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Critical Urogenital Disorders Causing Abdominal Pain in Intact Cats

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Abstract: This study aimed to evaluate, diagnosis and management of series cases in cats suffered from some critical urogenital problems causing abdominal pain. Forty-seven cats (21 Shiraz, 22 Siamese and 4 Egyptian Mau) were included. Diagnosis was based on history, clinical signs, cardiovascular and respiratory monitoring, radiography, abdominal ultrasonography, hematological and biochemical analysis. Feline Urologic Syndrome (FUS) was diagnosed in 18/47 cats (38.3%); urinary bladder rupture (UBR) 2/47 (4.3%); polycystic kidney (PKD) 1/47 (2.1%); uterine rupture (UtR) 1/47 (2.1%) and closed cervix pyometra (CP) 25/47 (53.2%). Cats were subjected to resuscitation and medical management before surgical intervention. Animals suffered FUS were treated using retrograde urohydropropulsion with cystocentesis and/ or tube cystostomy with successful recovery. Percutenous cystic aspiration was performed in the case of PKD. Ovariohystrectomy was the radical treatment in cats suffered from both CP and UtR. Cats with UBR were treated with cystorrhaphy. Results revealed successful recovery and good outcome inspite a case of FUS was died before treatment.. In conclusion, tube cystostomy is a successful method for treatment of refractory cases of obstructed FUS. Hyperkalemia and azotemia should be considered in cats suffering FUS, uroabdomen and PKD. Relevance rapid resuscitation, prompt diagnosis and accurate treatment are the corner stone for management of critical urogenital disorders causing abdominal pain.

Key words: Feline Urologic Syndrome · Polycystic Kidney · Uterine Rupture · Closed Pyometra Resuscitation and Hyperkalemia

INTRODUCTION

Acute abdomen syndrome is a multi-etiologic clinical affection that defines the sudden onset of abdominal pain of less than one week's duration and without intervention it may lead to death [1]. This syndrome is classified in pets into gastrointestinal, urinary, splenic, hepatobiliary, reproductive and peritoneal abdominal pain. Urinary causes include blockage, rupture of ureter, urethra and bladder, pyelonephritis and renal neoplasia. While, reproductive causes include, pyometra, ruptured uterus, prostatic abscess and testicular torsion [2, 3].

FUS is a group of symptoms occur cat secondary to inflammation, irritation and/or obstruction of the lower urinary tract [4]. The most common forms have been found to be feline interstitial cystitis (FIC; 55%–69%), urolithiasis (13%–28%) and urinary tract infections (UTI; 8%) [5, 6]. Struvite and calcium oxalate are found in >80% of uroliths [7]. Renal failure and uremia will follow complete urethral obstruction within 36- 48 hours and death within 72 hours [8, 9].

Uroabdomen results in severe metabolic and multi-systemic life-threatening consequences represented by profound dehydration, hypovolemic shock, hyperkalemia, azotemia, chemical peritonitis and metabolic acidosis over the subsequent 24 to 48 hours [10-13].

PKD is an inherited genetic disease affects Persians and related breeds [14]. Renal ultrasound was the only practical, non-invasive method available for its diagnosis [15]. No specific cure is available for PKD; therapy is comparable as for other causes of renal failure [16].

CP is more insidious in unneutered middle-aged cats [17]. The early clinical signs are general malaise, lethargy, anorexia, vomiting, diarrhea, polyuria and polydipsia escalate to clinical signs compatible with a life threatening disease in later stages. Treatment of pyometra typically

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involves immediate intravenous hydration and initiation of antibiotic therapy. After patient stabilization, ovariohysterectomy is the treatment of choice [18].

UtR is a potentially catastrophic event during the peri-parturient period by which the integrity of the myometrial wall is breached mostly due to trauma, uterine torsion, uterine epithelium defects, fetal or maternal dystocia, fetal overload or careless obstetrics procedures [19-21]. Treatment consists of ovariohysterectomy, removal of the fetuses, fluid replacement and antibiotic therapy [22].

The current work aimed to diagnose and evaluate a series of cats suffered from critical urogenital problems causing abdominal pain, as well as highlighting the important aspects of medical and surgical interventions of such cases.

MATERIALS AND METHODS

Animals: Forty seven cats; 21 Shiraz, 22 Siamese and 4 Egyptian Mau (20 male and 27 female) were diagnosed with urogenital disorders associated with abdominal pain. They were admitted between March 2011 to April 2014 to Mansoura Veterinary Teaching Hospital of the faculty of veterinary medicine, Egypt. Diagnostic investigations included history, clinical signs, cardiovascular and respiratory monitoring, radiography, abdominal ultrasonography, urinalysis, hematology and biochemical analysis.

Animal Resuscitation: Immediately after admission, cats were received either normal saline 0.9% or lactated Ringer's solution in a rate of 30-40 ml/kg/hr. One-third of the calculated volume was administered rapidly, then the patient's perfusion parameters as heart rate, capillary refill time, blood pressure and urine output were monitored. The rest of the volume was given slowly until aforementioned parameters regained to its normality. Additionally, all cats received Ephedrine HCL (Ephedrine, CID, Egypt; 0.1 mg/kg), Metoclopramide HCL (Primperan, Sanofi Aventis, Egypt; 0.2 mg/kg), Cefotaxime Na (Cefotax, EPICO, Egypt; 20-80 mg/kg), Diazepam (Neuril, Egypt; 0.4-0.8 mg/kg), Lidocaine (Debocaine, El-Debiky, Egypt; 2 mg/kg/h) and Butorphanol (Alvegesic, CP pharma, Germany; 0.1-0.2 mg/kg).

Diagnostic Procedures: Heart rate (HR), pulse quality, respiratory rate (RR), end tidal Co2 (EtCO2) and patient side oxygen saturation (SpO2) were examined regularly by patient monitor (M69S user's manual, China). Abdominal ultrasonography was performed using Shenzhen Mindray (DP-2200vet, PR China) with 5, 7.5 and 10 MHz linear transducer. Venous blood samples were obtained before treatment to evaluate complete blood count. Serum samples were used to evaluate creatinine, blood urea nitrogen (BUN) and potassium levels. As well, urine samples were collected by cystocentesis under ultrasonographic guidance for complete urinalysis.

Anesthesia: Animals were pre-medicated with diazepam (0.2-0.5 mg/kg/IV) and inducted by combination of diazepam (0.5 mg/kg/IV) and Ketamine Hcl(Ketamine, Sigma-Tec, Egypt) in a dose of 5 - 10 mg/kg.

Feline Urologic Syndrome **(n=18):**

Cystocentesis and retrograde urohydropropulsion were performed in 17/18 cats according to Osborne *et al*. [23]. In addition to tube cystostomy that performed in 15/18 cats [24, 25].

Urinary bladder rupture **(n=2)**

A fenestrated silicone tube catheter for peritoneal dialysis was inserted under the effect of diazepam and lidocaine Hcl [26]. A urine-collecting bag was connected to the free end of the catheter and a Fucidin antibiotic ointment (Fusidic acid 2%, Leo pharma, Denmark) with sterile gauze was placed over the entry site before placing a sterile abdominal wrap. After the patient was regained its normal potassium, creatinine and blood urea nitrogen levels, surgical repair of the bladder was performed by identification of the ruptured site, debriding of its edges and routine closure of the defect using coated vicryl no. 2/0.

Polycystic kidney **(n=1)**

In bilateral PKD, percutaneous aspiration of the cysts under ultrasonographic guidance was performed.

Uterine rupture **(n=1)**

A 10 month-old domestic short-haired cat weighed about 2 kg was presented. Exploratory laparotomy was performed for removal of two extra-uterine dead feti. Peritoneal lavage with warm isotonic saline at 200ml/kg [27] and hysterectomy was done.

Cervix pyometra **(n=25)**

Cats were surgically treated by hysterectomy according to Tobias, 2010 [24].

Histopathological Examination: One cat with obstructed FUS was died on arrival and samples from (kidneys, ureters, urinary bladder and urethra) were fixed in neutral buffered formalin 10%. Histopathological processing was performed acc. to Bancroft *et al*. [28].

Follow up after Surgical Intervention: Cats received maintenance dose of IV normal saline 0.9% (44 ml/kg/24h), Primperan (0.1-0.5 mg/kg/8h) and Cefotax (20-80 mg/kg/12h). Alvegesic (0.1–0.2 mg/kg/6-8h) was used in cats with FUS, PKD and UBR, while Ketoprofen (Ketofan, Amriya, Egypt; 2.2 mg/kg/24h) was used in cases of pyometra and UtR.

In Cats with FUS: Cats received diazepam (0.4-0.8 mg/kg/12h), vitamin K (Amri-K/Amriya, Egypt; 1mg/kg once daily), ascorbic acid (CebionEff, Amoun/Merk, Egypt, 200 mg/cat/day), ammonium chloride (Broncholase syrup, Memphis, Egypt; 700mg/cat/day) and prazosin (Minipress1mg tablets, Pfizer, Egypt; 0.5 mg/kg /once daily). The urine in the bag was removed three times a day. Urinary bladder flashing was performed using sterile normal saline daily. Normal micturation was tested by temporary tying the catheter which allowing its removal.

Cat with PKD: The cat had a dietary restriction of phosphorus, sodium and protein. She received antiemetic famotidine (Peptofam10, Gelatin, Egypt; 1 mg/kg/day/orally), anti-hypertensive enalapril (Enalapril 5, Octoberpharma, Egypt; 1 mg/kg/ day/orally), intestinal aluminum based phosphorus binders lanthanum carbonate (Fosrenol, shire, Egypt; 80 mg/kg/day/orally) and vitamin B12 (Neuroton/ Amoun, Egypt; 250 ug/cat/IM/once a week). He received Omega-3 fatty acids (Super omega, Mjestic, Egypt; 500 mg DHA/EPA/cat/day/orally) and beta-carotene (Oxidrex, Rexcel/Techno, Egypt; 2.1 mg/kg/orally/ daily). These medications were continued for 3 months.

RESULTS

Forty seven cats with various types of urogenital disorders causing abdominal pain were included in this study. Age, gender and body weight of the diagnosed cases were depicted in Table 1.

Results of Clinical Examination: Cases were admitted to the clinic within different time ranged from 24 h to three weeks after first appearance of clinical signs. Depression, dehydration, polydipsia, dysphagia, vomiting, abdominal distention and abdominal pain were the main features in the cats.

Five cats with FUS that admitted within 24- 36 h and nineteen cat with CP (one week) showed signs of tachycardia (220- 240 beats/m), tachypnea (40-50 breath/m), normal rose mucous membrane color, normal SpO2 (92-94%) and EtCO2 (33-34), rapid capillary refill time (CRT; 1-1.5 s) and bounding pulses.

Thirteen cats of FUS that admitted within three days, two cases of UBR (24-36h), In six cats with CP that admitted within (2-3weeks) and a cat with UtR (48h) and a case of PKD (2 weeks) showed signs of pale mucous membranes, prolonged CRT (2-3 s, weak peripheral pulses and hypothermia, bradycardia (80-92 beats/m), slow shallow respiration (18-21breaths/m) and decreased both SpO2 to an average of 90% and EtCO2 around 32 mmHg.

FUS suffered cats showed signs of dysuria 2/18 (11%), anuria 16/18 (89%, hematuria was found in 10 cats) and licking of the perineal region 18/18 (100%). The tip of the penis was swollen and dark red to purple in color and the urinary bladders were palpable and distended in all FUS cases. Cases with UBR showed anuria and thrilling with abdominal ballottement, abdominal paracentesis elicited presence of free urine in the peritoneal cavity. Polyuria and diarrhea were observed in cats with CP and PKD while in the cat with UtR, the main feature was offensive bloody vaginal discharge.

Results of Animals' Resuscitation: All animals received the whole fluid therapy volume, where 37 cats (78.7%) regainedor close to normal health parameters. While 10

Table 1: Incidence, age, gender and body weight of cats suffered abdominal pain

			Gender		
Case categories	Number of cases/ 47 (%)	Age (mean) years	Male	female	Body weight (mean) kg
FUS	18/ 47 (38%)	1 - 7 (3)	18	-	6.0-9.5 (7)
UBR	2/47 (4%)	2 and 4	1	1	6.9 and 8.3
PKD	1/47 (2%)	3	1	-	7.50
CP	25/47 (53%)	2-5 (3)	-	25	5.0 - 12 (9.5)
UtR	1/47 (2%)	10 month	-	1	3

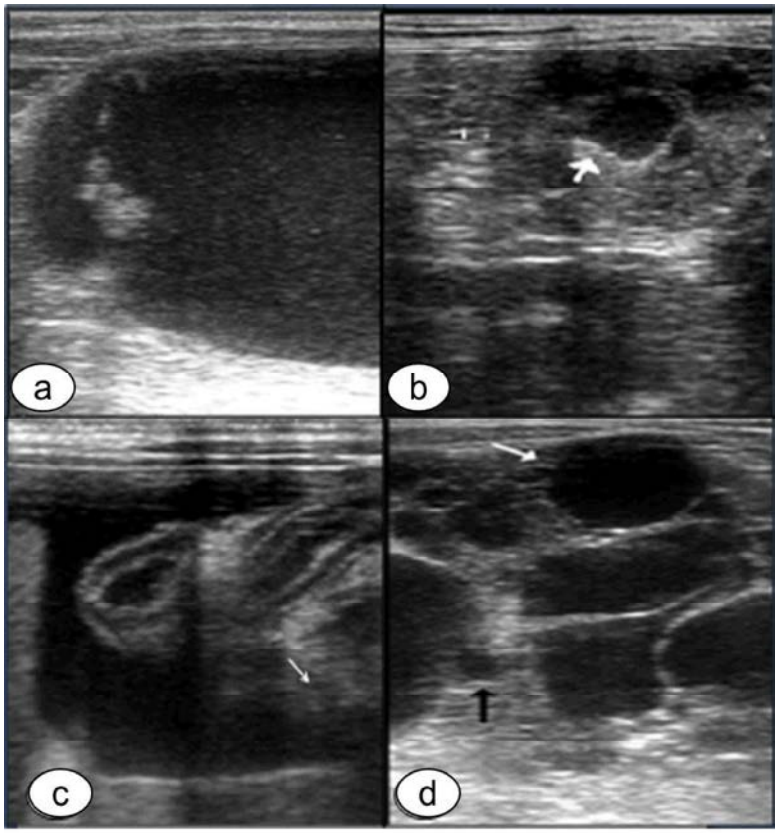

Fig. 1: (a, b) Showing ultrasonography of FUS. a)Longitudinal sonogram of the urinary bladder of a 3-year-old male Shiraz cat. There were cystic calculi. The urine is heteroechoic with shadowing mineralized dependent sediment. Irregular shaped blood clots appeared as non-shadowing medium to mildly hyperechoic that adhered to the bladder wall. b) Transverse sonogram of the left kidney in a 2-year-old male Siamese cat with a history of anuria of 2 days duration. There is moderate hydronephrosis with uniformly dilated hypoechogenic renal pelvis (Arrows). c) Showing ultrasonography of (UBR) with presence of anechoic fluid in the peritoneal space. Ileus was diagnosed as a distention of intestinal loops and the lumen filled with echogenic fluid (Arrow). d) Showing a transverse sonogram of the left kidney that replaced by large (White arrow) and small size (Black arrow) hypoechoic cysts. Note that these cysts are non-communicating ruling out hydronephrosis.

cats (21.3%) (FUS=8, UBR=1 and PKD=1) were severe hyperkalemic with hypotension and bradycardia. They additionally received constant-rate infusion of 10% calcium gluconate (0.5–1.0 ml/kg), regular insulin (0.1–0.25 U/kg), 25% dextrose (1–2 g/U of insulin) and Sodium bicarbonate (1–2 mEq/kg) slowly over 20 mins. They took about 12(n=7)-24(n=3) hours to regain their normal health parameters.

Results of Ultrasonographical Examinations: Cats with FUS showed fully distended urinary bladders and heteroechoic urine, with focal, dependent, hyperechoic, curvilinear echogenicity calculi which changed position as patient position changes. Shadowing mineralized dependent sediment was present. Mild to medium hyperechoic irregular/amorphous shaped blood clots were adhered to the bladder wall. Uniformly dilated hypoechogenic renal pelvis was observed in 2/16 (12.5%) of complete obstructed cases which indicate mild to moderate hydronephrosis, Figure 1 (A, B).

In cats with UBR, ultrasonography showed anechoic fluid accumulation in the peritoneal space dissecting between organs. Ileus was diagnosed in a Shiraz cat as a local distention of intestinal loops and the lumen filled with echogenic fluid, Figure 1 (C).

In PKD case, renal ultrasound showed renomegaly of both kidneys with an irregular outline and presence of varied size anechoic, smooth margined cysts in the renal tissue. These cysts eroded the normal renal architecture and showed distal acoustic enhancement, Figure 1 (D).

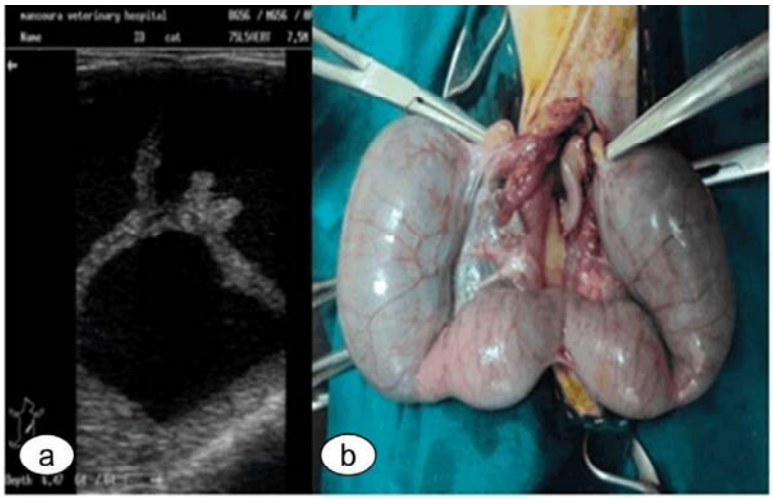

Fig. 2: A transverse sonogram of a cat with closed pyometra. a) The uterus was enlarged with multiple circular structures containing hypoechogenic material. b) The exteriorization of large uterus filled with fluctuating materials.

Table 2: Showed urine, hematological and biochemical analysis of cats (n=47) with urogenital disorders causing abdominal pain

Laboratory	FUS	UBR	PKD	Pyometra	UtR
examination	n = 18	n= 2	n= 1	n= 25	n= 1
USG	1.070 - 1.090	-	1.010	< 1.020	-
Proteinuria	+ve (n= 16)	-	+ve	-ve	-
Glucosuria	+ve (n= 1)	-	-ve	-ve	-
hematuria	+ve (n= 16)	-	-ve	+ve trace	-
Potassium (mEq/L)	<7 (n=12)				
	>7 (n=8)	5.8 and 7.6	8.2	-	-
BUN (mg/dl)	35-160	39 and 54	79	-	25
Creatinine (mg/dl)	1.9 -3.2	2.2 and 2.9	3.2	-	1.1
PCV (%)	55.6-69.8	56.8 and 61.1%	58.3%	63.7-69.9	62.1%
Albumin (g/dl)	-	4.1 and 4.3	-	1.8-2.2	1.9

In CP, abdominal ultrasound showed an enlarged multiple circular structures containing hypoechoic material. The endometrium was thickened with hyperechoic areas of varying size. Proliferative changes were visualized, Figure 2.

In UtR, abdominal ultrasound showed free gases appeared as hyperechoic structures with comet-tail artifacts immediately adjacent to the inner margin of the abdominal wall. Two echogenic fetal bone skeletons were seen extra-uterine beside the stomach in cranial region in the abdominal cavity. There were echogenic particles oscillating in the abdominal fluid with strands of hyperechoic tags of fibrin.

Results of Urine, Hematological and Biochemical Analysis Were Depicted in Table 2: Urinalysis of FUS validated cloudy and bloody urine where RBCs were ranged from 5-10 cells to over hundreds that masked the analytic film. The urine specific gravity (USG) was ranged from 1.070 to 1.090. Proteinuria was observed in 16/18 (88.9%) and glucosuria in 1/18 (5%). Calcium oxalate crystals were verified in all cases of obstructed urolithiasis 16/18 in a huge number that covered the field and in trace amount in FIC cases 2/18 (11.1%). Hyperkalemia (6 to7.5 mEq/L) was observed in 8/18 (44%). Both blood urea nitrogen (BUN) and creatinine levels were ranged in 35-160 mg/dl and 1.9-3.2 mg/dl, respectively in all cases. All cases showed increased PCV (55.6-69.8%).

In UBR cases, hyperkalemia (5.8 and 6.2 mEq/ L), increased BUN (39 and 54 mg/dl), increased creatinine (2.2 and 2.9 mg/dl), increased PCV (56.8 and 61.1%) and hyperalbuminemia (4.1 and 4.3g/dl) were observed.

In all CP cases leukocytosis, neutrophilia with shift to left, hypoalbuminemia (1.8-2.2 g/dl) and increased PCV (63.7-69.9%) were observed. Five cats had normocytic and normochromic anemia.Low USG < 1.020 was the main feature in urinalysis.

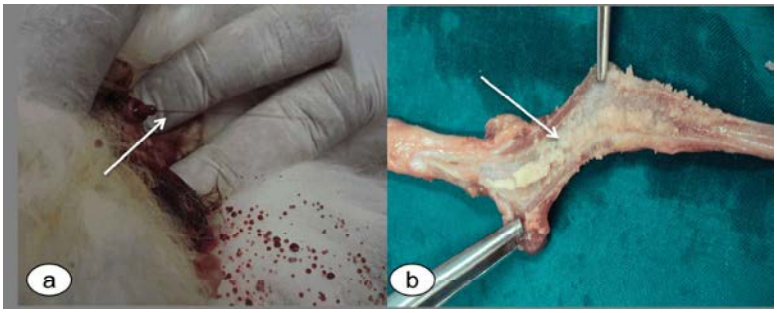

Fig. 3: a) Showing a stream of hematuria after retrograde urohydropropulsion in a cat. b) PM of the dead cat with obstructive urolithiasis. Notice that the urethra filled with sand like materials that occluded it completely.

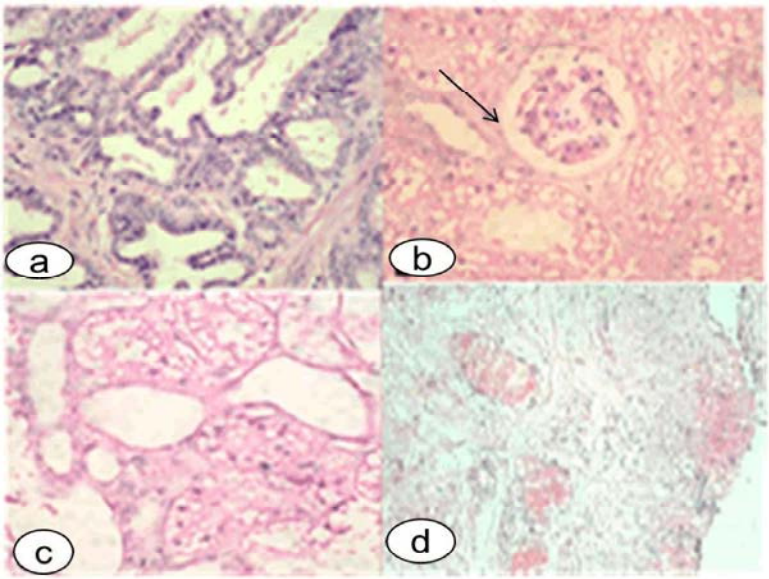

Fig. 4: Kidney with adenocarcinoma. a) Malignant cell adenocarcinoma with hyperchromatic, vesicular nuclei with tendency to form acini (HE, X 10). b) Kidney showing severe vacculation in renal tubular epithelium with dissolution of renal glomeruli (HE, X 10). c) Kidney showing cystic dilatation of renal tubules with atrophy of renal tubular epithelium (HE, X 10). d) Urinary bladder showing cystitis with sever congestion and lymphohistocytic infiltration with edema in submucosa beside necrosis in epithelium (HE, X 10).

In the case of PKD, non-regenerative normocytic normochromic anemia, increased PCV (58.3%), increased creatinine (3.2 mg/ dl) and BUN (79 mg/dl) were observed with Hypokalemia (3mEq/L). Urinalysis revealed low USG (1.010).

In case of UtR, hematology revealed leukocytosis (15.8 10X3/mm^3), neutrophilia, normochromic normocytic anemia and increased PCV (62.1%). Biochemical tests revealed hyperproteinemia (9.3 g/dl), hypoalbuminemia (2.2g/dL), normal levels of creatinine 1.1 mg/dl and BUN 25 mg/dl.

Intervention: FUS suffered cats, 17/18 showed complete recovery as; 2/18 (12%) had FIC were recovered using multiple retrograde urohydropropulsion with cystocentesis (Figure3, A), while 15/18 cases (83%) underwent tube cystostomy and recovered completely within 7 to 10 days.

A Shiraz cat with a history of 5 days anuria and 3 times trials of cystocentesis; was died on arrival. PM examination revealed uroabdomen and a fully distended urinary bladder with presence of huge amount of yellowish crystals filled the urinary bladder and completely occluded the urethra (Figure 3, B). Histopathological examination showed severe renal degenerative changes and cystic dilatation of renal tubular epithelium. Also malignant cells with cellular atypia and basophilic nuclei, with formation of acini replacing renal tissue were observed which directed the diagnosis toward adenocaecinoma (Figure 4).

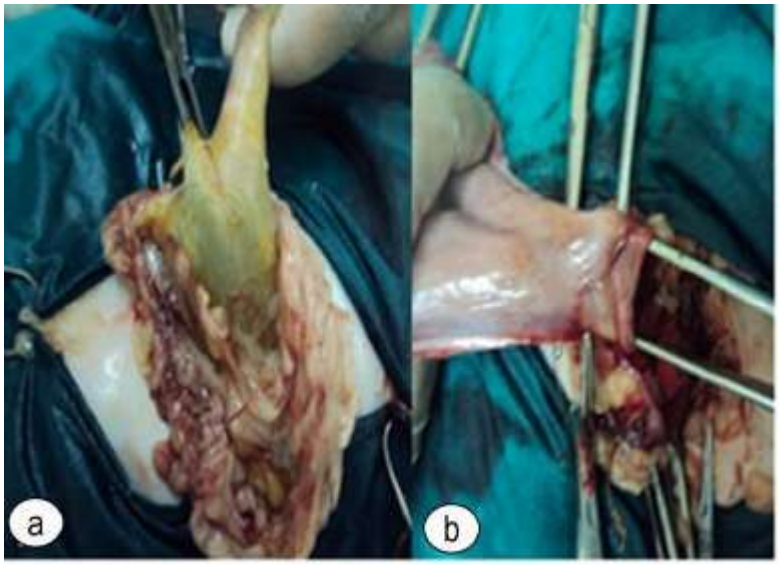

Fig. 5: Uterine rupture in a cat. a) Exteriorization of the dead fetus from the abdominal cavity. b)The seat of rupture in the uterine body.

After tube cystostomy, the urine in the collecting bag gradually changed from bloody color to clear straw yellow within 3- 4 days. Among 16 obstructed cats, three cats showed reluctant bloody urine continued from 3 -5 days necessitate multiple doses of vitamin K. Cats showed trials for normal micturition within 5- 8 days. After catheter removal, uroabdomen was diagnosed in 2/15 (13%) cats, which needed further cystorrhaphy. Stranguria and pollakiuria were observed in the first few days after catheter removal.

The two cats of UBR restored their normal physical, biochemical parameters and intestinal movement up to two days after peritoneal dialysis catheterization. The two cases showed complete recovery after cystorrhaphy and regaining normal urination.

After ovario-hystrectomy of the pyometra-suffering queens, the excised uteri, appeared enlarged and distended with purulent materials (Figure 2). All queens showed complete recovery.

The cat with PKD was died after three months from admission.

A Shiraz cat with a history of 24 h first parturition, oxytocin and prostaglandin treatment trials and massive instrumental misuse during vaginal labor was underwent exploratory laparotomy that revealed fetid odor and presence of bloody uterine fluid within the abdominal cavity. Uterine body rupture was identified and two dead feti were located cranially within the abdominal cavity, Figure 5. The cat was died immediately at the end of the operation.

DISCUSSION

Urogenital disorders causing acute abdomen is a challenging task, as the differential diagnosis of acute abdominal pain includes an enormous spectrum of disorders, ranging from life-threatening diseases to benign self-limiting conditions [3]. It is often associated with cardiovascular shock secondary to the underlying disease. The associated cardiovascular shock should be recognized immediately and addressed emergently as increased morbidity is associated with prolonged shock and subsequent tissue hypoxia. Those diseases carrying a grave prognosis are readily treatable with aggressive intervention, including fluid resuscitation, pain control and often, exploratory laparotomy [29].

In the present study 47 cats were suffered urogenital disorders (FUS (18), UBR(2), PKD (1), CP(25) and UtR(1)) causing abdominal pain and they were managed according to the classification of Tello [30]; non-surgical, that treated medically with supportive care and analgesia (Two cases of FIC and a case of PKD); urgent cases required surgical intervention after previous stabilization for a period up to 12 hours (Obstructed urolithiasis, UBR and CP suffered cats), while critical,(As in case UtR) that required emergent immediate surgery following a few hours of cardiovascular stabilization as rapid deterioration may occur if surgical intervention is delayed.

Patients were present with significant cardiovascular abnormalities and showed different clinical signs, this can be postulated to the cause and time frame of intervention

as the animal may present in one of three broad stages of shock: compensatory, early decompensatory and terminal decompensatory [31, 32].

Analgesia is an important element in the treatment of patients with acute abdomen [31]. Efforts were directed in this study towards minimizing pain while ensuring normal cardio-respiratory parameters. Although butorphanol has a relatively less analgesic potency and much shorter duration of action, it was the cornerstone for analgesia of the recorded cases. As non-steroidal anti-inflammatory drugs have, a potential to exacerbate gastrointestinal ulceration and renal perfusion in hypertensive patient [33, 34], ketoporfen was only used in non-uremic cats (CP and UtR cases).

In the present study, safe anesthesia for cats was conducted by a low dose of diazepam and ketamine combination to maintain cardiac function. This was coincided with the results obtained by Herold *et al*. [35] as most anesthetic drugs depress cardiovascular and respiratory function in a dose related manner. Therefore, drugs with minimal depressant effect should be importantly usedin low doses and in combination. Diazepam cause minimal cardiovascular depression, rarely cause hypotension, provides some narcosis, good muscle relaxation and no analgesia [36]. While ketamine as a sole anesthetic agent in critical ill patient has a direct depressant effects resulting in poor contractility, decreased cardiac output and respiratory depression [31, 34].

Cats were suffered signs of shock, so they received IV normal saline and empirical therapy with cafotaxime. Once hypovolemia and decreased tissue perfusion to abdominal viscera are present, compromise of the intestinal wall, can lead to translocation of intra-luminal bacteria and can predispose patients to septicemia and/or endotoxemia. Decreased venous return and portal hypertension are additional concerns during shock [2, 31]. As vomiting was one of important clinical signs in cats in this study; metaclopramide was used as recommended by Dye [37].

Eighteen out of forty-seven cats suffered FUS, two cats (11%) showed FIC with dysuria without obstruction and 16/18 (89%) showed obstructive urolithiasis. While Gerber *et al*. [38] recorded 24 (53%) idiopathic obstruction without urolithiasis, 13 cats (29%) urolithiasis and eight cats (18%) with urethral plug. These differences can be postulated to that Gerber *et al*. [38] performed their work mainly on neutered cats 39/45 and to the great differences in diets, environmental conditions and the culture of the owner.

The first line for management of FUS suffered cats was retrograde urohydropropulsion in addition to the empirical treatment. Cystocentesis was performed before retrograde urohydropropulsion to prevent bladder rupture, allow excretory renal function to resume and assist in dislodging the urethral plug [39]. In retrograde urohydropropulsion a stream of urine was obtained by increasing the intra-cystic pressure with physician hand compression while using the uretheral catheter. This was enough for treatment of two cases with FIC while re-obstruction was observed in the remaining cats with obstructive urolithiasis (15/18). The prolonged obstruction of the lower urinary tract produces increased pressure in the bladder and urethra proximal to the obstruction and this damages the wall, likely through the hypoxic damage caused by pressure induced reduction in the blood flow and disrupt tight junctions between detrusor myocytes that manifested clinically as post-obstructive detrusor atony. In most patients, this is transient and resolves clinically if the bladder is kept empty, unless, permanent detrusor dysfunction occur [9, 40]. Generally, the initial bouts of IC resolve within 7 days with or without treatment [4].

Severe hyperkalemia ($\geq$8mmol/l) was observed in 2 /16 (12.5%) cats suffered obstructed urolithiasis as recorded by Lee & Drobatz [8]. While BUN was increased in all cats suffered FUS. This was explained by Gerber [41] as post-renal azotemia develops about 24 hours after the obstruction of the urethra.

Tube cystostomy was operated in 15 cats diagnosed with obstructive urolithiasis. Thirteen of them were completely cured and returned to normal urine voiding within 5-8 days and no recurrence for 12-18 months follow-up. The other two cases were complicated with uroabdomen after removal of the catheter and cured after cystorrhaphy. This outcome were not the same as obtained by Gerber *et al*. [38] during their study on neutered cats with idiopathic cystitis and urethral obstruction, as 8/44 cats were died after treatment with urethral catheterization, indewelling catheter, perineal urethrostomy and cystotomy.

One cat with complete urethral obstruction for 72 hours was euthanized. This was assumed due to renal failure, uremia as well as the presence of adenocarcinoma. Pre-renal azotemia develops as an adaptive response to any cause of reduced renal perfusion [33]. Complete urethral obstruction until death may be less than 72 hours [9].

Uroabdomen in cats was diagnosed in two cases 2/47 (4%) due to blunt trauma according to owner allay in addition to two cases as complication after tube cystostomy removal during this study. Causes of bladder rupture and uroperitoneum in dogs and cats that recorded by Stafford and Bartges [42], were urinary tract obstruction, traumatic bladder expression or catheterization, neoplasia and postoperative leakage following abdominal or urogenital surgery.

Uroabdomen results in profound dehydration, life-threatening hyperkalemia, severe azotemia, chemical peritonitis and metabolic acidosis over the subsequent 24 to 48 hours [13]. This explained the severity of the clinical signs that observed on the two cats with UBR. Mayhew & Holt [43], clarified the pathophysiology of the abnormalities is multi-factorial; urine is hyperosmolar compared with extracellular fluid (ECF). Theseresults in creating a concentration gradient across the peritoneum from the ECF to the abdominal cavity, thus worsen the condition.

Diagnosis of uroabdomen in the present study was based on animal history (Trauma), clinical signs (Vomiting, abdominal distention and pain and ballottement), biochemical analysis (Increased potassium, BUN and creatinine levels) and mainly abdominal ultrasonography that detect the presence of fluid in the abdominal cavity. Tag and Day [44], confirmed the diagnosis of uroabdomen by measuring potassium and creatinine concentrations. A ratio of the creatinine concentration in the effusion to serum creatinine above 2:1 is diagnostic for uroperitoneum. A ratio of the potassium concentration in the effusion to serum potassium above 1.9:1 in cats is diagnostic for uroperitoneum. Urea is too soluble, so BUN cannot be used in the diagnosis of uroabdomen.

Ileus was detected in a case of UBR as a complication of uroabdomenas urine accumulates in the peritoneal space, chemical peritonitis ensues; if the peritonitis is sterile, it is not immediately life threatening but will cause abdominal pain and ileus [43]. Peritonitis results in an increased loss of albumin into the abdominal cavity, leading to decreased oncotic pressure, which also contributes to abdominal effusion [13].

In the present study, ten cats (8 with FUS, one with UBR and one with PKD) with hyperkalemia received additional therapy for treatment of hyperkalemia, as recommended by Tag and Day [44], to evade cardiac conduction disturbances. Moderate hyperkalemia (Serum [K+] <7.0 mEq/L) will often resolve using normal saline due to hemodilution and increased excretion from improved renal blood flow. While calcium gluconate does not alter serum [K+], but mitigates cardiotoxicity by permitting cardiac cell membrane depolarization in the face of severe hyperkalemia [45].

Cats with UBR restored their normal physical, biochemical parameters and intestinal movement up to two days after peritoneal dialysis catheterization. They showed complete recovery after cystorrhaphy and regaining normal urination. Stafford and Bartges [42], considered uroabdomen as a medical emergency, not a surgical emergency need acute management involves stabilization, treatment of hyperkalemia, Urinary diversion and, in some cases, peritoneal dialysis are necessary to stabilize the patient until life-threatening conditions resolve. Once the patient is stable for anesthesia, surgical repair, when indicated is performed.

The case of PKD was diagnosed accurately using renal ultrasound [15] with sensitivity and specificity of 91% and 100%, respectively, when performed in cats older than 36 weeks of age. Ultrasound of both kidneys showed renomegaly and the cysts seated in both renal cortex and medulla, vary in size and typically replace the normal renal parenchyma that affect the normal renal function [15, 16]. The biochemical analysis confirmed the ultrasonographic results as uremia and hyperkalemia were observed that indicated renal failure. The treatment after stabilization was based on percutenous aspiration of the cysts under ultrasound guidance to relieve pain [46] and received the medical therapy that used with chronic renal failure to maintain hydration, nutritional status and treating clinical signs associated with uremia [15]. Although that the death was occur after three months because cysts aspiration alone is inefficient as cysts will re-accumulate fluid due to an active chloride transport process. Elzinga *et al*. [47] recommended cyst decompression surgery as it is much better results in excellent improvement in renal function as well as effective, lasting pain relief up to 80% of patients were pain free at 12 months postoperatively and 62% at 24 months after surgery.

Closed pyometra constitute the high percent among the admitted cases 25/47 (53%) although Wiebe and Howard [48], mentioned that CP in cats is less common, likely because they are induced ovulators with more limited progesterone exposure. There were no definite causes for this high percent except that cat has a season usually about twice a year and undergoes all the hormonal changes associated with pregnancy whether she is pregnant or not. Thus increase the incidence to make infection with each cycle with age [17, 18]. In addition, the cause for this high percent may be due to the haphazard

injections by non-veterinarian with some hormones to stop seasons or for treatment of other conditions. Treatment of pyometra typically based on immediate patient stabilization, antibiotic therapy and ovariohysterectomy with good prognosis. CP requires more immediate surgical intervention, following stabilization, because drainage of the infected uterus is not occurring [2].

Uterine rupture was diagnosed in this study in one cat with a percent of 2%. Diagnosis of uterine rupture is made through the animal's history, clinical signs, laboratory tests, abdominal ultrasound and radiography, but a definitive diagnosis was accurate after exploratory laparotomy. Animal history showed erroneous oxytocin and prostaglandin administration and massive manually assisted whelping [19, 20].

Normocytic normochromic anemia in the cat with UtR can be explained by blood loss subsequent to uterine rupture and passage of red blood cells into the uterine lumen by diapedis. Hyperproteinemia was resulting from dehydration or increased synthesis of acute phase proteins and antibodies in response to bacterial infection and inflammation. Hypoalbunemia was due to a lack of protein ingestion consequent to anorexia as a result of decreased liver synthesis of albumin, hemorrhages, protein loss due to peripheral edema caused by vasculitis or compensation to maintain osmotic pressure caused by increased globulins [21, 49, 50].

Although treatment of the case with UtR consisted of fluid replacement, antibiotic therapy, ovariohysterectomy, removal of the fetuses as recommended by Linde Forsberg [22], animal was died after surgery. This can be postulated to intestinal compression, severe adhesions, septic peritonitis and hemorrhage [51].

CONCLUSIONS

It was concluded that rapid resuscitation, prompt diagnosis and accurate treatment are the corner stone for management of urogenital disorders causing abdominal pain in cats with good prognosis. Tube cystostomy is a successful method for treatment of refractory cases of obstructed FUS cases without recurrence. Hyperkalemia should be concerned in cases with FUS, uroabdomen and polycystic kidney.

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