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Augmentation colocystoplasty for improving bladder filling capacity in dogs

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Abstract

A total of 14 apparently healthy male Mongrel dogs were studied in two parts: the experimental and the clinical part. The experimental part was divided into group 1 (7 dogs) subjected to apical cystectomy with colocystoplasty and group 2 (3 dogs) were subjected to apical cystectomy with cystorrhaphy as a control group. The clinical part was consisted of 4 dogs: two were suffering from urinary bladder (UB) mass and two suffering from ruptured UB were subjected to colocystoplasty after total excision of masses and necrosed wall trimming. Colocystoplasty was performed by using 6 cm loop of descending colon with its own mesentery. The stability of the augmentation technique was evaluated via clinical findings, ultrasonographic examination, positive contrast retrograde cystography and kidney function test before surgery and at 1st, 3rd, 7th, 15th and 30th days postoperation. Postoperation follow up of the group 1 and the clinical part revealed gradual improvement of urination frequency from 2-3 urinations/hour during the first week to 1-2 urinations/4 hours between the 20th and 30th days. The mean UB capacity at 30th day showed non-significant ($P \leq 0.05$) difference with the normal mean. Ultrasonographic and radiographic examinations at 30th day showed fully distended UB, superiorly located augmented colon segment and intact line of anastomosis. No signs of leakage were noted ultrasonographically or radiographically and there were no signs of rejection. In conclusion, colocystoplasty as a technique for bladder augmentation provides promising results in compensating impaired filling capacity and subsequent incontinence as a result of partial cystectomy.

Keywords: Colocystoplasty; Filling capacity; Dog

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Introduction

Storing of adequate urine volume at low pressure and consequent encouraging continence with protection of the upper renal systems is the main function of the urinary bladder (Abou-Elela, 2011; Sarah et al., 2015).

Suturing of bladder results in limited bladder lumen and storage capacity (Ansari and Sharma, 2013; Breen et al., 2015). Affections resulted in reduced bladder capacity may be neurogenic, carcinogenic, rahbidomy-osarcoma or neurofibromatosis, multiple surgeries, traumatic rapture, infectious as tuberculosis or recurrent urinary tract infection and inflammatory as interstitial cystitis (Kispal et al., 2011; Valsangkar, 2016).

Wongsetthachai et al. (2011) and Chi-Fai et al. (2013) reported that bladder augmentation or

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augmentation Cystoplasty (AC) refers to the surgical refashioning of the urinary bladder to increase its filling capacity and compliance, maintain bladder wall integrity, decrease intravesical pressure and subsequently avoid further damage of the renal system due to high bladder pressures. Various types of grafting materials have been used for AC including dilated ureter (Babu and Ragoori, 2012), bovine amniotic membrane (Sheta et al., 2014), autologous tunica vaginalis (Wongsetthachai et al., 2011), renal capsule (Salehipour et al., 2016), porcine a cellular collagen matrix (Ayyildiz, 2006) and latex biomembrane (Domingos et al., 2009), enterocystoplasty still the method of choice for restoring the bladder capacity and improving compliance with tremendous results (Stein et al., 2012; Valsangkar, 2016).

Enterocystoplasty could be achieved by using different segments of the gastrointestinal tract including colon in colocystoplasty (Jednak et al., 2001; Pozzi et al., 2006; Kispal et al. 2011; Turner et al., 2014), ileum in ileocystoplasty (Biers et al., 2012), caecum in caecocystoplasty (Chakravarti et al., 2004) or stomach in gastrocystoplasty (Aponte et al., 2015).

Follow up period ranged between 6 months and 12 years after colocystoplasty revealed positive clinical feedback, increase in bladder capacity from 2.4 to 4 folds, histologic adaptation of colonic mucosa, no evidence of native bladder or augmented segment perforations, no metabolic disturbances, clinically non-significant mucus production, absence of renal deterioration and no mortality (Jednak et al., 2001; Bhatnagar et al., 2002; González et al., 2009; Jednak, 2014; Hamdan, 2015).

The aim of the present study was to evaluate the potential of colocystoplasty as a technique for urinary bladder augmentation to improve its filling capacity in dogs.

Materials and Methods

Study design

This study was conducted on 14 apparently healthy male Mongrel dogs with mean weight 19.11 ± 4.01 kg and mean age 45.56 ± 1.07 months. Dogs were kept in separate strongly disinfected cages at Surgery Department, Faculty of Veterinary Medicine Benha University with free access to feed and water. The study was divided into two parts: the experimental part and the clinical part. The experimental part consisted of group 1 (7 dogs), subjected to apical cystectomy and colocystoplasty and group 2 (3 dogs), subjected to apical cystectomy and cystorrhaphy as a control group. Clinical part consisted of 4 dogs: 2 dogs suffered from urinary bladder mass and 2 dogs suffered from ruptured bladder and uroperitonium were subjected to colocystoplasty after total excision of the masses and trimming of the necrosed wall.

The experimental part of the study was approved by the Committee of Animal Welfare and Ethics, Faculty of Veterinary Medicine, Benha University.

Preoperative preparation and anesthesia

Twenty-four hours before the operation, all dogs were fasted, received Cefotaxime *(Cefotax®, Epico, Egypt, Co.)* at the rate of 20 mg/kg body weight (intravenous). The ventral abdomen was clipped and shaved. Premedication was performed through atropine sulphate *(atropine sulphate 1%, Adwia, Eg. Co.)* (0.04 mg/kg body weight intramuscular). General anesthesia was induced using a combination of xylazine HCl *(Xylaject 2%®, Adwia, Egypt, Co.)* (1mg / kg b.wt.) and Ketamine HCl *(Ketamine 5 % ®, Sigma, Egypt, Co.)* (10 mg/ kg b.wt) as slow intravenous. Maintenance of anesthesia was performed with thiopental sodium 2.5% *(Thiopental Na, Epico, Egypt, Co.)* (30 mg / kg b.wt intravenous) (Kumar, 2009).

Preoperative preparation of dogs suffered for uroperitonium included, intravenous fluid therapy using normal saline *(sodium chloride 0.95%, Nile Co., Egypt)* in a dose rate of 20 ml/ kg b.wt, 4 times per day for two successive days. Peritoneal catheter for continuous abdominal drainage was performed to allow drainage for 48 hours via ventral abdominal small stab incision performed in a well-controlled dorsal recumbent animal under the effect of local infiltration analgesia.

The dog was positioned in dorsal recumbency, the surgical site was aseptically prepared and draped with sterile surgical towels. Urinary catheterization was done before surgery using 10 gauges catheter *(Medical Drainage Nelaton Foley catheter, 3.3mm, 40cm, Jiangsu, China, Mainland)* to ensure complete evacuation of the urinary bladder. Intravenous infusion of metronidazole 500 mg *(Flagyle®, Pfizer Inc.)* was performed to control the anaerobic bacteria.

Operative techniques

Posterior right Paramedian celiotomy incision extending from umbilicus to pubis was performed to expose both the urinary bladder and colon. Then followed the course of the rectum cranially to reach the descending colon. After the colon had been identified, grasp a loop in an upward-caudal direction by keeping in contact with the apex of the urinary bladder. A 6 cm length segment of colon was transacted with its own mesentery and the other 2 free ends were anastomosed (Joyce et al., 2002) as shown in Figure 1.

The urinary bladder was exposed from the caudal abdominal region and completely evacuated from urine by the catheter. Apical third-cystectomy was achieved by clamping about 30% of the bladder wall at the apex area between the two ureters using an intestinal forceps followed by full thickness excision of the clamped part. If suffered from bladder mass and localized thickening

of the bladder wall, the resected part was detected via intraoperative ultrasonography after filling the bladder with normal saline. Cases suffered from a ruptured bladder subjected to complete trimming of the hyperemic and necrosed lips. The colon segment was thoroughly irrigated by using 0.25% neomycin solution. The cranial end of the colon segment was closed by Parker-Kerr suture pattern and the caudal end was anastomosed to the urinary bladder at the area of cystectomy via continuous horizontal mattress and overlaying Cushing suture patterns by using PGA 3-0 suture material *(Dexon, Unimed., KSA)* (Figure 1).

After completion of the process of anastomosis, potassium permanganate solution 1:10,000 was used for checking for any leakage and flushing the bladder lumen. Finally, the fluid-tight augmented bladder was placed back into the pelvic cavity and the abdomen was then routinely closed. Urinary catheterization remained until the 5th post-operative day and a penrose was inserted in perivesical space via the laparotomy incision for the external drainage for 3 days, postoperatively.

Post-operative care

Postoperative Cefotaxime was administrated at a dose rate of 30 mg/kg b.wt intramuscular twice daily for 5 successive days to guard the infection. Nonsteroidal anti-inflammatory as meloxicam (Mobic®, Amria Pharma, Ind.) was given at a dose rate of 0.2 mg / kg b.wt. The skin wound was touched twice daily with Povidon iodine 10% *(Betadine®, Nile Co., Egypt)* and sprayed with Bavitracin antibiotic spray *(Neomycin, Bacitracin Aerosol powder Spray 150 ml, ACDIMA International, Eg., CO.)*. Dogs received fluid therapy for the first 48 hours postoperation with obligatory fasting, thereafter given a small portion of easily digestible food and the amount of food was increased gradually until returning to full feed at the end of the first week.

Postoperative follow up and technique of evaluation

The stability of the augmentation technique was evaluated through clinical evaluation, ultrasonographic examination, positive contrast retrograde cystography and kidney function test before surgery and at 1st, 3rd, 7th, 15th and 30th days postoperative. Postoperative follow up was achieved for 12 out of 14 animals included in the study. One out of seven cases of group 1 was died 24 hours postoperation and we lost all the communication with an owner of another case in the clinical part which was suffering from ruptured bladder.

Clinical evaluation included body temperature, respiratory rate, pulse rate, feed intake, frequency of urination, frequency of defecation and abdominal distention (Nelson and Guillermo, 2013). Kidney function test included Blood Urea Nitrogen (BUN) (mg /dl) and Creatinine (Cr) (mg/dl) (Bishop et al., 2010). Ultrasonographic examination of the urinary bladder and two kidneys was carried out via transcutaneous approach after clipping, shaving, cleaning with alcohol and application of acoustic gel by using a portable

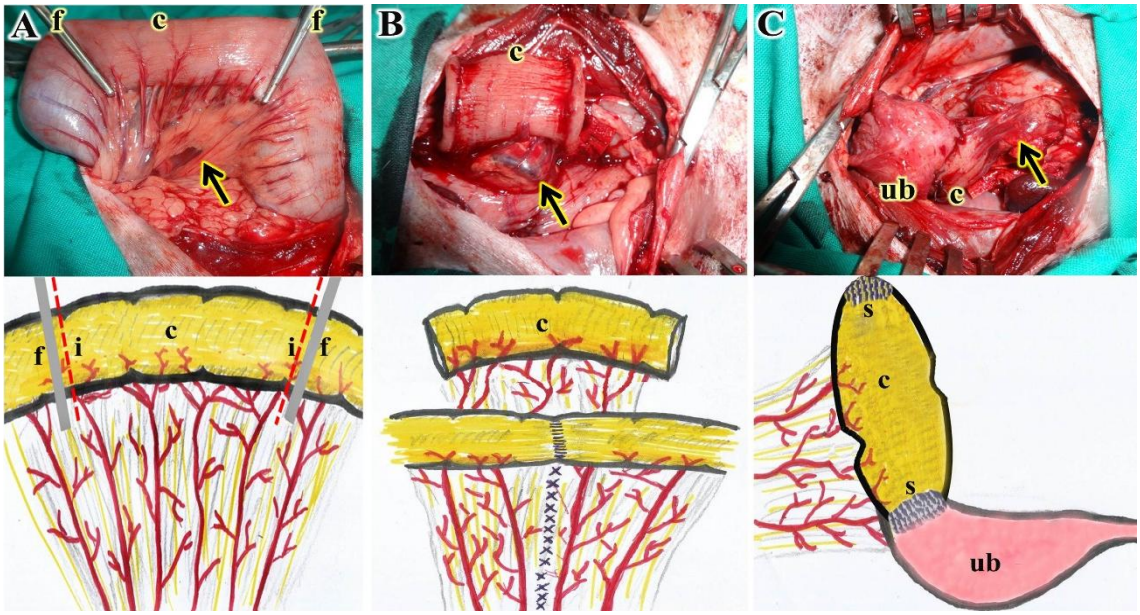

Fig. 1: Step sequence of colocystoplasty. A: clamping of target loop of colon and its blood supply (arrow) for resection and anastomosis. B: resected loop of colon with its own blood supply (arrow) and anastomosed intestine and mesentery. C: Augmentation of cystectomies bladder with colon loop (Colocystoplasty). Colon (c), Intestinal forceps (f), incision line (i), Urinary bladder (ub), Suturing line (s) and resected loop mesentery and blood supply (arrow).

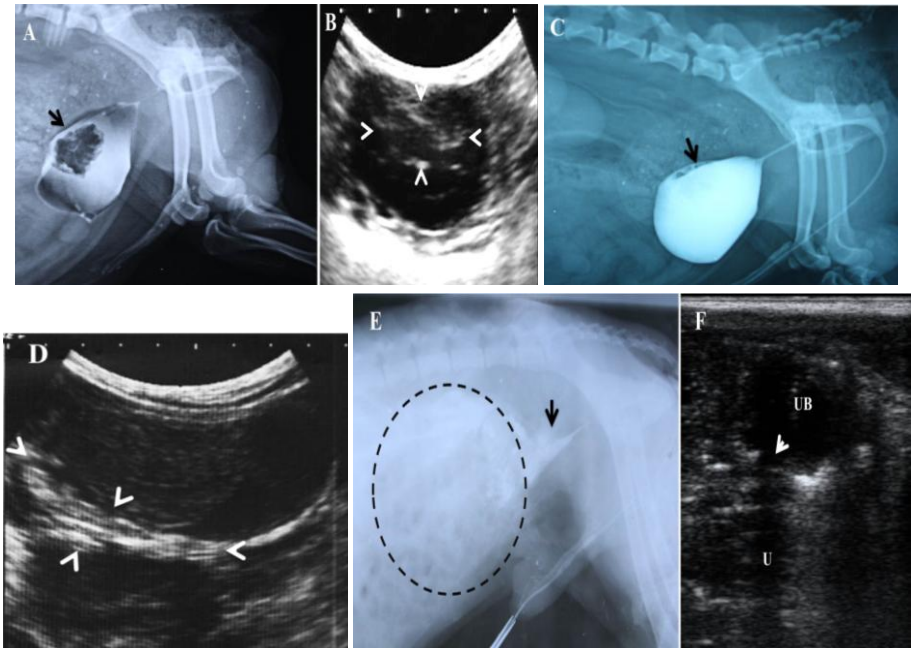

Fig. 2: Retrograde positive contrast cystography (A) and lateral inguinal ultrasonography of UB (B) of 5 year old male dog; showing abnormal mass originated from the apex of UB as a radiolucent filling defect in radiography (black arrow) and hypoechoic mass in ultrasonography (arrow heads). Retrograde positive contrast cystography (C) and ventral inguinal ultrasonography of UB (D) of 6year old male dog; showing localized thickening of apical wall as a radiolucent localized wall thickening in radiography (black arrow) and echogenic wall thickening with hypoechogenic bladder contents in ultrasonography (arrow heads). Retrograde positive contrast cystography (E) and ventral abdominal ultrasonography (F) of UB of 4 years old male dog; showing leakage of contrast materials into the peritoneal cavity to obscure the visceral detail (circle) and small sized collapsed urinary bladder (black arrow) in radiography and small anechoic urinary bladder (UB) with wall defect (arrow) and escaped anechoic urine into peritoneal cavity (U) in Ultrasonography.

ultrasound machine *(Eickemeyer, Magic 1500, Co., Ltd, UK)* with adjusted 7.5 MHz linear transducer (Bala and Chou, 2010).

Positive contrast retrograde cystography using Urographin *(Tri-iodinated contrast medium; Iodine 76 %, Schering Co. USA)* as contrast agent was performed at 30th day postoperation according to Kelly and McAllister (2005). The lateral radiographic view was taken after 48 hours of fasting by mobile X ray machine (100 KV, 80 mAs, Simply HP, Italy) at Focal Film Distance 80 cm, 52 kV and 5 mAs.

The bladder capacity was estimated at the 30th day postoperation by estimating the amount (ml) of normal saline used to complete fill the urinary bladder and augmented colon segment without resistance (Atalan et al., 1998).

Animals of group 1 were euthanized at the 30th day postoperation via overdosed thiopental sodium (100 mg/kg) rapid intravenous injection. The postmortem examination of the urinary bladder and the colon segment was performed for any alterations. Autopsy sample was taken from the site of anastomosis and 1 cm from the urinary bladder side and colonic side and the obtained (H&E) slides was microscopic examined at 10X power lens (Banchroft et al., 1996).

Statistical analysis

Data was statistically analyzed with the help of one way ANOVA and post-hock Duncan multiple comparison test using a statistical software program (SPSS for windows version 20, USA). Differences were considered significant at P≤0.05.

Results

Dogs suffered from bladder tumour showed recurrent episodes of heamaturia, strainguria and frequent urination (4-5 urinations/hr) of scanty amount of urine. Ultrasonographic examination in different planes and from different windows revealed apical hypoechogenic mass (3.2 x 2.6 cm) in one animal and focal thickening of bladder apex (3.8 x 1.2 cm) in the other animal. The bladder contents appeared slight hypoechogenic due to the presence of bloody urine (Fig. 2B & D). Retrograde positive contrast cystography showed a radiolucent mass as filling defect within the complete radiopaque urinary bladder, and radiolucent thickening of the radiopaque bladder wall (Fig. 2A &C).

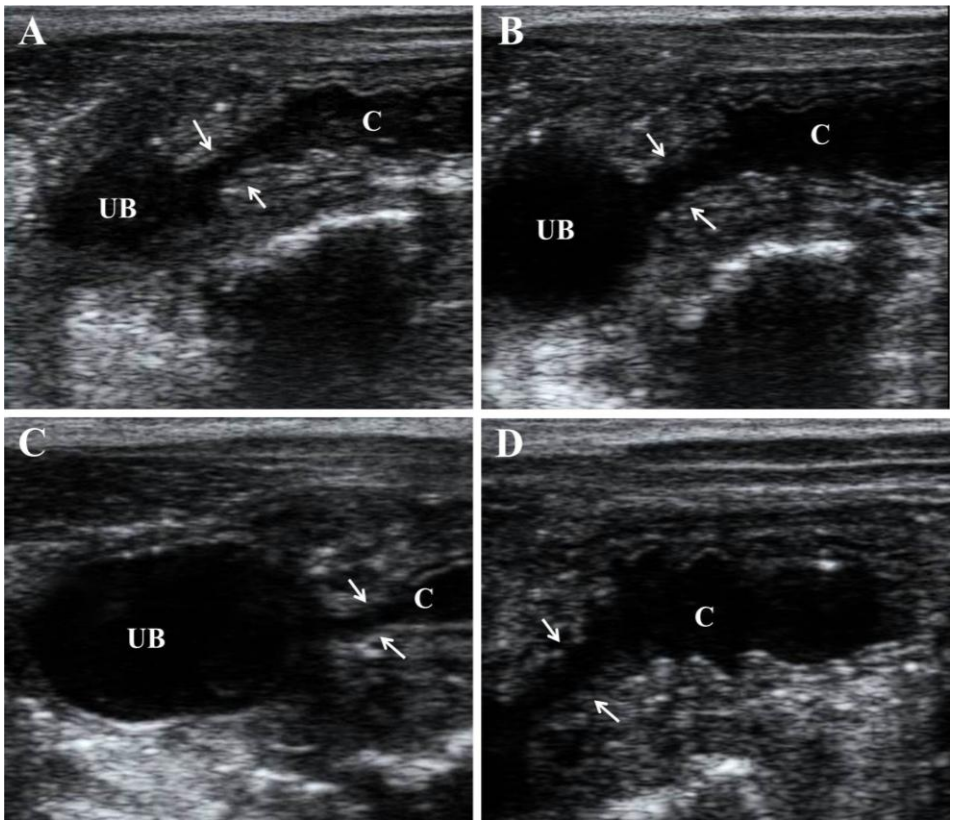

Fig. 3: Ultrasonographic examination of group-1 at 24 hours (A) and 30th day (B, C and D) postoperative. Ultrasonography at 24 hours showing small oval with thick wall urinary bladder (UB), small tubular shape and superior located augmented colon segment with its characteristic gut wall appearance (C) and intact line of anastomosis (arrows). Ultrasonography at 30 day showing round shape distended with less thicken wall urinary bladder (UB), tubular to oval shape augmented colon segment (C) which still retained its characteristic gut wall appearance and intact line of anastomosis with no evidence of urine leakage.

Dogs suffered from a ruptured bladder showed signs of depression, anorexia, lethargy, dysuria and slight abdomen distension. One dog had a history of abdominal pain relieved after 72 hours to exhibit the aforementioned signs and the other dog had a history of blunt abdominal trauma 48 hours earlier. Ultrasonographic examination revealed wall defect with extravasated anechoic urine (Fig. 2F). Positive contrast retrograde cystography revealed leakage of contrast medium into the peritoneal cavity to obscure the visceral detail (Fig. 2E).

Postoperative clinical follow-up of the clinical part and group-1 (colocystoplasty group) revealed that all animals pass blood tinged urine through the catheter only during the 3rd and 5th days postoperation. After removing the catheter at the 5th day postoperation, 3 animals showed strainguria which completely disappeared by the 10th day post-operation. The frequency of urination decreased gradually from 2-3 urinations/hour during the first week postoperation to a normal frequency (1-2 urinations/4 hours) between the 20th and 30th days postoperation. After a period of obligatory fasting, the animals showed reduction in feed intake and water consumption and return normal between the 10th and 15th days postoperation. Defecation was ceased for the first 12 hours postoperation and then return normal with blood tinged feces for the following 24 hours and with signs of straining which completely disappeared during the 1st week post-operation.

Clinical follow-up of the group-2 (cystorraphy group) revealed that strainguria persisted till the 30th day, the frequency of urination was fluctuating between 3-6 urinations/hour till the 30th day postoperation. The maximum period of reduction in feed intake was 5 days postoperation. Defection was ceased for the first 12 hours postoperation and then returned normal without changes or signs of straining.

All operated animals revealed significant ($P \leq 0.05$) increase in body temperature at the 1st day post-operation, significant ($P \leq 0.05$) increase of pulse rate on the 1st and 3rd day postoperation and significant ($P \leq 0.05$) increase of respiratory rate at the 1st and 3rd day postoperation (Table 1).

Table 1: Mean ± Standard Deviation of Blood Urea Nitrogen level (BUN), Creatinine level (Cr), Body temperature (Temp.), Pulse Rate, Respiratory Rate (Resp. Rate) and Bladder Capacity of Group-1 of experimental part and the clinical part (G1+CP) and group-2 of the experimental part (G2)

	BUN mg/dl		Cr mg/dl		Temp.		Pulse Rate		Resp. Rate		Bladder Capacity	
	G1+CP	G2	G1+CP	G2	G1+CP	G2	G1+CP	G2	G1+CP	G2	G1+CP	G2
Normal	20.00± 1.58^{a}	20.33± 1.53^{a}	1.15± 0.23^{a}	1.08± 0.04^{a}	38.54± 0.15^{a}	38.53± 0.21^{a}	67.40± 4.67^{ab}	67.30± 6.43^{a}	15.30± 1.14^{a}	15.47± 1.53^{a}	135.71± 13.60^{a}	156.67± 14.53^{a}
1st day	23.56± 1.19^{b}	24.26± 0.85^{bc}	1.83± 0.12^{c}	1.89± 0.11^{d}	39.94± 0.67^{b}	39.57± 0.61^{b}	128± 5.70^{c}	125.0± 5.00^{b}	30.20± 6.65^{b}	31.63± 8.08^{b}	--	--
3rd day	26.31± 1.36^{c}	26.33± 1.73^{c}	1.64± 0.11^{bc}	1.63± 0.11^{cd}	38.78± 0.18^{a}	38.71± 0.17^{a}	121.4± 7.40^{c}	124.0± 5.29^{b}	28.01± 5.45^{b}	26.03± 5.86^{ab}	--	--
7th day	22.15± 1.57^{ab}	22.14± 1.99^{ab}	1.42± 0.21^{ab}	1.49± 0.15^{bcd}	38.68± 0.08^{a}	38.71± 0.11^{a}	75.80± 4.21^{b}	74.67± 4.93^{a}	15.40± 1.67^{a}	16.09± 1.53^{a}	--	--
15th day	21.24± 1.07^{ab}	21.59± 1.25^{ab}	1.29± 0.34^{ab}	1.32± 0.29^{abc}	38.60± 0.16^{a}	38.63± 0.21^{a}	71.40± 3.91^{ab}	71.00± 4.58^{a}	15.83± 1.30^{a}	15.07± 1.53^{a}	--	--
30th day	20.02± 1.52^{ab}	21.31± 2.04^{ab}	1.19± 0.23^{a}	1.09± 0.09^{ab}	38.58± 0.13^{a}	38.47± 0.15^{a}	65.00± 4.79^{a}	63.33± 5.77^{a}	14.45± 0.84^{a}	15.00± 1.00^{a}	117.14± 14.14^{a}	35.67± 4.97^{b}

The means within the same Column having different superscript are significantly different at level ($p \leq 0.05$).

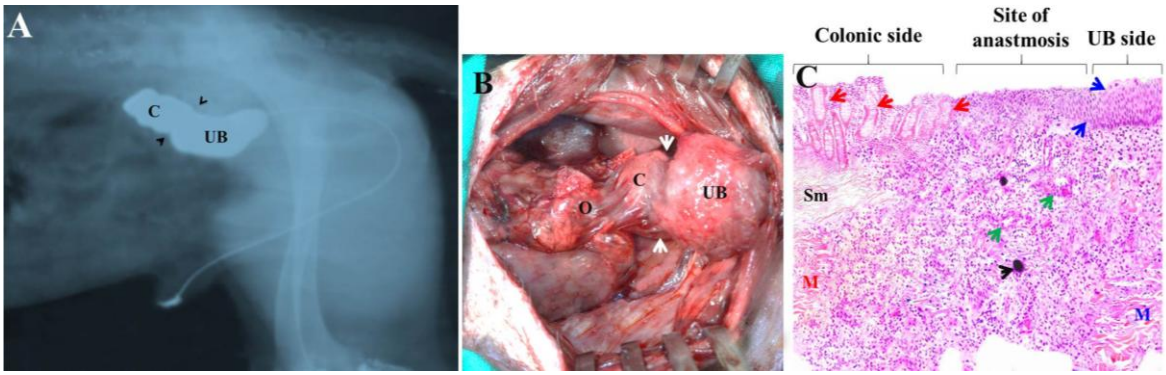

Fig. 4: Retrograde positive contrast cystography (A) of group- 1 at the 30th day postoperative revealed, normal position of the native bladder (UB), superiorly located augmented colon segment (C) and in between invaginated site of connection (arrow head). Gross (B) and Histopathological examinations (C) of the urinary bladder, site of anastomosis and augmented colon segment at 30th day post colocystoplasty. Colon (C); Urinary bladder (UB); Omentum (O); site of anastomosis (white arrow); urothelium (blue arrow); colon epithelium (red arrow); new blood vessels (green arrow) and suture material (black arrow); colon submucosa (Sm), colon musculos (red M); urinary bladder musculosa (blue M).

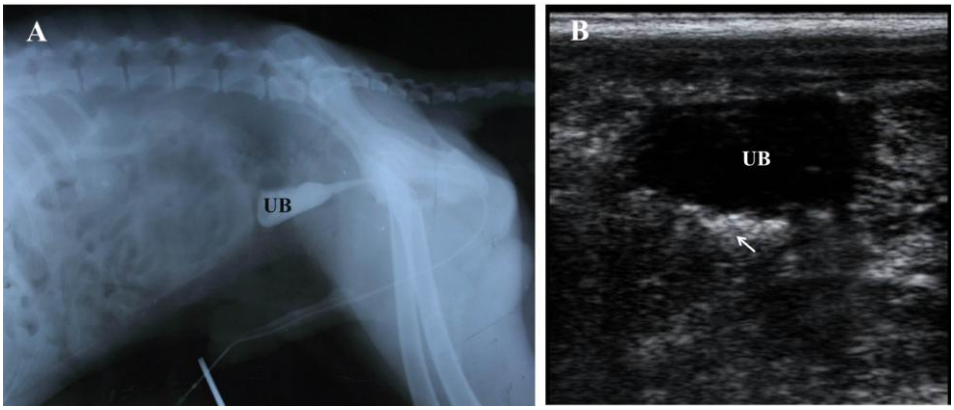

Fig. 5: Retrograde positive contrast radiography (A) and ventral abdominal ultrasonography (B) of the urinary bladder of group-2 at 30th day post-operative. Contrast cystography (A) showing small oval to tubular shape non-distended urinary bladder. Ultrasonographic examination (B) showing small oval shape not fully distended urinary bladder (UB) with thicken irregular wall and hyperechoic signals at the cranial border represent remnants of the suture material (arrow).

The mean BUN and Creatinine of group-1 and of clinical part showed significant ($P \leq 0.05$) increase at the 1st and 3rd day postoperation. The group-2 showed significant ($P \leq 0.05$) increase in BUN and Creatinine at the 1st and 3rd day and at 1st, 3rd and 7th day postoperation respectively. Thereafter, both parameters of both groups were decreased gradually and reached near normal at the 30th day postoperation (Table 1).

The mean UB capacity of group-1 at 30th day postoperation showed non-significant ($P>0.05$) difference with the normal mean, while the mean UB capacity of group-2 at 30th day postoperation showed significant ($P \leq 0.05$) decrease than the normal mean.

Ultrasonographic examination of group 1 (colocystoplasty group) of the clinical part at 24 hours postoperation (Fig. 3A) revealed that the urinary bladder showed oval shape, not fully distended, with thicken irregular wall and mixed echogenic intraluminal debris that persist until the 7th day postoperative. The augmented segment is located in a superior position to the bladder, appeared tubular shape, with thicken wall and retained its characteristic gut wall appearance with two overlapped inner hyperechoic layers and outer thickest hypoechoic layer. The intraluminal debris in the augmented segment appeared more echogenic than that of the native bladder lumen. Ultrasonographic examination at the 30th day postoperation (Fig. 3-B, C &D) revealed rounded shape urinary bladder, homogenous appearance, decreased wall thickness and normal clearly anechoic bladder lumen. The augmented segment appeared tubular to oval shape, decreased intraluminal echogenicity, decreased wall thickness, and still retained its characteristic gut wall appearance. There was no evidence of urine leakage at any time point of the experiment.

Ultrasonographic examination of the right and left kidneys in both groups showed no changes at any time of the experiment, except one animal was suffering from a ruptured bladder showed slight dilatation of the renal pelvis after 24 hours postoperation and was not detected on 3rd day postoperation.

Ultrasonographic examination of group 2 (cystorraphy group) after 24 hours postoperation revealed small oval UB, not fully distended with urine, with thicken irregular wall, hyperechoic signals at the cranial border represented the suture material and mixed echogenic intraluminal debris. Ultrasonographic examination on 30th day was not distinguishable from that at 24 hours except slightly wider bladder lumen (Fig. 5B).

Radiography

Positive contrast retrograde cystogram of the group 1 and the clinical part at the 30th day postoperation revealed normal position of the bladder with superiorly located augmented segment and in between invaginated site of connection. The bladder and the augmented segment showed normal smooth contour outlining, normal filling effect with no signs of contrast material leakage (Fig. 4A).

Positive contrast retrograde cystogram of group 2 at the 30th day postoperation revealed, small oval to tubular shape non-distended urinary bladder with normal smooth contour outlining, normal filling effect and no signs of contrast material leakage (Fig. 5A).

Gross and histopathological examination

Gross pathological examination of group 1 at 30th day revealed complete healing of the anastomotic area with the presence of some remnant of suture material above the healed surface and there were no signs of necrosis or discoloration (4B). Histopathological examination revealed the presence of fibrovascular tissue formation in the area of the anastomosis in between and diffused towards the native urinary bladder and the colon segment with newly formed blood vessels, fibroblast and immature collagen fiber proliferation. The characteristic histologic appearance of the urinary bladder and colon walls was distinguished without any evidence of degenerative changes (Fig. 4C).

Discussion

Enterocystoplasty is the major reconstructive operation that seeks to protect the upper urinary tract and accomplish urinary continence by decreasing the bladder's storing pressure and increasing its capacity (Jeong et al., 2016).

Colocystoplasty is characterized by favorable maneuverability, tissue availability with sufficient length, the colon has a copious amount of mesentery to be used, the colon is a large bowel which minimizes the chance of postoperative intestinal stenosis, the colon has the least absorptive and secretory properties among the gastrointestinal tract as its main function is to store feces that will be emptied into the rectum (Hounnou et al., 2002; Abou-Elela, 2011). Therefore, the incidence of post augmentation complications either obstructive (urinary tract infection and urolithiasis) or metabolic is decreased in such type of Enterocystoplasty (Defoor et al., 2004, Abou-Elela, 2011; Stein et al., 2012).

Although, the ileum has been widely used in bladder augmentation, it potentially problematic due to its short mesentery and its narrow lumen so a long segment of ileum about 40 cm should be obligatory isolated with its own mesentery for refashioning. This results in wide range of complications such as severe diarrhea, vitamin B12 deficiency, hyperchloremia, hypokalemia, metabolic acidosis, bowel obstruction, stone formation, heavy mucus production and urinary tract infections (Atala et al., 2006; Sountoulides, 2009; Chi-Fai et al., 2013; Breen et al., 2015).

Catheterization for 5 days post-operation was applied to prevent direct contact of urine with the site of augmentation. Moreover, Bakhtiari et al. (2000) added that post-operation catheterization seems to have a great impact and facilitates epithelial growth, minimize pressure on the line of suturing and prevent accumulation of urine until removal of the catheter.

In the present investigation, no signs of rejection were noticed as weight loss, off food or fever. Moreover, ultrasonographic, gross and histopathological examinations at 30th day postoperation revealed normal native bladder and its augmented colon segment with evidence of successful healing process, characteristic gut wall appearance and no signs of necrosis or degeneration. This result was coincided with the findings of Pozzi et al. (2006), González et al. (2009), Kispal et al. (2011) and Hamdan (2015) supporting the potential of the autologous bladder augmentation by using colon segment with its own mesenteric blood supply. Moreover, this result agreed with the findings of Turner et al. (2014) who stated that the urothelium has a great ability for healing and regeneration.

Although detubularization of the bowel segment maximizes the capacity and preventing a narrow anastomosis deformity, yet a high incidence of necrosis and subsequent leakage occur (Hamdan, 2015). In the present study, the procedure of detubularization could be replaced with adequate bladder opening anastomosed to a large diameter segment of the colon, which resulted in proper emptying capability without post-void residual urine.

In the present investigation, the post-operative bladder capacity of group 1 with colocystoplasty was about 3.34 times greater than group 2 which include only cystorrhaphy without augmentation. On the same respect, Jeong et al. (2016) reported a 2.4 times increase in bladder capacity after augmentation cystoplasty.

Serum urea nitrogen and creatinine increased gradually postoperation, but remained within normal limits in both groups. This result was in good agreement with Shivaprakash (1990) and Bakhtiari et al. (2000) and in contrast to Pozzi et al. (2006) who recorded a significant increase in blood urea level and serum creatinine to the abnormal limits following bladder reconstruction.

Hematuria, copious amount of mucous production and death of one animal at the early postoperation stage was recorded in the present study. Bakhtiari et al. (2000), DeFoor et al. (2004), Metcalfe et al. (2006), Sountoulides (2009) Kispal et al. (2011) and Sarah et al. (2015) stated that bladder augmentation like any other surgical procedure is not without risk or complications such as bowel obstruction, reservoir perforation, malignancy, calculi, bone demineralization (due to the abnormal incorporation of GIT into the urinary system), hematuria-dysuria syndrome and urinary tract infections. Moreover, Shivaprakash (1990) and Bakhtiari et al. (2000) attributed the presence of blood in urine to surgical trauma.

In conclusion, colocystoplasty provides promising results in compensating impaired filling capacity of bladder and subsequent complications due to partial cystectomy.

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