and the penile body was scanned transcutaneously. Sonographic examination of the urinary tract and the abdomen was carried out as reported (Braun et al. 1992; Tharwat 2021a; Stieger-Vanegas and McKenzie 2021; Sadan et al. 2023). Because of the poor prognosis of the caprine buck, the owner selects euthanasia, and therefore a thorough postmortem examination was carried out. The thorax and abdomen were examined fully, and a kidney specimen was taken on 10% buffered formalin, processed in wax, sectioned to 4µm and stained with hematoxylin and eosin for routine histopathology.

Table 1: Acid-base, blood gases, and hematobiochemical parameters in a male goat with suppurative pyelonephritis compared to healthy goats

Parameter	Result	Reference values*
pH	7.28	7.38±0.04
PCO_2 (mmHg)	41.1	39.9±6.3
PO_2 (mmHg)	32	38±6.4
BE (mmol/L)	-7	1.9±4.7
HCO_3 (mmol/L)	19.5	27.4±4
TCO_2 (mmol/L)	21	27.5±4.1
sO_2 (%)	54	65.3±6.6
Anion Gap (mmol/L)	17	4.1±0.5
Total white blood cells ($\times10^9$/L)	23.8	14.6±3.6
Lymphocytes ($\times10^9$/L)	4.99	6.2±3.2
Neutrophils ($\times10^9$/L)	18.6	9.3±4.1
Erythrocytes ($\times10^{12}$/L)	14.8	16.6±2.1
Hemoglobin (g/dL)	7.5	12.0±2.7
Hematocrit (%)	18.3	26.1±3.2
MCV (fL)	12	16.4±2.3
MCH (pg)	5.1	7.2±3.9
MCHC (g/dL)	41.4	39.8±1.5
Albumin (g/L)	42	44.8±2.3
Alkaline phosphatase (U/L)	46	85±27
Aspartate aminotransferase (U/L)	76	73±20
Calcium (mmol/L)	3.1	2.3±0.2
Gamma-glutamyl transferase (U/L)	45	42±7
Total proteins (G/L)	98	72.3±6
Globulin (G/L)	56	27.9±5.0
Blood urea nitrogen (mmol/L)	55.3	3.6±1.7
Creatinine (µmol/L)	1277	50±5
Creatine kinase (U/L)	161	177±59
Phosphorus (mmol/)	2.2	2.1±0.8
Magnesium (mmol/L)	2.03	1.2±0.5
Glucose (mmol/L)	15.2	4.3±1.4

PCO_2, partial pressure of carbon dioxide; PO_2, partial pressure of oxygen; BE, base excess; HCO_3, bicarbonate; TCO_2, total carbon dioxide; SO2, oxygen saturation. *Reference values from Tharwat and Al-Sobayil (2017) and Tharwat (2021b).

RESULTS

The main clinical presentation of the case under investigation included anorexia, diarrhea, abdominal distension, and intermittent dribbling of discolored urine during the last three weeks. The buck has been admitted in a depressed state, head lowering, and abdomen distended (Fig. 1). The rectal temperature was subnormal (37.5°C), pulse was accelerated (120/min), and harried respiration (40/min). Voided urine was centrifuged, and hematuria was proved upon getting urine sedimentation. Blood acid-base balance, blood gases, and hematological and biochemical parameters are displayed in Table 1. Results of acid-base balance and blood gases included metabolic acidosis. The PO_2, BE, HCO_3, TCO_2, and sO_2 were low while the Anion Gap was high compared to reference ranges. The tested hematological parameters RBCs, HCT, Hg, MCV, and MCH were low while WBCs and neutrophils were high, and lymphocytes were low compared to reference ranges. The most important biochemical findings included hyperproteinemia, hyperglobulinemia, hyperglycemia, and marked elevation in BUN and creatinine concentrations.

During abdominal ultrasonography, a massive amount of peritoneal effusion was found in the peritoneal cavity and the urinary bladder appeared severely distended with

Fig. 1: A male goat with suppurative pyelonephritis. The animal was admitted with a history of depression, off food, diarrhea, and abdominal distension.

echogenic urine. Renal scanning revealed the kidney architecture was misshaped, the renal pelvis was dilated, and the cortex and medulla could be differentiated (Fig. 2). Penile ultrasonography failed to detect any object that obstructed urine flow. Postmortem examination showed a much-distended urinary bladder, with massive amounts of hemorrhagic fluid within the peritoneal cavity. The renal pelvis was dilated in the kidneys and pin-point abscesses were seen on close inspection (Fig. 3). On histological examination of renal specimens, the renal cortex and medulla showed diffuse suppurative pyelonephritis (Fig. 4).

DISCUSSION

In the current case report, clinical signs included anorexia, diarrhea, abdominal distension, and intermittent dribbling of discolored urine during the last three weeks. The discolored urine points to possible affection in the urinary tract. The metabolic acidosis found in the buck indicated by decreases in PO_2, BE, HCO_3, and TCO_2 may explain polypnea and tachycardia observed in this animal at clinical examination. In addition, the remarkable increases in BUN and creatine support clinical findings. The state of hyperglobulinemia also indicated the chronic nature of the disease. Similar findings are reported in small ruminants with urinary tract disorders (Tharwat 2021a,b).

Diagnostic ultrasound also has been used in large animals to diagnose various renal disorders (Floeck 2007; Tharwat et al. 2012; Tharwat and Al-Sobayil 2016; Tharwat et al. 2017; Tharwat et al. 2018a,b; Tharwat 2020; Tharwat 2021c; Tharwat 2024). In cattle, transrectal and transcutaneous scanning of the kidneys showed dilatation of both ureters and unilateral or bilateral dilatation of the renal sinus. In the current report, transcutaneous ultrasonography of the kidneys showed overall increases in the parenchymal echogenicity making it difficult to distinguish the renal cortex from the medulla with bilateral dilatation of the renal sinuses (Floeck 2007). Our results agree in this investigation with our previous report describing urinary tract diseases in sheep and goats (Tharwat, 2021a).

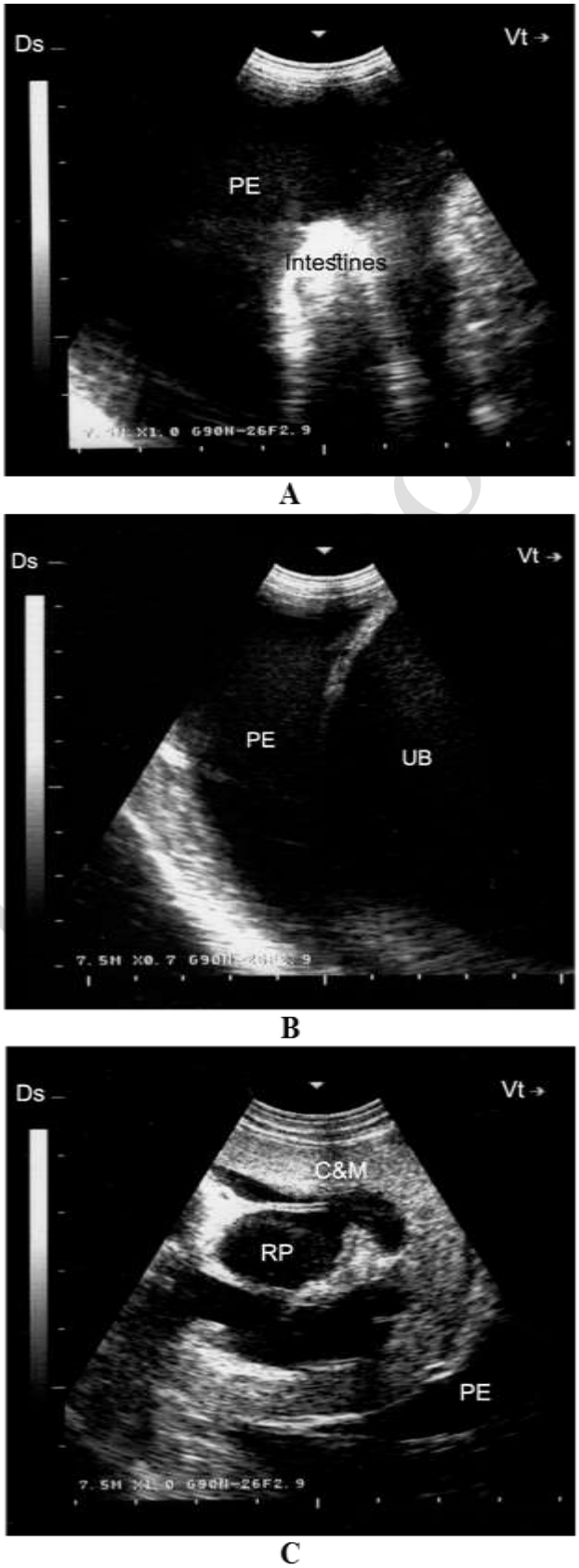

Fig. 2: Ultrasonographic findings in a male goat with suppurative pyelonephritis. A massive amount of peritoneal effusion was found in the peritoneal cavity (A). The urinary bladder (UB) appeared severely distended with echogenic urine (B). The kidney architecture was misshaped, the renal pelvis (RP) was dilated, and the cortex and medulla (C&M) could be differentiated (C). PE, peritoneal effusion; Ds, dorsal; Vt, ventral.

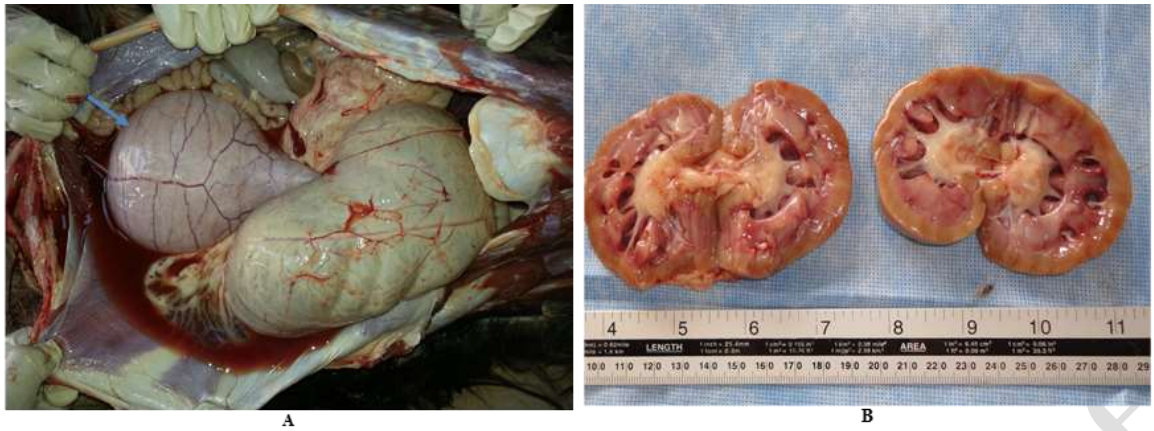

Fig. 3: Postmortem findings in a male goat with suppurative pyelonephritis. The urinary bladder in image A was severely distended (arrow) with massive amounts of hemorrhagic fluid within the peritoneal cavity. The renal pelvis was dilated in the kidneys (B) and pin-point abscesses were seen on close inspection.

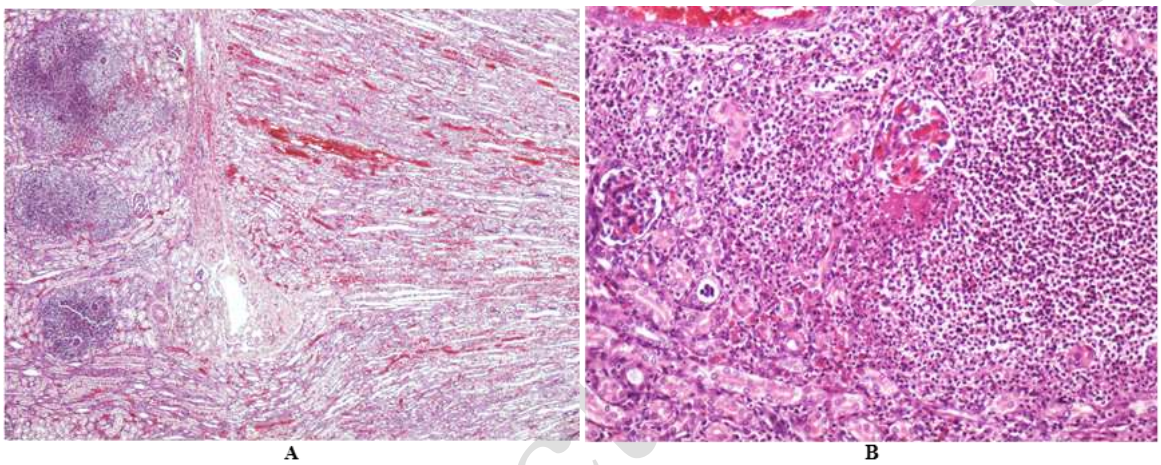

Fig. 4: Histopathological findings in the right kidney of a male goat with suppurative pyelonephritis. Renal cortex and medulla showing diffuse suppurative pyelonephritis (Hematoxylin and Eosin: A ×40; B ×200).

Our results also agree with another report in a goat with bilateral pyelonephritis and cystitis where renal scanning showed enlargement of the right kidney and dilatation of the renal pelvis (Kose et al. 2018). In large animals with bilateral pyelonephritis, renal ultrasonography showed an increased echogenicity of renal parenchyma as found in the current report. In addition, a low echogenicity fluid was found peri renal (Tharwat et al. 2018b; Tharwat 2023). In another report with unilateral pyelonephritis, renal ultrasonography showed an enlarged right kidney with polycystic heterogeneous pyogenic inclusions (Tharwat et al. 2018a).

Unfortunately, in this study, the etiological agent of the suppurative pyelonephritis in the caprine buck was not determined. Several pathogens were isolated from animals with pyelonephritis. *C. renale* has been isolated from sheep and goats with pyelonephritis (Higgins and Weaver 1981; Elias et al. 1991). In addition, *Salmonella dublin* was isolated from a Holstein calf with giant hydronephrosis and secondary pyelonephritis (Taghipur-Bazargani et al. 2015). In addition, *Mannheimia varigena* was detected in another Holstein calf with pyelonephritis (Komatsu et al. 2019). *C. renale* and *Escherichia coli* (*E. coli*) were isolated from cattle suffering from pyelonephritis (Floeck 2007). *Staphylococcus lugdunensis and E. coli* were also isolated from camels with unilateral and bilateral pyelonephritis (Tharwat et al. 2018a,b).

In conclusion, diagnostic ultrasound was very useful in this case in verification of the diagnosis of pyelonephritis. It was especially helpful in scanning the renal parenchyma and detecting the abnormal architecture and misshaping of the kidneys. It also revealed severe urinary bladder distension with echogenic urine sediments as well as considerable amounts of peritoneal effusions. All these findings were found at the postmortem examination. Despite all these results, the histological examination of the kidneys remains the final and decisive diagnosis in such cases.

Conclusion

Diagnostic ultrasound was very useful in this case in verification of the diagnosis of pyelonephritis. It was especially helpful in scanning the renal parenchyma and detecting the abnormal architecture and misshaping of the kidneys. It also revealed severe urinary bladder distension with echogenic urine sediments as well as considerable amounts of peritoneal effusions. All these findings were found at the postmortem examination. Despite all these results, the histological examination of the kidneys remains the final and decisive diagnosis in such cases.

Author's Contribution

Mohamed Tharwat: Carried out the practical and laboratory work and, drafted the manuscript. Abdulla Al-Hawas: Shared in the practical work. Both authors read, revised, and approved the final manuscript.

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