

Dept. of Internal Medicine
Faculty of Vet. Medicine- Assiut Univ. Egypt

**STUDIES ON PYELONEPHRITIS AND CYSTITIS
OF FATTENING BUFFALO-CALVES
IN ASSIUT GOVERNORATE**
(With 5 Tables and 3 Figures)

By

A.H. SADIEK; A.SAYED and M.F. RAGHIB

دراسات عن الالتهاب الكلوي الصديدي والتهاب المثانة البولية
في عجول التسمين الجاموسي بمحافظة أسيوط

على حسن صديق ، عرفات صادق سيد ، محمد فاروق راجب

أجريت الفحوص الإكلينيكية و المعملية على عدد ٤٠ من عجول التسمين الجاموسي والتي تراوحت أعمارها بين ١٢-٢٤ شهرا و كانت هذه الحيوانات تابعة لمزارع التسمين بمحافظة أسيوط، وبعضها تم تشخيصه في بعض المجازر أثناء فحص الحيوانات قبل و بعد الذبح. كان من بينهم ١١ حالة مصابة بالالتهاب الكلوي الصديدي و ٩ حالات كانت مصابة بالتهاب المثانة البولية، بينما العشرون الأخيرة كانت سليمة إكلينيكية و استخدمت كمجموعة ضابطة في البحث. هذا وقد تلخصت المظاهر المرضية للحيوانات المصابة بالالتهاب الكلوي الصديدي في ارتفاع درجات حرارة الجسم و فقدان الشهية مع خروج بول معكر. وقد أظهرت الفحوصات بعد الذبح وجود تضخم في الكلى المصابة، أوديا بحوض الكلى، صعوبة نزع غشاء الكلى ، وجود بقع صديدية على جدار و داخل النسيج الكلوي و تضخم الحوالب بسبب الالتهابات و امتلائها بالافرازات الصديدية. وقد أظهر الفحص النولي عكارة في البول، ارتفاع الجاذبية النوعية للبول ، وجود بروتين و كريات دم حمراء و خلايا صديدية و طلائية و اسطوانيات البول. كما أفاد الفحص الدموي و الكيمائي للدم ارتفاعا معنويا في كريات الدم البيضاء و الخلايا المتعادلة و البولينا و الكرياتينين و الفوسفور الغير عضوي و الماغنسيوم بمصل الدم مع نقص معنوي في بروتينات الدم. أما بالنسبة لحالات التهاب المثانة البولية فقد تم تشخيصها إكلينيكيًا في عدد ٤ حالات و داخل المجازر في عدد ٥ حالات أخرى و تلخصت المظاهر المرضية في صعوبة التبول ، نزول البول بكميات قليلة و على فترات متقاربة مع تغير في خواص البول، حيث أظهر الفحص المعمل للبول وجود خلايا صديدية و كريات دم حمراء و أملاح بلورية و بكتيريا و خلايا طلائية. كما أفاد الفحص الدموي ارتفاعا معنويا في كريات الدم البيضاء و الخلايا المتعادلة. و بالفحص البكتيريولوجي تم عزل بكتيريا الكورايين باكتيريم رينال و الميكروبات القولونية (إيشريشيا كولاي المرضية) و البكتيريا المعقودية بصفة أساسية في كل من الحيوانات المصابة بالالتهاب

الكروي الصديدي وكذا المصابة بالتهاب المثانة علاوة على عزل أنواع أخرى من الميكروبات أهمها الميكروبات السبحية والتي تم عزلها من الحيوانات المصابة بالتهاب الكروي الصديدي فقط بينما تم عزل ميكروب البروتيس في الحيوانات المصابة بالتهاب المثانة.

SUMMARY

Clinical and laboratory investigations of 40 fattening calves, 12-24 months old, belonged to fattening stations and abattoirs in Assiut Governorate were achieved. Twenty fattening calves were clinically healthy and served as control, however 11 calves were suffering from pyelonephritis and 9 calves were suffering from cystitis. Clinical signs of pyelonephritis were mainly fever, anorexia, passage of little turbid urine in association with signs of restlessness and pain. Post-slaughtering examinations revealed enlarged kidneys with partial loss of lobulations, edematous swelling of renal pelvis, adhered renal capsule, scattered white yellowish small foci on the surface and cortex of kidneys and enlarged thickened ureters filled with purulent fluid. Urine analysis revealed turbid flocculent urine, elevated specific gravity, marked proteinuria, hematuria, pyuria and granular & leucocytic casts. Significant increase in blood urea, serum creatinine, serum phosphorus and serum Mg, with significant decrease in blood serum proteins, serum sodium and neutrophilic leucocytosis were found in cases of pyelonephritis. Cases of cystitis were detected clinically (4 cases) and in slaughter houses (5 cases). Calves suffering cystitis showed dysuria, frequent passage of little urine associated with straining, and abnormal urine. Pus cells, red blood cells, crystals, bacteria and increased desquamated epithelium were found in the urinary sediments. Leucocytosis with neutrophilia were evident. *C. renale*, *E. coli* and *Staphylococci* were isolated from the urinary samples collected from calves suffering pyelonephritis and cystitis. *Streptococci* were isolated only from cases of pyelonephritis, however *Proteus* spp. were only isolated from those suffering cystitis.

Key words: Pyelonephritis -Cystitis- Buffalo-Calves

INTRODUCTION

Urinary tract diseases constitute an important problem in feedlot cattle with special reference to the urinary stones and its complications

leading to a great economic losses for feedlot industry (Udall, 1954). However, urinary tract infections may contribute to a lesser extent and occur mostly in association with urinary stone formation. It varies in severity from slight unnoticed infection to a severe form of systemic disturbances (Ziemer and Smith, 1988 and Radostits *et al.*, 1994).

Diagnosis of urinary tract disorders of cattle could be achieved clinically and laboratory. General examination of the animal, rectal and vaginal examinations of urinary organs may suggest infection any where in urinary tract (Böll and Gründer, 1981). The authors declared that rectal palpation of parts of the kidneys, ureters, urinary bladder and urethra is considered of value in diagnosis of urinary tract diseases of cattle. Observation of the act of urination, urine analysis and kidney function tests are considered of special importance in diagnosis and differential diagnosis of urinary tract diseases (Radostits *et al.*, 1994).

Pyelonephritis means bacterial inflammation of renal pelvis which extends to the kidney parenchyma, and often develops by ascending infection from the lower urinary tract (Freenstra *et al.*, 1945) and occasionally via spread of infection from embolic nephritis of hematological origin (Radostits *et al.*, 1994). The acute stage is rarely recognized because of its subclinical nature. It is often diagnosed after marked renal changes, and is characterized clinically by pyuria, suppurative nephritis, cystitis and urethritis (Ziemer and Smith, 1988).

The development of pyelonephritis depends upon the presence of common infection in the urinary tract and stagnation of urine which permits the multiplication and progression of the infection up to the urinary tract (Divers, 1989). The author added that urine stasis may occur as a result of bacterial infection and the blocking of ureters by inflammatory swelling or debris, by pressure from the uterus in pregnant female and by obstructive urolithiasis in males.

Diagnosis of pyelonephritis depends mainly on rectal palpation of enlarged left kidney and other urinary organs in association with the findings of urine analysis (Gründer, 1977). On necropsy, the kidney is usually enlarged and lesions in the parenchyma are in varying stages of development and is characterized by necrosis and ulceration of the pelvis and papillae and the pelvis is usually dilated and contains clots of pus and turbid urine (Radostits *et al.*, 1994). Regarding the etiology of bovine pyelonephritis, it was multibacterial, however, *C. renale* was the specific organisms (Morse, 1950 and Ziemer and Smith (1988)

Cystitis is the inflammation of the mucous membrane of the urinary bladder which is usually caused by bacterial infection and characterized clinically by frequent, painful urination and the presence of blood, inflammatory cells and bacteria in urine (Jones and Little, 1925 and Rebhun *et al.*, 1989). Cystitis occurs sporadically due to the entrance of infection into the bladder as a result of bladder trauma or due to stagnation of urine in it. Bacterial population described in cystitis are usually mixed, but *E. coli* is the predominant ones (Jones and Little, 1925; Ali, 1982 and Radostits *et al.*, 1994). Retention and stagnation of urine are the most important predisposing factors in occurrence of cystitis, which enhance growth and multiplication of certain bacterial flora in the bladder (Gründer, 1977). Deposition of insoluble salts and crystals in the folds of mucous membrane of bladder in association with oligouria or obstruction of urethra aggravate the condition (Anderson, 1983).

Cystitis may be acute or chronic, where, the acute types may be catarrhal, hemorrhagic, purulent, diphtheritic and fibrinous (Harenda *et al.*, 1990). Acute cystitis is diagnosed grossly when bladder mucosa was very red, but not thickened. Ali, (1982) described some usual varieties of chronic cystitis with numerous small cysts in the mucosa. The simplest form of chronic cystitis occurs in association with the presence of stones in the bladder (Jones and Little, 1925). Moreover it is characterized by irregularity, thickening and reddening of the mucous and accompanied with epithelial desquamation. Two criteria were applied in assessing lesions of chronic cystitis on gross examination. Specimens with rough, coarsely granular, or irregularly reddened, thickened mucous with no proliferative lesions were classified as uncomplicated chronic cystitis. Bladder which had nodular, villous or papillary projections or extensive corrugations were classified as proliferative chronic cystitis (Harenda *et al.*, 1990).

The present study aimed to throw a light on urinary tract infection in fattening buffalo-calves, its possible causes, as well as the associating changes in urine and blood.

MATERIALS and METHODS

I. Animals:

A total number of 40 fattening male buffalo-calves, 12-24 months old were used. Twenty fattening calves were clinically healthy and served as control. Eleven calves were suffering from pyelonephritis

and 9 calves were suffering from cystitis. All animals were examined at fattening stations and slaughter houses in Assiut Governorate. History of dysuria, colicky pain, discomfort, partial to complete loss of appetite and anuria were the main alarming signs for urinary tract troubles in the examined animals.

Calves in fattening stations were fed a basal diet composed of commercial concentrate mixture, rice and wheat straw as roughage. The concentrate mixture composed of cotton seed cake, wheat bran, corn, calcium carbonate and molasses. Approximately 4-6 kg feed mix, and 4-6 kg straw were fed for each calf daily. Healthy drinking water was offered ad. lib.

II. Samples:

II.1- Urine samples and urinary organs:

Urine samples were collected during spontaneous urination or by rectal massage of urinary bladder as that described in Kelly (1984). To minimize extraneous bacterial contamination, the prepuce was reflected from the penis and the tip of the penis was gently wiped with clean gauze sponge before urine collection. In certain circumstances where anuria and severe colicky pain are evident, and the animal was indicated for slaughtering, sterile urine samples were taken directly by means of urinary bladder puncture from fattening bulls after slaughtering. The obtained urine samples were kept in a sterile screw capped bottle and sent for routine urine analysis and direct bacterial culturing.

Both kidneys, ureters, bladder and urethra were examined in cases with a history of urinary problems before slaughtering as well as that discovered in abattoir.

II.2- Blood samples:

For estimation of PCV, total and differential leucocytic count, about 2 ml whole blood were collected in a clean glass vials containing EDTA as an anticoagulant. For estimation of blood serum levels of Na⁺, K⁺, CL⁻, Ca, P, Mg, urea, creatinine, total protein and albumin, about 5-10 ml whole blood were collected, left to clot, then centrifuged and a clean sera were obtained and kept at -20° C until analysis.

III- Adopted methods:

III.1- Clinical examination of fattening calves:

Both healthy and diseased calves were examined clinically and a special examination was oriented towards the urinary tract according to Rosenberger, (1990) and Radostits *et al.* (1994).

III.2: Slaughter house specimens.

Post-slaughter examination of the whole carcasses were carried out. Inspection and palpation of both kidneys, ureters, bladder and urethra were achieved. Several sections were done in both kidneys to screen its texture for abscess, calculi, pus, hydronephrosis and any other lesions. Ureters were ligated at both ends, urinary bladders with its contents were tied and sent immediately to the laboratory for physical, chemical and bacteriological examinations of urine. Sterile swabs from renal pelvis and urine sediments were collected for subsequent bacterial culture.

III.3- Urine analysis:

Routine urine analysis was done according to the methods described by Böll and Gründer (1981) and Coles (1986). Compur 10 test strips supplied by Boehringer Mannheim Diagnostica were used for physical and chemical examinations of urine. Bacteriological examination of urine samples and collected swabs were carried out according to that described in Carter, (1984).

III.4- Examination of blood samples for estimation of PCV (%), total WBCs (G/l) and differential leucocytic count (%) were carried out according to Coles, (1986). Blood serum electrolytes (Na^+ , K^+ and Cl^-) were estimated colorometrically by means of test kits supplied by Quimica Clinica Aplicada., S.A. Espana. Blood serum urea, creatinine, Ca, P, Mg, total protein and albumin were estimated colorometrically by means of test kits supplied by Boehringer Mannheim GmbH Diagnostica

IV- Statistical analysis:

The obtained data were analyzed for obtaining mean, SD and analysis of variance using a software computer program (Spsswin, 1995).

RESULTS

I- Clinical and post-slaughtering findings (Table, 1):

On the basis of history, clinical signs, rectal palpation of the left kidneys and results of urine and blood analysis as well as the post-slaughtering findings, a total of 11 fattening calves were diagnosed as pyelonephritis. The main clinical findings were fever, depression, anorexia, frequent passage of cloudy urine. Enlarged kidneys with signs of hydropic degeneration, mucopurulent secretions in the renal pelvis and ureters and presence of pyogenic foci on cutting of the renal tissues

were noted on post-slaughtering examination. Stones of variable sizes and shapes were recognized only in 3 cases (Fig. 1).

Cystitis was detected in 9 cases. Restlessness, dysuria, and frequent attempts of urination with passage of little urine were the main signs observed in affected cases. Changes in the constituents of the obtained urine were also noted. Post-slaughtering findings revealed irregular, red mucous with thickening and corrugation of the bladder wall. Desquamated epithelium, minute ulcers were also noted. Small stones were detected in 2 cases (Table 1 and Fig. 2 & 3).

II- Urine analysis (Table 2):

Cloudy turbid urine, elevated specific gravity, excess hematuria, proteinuria, pyuria and leucocytic casts were mostly the main urinary findings in calves with pyelonephritis. Urine analysis in fattening calves suffering from cystitis were mainly non specific, however, it was turbid, flocculent, with alkaline pH and bacteruria.

III- Bacteriological examination (Table 2):

In calves with pyelonephritis, the collected samples revealed *E. coli* & *C. renale* (7 cases); *C. renale* & *Staph. spp.* (2 cases); *E. coli* & *Strept. spp.* (2 cases), while in those calves suffering from cystitis, the bacterial isolates were *E. coli* & *C. renale* (3 cases); *Staph. spp.* and *E. coli* (4 cases) and *E. Coli* & *Proteus spp.* (2 cases).

IV- Hematological and biochemical findings (Tables 3-5).

Leucocytosis and neutrophilia were evident in pyelonephritis and cystitis. Significant increase in blood urea, serum creatinine, serum phosphorus and serum Mg associated with significant decrease in serum total protein, globulin and serum sodium were observed in calves with pyelonephritis. Blood serum levels of calcium, potassium (K) and chloride (Cl) showed insignificant changes in pyelonephritis and cystitis.

DISCUSSION

The major observed signs in pyelonephritis in this work were fever, anorexia, passage of little turbid urine in association with signs of restlessness and with strips pain. Rectal examination of affected adult calves revealed enlarged left kidneys with partial loss of lobulations. Routine urine screening and subsequent urine analysis as well as bacterial urine culture examination confirmed acute and subacute pyelonephritis. Many reports described pyelonephritis in cattle

supporting the obtained clinical findings were recorded, (Divers *et al.*, 1982; Divers, 1983 and Rebhun *et al.*, 1989).

Pyelonephritis was grossly diagnosed in 8 cases of fattening buffalo-calves in slaughter houses. Post slaughtering examination revealed enlargement of both kidneys with edematous swelling of renal pelvis, loss of lobulation, adhered renal capsule and scattered white yellowish small foci on the surface and cortex of kidneys (Fig. 1). Enlarged thickened ureters mostly filled with purulent fluid suggesting chronic pyelonephritis in 3 cases were noted. Small stones were noted in the renal pelvis of 3 cases. These observations were mostly similar to those described by Elias (1979); Ziemer and Smith, (1988) and Harenda *et al.* (1990).

Cystitis was detected in fattening buffalo-calves both clinically (4 cases) and in slaughter houses (5 cases). Dysuria, frequent passage of little urine associated with straining, and abnormal urine constituents were the main signs observed. On post slaughtering examination, small calculi were noted in urinary bladder of 2 cases (Fig. 2). Serohemorrhagic cystitis with foci of nodular lesions were detected in 3 case (Fig. 2 & 3). Urinary bladder ulcers were observed in 2 cases. Rough coarse, granular and reddened thickened mucosa were observed in 3 cases. Lesions of urinary bladder in cattle were previously reported by many authors (McKenzie, 1978; Böll and Gründer, 1981; Ali, 1982; Anderson, 1983 and Harenda *et al.*, 1990). Cystitis is generally not uncommon in cattle and it may be as a result of the presence of calculi which may hinder the urine outflow leading to stagnation of urine, which facilitates bladder inflammation (Anderson, 1983) and it is usually a precursor of pyelonephritis (Ziemer and Smith, 1988).

Examination of urine showed great variations in those suffering from pyelonephritis and cystitis (Table 2). In those suffering from pyelonephritis, the color of urine varied from yellowish to whitish milky and yellowish brown in other cases. Urine was turbid in all cases and showed elevated specific gravity. Elevated specific gravity reflecting the decreased urine flow that may also lead to increased alkalinity of urine as a result of urea splitting by bacteria to ammonia (Divers, 1989). Mild to marked proteinuria, granular and leucocytic casts, microscopic haematuria (20-50 cells/HPF) were the main observed urinary findings in these animals. Pyelonephritis in cattle is likely to produce varying amounts of protein in urine depending on the amount of tissue involvement and acuteness of the diseased condition which may be little

or marked (Cornelius and Kaneko, 1963; Gründer, 1979 and Radostits *et al.*, 1994). In those suffering from cystitis, urine was mostly turbid or cloudy and sometimes bloody. The turbidity and cloudiness may be attributed to the presence of pus cells, protein, crystals, bacteria and desquamated epithelium (Lovell, 1953 and Ziemer and Smith, 1988). Abnormal foul putrid odor may reflect the urine fermentation caused by bacteria in pyelonephritis and cystitis.

Bacterial culture of collected urine from both affected calves with pyelonephritis (table, 2) revealed the presence of mixed infection of *E. coli*; *C. renale* (7 cases); *C. renale* & *Staph. aureus* (2 cases); *E. coli* & *Strept. pyogenes* (2 cases). Similar results were previously reported by many authors (Hirmane *et al.*, 1981; Divers, 1983; Monaghan, 1983 and Rebhun *et al.*, 1989). Bacterial pyelonephritis could be attributed to ascending infection of the urinary passages by *E. coli* and/or *C. renale* (Jillespie *et al.*, 1981). *C. renale* possesses pilli that promote attachment to urinary mucosae and colonization there (Boyd, 1927). Many serotypes of *C. renale* were normally inhabitant in male urethral sheath (Jones and Little, 1925 and Lovell, 1946). Pyelonephritis caused by Gram-negative organisms was seen more frequent than that caused by *C. renale* infection (Drivers *et al.*, 1982 and Monaghan, 1983). The most isolated organisms in fattening calves with cystitis in this investigation were *E. coli* & *C. renale* (3 cases); *Staph. spp.* and *E. coli* (4 cases) and *E. Coli* & *Proteus spp.* (2 cases). Similar findings were recorded by Boyd, (1927), Anderson (1983) and Ziemer and Smith (1988) where they describe similar etiological organisms of cystitis in cattle. In case of urogenous sources or ascending type of infection, the bladder was first involved with secondary involvement of the ureters and kidneys (Jones and Little, 1925 and Boyd, 1927).

Leucocytosis and neutrophilia were evident in both groups of pyelonephritis and cystitis, that may be attributed to bacterial infection, reflecting also the processes of inflammation and traumatic lesions caused by urinary stones in kidneys and urinary bladders (tables 2 & 3). Similar results were previously described in cases of acute pyelonephritis and uremia in cattle (Jones, 1972). Most renal diseases, even the acute inflammatory conditions do not have an associated Leucocytosis and neutrophilia, however if pyelonephritis or renal abscess are present, a classical Leucocytosis could be expected (Coles, 1986). In chronic renal disease and its associating stress, there may be a slight neutrophilia and lymphopenia (Smith, 1990).

Blood urica and serum creatinine were found to be significantly increased ($P < 0.001$) in fattening calves with pyelonephritis (Table, 5). It is a marked pathognomic laboratory findings in pyelonephritis confirming the condition and reflecting azotemia and renal insufficiency due to bilateral involvement of both kidneys in the affected calves (Ziemer and Smith, 1988 and Divers, 1989). It also reflect the stage of urine retention especially in cases associated with renal involvement. The results of the present investigation especially the cases of pyelonephritis detected in slaughter houses support the previous reports of Elias, (1979) and Monaghan, (1983) stating that acute pyelonephritis may occur without clinical illness and passed unnoticed resulting in chronic renal infection.

Hypoproteinemia was evident in the group of pyelonephritis, that may be attributed in part to the continuous loss of protein in cases associated with renal involvement and partly to decreased feed intake in diseased animals. Observations of Böll and Gründer (1981) and Ziemer and Smith (1988) supported such findings.

Significant increase in blood serum P and Mg with concurrent insignificant changes in serum Ca were obtained in pyelonephritis. Hyperphosphaemia may results from decreased glomerular filtration of P (Divers *et al.*, 1982) or it may results from catabolism of high energy organic phosphate compounds (Sockett and Knight, 1984 and Ziemer, and Smith, 1988).

Significant decrease ($P < 0.05$) in serum Na^+ with insignificant decrease in serum Cl^- were observed in calves suffering from pyelonephritis in this work, supporting the previous findings of Ziemer and Smith (1988). The authors attributed low Na^+ & Cl^- levels in renal diseases due to decreased sodium resorption in damaged tubules.

The present investigation finally declared that urinary tract infections such as pyelonephritis and cystitis were not uncommon and are mostly suspected clinically and confirmed on post slaughtering inspection. Case history, complete clinical examination of urinary tract within the scope of general examination of the animals together with physical, chemical and microscopical examinations of urine may suggest urinary tract infections in fattening buffalo-calves. Additionally, bacterial examination of urine sediment as well as kidney function test add information that may confirm the urinary tract infections.

REFERNCES

- Ali, M. Seham (1982):* Incidence of cystitis in sheep with special reference to caustitive agents and morphological changes of urinary bladder in Assiut Province. M. V. Sci. thesis (General Medicine), Faculty of Vet. Medicine, Assiut University.
- Anderson, B. (1983):* Emphysematous cystitis in a cow/ and incidental lesions. *Vet. Med. Small Anim. Clin.* 78:406-408
- Boyd W.L. (1927):* Pyelonephritis in cattle. *Cornell vet.* 17:45-56.
- Böll, H.B. and Gründer, H.D. (1981):* Harnsedimentuntersuchungen in der Rinderpraxis, Technik und diagnostiche Bewertung, (Examination of the urine sediment in cattle clinic, Technique and evaluation). *Tieraerztl. praxis* 9, 119-126. Hans Marseile Verlag GmbH Muenchen.
- Carter, G.R. (1984):* Diagnostic Procedures in Vet. Bacteriology and Mycology. 1st Ed. Charles C Thomas Publisher. Springfield Illions USA. pp. 20-34.
- Coles E.H. (1986):* Veterinary Clinical pathology 4th Ed Saunders comp. Philadelphia, London, Toronto. pp. 10-175.
- Cornelius C.E. and kaneko J.J. (1963):* Clinical Biochemistry of domestic animals. Academic Press, New York and London. pp. 210-350.
- Divers, T.J. (1983):* Diagnosis and therapy or renal diseases of dairy cattle in Proceed. Am. Assoc. Bov. Pract. 15: 74-78.
- Divers, T.J. (1989):* Urinary tract disorders in cattle. *The Bovine Pract.* No. 24: 150-153.
- Divers, T.J.; Crowell, W.A. and Duncan, J.R. (1982):* Acute renal disorders in cattle. Part I: A retrospective study of 22 cases. *J. A. V. M. A.* (181: 694-693
- Elias, A.H. (1979):* Some studies on pyelonephritis in buffaloes. M. V. Sci. (Internal Vet. Med.) Faculty of Vet. Medicine, Assiut Univ.
- Freenstra, E.S.; Thorp, F.J.R. and Clark, C.F. (1945):* Two distinct diaptheroids isolated from cases of infection bovine pyelonephritis. *J. Bact.* 49: 202.
- Gründer, H.D. (1977):* Harnapparat, In: Rosenberger, G.: Die Klinische Untersuchung des Rindes. 2. Auf. Parey, Berlin- Hamburg.
- Gründer, H.D. (1979):* Labordiagnostik in der Rinderpraxis. 7:101-114.

- Harenda D.; Thomas, W.D. and T.E. Feltmate (1990):* An Abattoir survey of urinary bladder lesions in cattle. *Can. Vet. J. Volume 31: 515-518.*
- Hirmane T. Murase, N. and Hilman, F. (1981):* Efficiency of antibiotic treatment of cow affected with cystitis and those affected with pyelonephritis due to *C. renale*. *Jpn. Vet. Sci. 37: 273-276.*
- Jillespie, J.H.; Timmony, J.H. and Buners, H. (1981):* Infectious diseases of domestic animals. 7th Ed. Ithaca, NY, Cornell University : 231.
- Jones, A. (1972):* Physiochemical properties of bovine serum high density lipoprotein. *J. Biochem. 247: 7767-7772.*
- Jones, E.S. and Little R.B. (1925):* Specific infectious cystitis and pyelonephritis of cows: *J. Exp. Med. 42:593-607*
- Kelly, W.R. (1984):* "Veterinary Clinical Diagnosis" 3rd Bailliere Tindall
- Lovell, R. (1946):* Studies on *C. renale* A systemic study of strains. *Comp. Path. 56: 196-204.*
- Lovell, R. (1953):* Discussion on pyelonephritis. *Proc. Roy. Soc. Med. 46-179.*
- Mckenzie, R. A. (1978):* An abattoir survey of bovine urinary bladder pathology. *Aust. Vet. J. 54: 41-44;*
- Monaghan, M.L.N. (1983):* Abattoir survey of bovine kidney disease. *Vet. Sci. 113: 55-57.*
- Morse, E.V. (1950):* An ecological study of *C. renale*. *Cornell Vet. 40: 178.*
- Radostits, O.M.; D.C. Blood and Gay C.C. (1994):* Veterinary Medicine. A text book of the diseases of cattle, sheep, pigs, goats and horses. 8th Ed. Bailliere Tindall London Philadelphia Sydney Tokyo Toronto.
- Rebhun, W.C.; Stephen, G. Dill; Jhon, A. Perdrizet and C. E. Hatfield (1989):* Pyelonephritis in cows: 15 casses (1982-1986). *JAVMA, Vol. 194, 7: 953-955.*
- Rosenberger, G. (1990):* Die Klinische Untersuchung des Rindes.3. Auflage herausgegeben von Dirksen, G. Gründer, H.- D. and Stober, M. Verlag Paul Parey Berlin und Hamburg.
- Smith, B.P. (1990):* Large Animal Internal medicine, A text book diseases of horse, cattle, sheep and goats, The C.V. Mosby Company, St. Louis Baltimore, Philadelphia, Toronto.
- Sockett, D. and Knight, A.P (1984):* Metabolic changes associated with obstructive urolithiasis in cattle. *Compend. Contin. Educat. Pract. Vet. 6 :5311-5315.*

- Spsswin, (1995):* Statistical programe under windows, USA
Udall, D.H. (1954): The practice of Vetrinary Medicine, Ithaca N. Y:
 Published by the author, 270-272.
Ziemer, E.L. and Smith, B.P. (1988): Pyelonephritis, glomerulonephritis,
 and urolithiasis in a Holstein bull with diarrhoea. Compendium
 Food Animal, Vol. 10, 1: 82- 85.

Table 1: Clinical and post-slaughtering findings in fattening buffalo-calves suffering from pyelonephritis and cystitis as well as clinically healthy ones.

Aspects of examination	Pyelonephritis (11)	Cystitis (9)	Clinically healthy (20)
Clinical cases	3	4	10
Abattoir cases	8	5	10
Main clinical signs	Fever (40.0 -41.5 °C), depression, anorexia, passage of cloudy turbid urine.	Restlessness, frequent attempt of urination with passage of little urine. Anorexia, abnormal urine.	Clinically healthy, No special findings.
Post slaughtering /Post mortem findings	Enlarged kidneys with signs of hydropic degeneration and presence of pyogenic foci on cutting of renal cortex. Renal pelvis & ureters were mostly filled with pus. Small stone (3 case)	Laceration and ulcers of bladder mucous membranes, Small stones (2 cases) Serohaemorrhagic cystitis with focci of nodular lesions. Rough coarse, granular and thickened mucosa were observed in 3 cases	No special findings in the 10 slaughtered healthy cases.

Table 2: Physical, chemical, microscopic and bacteriological findings of urine of fattening calves suffering from pyelonephritis and cystitis as well as healthy ones.

Aspects of examination	Pyelonephritis	Cystitis	Clinically healthy (Control)
Number of cases	11	9	20
Specific gravity	1.030-1.040	1.015-1.025	1.015-1.035
Color	Whitish yellow to brownish yellow	Yellow to whitish yellow	Amper yellow
Aspect	Flocculant turbid	Cloudy - Flocculant	Clear, slightly hazy
Odour	Putrid ammonical	Putrid	Urinefrous
Deposit	large brownish white	Little whitish yellow	Little white sediment (3 cases)
PH	7.0-8.0	6.0-7.5	6.0 - 6.5
Protein	1 to 3 +ve	Traces to 1 +ve	Nil - traces
Glucose	Nil	Nil	Nil
Nitrite	Nil. (3) 1-2+ (8)	Nil. (2) 1-2+ (9)	Nil.
RBCs / HPF	15- 100	4-15	0-4
Pus cells/HPF	25-75 Overcount (2 cases)	12-25	0-5
Epth. cells /HPF	5-18	6-11	1-4
Crystals / HPF	Ca-oxalate* (4); Triple phosphate* & Amorph. phosphate* (3). Nil. (4)	Triple phosphate** (6). Nil (3)	Ca-oxalate* (7) Amorph. phosphate* (6). Nil. (7)
Casts / LPF	Cellular and granular ^b (5); Leucocytic ^c (2) Haemorrhagic + Granular ^a (4)	Hayline castsa ^a (2) Granular casts ^a (2) No Casts (5)	No casts (16) Hayline casts ^a (4)
Isolated bacteria	<i>C. renale</i> + <i>E. Coli</i> (7) <i>Staph</i> + <i>C. renale</i> (2) <i>E. Coli</i> + <i>Strep. spp.</i> (2)	<i>C. renale</i> + <i>E. Coli</i> (3) <i>Staph. spp</i> + <i>E. Coli</i> (4) <i>E. coli</i> & <i>Proteus spp.</i> (2)	-

* - means 1 + ve ** - means ++ ve *** - means +++ ve ^a - (0 - 2 / HPF)
^b - (2- 4/ HPF) ^c - (more than 4 /HPF).
 The number between brackets () indicate the number of diseased condition

Table 3: Means, S.D. and ANOVA of Packed cell volume (PCV), Total and differential leucocytic count in calves suffering from pyelonephritis and cystitis as well as healthy ones.

Aspects of examination	Statistics	Pyelonephritis (11)	Cystitis (9)	Clinically healthy (20)
PCV %	X	39.87	35.8	36
	SD	4.51	4.16	4.63
	ANOVA	n.s.	n.s.	
TWBCs G/l	X	15.80	11.074	7.53
	SD	4.093	2.019	1.85
	ANOVA	↑***	↑**	
Imm. %	X	6.066	4.6	2.65
	SD	2.25	2.29	1.292
	ANOVA	↑**	↑*	
Mature Neut. %	X	54.67	46.40	38.25
	SD	8.051	6.219	8.325
	ANOVA	↑***	↑**	
Lymph %	X	31.27	38.066	48.8
	SD	7.8	4.48	7.26
	ANOVA	↓**	↓*	
Monoc. %	X	4.533	6.20	4.90
	SD	2.325	2.569	1.63
	ANOVA	n.s.	↑*	
Eosin %	X	3.466	4.866	4.85
	SD	2.80	2.231	1.93
	ANOVA	n.s.	n.s.	

Table 4: Means, SD. and ANOVA of blood serum total protein, albumin, globulin and A/G ratio in healthy and diseased calves suffering from pyelonephritis and cystitis.

Aspects of examination	Statistics	Pyelonephritis (11)	Cystitis (9)	Clinically healthy (20)
Total protein gm/l	X	58.60	67.50	74.57
	SD	9.39	13.37	11.35
	ANOVA	↓**	ns	
Albumin gm/l	X	26.65	28.76	30.40
	SD	6.90	8.2414	5.814
	ANOVA	n.s.	n.s.	
Globulin gm/l	X	31.95	38.74	44.14
	SD	5.342	10.214	12.087
	ANOVA	↓**	ns	
A/G	X	0.8271	0.74	0.753
	SD	0.2883	0.31	0.254
	ANOVA	n.s.	n.s.	

X : Mean. SD.: Standard deviation. ANOVA: Analysis of Variance. ↑: Increase.
↓ Decrease. *: (P<0.05); **: P<0.01. ***: P<0.001. G/l: Giga/liter (10⁹/l)

Table 5: Means, SD. and ANOVA of blood urea, serum creatinine, serum calcium (Ca), phosphorus (P), Magnesium (Mg), Sodium (Na), Potassium (K) and chloride (Cl) in healthy and diseased calves suffering from pyelonephritis and cystitis.

Aspects of examination	Statistics	Pyelonephritis (11)	Cystitis (9)	Clinically healthy (20)
Urea mmol/l	X	57.77	18.368	13.52
	SD	11.585	6.47	8.35
	ANOVA	↑***	ns	
Creatinine umol/l	X	245.13	141.82	122.88
	SD	84.8	35.24	28.43
	ANOVA	↑**	ns	
Ca mmol/l	X	3.70	3.475	3.366
	SD	1.97	1.00	0.81
	ANOVA	n.s.	n.s.	
P mmol/l	X	8.387	3.95	2.985
	SD	5.59	1.430	1.63
	ANOVA	↑**		
Mg mmol/l	X	1.29	0.95	0.833
	SD	0.47	0.243	0.494
	ANOVA	↑**	n.s.	
Na mmol/l	X	118.933	132.06	129.07
	SD	10.633	11.3	13.83
	ANOVA	↓*	n.s.	
K mmol/l	X	3.566	3.34	3.92
	SD	0.7556	0.783	1.47
	ANOVA	n.s.	n.s.	
Cl mmol/l	X	85.67	88.6	91.50
	SD	11.36	10.18	9.6
	ANOVA	n.s.	n.s.	

X : Mean SD : Standard deviation ANOVA: Analysis of Variance
 ↑: Increase ↓Decrease * : (P<0.05) ** : P<0.01 *** : P<0.001



Fig. 1: Cut section of an enlarged kidney with suppurative inflammation, showing a large amount of pus in the renal pelvis, redness and petechial haemorrhage in the renal cortex. Small sized stones were noted in renal cortex also.

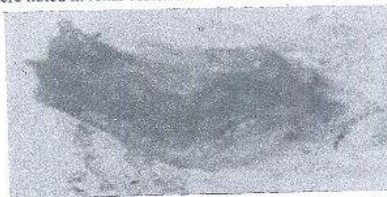


Fig. 2: Opened inflamed urinary bladder, showing congestion, haemorrhagic ulceration in case of acute cystitis.

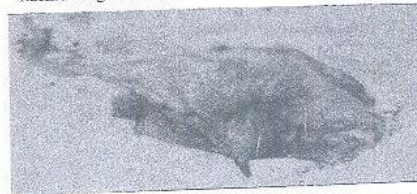


Fig. 3: Opened inflamed urinary bladder, showing some nodular foci, thickened epithelium, and small sized stones in chronic cystitis.