

LAPAROSCOPIC ILEAL LOOP CONDUIT AN EXPERIMENTAL STUDY IN DOGS

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Objective This experimental study in dogs aimed at establishing a technique for laparoscopic construction of an ileal loop conduit for urinary diversion.

Material and Methods Eight mongrel dogs were included in the study. All of them were subjected to preoperative intravenous urography (IVU) for evaluation of the upper urinary tract. In the first four dogs (Group I) ileal loop conduits were constructed via a transperitoneal approach with implantation of the right ureter only to the newly fashioned conduit. Group II consisted of another four dogs in which the conduits were created and both ureters were re-anastomosed to their walls. All procedures were done laparoscopically. Postoperatively, all dogs were evaluated by IVU and diuretic renography. The conduits were further evaluated by loopograms.

Results Open conversion was not necessary in any animal. The mean operative time was 5 ± 1.5 hours and 4 ± 0.5 hours for

Groups I and II, respectively. One dog of Group I died postoperatively because of urinary leakage. Thus, only three units were evaluable. Two of them showed a perfect configuration on IVU film, while a uretero-ileal stricture was detected in one. Mean renographic clearance was 55 ± 10.5 ml/minute. Eight renal units could be assessed in Group II. On radiological assessment all showed perfect postoperative configurations with a mean renographic clearance of 56 ± 8 ml/minute. The loopograms revealed adequately fashioned conduits in all dogs with no leakage.

Conclusion This experimental study confirmed the feasibility of laparoscopic ileal conduit construction with a satisfactory outcome. Although technically challenging, ongoing technical refinements will make the performance of reconstructive laparoscopy more widely acceptable.

Key Words laparoscopy, experimental, ileal loop conduit

INTRODUCTION

Since the introduction of laparoscopic procedures in urology, the main concern has been directed towards ablative surgeries. A large series of laparoscopic nephrectomies, adrenalectomies, radical nephrectomies and live donor nephrectomies have been reported¹⁻⁵. Currently, all of them are considered established ablative procedures. However, reconstructive laparoscopic surgery has not gained the same wide popularity in urology, yet. This is attributed to the difficulties encountered during the training on laparoscopic intracorporeal suturing and knotting. Recent publications confirm satisfactory results with laparoscopic ureterolithotomy and pyeloplasty^{6,7}. Some few reports have also been published about trials of performing a laparoscopic ileal loop conduit in a very small number of

patients^{8,9}. However, their data clearly showed the difficulties that could be encountered during application of such procedures in humans, especially with an early learning curve. Thus, for the time being, it might be preferable to experimentally explore this field aiming at building up some experience with laparoscopic reconstructive bowel surgery and at shortening the learning curve. This may help to pave the way for a wider use of laparoscopic ileal loop conduit as a method for bladder replacement and urinary diversion in humans.

MATERIAL AND METHODS

Eight mongrel dogs were included in the study. Six were males and two were females. Intravenous urography (IVU) done in order to evaluate the upper urinary tracts revealed per-

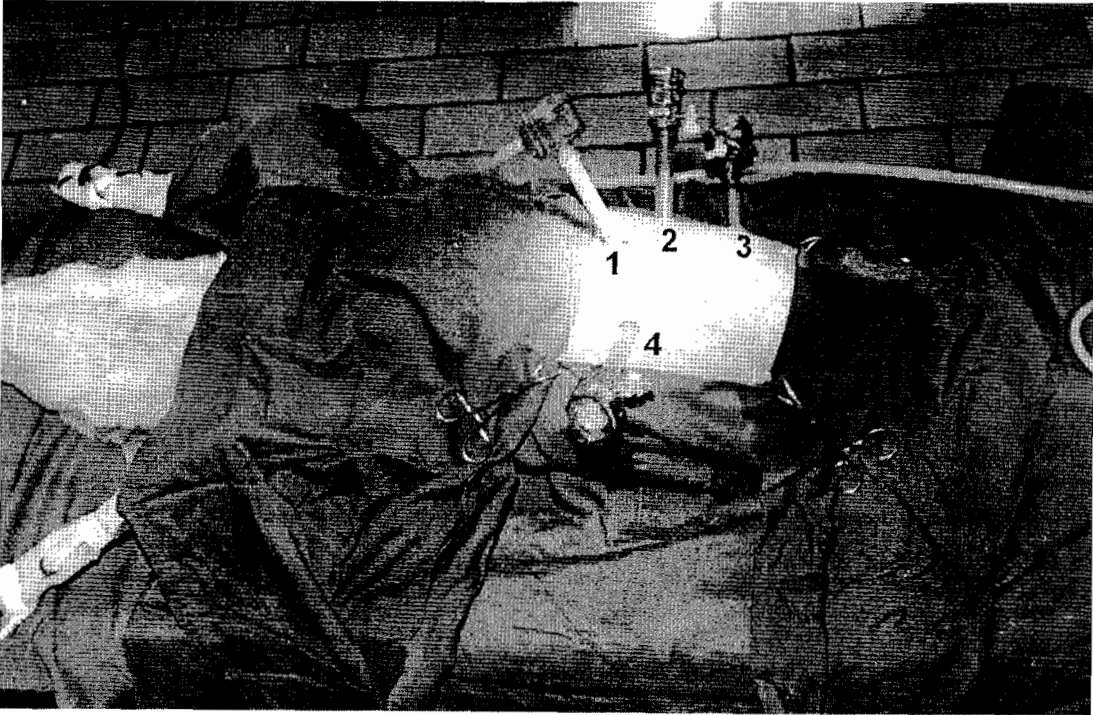


Fig. 1: Illustration of the sites of the ports: 1. 10 mm port, 4 cm below the Xiphi-sternum for the laparoscopic lens and camera; 2. 12 mm port at the lateral border of the left rectus muscle, 1 cm below the level of port no. 1. It is used for the right hand instrument of the operating surgeon; 3. 12 mm port 2 cm below and laterally to port no. 2. It is used for the left hand instrument of the operating surgeon; 4. 10 mm port at the lateral border of the right rectus muscle, 1 cm below the level of port no. 1. It is used for the instruments of the assistant.

fect renal units in all dogs. The dogs were classified into two main groups. Group I included the first four dogs that were subjected to construction of a laparoscopic ileal loop conduit with direct anastomosis of the right ureter to the ileum. The left ureter was not included to decrease the morbidity and to shorten the operative time during the early phase of the study where the experience with reconstructive surgery was still small. Group II included another four dogs in which both ureters were implanted into the ileal loop conduit. Thus, a total of twelve renal units were considered for evaluation. All the procedures were performed exclusively by intracorporeal laparoscopic techniques.

Techniques:

The dogs were generally anesthetized using Thiopental sodium 20 mg/kg with endotracheal intubation and mechanical ventilation using an air pump machine. Broad-spectrum antibiotics were given intravenously before the

procedure (Cefotaxim 50 mg/kg and Metronidazol 40 mg/kg). With the dog in the supine position, a Verres needle was inserted in the midline 4 cm below the level of the Xiphisternum to create a pneumoperitoneum at 13 mm/Hg. After removing the Verres needle, a 10 mm port was placed at the same point. Then another three ports were inserted (12 mm, 12 mm and 10 mm) as shown in Fig. 1. Port no.1 was used for the laparoscopic camera. Ports no. 2 and 3 were used for the operating surgeon's laparoscopic instruments and port no. 4 was left for the assistant.

The ureters were identified near to their entry to the bladder. They were clipped and divided approximately 3 cm from the bladder and mobilized up for about 10 cm. The left ureter was delivered to the right side of the abdomen under the sigmoid mesocolon. The caecum was identified, and a 15-cm portion of the small bowel was selected, approximately 10 cm proximal to the ileocaecal valve. The measurement was carried out using a thread of 15 cm length that was introduced via one of



Fig. 2: Loopogram of a dog with bilateral uretero-ileal reflux.

the ports. The vascular mesentery arcade supplying the selected portion of the bowel was easily visualized through the thin wall mesentery of the dogs. The bowel segment was selectively ligated using 3/0 vicryl intracorporeal sutures and cut using a laparoscopic scissors. The ileal loop was isolated using two 30 mm endo GIA staplers (gastrointestinal anastomotic staplers) that were fired at both ends of the loop.

The conduit was dropped inferiorly and bowel continuity was regained by reanastomosis of both cut ends using laparoscopic 3/0 vicryl continuous intracorporeal sutures. The needle used for suturing was a 30 mm, 1/2 circle needle with round tip. The sutures were done and handled by two laparoscopic needle holders via ports no. 2 and 3 (Fig. 1). The site of the ileal loop stoma was determined over the skin of the dog, two 2 cm above the iliac crest. The skin was incised and also the muscles lying underneath down to the peritoneum. The distal end of the ileal loop was exteriorized through the stoma site. The distal

staple line of the loop was excised and the distal end was anastomosed to the skin to create the ileal loop stoma. A blunt right angle clamp was carefully introduced through the stoma to the conduit lumen and pushed gently against its wall. Thus the wall was tented at the desired site for ureteral implantation. Using a laparoscopic scissor, a small elliptical portion of the conduit wall was excised at that site. Then the right ureter was laparoscopically spatulated and anastomosed to the ileostomy opening using interrupted 4/0 vicryl sutures. After finishing half the circumference of the anastomotic line, a 4 Fr. ureteric catheter was introduced through the external stoma of the loop up to the site of the anastomosis with the aid of a right angle clamp. Under laparoscopic visualization, the stent was introduced into the ureter. Then the ureteroileal anastomosis was completed with interrupted sutures. The left ureteroileal anastomosis was carried out in a similar manner. Laparoscopic free-hand suturing and in situ knot-tying techniques were used.

Postoperatively, no oral feeding was allowed for five days. Parenteral fluids were given in the form of 500 ml glucose 5% and 500 ml of saline 0.9% twice a day under general anaesthesia with broad-spectrum antibiotics every 12 hours. Thereafter oral feed was started. The ureteral stents were removed on the 7th postoperative day.

Follow-up loopography and IVU were done on the 8th and 10th days, respectively. Diuretic renography was also done on the 15th postoperative day using MAG3.

RESULTS

The procedures were successfully completed without intraoperative complications using the laparoscopic technique in all dogs. One dog of Group I died on the first postoperative day. Postmortem autopsy showed urinary leakage via ureteroileal anastomosis. Thus three dogs with three renal units were evaluable in Group I. The mean operative time was 5 ± 1.3 hours. Loopography showed a normal conduit configuration with no leakage in all dogs of this group. Two of three units were perfect on postoperative IVU with a mean renographic clearance of 55 ± 10.5 ml/min. One unit showed no dye excretion with moderate hydronephrosis on ultrasonography. Laparoscopic re-exploration of this dog on the

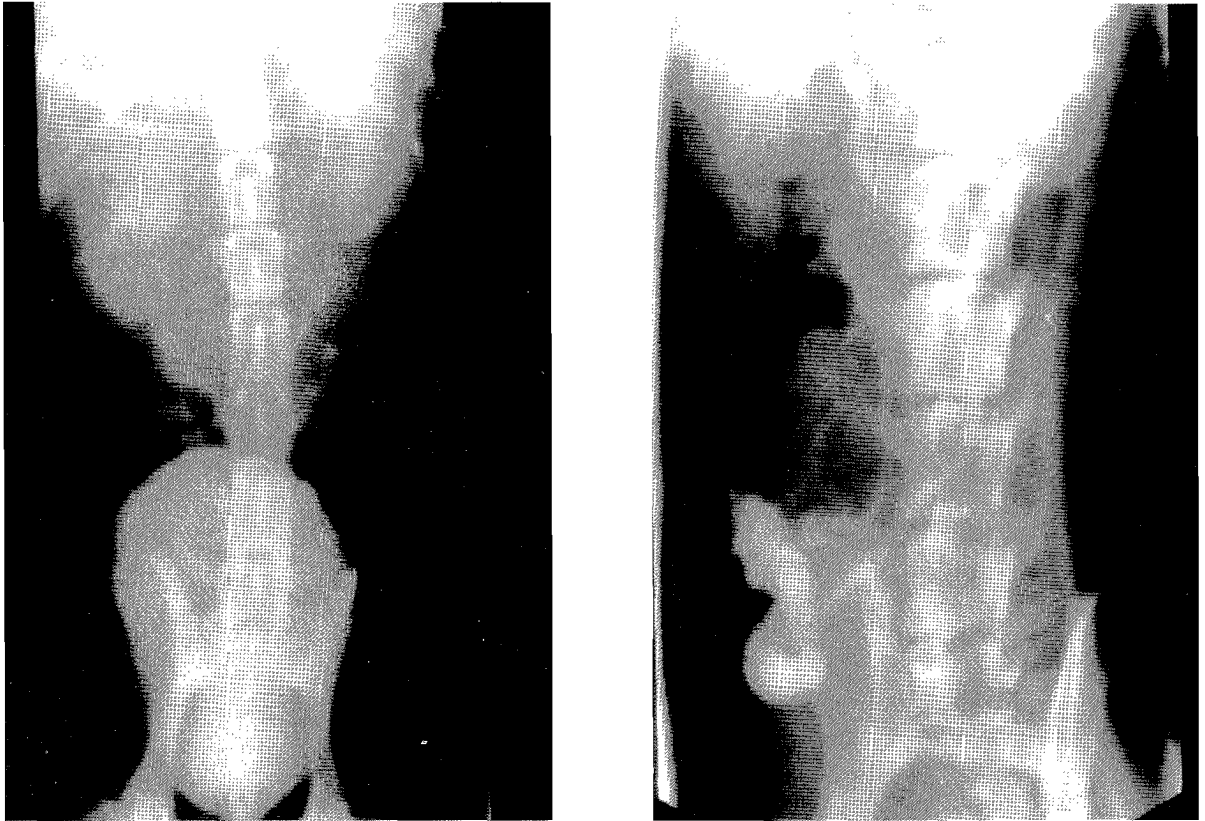


Fig. 3: A: Preoperative IVU of one dog. B: Postoperative IVU of the same dog after creation of the ileal loop conduit and bilateral ureteroileal anastomosis

15th postoperative day revealed a stricture at the ureteroileal anastomosis. The ureter was disconnected from the loop and the strictured area was excised. The ureteral end was spatulated again and re-anastomosed to the ileum using intracorporeal laparoscopic interrupted sutures.

In Group II all dogs survived. Thus, 8 units were evaluable. The mean operative time was 4 ± 0.5 hours. Loopography showed an adequate conduit configuration in all dogs (Fig. 2). IVU showed a perfect configuration of all renal units with no evidence of leakage or strictures (Fig. 3 A, B). The mean renographic clearance was 65 ± 8 ml/minute.

DISCUSSION

Laparoscopic surgery has well-established advantages over the traditional open procedures. Less postoperative pain due to the absence of generous incisions, magnification of

the operating field, a shorter hospital stay and early recovery are examples of these advantages⁸ which have led to a wide use of laparoscopic procedures in different surgical fields including urology. Laparoscopic nephrectomy was first reported by Clayman et al.¹⁰. Since then, with increasing experience, most of the urologic organs have been considered amenable for laparoscopic removal including adrenalectomy, radical nephrectomy and radical prostatectomy^{3,4,11}. However, laparoscopic cystectomy has not gained the same acceptance as other procedures. Isolated clinical reports with a small number of patients have been recorded in the literature^{12,14}. These reports show that the bladder could be successfully taken out via a transperitoneal laparoscopic approach. However, the procedures ended with laparotomy incisions for urinary diversion and bowel reconstruction as a substitution for the removed bladder. Thus, the main profit of laparoscopic intervention was not achieved. The main obstacle for laparoscopic urinary diversion is the known difficulty of doing

sutures and knot tying via the laparoscopic route, a step that requires considerable experience and a long learning curve¹⁵. Thus, it is evident that the main limitation is not the bladder removal itself, but the construction of a neobladder from the bowel. This was our motivation for exploring the possibility of doing laparoscopic urinary diversion on an experimental basis. The ileal loop conduit was chosen because of the simplicity of its construction. Furthermore, the ileal loop conduit remains one of the most widely used methods for bladder substitution throughout the world⁹, especially in Egypt.

Although dogs are not as suitable for laparoscopic training as pigs, they were used because of their availability. However, they have some inherent drawback as a laparoscopic model. Their abdominal cavity is relatively narrow and slim. Moreover the ureters are of a small caliber increasing the difficulty of their spatulation and reimplantation to the ileum. However, mastering the technique in these situations may allow an easier and faster clinical application in humans with a large abdominal cavity and an acceptable working space.

During the laparoscopic procedures it was evident that laparoscopy provided an excellent visualization of the ureters and facilitated their meticulous dissection within their periureteral sheath. Moreover, laparoscopy rendered the identification and isolation of the conduit straightforward. The optical magnification offered by laparoscopy facilitates a meticulous mucosa-to-mucosa ileoileal and ureteroileal anastomosis. Both types of anastomosis could be performed completely using intracorporeal suturing and knotting. However, the learning process was difficult and showed its impact on the outcome of Group I where the operating time was long (5 hours) and two cases of leakage and stricture were reported due to an inadequate ureteroileal anastomosis. It was interesting that the stricture could be managed by laparoscopic re-exploration and ureteral reimplantation. This may show the importance of the minimal tissue dissection offered by laparoscopy which leads to minimal tissue adhesions and offers the possibility of laparoscopic re-intervention.

The impact of the increasing experience was more evident in the next phase of the study where the mean operative time had decreased to about 4 hours inspite of bilateral

ureteral implantation. Moreover, no strictures were reported in the 8 renal units treated.

Considering the results of this study we have got the impression that a laparoscopic ileal loop conduit is feasible with a satisfactory outcome after mastering the intracorporeal suturing techniques. Although the surgical time was lengthy, the precision with which all essential ablative maneuvers could be performed laparoscopically was encouraging. Furthermore, building up experience could significantly shorten the operative time of laparoscopic surgery. Eraky et al. showed that the operative time decreased from 3.5 hours in the first 50 cases of laparoscopic nephrectomy to 2 hours in the next 50 cases². Based on the results of the present series, a clinical application of radical cystectomy and ileal loop conduit is supposed to be tried in the near future at our center.

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RESUME

La Dérivation Cutanée Trans-Intestinale par Voie Laparoscopique: Une Etude Expérimentale chez le Chien

Objectif Cette étude expérimentale avait pour but d'établir une technique pour la confection par voie laparoscopique d'une dérivation urinaire trans-intestinale. **Matériel et Méthodes** Huit chiens de race Mongrel ont été inclus dans cette étude. Tous ont eu une urographie intra-veineuse (UIV) pour l'évaluation de leur haut appareil urinaire. Chez les 4 premiers chiens (Group I) la dérivation a été réalisée par voie trans-péritonéale avec implantation de l'uretère droit seul dans le conduit nouvellement confectionné. Le groupe II comprenait 4 chiens chez lesquels les conduits étaient créés et les deux uretères anastomosés dans la paroi. Toutes les opérations ont été réalisées par voie laparoscopique. En post-opératoire, tous les chiens ont été évalués par UIV et néphrographie aux diurétiques. Les conduits de dérivation ont été évalués par opacification de l'anse de dérivation. **Résultats** Une conversion en chirurgie ouverte n'a été nécessaire chez aucun animal. La durée moyenne de l'opération était de 5 ± 1.5 heures et 4 ± 0.5 heures pour les groupes I et II respectivement. Un des chiens du groupe I décéda en post-opératoire du fait de fuites urinaires. Ainsi, seuls trois unités ont été évaluables. Parmi ces dernières deux ont montré une belle configuration à l'UIV tandis que chez un a été retrouvée une sténose urétéro-iléale. La clairance rénale moyenne était de 55 ± 10.5 ml/minute. Huit unités rénales ont pu être évaluées dans le groupe II. Elles ont toutes montré une parfaite configuration post-opératoire à l'évaluation radiographique avec une clairance rénale moyenne de 56 ± 8 ml/minute. Les opacifications du conduit iléal de dérivation ont montré des conduits adéquatement confectionnés sans aucune fuite urinaire. **Conclusion** Cette étude expérimentale confirme la faisabilité de la confection par voie laparoscopique d'un conduit de dérivation urinaire trans-intestinale avec des suites satisfaisantes. Bien que techniquement exaltante, les affinements techniques en cours vont rendre les performances de la laparoscopie reconstructrice plus largement acceptable.

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