SCIENTIFIC PAPER

# A Comparison of Continuous and Interrupted Suturing in Laparoscopic Pyeloplasty

Manickam Ramalingam, MCh, Anandan Murugesan, MCh, Kallappan Senthil, MCh, Mizar Ganapathy Pai, MCh

## ABSTRACT

**Background:** Laparoscopic pyeloplasty is one of the most common reconstructive procedures performed by urologists. Both continuous and interrupted sutures are being practiced for ureteropelvic anastomosis. The success rate and the complications associated with the suturing technique needs evaluation. We analyzed the results from of our patients who underwent laparoscopic pyeloplasty using both techniques.

**Objective:** To review the outcome differences among patients undergoing laparoscopic pyeloplasty regarding suturing technique.

**Materials and Methods:** All patients who underwent laparoscopic, transperitoneal dismembered pyeloplasty of the primary pelviureteric obstruction were analyzed. The primary outcome was successful pyeloplasty, as assessed by the resolution of symptoms and T½ <10 minutes. The secondary outcomes were the complication rate and the operative parameters. The difference in the parameters was assessed by Student *t* test analysis.

**Results:** Of the 107 patients we studied, 65 had interrupted suturing and 42 had continuous suturing. The success rate was not significantly different among the 2 groups. The mean suturing time, postoperative drainage volume, postoperative hospital stay, and total cost of the procedure were significantly less in the continuous suturing group.

**Conclusion:** The continuous suturing technique is preferred over the interrupted suturing technique for laparoscopic pyeloplasty because the success rates are equal and the postoperative stay, suturing time, drain output, and cost of the procedure are better.

**Key Words:** Laparoscopy, Pyeloplasty, Suturing technique, Cost effectiveness.

## INTRODUCTION

Laparoscopic pyeloplasty is one of the most common laparoscopic reconstructive procedures performed by urologists since it was first described by Schuessler et al in 1993.[1] Ureteropelvic anastomosis is the most important step in pyeloplasty and has a large bearing on its success rate. Intracorporeal suturing is one of the significant factors in the outcome of laparoscopic pyeloplasty.[2] Both interrupted and continuous suturing are being practiced for ureteropelvic anastomosis.[3,4] Although continuous sutures are more watertight compared with interrupted sutures,[5] the possibility of seeing the purse-string effect and tissue damage may be a concern.[6–8] We present the results of our retrospective analysis of the effects and outcome of continuous and interrupted sutures during laparoscopic pyeloplasty.

## MATERIALS AND METHODS

We retrospectively reviewed all patients who underwent laparoscopic pyeloplasty at our center from June 1998 to March 2012. A total of 129 patients underwent laparoscopic pyeloplasty. All procedures were performed by a single surgeon with >3 years of prior laparoscopic suturing experience.

Twenty-two patients were excluded from the study: 8 patients who underwent transperitoneal but nondismembered pyeloplasty (which included 3 redo nondismembered pyeloplasties), 9 patients who underwent retroperitoneoscopy, 2 patients who underwent redo dismembered pyeloplasty, and 3 infants who underwent laparoscopy-assisted pyeloplasty (pelvis and ureter brought out through a 10-mm flank port for extracorporeal anastomosis). Hence, 107 patients were included in the study.

Department of Urology, PSG Institute of Medical Sciences and Research, PSG Hospitals, Peelamedu, Coimbatore, India (Drs. Ramalingam, Murugesan).

Urology Clinic, Gowtham Annexe, Coimbatore, India (Drs. Senthil, Ganapathy).

Address correspondence to: Manickam Ramalingam, MCh, Department of Urology, PSG Institute of Medical Sciences and Research, PSG Hospitals, Peelamedu, Coimbatore 641004, India. Telephone: (+91) 422-257-0170, Fax: (+91) 984-222-1138, E-mail: uroram@yahoo.com

DOI: 10.4293/108680813X13753907291873

The initial 65 patients (until December 2007) underwent anastomosis using interrupted sutures, and the latter 42 patients had continuous sutures. All patients had a preoperative ultrasonogram, intravenous urogram or computed tomography urogram, and diuretic renogram; a sterile urine culture before surgery; and an indwelling ureteric stent placed during surgery. Postoperatively, the stent was removed after 6 weeks. Patients were followed up with a urine culture and diuretic renogram at 6 months and then annually for 5 years. Data on the operation time, suturing time, drain quantity, hospital stay, success rate (based on renogram done at 6 months), complications, and the overall cost of the procedures were analyzed. The cost analysis was done using the methodology of converting historic cost into present values and applying average rates of inflation in India obtained from the Consumer Price Index. The cost included the combined costs of hospital stay, operation charges, and drug charges. We compiled the data using a spreadsheet and the formula "FVschedule," which is designed to calculate future values as they relate to current values. The statistical analysis using Student *t* test to assess the level of significance was done with SPSS 20.0 software (SPSS, Inc./IBM, Armonk, New York).

### Operative Technique

While under general anesthesia, the patient was placed in the lithotomy position and a retrograde pyelogram was done to assess the length of the adynamic segment of the ureteropelvic junction (UPJ) and ureter. A guidewire was placed to aid identification of the ureter and to facilitate suturing. A stent was not placed at the same time because it would have been a hindrance for spatulation.

The patient was then placed in 70° lateral position. Four ports were used (10-mm port 3 cm above and lateral to the umbilicus for the camera; two 5-mm ports in the midclavicular line in the subcostal region and iliac fossa, and the fourth port in the anterior axillary line for suction or irrigation) **(Figure 1)**. For the transperitoneal approach, the colon was reflected medially and the renal pelvis was mobilized. The proximal ureter was mobilized, with care taken to preserve the vascularity and crossing vessels if present. In patients with left UPJ obstruction, if the vascular pattern of the mesocolon was conducive[9] and if the fat in the mesentery was minimal, the UPJ was dissected using the transmesocolic approach. The UPJ was dismembered and the ureter spatulated laterally using scissors without using diathermy. All ureteropelvic anastomoses were performed by intracorporeal suturing.

The size of the suture used depended on the age of the patient: 4-0/5-0 polyglactin and 4-0/5-0 polydioxanone

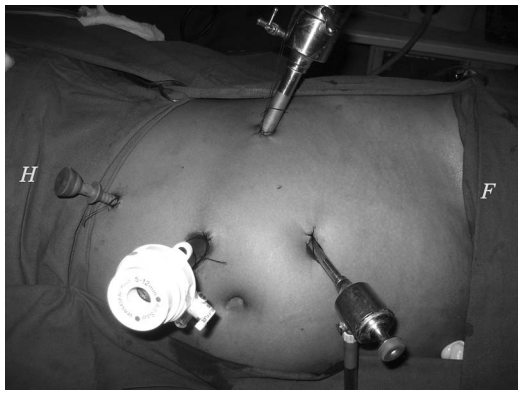


**Figure 1.** Port positions.

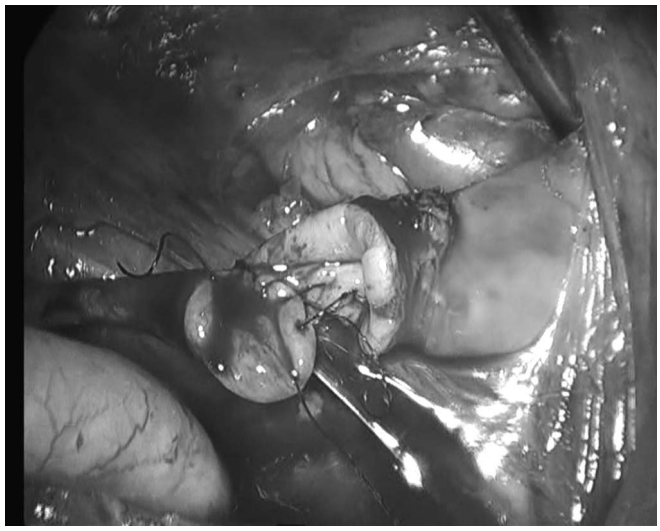

**Figure 2.** Posterior layer suturing in progress.

sutures were used for interrupted and continuous sutures, respectively. The posterior layer suturing was done initially **(Figure 2)**, followed by antegrade stent insertion **(Figure 3)**. The anterior layer suturing was completed subsequently **(Figures 4** and **5)**. Sutures were equidistant in both the continuous and interrupted sutures. In both the continuous suture group and the interrupted suture group, tube drains were placed. Postoperatively, the urethral catheter was removed on the second or third day once the urine cleared. The tube drain was removed if the drainage was <20 mL per day and if there was no perirenal or intraperitoneal collection on ultrasonography.

The procedure was defined as successful if there was an improvement or stabilization of the renal function and improved drainage (based on the measurement of glomerular filtration rate [GFR] and T½ on isotope renogram postoperatively), along with relief of symptoms. Blood loss and pain score were not analyzed in the study.

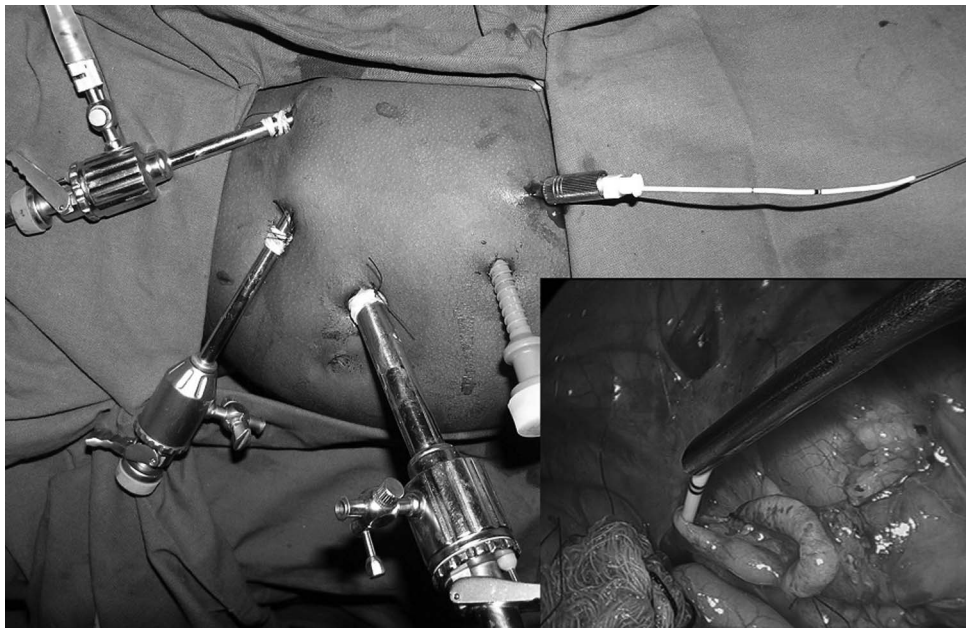

**Figure 3.** Antegrade stent being inserted.

## RESULTS

A total of 107 patients who were included in the study were analyzed. None of the patients needed conversion to open procedure. Sixty-five patients had interrupted suturing and 42 patients had continuous suturing for pelviureteric anastomosis. Twelve patients had crossing vessel (7 in the interrupted suturing group and 5 in the continuous suturing group). Six patients had secondary renal pelvic calculi (4 in the interrupted suturing group and 2 in the continuous suturing group). These were removed at the time of surgery. The demographic characteristics and clinical features are shown in **Table 1**.

The mean operative time was 219 minutes (range, 180–240) for the interrupted suturing group patients and 186 minutes (range, 135–225) for the continuous suturing group patients. In the interrupted suturing group, anastomosis was done using 4-0 or 5-0 Vicryl interrupted sutures for the pelviureteric anastomosis. In the continuous suturing group, continuous 4-0 or 5-0 polydioxanone sutures were used for the anastomosis. The operative findings and postoperative course are described in **Table 2**.

The mean drain output (108 mL vs 175 mL), drain tube retention (2.8 days vs 4.2 days), and duration of hospitalization (2.7 days vs 4.6 days) were significantly less in the continuous suturing group compared with the interrupted suture group **(Table 2)**. The overall cost of the procedure was reduced among the continuous suturing group (mean 59 530 Indian rupees [1101 USD] vs 55 760 Indian rupees [1031 USD]; $P < .001$).

The complication rate was 15.38% in the interrupted suturing group and 7.14% in the continuous suturing group **(Tables 3** and **4)**. Two patients in the interrupted suturing group had stent malfunction. In one patient, the end of the stent extruded through the suture line, and in the other patient the stent came out during removal of the urethral catheter. In the first patient, the stent was replaced, but the patient developed a stricture and underwent an open re-pyeloplasty. In the other patient, stent replacement was also done, and there was also an unfavorable outcome. This patient preferred to have the stent in the long term. Fungal pyelonephritis developed in one patient in the continuous suturing group; he was both obese and diabetic. He had extravasation and prolonged ileus, which resulted in partial anastomotic disruption and he required an open re-pyeloplasty. One child in the continuous suturing group had omental protrusion through the drain site after drain removal, which required reduction under anesthesia.

The mean duration of follow-up was 78 months (range, 156 months to 6 months). Overall, 5 patients had failure of pyeloplasty. Among them, 3 patients were in the interrupted suturing group and 2 were in the continuous suturing group. Among the 3 failed pyeloplasties in the

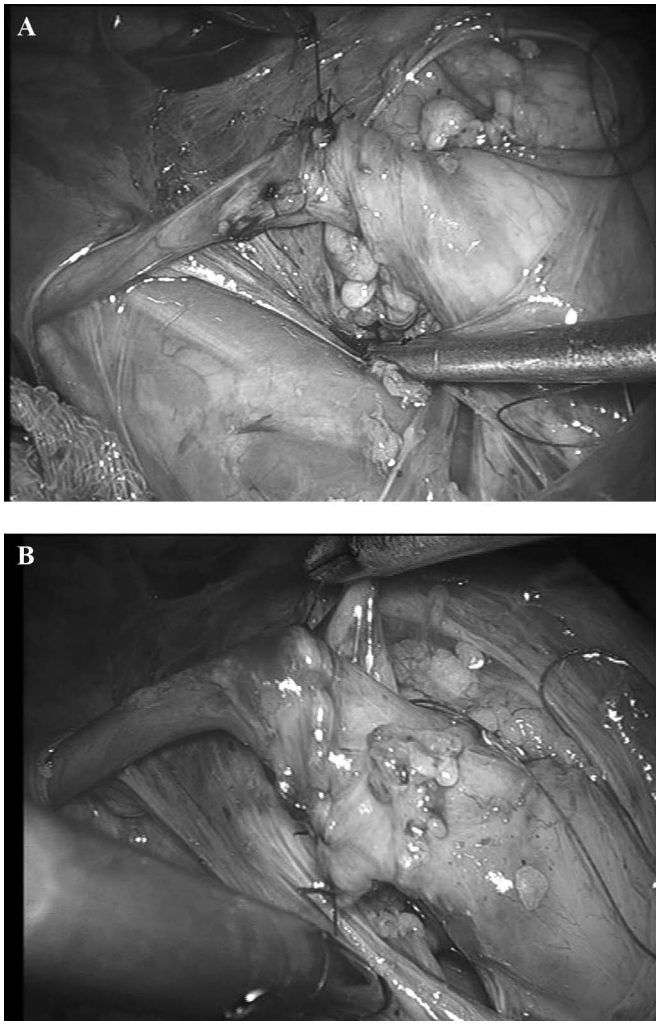


**Figure 4.** A, Completed posterior layer continuous sutures. B, Completed anterior layer continuous sutures.

interrupted suturing group, one patient preferred repeated long-term ureteric stenting and 1 patient underwent open re-pyeloplasty. One 3-year-old child who had gross hydronephrosis with a GFR of 15 mL/min had deterioration of GFR (3 mL/min) over 2 years after pyeloplasty. He had recurrent episodes of UTI and hence nephrectomy was done. Among the 2 failed pyeloplasty in continuous suturing group, 1 had laparoscopic redo pyeloplasty and 1 patient had open redo pyeloplasty.

## DISCUSSION

Laparoscopic pyeloplasty is becoming the gold standard for UPJ obstruction. Pyeloplasty comprises most of the laparoscopic procedures done at our center (22% of all the laparoscopic urological procedures performed at our center).

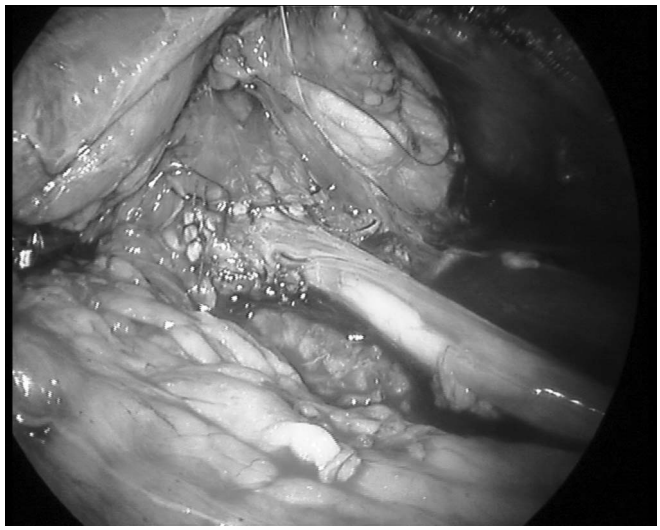

**Figure 5.** Completed interrupted sutures.

Suturing is the most time-consuming step of any laparoscopic reconstructive procedure. Continuous and interrupted suturing techniques are used for laparoscopic pyeloplasty.[3,4] We use freehand suturing for laparoscopic pyeloplasty. For the initial 65 patients (60%), interrupted sutures with intracorporeal knotting were used (interrupted suturing group), and for the subsequent 42 patients (40%), continuous sutures using polydioxanone (nonbraided suture) were used (continuous suturing group).

The effect of continuous and interrupted sutures with regards to tissue vascularity and collagen damage is controversial.[6–8,10,11] Most of the experimental studies were done in laboratory animals and mainly involved bowel anastomoses. Sarin et al concluded that there was no significant increase in the incidence of leak or tissue damage with continuous sutures, although previous reports suggest that there can be vascular compromise with continuous suturing.[10] Continuous sutures may also cause deficiencies in collagen regeneration.[8] Margo et al compared continuous and interrupted suturing techniques for ureteroneocystostomy in cats and inferred that continuous suturing causes more tissue ischemia and necrosis.[6]

Kass et al have suggested using interrupted sutures, especially for pyeloplasty in infants, to prevent the purse-string effect.[7] Another difficulty with using continuous sutures in laparoscopy is maintaining appropriate tension during the procedure. When the continuous sutures are not tight enough, leakage may occur. When braided polyglactin

**Table 1.**
Patient Demographic Characters and Preoperative GFR

| | Interrupted Suturing Group | Continuous Suturing Group |
|---|---|---|
| Number | 65 | 42 |
| Age | 4 mo to 67 y (mean, 28.3 y) | 4 mo to 68 y (mean, 26.8 y) |
| Sex (M/F) | 1.24:1 | 1.5:1 |
| Side (right/left) | 36/29 | 24/28 |
| Mean GFR of obstructed kidney (mL/min) | 29.7 | 33.5 |

**Table 2.**
Operative and Postoperative Details

| | Interrupted | Continuous | *P* Value |
|---|---|---|---|
| Mean operative time (min) | 219 | 186 | <.001 |
| Mean suturing time (min) | 64 | 55 | <.001 |
| Duration of postop drainage (d) | 4.2 | 2.8 | <.001 |
| Mean drain output (mL) | 175 (70–280) | 108 (30–108) | <.001 |
| Postop hospital stay (d) | 4.6 | 2.7 | <.001 |
| Postop mean GFR (mL/min) | 34.7 | 36.1 | NS |
| Failure rate | 4.61% | 4.76% | NS |
| Improvement in GFR (mL/min) | 4.76 | 4.65 | NS |
| Cost of procedure (in USD) | 1101 | 1031 | <.001 |

**Table 3.**
Complications

| | Interrupted Suturing Group | Continuous Suturing Group |
|---|---|---|
| UTI | 4 | 2 |
| Extravasation (prolonged drainage) | 2 | 0 |
| Stent malposition | 2 | 0 |
| Prolonged ileus (>2 d) | 2 | 0 |
| Drain site/port site hernia | 0 | 1 |
| Total | 10/65 (15.38%) | 3/42 (7.14%) |

UTI = urinary tract infection.

sutures are used for continuous suturing, tightening of the suture after 3 or 4 continuous sutures may become difficult. The memory of nonbraided sutures can sometimes be a hindrance, but the advantage is that the sutures could be appropriately tightened at any stage.

Haudart et al studied continuous and interrupted sutures in bowel anastomosis and concluded that there is no difference in the leak rate between the 2 types of anastomosis.[11] Bruch et al reported that single-layer continuous suturing could be accomplished in bowels in less time and at a lower cost.[12]

In a study on porcine models, Leiber et al concluded that interrupted sutures were more often associated with extensive muscular fibrosis compared with continuous suturing.[13] The improvement in GFR among patients in the interrupted suturing group was 4.6 mL/min and in the continuous suturing group was 4.7 mL/min. The difference was not statistically significant.

**Table 4.**
Complications Grading (Clavien–Dindo Classification)

| Grade | Interrupted | Continuous |
|---|---|---|
| 1 | 2 | 0 |
| 2 | 4 | 2 |
| 3 | 4 | 1 |
| 4 | 0 | 0 |
| 5 | 0 | 0 |

However, reports of large studies of laparoscopic pyeloplasty by Rassweiler et al[5] and Teber et al,[14] wherein continuous sutures have been used, show comparable outcomes and complication rates.

Recently, barbed sutures have been used for pyeloplasty. In vivo studies indicate that the suturing time is not significantly different between standard suturing and self-retaining barbed sutures.[15] Self-retaining barbed sutures are more frequently used for vesicourethral anastomosis during laparoscopic radical prostatectomy.[16]

The mean suturing time was considerably reduced using continuous sutures, from 64 minutes (range, 55–80) to 55 minutes (range, 50–65) ($P < .001$). Papalia et al and Shao et al have also mentioned similar findings in a study comparing interrupted and continuous sutures.[3,4] However, Papalia et al mentioned that the reduction in operative time was related to the combined use of continuous suture and retrograde stenting. Drain volume and its relation to the continuous or interrupted suture were not studied. In our study, all patients had antegrade stenting.

There are fallacies when we estimate the time taken for the procedure and suturing. If a large redundant pelvis needs to be sutured, the time taken would be longer. The presence of secondary calculi may also prolong the procedure. The time taken for stenting may also vary from patient to patient. The transmesocolic approach to the UPJ would also reduce the overall operative time.[9] Recently, a few reports of robot-assisted pyeloplasty have been published and show no difference in all the parameters, even though suturing may be easier.[17,18]

The volume of drainage was significantly less in the continuous suturing group, and hence the drain tube was retained for a shorter period (mean, 2.8 days for the continuous suturing group vs 4.2 days for the interrupted suturing group, $P < .001$). This may be caused by less leakage from the suture line with the use of continuous sutures. Reduced drain output also had an impact on the duration of hospitalization (2.7 days vs 4.6 days in favor of continuous sutures; $P < .001$), because many of the patients preferred to be discharged after the drain was removed. The overall cost of the procedure was less among the continuous suturing group patients (mean, 59 530 Indian rupees or 1101 USD vs 55 760 Indian rupees or 1031 USD; $P < .001$). The reduced overall cost of the surgery for the continuous suturing group patients may be attributed to the reduced duration of surgery and hospitalization and fewer complications.

Shao et al[3] mention that the incidence of urine leak was negligible in the continuous suturing group. However, the mean hospital stay was 6 days in their study vs a mean stay of 2.7 days in the continuous suturing group in our study. Similarly, Papalia et al[4] mention that one patient had a significant leak in the continuous suturing group. However, no comparison was made between the volume of drainage output and its impact on the hospital stay, as in our study. The urinary leak and drain output are more relevant to the transperitoneal approach than the retroperitoneal approach. In the study by Shao et al, all of the patients were operated by the retroperitoneoscopic route.

There may be bias in this study related to the learning curve. However, all of the procedures were done by a single surgeon with 3 years of laparoscopic suturing experience. Thus, the influence of the learning curve may not be significant. Another consideration is that it is a retrospective study, with its own limitations.

## CONCLUSION

Ureteropelvic anastomosis using the continuous suturing technique has a comparable success rate with that using interrupted suturing. The time taken for suturing, postoperative drain output, and duration of drainage were lower, hence the duration of hospitalization was significantly less with continuous suturing. This reduced the overall cost of the procedure. Continuous suturing may be preferred to interrupted suturing for ureteropelvic anastomosis in patients undergoing laparoscopic pyeloplasty.

**References:**

1. Schuessler WW, Grune MT, Tecuanhuey LV, Preminger GM. Laparoscopic dismembered pyeloplasty. *J Urol.* 1993;150(6): 1795–1799.

2. Arvind NK, Singh O, Gupta SS. Laparoscopic pyeloplasty: an analysis of first 100 cases and important lessons learned. *Int Urol Nephrol.* 2011;43:85–90.

3. Shao P, Qin C, Ju X, et al. Comparison of two different suture methods in laparoscopic dismembered pyeloplasty. *Urol Int.* 2011;87:304–308.

4. Papalia R, Simone G, Leonardo C, et al. Retrograde placement of ureteral stent and ureteropelvic anastomosis with two running sutures in transperitoneal laparoscopic pyeloplasty: tips of success in our learning curve. *J Endourol.* 2009;23(5):847–852.

5. Rassweiler JJ, Teber D, Frede T. Complications of laparoscopic pyeloplasty. *World J Urol.* 2008;26(6):539–547.

6. Mehl ML, Kyles AE, Pollard R, et al. Comparison of 3 techniques for ureteroneocystostomy in cats. *Vet Surg.* 2005;34(2): 114–119.

7. Kass EJ, Feber K. Pyeloplasty. In: Graham SD, Keane TE, editors. *Glenn's Urologic Surgery.* 7th ed. St. Louis, MO: Wolters Kluwer Health; 2010: 648.

8. Jiborn H, Ahonen J, Zederfeldt B. Healing of experimental colonic anastomoses. The effect of suture technique on collagen concentration in the colonic wall. *Am J Surg.* 1978;135(3):333–340.

9. Ramalingam M, Selvarajan K, Senthil K, Pai MG. Transmesocolic approach to laparoscopic pyeloplasty: our 8-year experience. *J Laparoendosc Adv Surg Tech A.* 2008;18(2):194–198.

10. Sarin S, Lightwood RG. Continuous single-layer gastrointestinal anastomosis: a prospective audit. *Br J Surg.* 1989;76(5):493–495.

11. Houdart R, Lavergne A, Galian A, Hautefeuille P. Anatomo-pathological evolution of single-layer end-to-end digestive anastomoses. A study of 210 colonic anastomoses in rats from the 2d to the 180th day. *Gastroenterol Clin Biol.* 1983;7(5):465–473.

12. Burch JM, Franciose RJ, Moore EE, Biffl WL, Offner PJ. Single-layer continuous versus two-layer interrupted intestinal anastomosis—a prospective randomized trial. *Ann Surg.* 2000; 231(6):832–837.

13. Lieber D, Tran V, Belani J, et al. Comparison of running and interrupted vesicourethral anastomoses in a porcine model. *J Endourol.* 2005;19(9):1109–1113.

14. Teber D, Guven S, Yaycioglu O, et al. Single-knot running suture anastomosis (one-knot pyeloplasty) for laparoscopic dismembered pyeloplasty: training model on a porcine bladder and clinical results. *Int Urol Nephrol.* 2010;42:609–614.

15. Weld KJ, Ames CD, Hruby G, Humphrey PA, Landman J. Evaluation of a novel knotless self-anchoring suture material for urinary tract reconstruction. *Urology.* 2006;67(6):1133–1137.

16. Williams SB, Alemozaffar M, Lei Y, et al. Randomized controlled trial of barbed polyglyconate versus polyglactin suture for robot-assisted laparoscopic prostatectomy anastomosis: technique and outcomes. *Eur Urol.* 2010;58(6):875–881.

17. Mufarrij PW, Woods M, Shah OD, et al. Robotic dismembered pyeloplasty: a 6-year, multi-institutional experience. *J Urol.* 2008; 180(4):1391–1396.

18. Sivaraman A, Leveillee RJ, Patel MB, et al. Robot-assisted laparoscopic dismembered pyeloplasty for ureteropelvic junction obstruction: a multi-institutional experience. *Urology.* 2012; 79(2):351–355.