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## **Clinical and Radiological Findings Following Continent Urinary Diversion with Colonic Segment in Dog**

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**Abstract:** In order to assess clinico-radiological findings of urinary diversion, five adult healthy mongrel dogs of both sexes weighing between 25-40 kg and average age of 1.5 years, underwent continent urinary diversion surgery. In this approach fifteen centimeters of the descending colon with preservation of its mesenteric vessels was resected and this segment longitudinally was opened and flushed with an aqueous solution of povidine iodine 0.1% and the remaining colon re-anastomosed by seromuscular sutures. Then two ends of transected ureters were drawn into the resected colon by mosquito hemostatic forceps and simple interrupted sutures were placed between the ureter and the colonic mucosa for uretero-colonic anastomosis. The uretero-colonic part in a cap form transplanted to partially cystectomized bladder with one layer of cushing pattern suture. All animals survived after the operation. Clinically, all dogs were dull and depressed and passed blood tinged urine for first few postoperative days. There was pollakiuria in all of animals distinctly, but urinary incontinence was not observed. At the first few postoperative days, anorexia, nausea and vomiting were seen in three dogs. In all animals, polydipsia were seen and continued until the end of study. Intravenous urograms showed hydronephrosis and upper urinary tracts dilatation in all animals at 25th day but there were signs of improvement at 45th day distinctly. Unilateral ureteral obstruction was observed in two dogs. In regards to clinico-radiological findings can be concluded that this operation has some distinct sequela that some of them may be seen in radiographic assessments.

**Key words:** Urinary diversion, ureter, colon, urography, dog

### **INTRODUCTION**

For more than a century the gastrointestinal tract has been employed in numerous creative and sophisticated procedures to correct abnormalities of the genitourinary tract (Ramon *et al.*, 1996). Intestinal segment are frequently used in the reconstruction of the urinary tract in human undergoing radical cystectomy for invasive bladder cancer (Murray *et al.*, 1987). A myriad of procedures incorporating stomach, jejunum, ileum, different parts of the colon and a combination of the above bowel segment have been used in diverting, reconstructing and remodeling different portions of the unitary tract (Ramon *et al.*, 1996).

Permanent urinary diversion may be indicated in small animals especially dogs when neoplasia involves the bladder trigone (Fossum, 2002), or when the bladder can no longer safely function as a reservoir for urine storage (Schwartz, 1999). Urinary diversion includes performing partial or total cystectomy with surrounding tissues and re-routing of urinary stream by re-anastomosing the

ureters to an isolated bowel conduit or ileum (Fossum, 2002; Sabiston and Lyerly, 1997; Schwartz, 1999). Ureterocolonic anastomosis and trigonal-colonic anastomosis have been the most commonly performed techniques for permanent urinary diversion in dogs (Fossum, 2002; Smith *et al.*, 1995).

The indications for urinary diversion include bladder cancer, hostile neurogenic bladder, intractable incontinence, refractory interstitial or radiation cystitis, exstrophy or tuberculosis of the lower urinary tract (Murray *et al.*, 1987; Slatter, 2002). Bladder cancer (Transitional cell carcinoma) is the most common indication for continent urinary diversion. These malignancies account for about 3% of all cancer deaths. Superficial bladder tumors are managed by transurethral resection or laser ablation with or without intravesical chemotherapy, but more invasive tumors (for example transitional cell carcinoma) require radical cystectomy and urinary diversion (Murray *et al.*, 1987). Urinary diversion is a suitable method to counteract bladder carcinoma when modern approaches have not been successful or

when there is recurrence of the disease invading the muscle wall of the bladder (Sabiston and Lyster, 1997; Schwartz, 1999). In animals because the literature documents too few cases, no specific discussion concerning effectiveness, complications or postoperative management is presented (Slatter, 1985, 2002), therefore the primary aim of this study is to introduce a continent, simple and effective technique in urinary diversion surgery with colonic segment in dog and evaluate the outcome of this operation based on clinical and radiological complications.

#### MATERIALS AND METHODS

Between November 2005 and October 2006, five adult healthy mixed breed dogs, 3 males and 2 females, weighing between 25-40 kg and average age of 1.5 years underwent continent urinary diversion with colonic segment in Shahid Chamran University of Ahwaz. Anesthesia was induced with thiopental sodium ( $10 \text{ mg kg}^{-1}$ , IV) and maintained by halothane in oxygen (1-1.5%) delivered in a closed circuit anesthetic system.

The abdomen was opened by a midline incision. In this approach fifteen centimeters of the descending colon with preservation of its mesenteric vessels was isolated and the continuity of the intestinal tract was re-established by a one layer seromuscular end-to-end anastomosis with polyglycolat coated 2/0. The isolated colonic segment was opened longitudinally along its antimesenteric border to form an intestinal plate. The mucosa of this intestinal plate was thoroughly cleaned with an aqueous solution of povidin iodine 0.1%. The ureters were severed at ureterovesical junction. A mosquito homeostatic forceps was passed from inside to outside of the colonic wall at a slightly oblique angle to create short submucosal tunnel and the ureters were drawn in to the colon via the tunnels (Fig. 1). Then the ends of severed ureters were incised one centimeter in longitudinal direction to provide a longer length for suturing. At first the preplaced sutures were introduced between ureteral walls and the colonic mucosa in up, down, left and right direction with 5/0 polydioxanone sutures and then more sutures were placed between them. At last all sutures were tied and ureterocolonic anastomoses were complete (Fig. 2). Then the intestinal plate was sewn to the partially cystectomized bladder in one layer with 2/0 polydioxanone in cushioning pattern, thus forming a cap over the bladder plate (Fig. 3).

Cefazolin sodium ( $20 \text{ mg kg}^{-1}$ , IV, bid), Gentamicin ( $4 \text{ mg kg}^{-1}$ , IV, bid) and fluid therapy (with normal saline 0.9% and dextrose 5%) were administered for one week. Tramadol ( $2 \text{ mg kg}^{-1}$ , bid) was used for pain management



Fig. 1: The ureters were drawn in to the colon via the tunnels

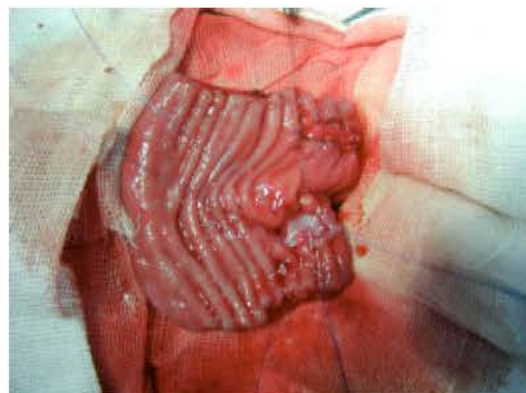


Fig. 2: The preplaced sutures between ureter and the colonic mucosa. The completion of ureterocolonic anastomoses was seen in the other side

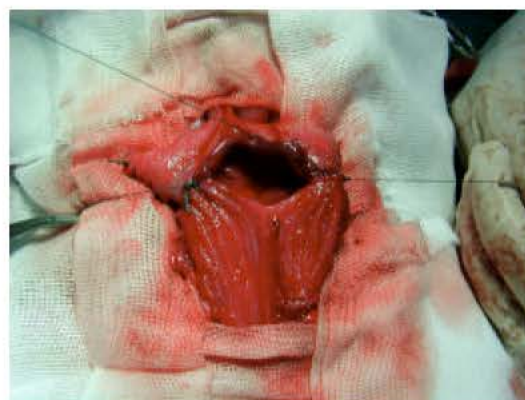


Fig. 3: The suturing of intestinal plate in a cap form with partially cystectomized bladder

in dogs for five days. All ordinary clinical sign like pulse, respiratory rate, body temperature, appetite and animal behavior were examined and inspected daily. Intravenous urography was performed at 25th and 45th days after operation.

### RESULTS

All five dogs survived after surgery. There were no urinary leaks or extravasations of urine into the abdominal cavity based on clinical examination and radiography. Clinically, all dogs were dull and depressed for first few postoperative days. Presence of blood in urine was observed during first 1-3 postoperative days in all animals. All dogs passed mucus tinged urine from first postoperative day that continued until the end of study but none of them did not require to urinary catheterization. There was pollakiuria in all animals

distinctly, but urinary incontinence was not observed. At the first 1-4 postoperative days, anorexia and nausea were seen in 3 dogs but the remaining animals did well, had a normal appetite and behavior. In all animals polydipsia was seen from first postoperative day that continued until the end of study.

Intravenous urography showed hydronephrosis and upper urinary tracts dilatation in all animals at 25th day after operation (Fig. 4) but there were signs of improvement at 45th day distinctly (Fig. 5). Also, persistent unilateral ureteral obstruction was observed in two dogs.

### DISCUSSION

The present study is the detailed report on clinical findings and specific radiographic alterations of the upper urinary tract after continent urinary diversion with colonic segment in dog. In this study all dogs were depressed for few postoperative days that in regards to the extent of surgery that were included intestinal re-anastomosis, ureterocolonic anastomosis, partial cystectomy, creation of a neobladder and postoperative stress were predictable. Postoperative depression due to postoperative stress is mentioned by Bakhtiari *et al.* (2000) in augmentation cystoplasty previously.

In this study the presence of blood in urine was seen in the first 1-3 postoperative days and obviously it is not specific complication of urinary diversion and has been shown by Saberi Afshar *et al.* (2005) and Raghavandra *et al.* (1989) after different grafts for bladder reconstruction in dogs. The best reason for bloody urine is surgical trauma in urinary bladder that has reported by Bakhtiari *et al.* (2000).

Mucus tinged urine in our study was related to mucus secretion by goblet cells in mucosal layer of colonic segment. Although mucus output never stopped, it has not been problem in this study. Gearhart (1987) reported villous atrophy in ileum with long-term storage of urine after augmentation ileocystoplasty and suggested that such atrophy may result a decrease in mucus production and in contrast Murray *et al.* (1987) found no decrease in mucus production in patients with cecocystoplasty, ileocystoplasty or ileal conduit diversion. Although some investigators noted the mucus production tended to decrease progressively with time (Hendren and Hendren, 1990; Rink *et al.*, 1995), however, these findings were not confirmed by the others (Akerlund, 1989; N'Dow *et al.*, 2004). Unfortunately, there is no treatment has been shown to be effective in decreasing mucus production in intestinal urinary reservoirs and conduits (N'Dow *et al.*, 2004). Although



Fig. 4: Hydronephrosis and upper urinary tracts dilatation at 25th day after operation



Fig. 5: The improvement of hydronephrosis and upper urinary tracts dilatation at 45th day

the voiding problem caused by the mucus contribute to urinary retention and potentially contribute to delayed bladder rupture, are reported in patients after augmentation cystoplasty or continent orthotopic diversion (Haupt *et al.*, 1990; Rushton *et al.*, 1988), but significant problems with mucus obstruction are unusual (N<sup>o</sup>Dow *et al.*, 2004).

In this study there was pollakiuria in all animals distinctly, that it may be related to nervous reaction due to cystic irritation. This finding is mentioned by Light and Scott (1984). Also, Bastian *et al.* (2004) have been reported pollakiuria in 36% of their patients.

In the present investigation at the first 1-4 postoperative days, anorexia, nausea and intermittent vomiting were observed in three dogs. Stricture of the uretero intestinal anastomotic site due to inflammation and edema at the first few postoperative days and also, resistance in urine stream due to submucosal tunnel are the best reasons to explain temporary postrenal uremia with signs of anorexia, nausea and intermittent vomiting at the first few postoperative days. Ureteral stoma swelling is probably common after ureteroneocystostomy in dogs and may cause some obstruction to ureteral flow, but it usually goes undetected and resolves without therapy (Fossum, 2002). Probably after subside of inflammation and edema and because of hypertrophic reaction of distal ureteral stoma for adaptation in new position, the recovery of the animals was seen gradually. Complications from the diversion procedure in dog include intermittent vomiting, neurological abnormalities, hyperchloremic metabolic acidosis, anorexia and pyelonephritis have been reported (Slatter, 2002). Gastrointestinal disturbances including anorexia, nausea and weight loss were reported by Bovee *et al.* (1979) in dogs after trigonal- colonic anastomosis, but the cause was not determined. The gastrointestinal and neurologic disturbances were reported by Stone *et al.* (1988a) in 4 of 13 dogs probable had interrelated causes including metabolic acidosis, hyperammonemia and azotemia. The neurologic and gastrointestinal signs may have been caused by hyperammonemia, metabolic acidosis and uremia (Stone *et al.*, 1988a). Nausea and vomiting due to entero-pouch fistula in 2 of 36 patients is mentioned by Tarter *et al.* (1995). Anorexia, nausea and vomiting due to metabolic acidosis result ammonia ions in patients with ileal orthotopic bladder substitution reported by Varol and Studer (2004).

Other distinct clinical finding in our study was polydipsia that continued until the end of study. Polydipsia in patients with ureterosigmoidostomy was reported by Ferris and Odel (1950). Polydipsia is a

common finding in patients with ileal or colonic urinary diversion (Talner, 1990) probably due to reabsorbing of some urine material from intestinal segments.

In this report, intravenous urography showed hydronephrosis and upper urinary tracts dilatation at 25th day after operation but there were signs of improvement at 45th day distinctly. Hydronephrosis and hydroureter in some of dogs reported by Stone *et al.* (1988b) and they suggested some degree of anastomotic stenosis, although this was not apparent macroscopically. Rawlings (1998) has been introduced long submucosal tunnel in ureteral transplantation for hydronephrosis and hydroureter in dogs. Abd-el-Gawad *et al.* (1999) showed that urinary tract dilatation is a frequent finding early after urinary diversion surgery in children but it subsides in most cases 3-12 month after operation. Hydronephrosis due to ureteral obstruction in 2 of 29 patients reported by Bissada *et al.* (2004), but the hydronephrosis or hydroureteronephrosis does not necessarily indicate obstruction and mild to moderate hydronephrosis in patients with urinary diversion is not unusual (Abd-el-Gawad *et al.*, 1999). Occurrence of upper urinary tract dilation in vast majority of cases is mentioned by Thoeny *et al.* (2004) that it had resolves spontaneously with further follow-up. Simultaneous urodynamic studies clearly excluded reflux as a potential reason for upper tract dilation in patients with an afferent tubular segment but in contrast to the true bladder, orthotopic intestinal low-pressure reservoirs have no coordinated contraction during voiding thus, an isolated intravesical pressure rise, which could cause urine reflux and an increase in intrapylelic pressure, is not possible (Studer *et al.*, 1991). Moreover, the patients who received an ileal low-pressure bladder substitute with an anti reflux flap valve showed the same transient dilatation as did the patients with an afferent tubular ileal segment without a flap valve mechanism (Ralls *et al.*, 1986; Studer *et al.*, 1996; Talner, 1990). The most plausible explanation for the constant dilatation in the early postoperative period is lack of ureteric peristalsis which is additionally maintained by the frequently elevated pressure in the initially small- capacity reservoirs, the higher the end-fill pressure in the reservoir, the higher the pressure in the renal pelvis (Varol and Studer, 2004). Dilatation of the upper urinary tract after urinary diversion is a very frequent urographic finding during the early postoperative period, which should not be over interpreted as a sign of obstruction (Varol and Studer, 2004). Irrespective of the exact mechanism leading to dilatation of the upper urinary tract during the early postoperative period in patients with various types of bladder substitutes, it is important for radiologists to

know that it exists (Varol and Studer, 2004). It is of major clinical relevance to discriminate the described temporary functional dilatation of the upper urinary tract from one caused by a mechanical outlet obstruction, which is most often due to a ureteric stenosis. The discrimination between dilatation only and obstruction is best made by judging whether contrast medium excretion is present or delayed on the 5 min film and whether the collecting system is drained after 60 min (Varol and Studer, 2004). Whether upper urinary tract dilatation was from lack of ureteral peristalsis in the early postoperative period as proposed by Thoeny *et al.* (2004) it is condition resolved in the overwhelming majority of patients with longer follow-up.

In our study persistent unilateral ureteral obstruction were observed in two dogs. As has been proposed by Stone *et al.* (1988b), placing the ureter in a submucosal tunnel should help prevent reflux, but increases the risk of ureteral obstruction. Shrinkage of the parenchyma of a preoperatively normal kidney was reported by Thoeny *et al.* (2004) in 2 (1%) renoureteral units associated with stenosis of the ureteroileal anastomosis. Also, of the 148 renoureteral units, 14 (9%) presented with nonobstructive dilation and 4 (3%) with complete obstruction (Varol and Studer, 2004). Pyelonephritis and renal failure due to end-stage kidney are possible complications of ureterocolonic urinary diversion in dogs (Fossum, 2002). Also, ascending infection due to intestinal segment may result in pyelonephritis, reduced renal function and stenosis at the site of uretero intestinal anastomosing causing impaired ureteral function or progressive hydronephrosis (Slatter, 1985). In present investigation, unilateral ureterointestinal anastomotic stricture due to submucosal tunnel may result in persistent unilateral ureteral obstruction which leads to the reduced renal function and end-stage kidney.

In conclusion there are some temporary and permanent complications after continent urinary diversion with colonic segment in dog. Although normal clinical signs in all animals especially in the end of study may be seductive, but to avoid misinterpretation, radiologists and urologists must be aware of these specific urographic findings of the upper urinary tracts after urinary diversion in the early and late postoperative period.

#### **ACKNOWLEDGMENTS**

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