Percutaneous endopyeloplasty: current clinical status

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INTRODUCTION

The search of the ideal minimally invasive treatment option for PUJ obstruction (PUJO) is ongoing. Over the past two decades there has been widespread use of endopyelotomy for managing selected patients with PUJO. Endopyelotomy, based on the principle of the intubated ureterotomy, is associated with a 10–15% failure rate [1]. This is clearly inferior to the standard open pyeloplasty, which has a long-term success rate of >95%. Also, the failure rate of endopyelotomy may be even higher in patients with severe hydronephrosis, poor renal function, associated crossing vessel, or failed previous endourological intervention [2,3]. Recently, at selected centres, laparoscopic pyeloplasty is giving high success rates and low morbidity [4]. However, the training and experience associated with intracorporeal laparoscopic suturing has limited laparoscopic pyeloplasty to centres experienced with intracorporeal suturing. Percutaneous endopyeloplasty essentially consists of horizontal suturing of a standard vertical endopyelotomy incision through a percutaneous renal tract via a nephroscope. Percutaneous intrarenal suturing was initially described by Oshinsky *et al.* [5] but technical difficulty with their technique resulted in discontinued use by the authors. Our technique of percutaneous endopyeloplasty incorporates the use of a novel laparoscopic suturing device (SewRight SR5, LSI Solutions, Victor, NY) that was modified to enable use through the working channel of a 26 F nephroscope (Karl Storz, Culver City, CA) that allows for precise intrarenal suturing [6,7].

TECHNIQUE

The SewRite SR5 is a 5-mm laparoscopic suturing instrument used for placing interrupted sutures (Fig. 1). The laparoscopic device was modified in length and diameter to enable its use through the working channel of a 26 F nephroscope.

STEP 1

Retrograde ureteric access is obtained cystoscopically by placing a 6 F open-ended ureteric catheter into the pelvicalyceal system.

STEP 2

Percutaneous renal access is obtained in a standard fashion through an upper or midpole calyx, which provides direct access to the PUJ. A 30 F Amplatz sheath is positioned within the renal pelvis.

STEP 4

A conventional, laterally placed, full-thickness endopyelotomy incision is made using cutting current and a Bugbee electrode (Fig. 2). The incision is made across the stricture segment and extends for ≈1 cm into the normal ureter distally and normal pelvis proximally. Care is taken to ensure a clean and sharp cut, and to avoid ragged edges, to facilitate subsequent endopyeloplasty suturing.

STEP 5

Mobilizing the distal ureteric lip is a crucial step in preparing for endopyeloplasty suturing (Fig. 2). The peri-ureteric fibro-areolar tissue is carefully dissected away from the incised ureteric margin and the adjacent un-incised ureter. This manoeuvre is done carefully under vision using a 5-mm laparoscopic Endoshears [United States Surgical Corporation (USSC), Norwalk, CT]. Recently, we have used the 3 mm MicroEndoshears (USSC), which enables even more precise dissection. Care is taken not to excessively thin out the ureteric wall during this step. The entire dissection is done ‘cold’, with no cautery. Only specific spot coagulation of bleeding points is carried out as required. Occasionally there may be a significant sized vessel, which can be gently dissected away from the ureteric wall. This critical step serves three important purposes: first, it provides space for the suturing device while placing the distal bites; second, it defines the distal ureteric lip, enabling precise full-thickness suturing; and third, it releases tension on the horizontal suture line.

STEP 5

The loaded SewRight SR5 is passed through the working channel of the 26 F nephroscope; the initial suture approximates the distal and proximal angles of the endopyelotomy incision, thereby dividing the horizontal suture-line into halves (Fig. 3A–C). Additional sutures are placed on either side of the initial suture to complete the procedure (Fig. 4). The number of sutures depends upon the length of the endopyelotomy incision; typically, three are required, one on either side of the initial suture, but 1–4 sutures may be placed in the individual case.

STEP 6

After obtaining precise mucosa-to-mucosa coaptation, a JJ ureteric stent is placed antegradely and a 20 F nephrostomy tube placed.

EXPERIMENTAL DATA

We assessed the feasibility and efficacy of percutaneous endopyeloplasty in a chronic porcine bilateral PUJO model, and compared outcome data with conventional endopyelotomy and laparoscopic pyeloplasty [6]. Partial PUJO was created successfully in 20 kidneys (11 pigs) by laparoscopic ligation of the upper ureter over a 5 F ureteric catheter. Subsequently, after the development of hydronephrosis over 4–6 weeks, percutaneous endopyeloplasty (in 10), conventional percutaneous endopyelotomy (in 5) or laparoscopic pyeloplasty (in 5) were performed. Percutaneous endopyeloplasty was technically successful in all 10 kidneys, with a mean (range) total operative duration of 81.4 (51–117) min. The mean endopyeloplasty suturing time was 29.4 (20–64) min. Three kidneys required two sutures and seven

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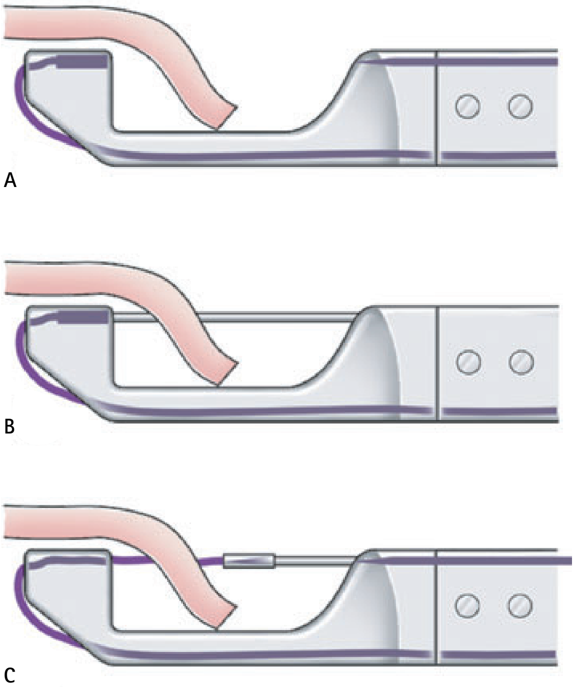


FIG. 1. The instrument is positioned such that the edge of the tissue to be sutured is brought into the trough on the instrument tip (top). Squeezing the handle pushes the needle, which pierces the tissue and locks into the metal ferrule (middle). When the handle is released, the needle retracts into its resting position thereby pulling one end of the suture through the tissue (bottom). The lever is switched to activate the other needle and the suture is passed through the other tissue edge to be sutured.

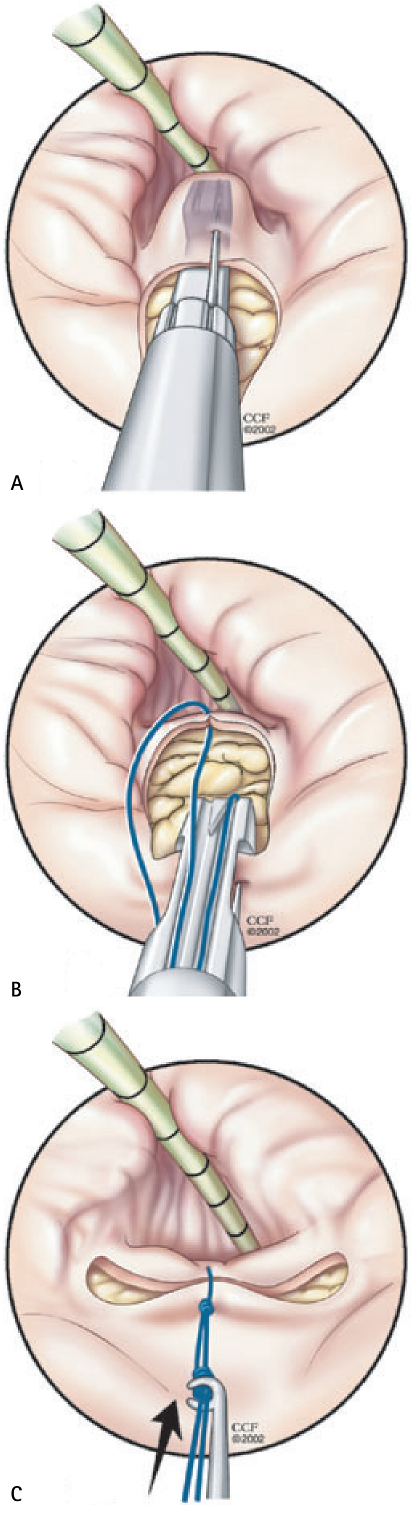
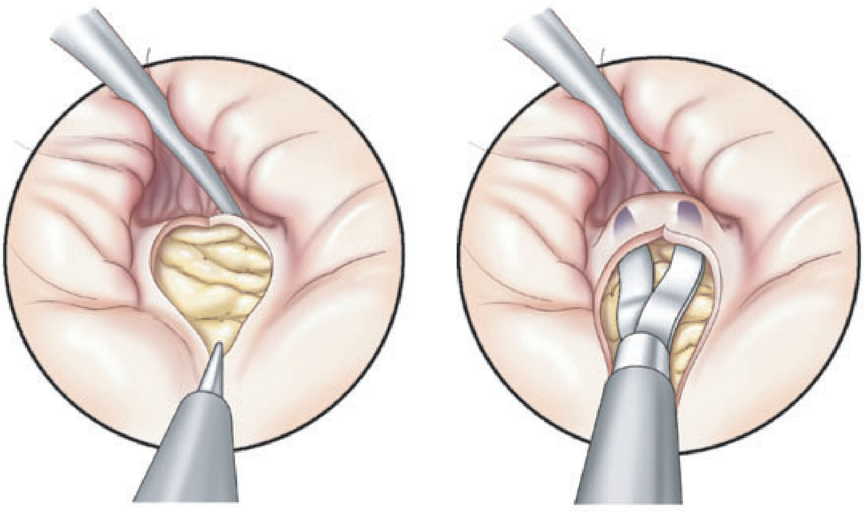


FIG. 3. (A–C) Placing the first suture during an endopyeloplasty. The initial suture approximates the proximal and distal angle of the endopyelotomy incision, thereby dividing the incision into halves.

FIG. 2. Percutaneous renal access is obtained through a suitable upper or middle calyx. A laterally orientated full-thickness endopyelotomy incision is made using a Bugbee electrode and cutting current. The distal ureteric margin is mobilized using a 5-mm micro-endoshears. The extraluminal aspect of the ureter is dissected by a combination of sharp and blunt dissection, with minimal use of electrocautery and preserving a reasonable amount of peri-ureteric tissue. This is important to prevent excessive thinning of the ureter and thereby risk cutting through of the sutures. This step serves two purposes. First, it creates adequate space for passage of the suturing device, and second it releases tension on the suture-line.



required three sutures to complete the endopyeloplasty. The only complication was a lower-pole infundibular stenosis. Over a mean follow-up of 7.7 weeks, all renal units were relieved of obstruction, as shown by regression of hydronephrosis, improvement in the half-time and GFR on diuretic renal scan, and a low intrapelvic pressure on the Whitaker test. At autopsy, the endopyeloplasty site showed a fine, well-healed transverse scar with no evidence of residual suture on the mucosal surface. The

FIG. 4. (A) A diagrammatic and (B) a nephroscopic view of a completed endopyeloplasty. Typically, two additional sutures are placed on either side of the initial suture, providing precise mucosa-to-mucosa approximation.

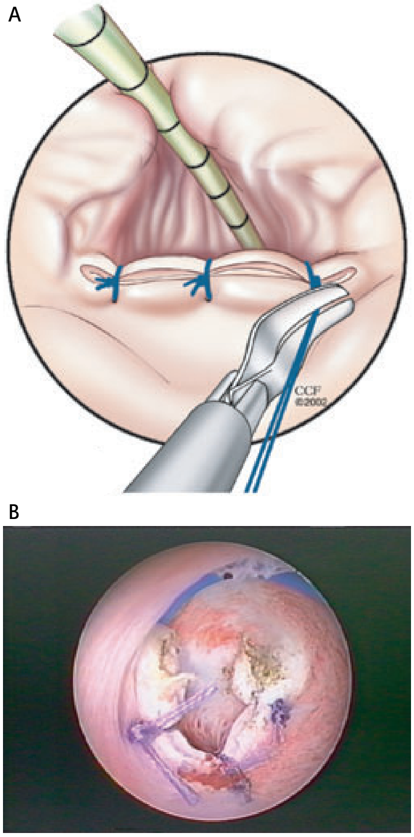
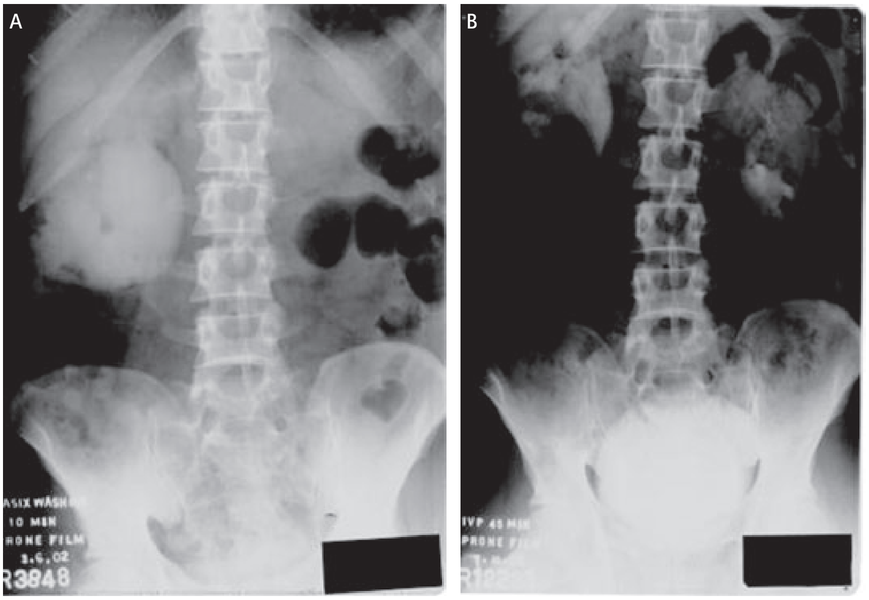


Fig. 5. (A): Preoperative IVU shows right PUJO (B) Follow-up IVU at 3 months after endopyeloplasty; on the right side there is a significant reduction in hydronephrosis, funnelling and wider calibre of the PUJ, and prompt drainage of contrast medium.



mean (SD) calibre of the PUJ after endopyeloplasty, at 13.8 (2.2) F, was significantly greater ($P = 0.01$) than that after conventional endopyelotomy, at 7.5 (1.9) F. Intraoperative extravasation on completing endopyeloplasty was absent in six or mild in four, compared with significant extravasation in all five kidneys after conventional endopyelotomy. Thus, this detailed animal study showed that endopyeloplasty is technically straightforward and reproducible, with primary intention full-thickness healing, and creates a wider calibre PUJ than conventional endopyelotomy. Also, in contrast to endopyelotomy, the meticulously sutured endopyeloplasty was associated with no or minimal contrast extravasation on an antegrade contrast study during surgery and immediately after suturing. Given the known detrimental effect of urinary extravasation on ureteric healing [8], these findings suggest that endopyeloplasty may provide an optimum environment for full-thickness primary intention healing of the reconstructed PUJ. Thus, this animal experiment provided evidence for a possible functional advantage of endopyeloplasty over endopyelotomy in the surgical treatment of PUJO.

CLINICAL DATA

Since our initial clinical report [7] we have now used percutaneous endopyeloplasty in 32 patients with primary PUJO. Inclusion criteria included short (<1 cm) segment stenosis, absence of crossing vessel on preoperative imaging, and no previous surgery on the PUJ. The mean age of the group was 27.5 years; hydronephrosis was mild in three, moderate in 19 and severe in 10 patients, with a high insertion of the PUJ in 11 and in one there was a crossing vessel on preoperative imaging. Success was defined as the absence of pain and improvement of drainage on IVU and/or diuretic renal scan. Percutaneous endopyeloplasty was technically successful in 32 patients. The mean operative duration was 106.3 min and the time for suturing 29.7 min. Endopyeloplasty involved placing one suture in two patients, two in three, three in 22, four in four and five in one patient. Intraoperative complications included irrigant extravasation in one and suture cut-through in one patient. Complications after surgery included pyrexia requiring prolonged JJ ureteric stenting in three patients. The follow-up was >2 years in nine patients, 1–2 years in seven, >6 months in five and <6 months in 11, with a mean (range) of 14.1 (1–27) months. All 32 patients remain symptom-free and show improved drainage on IVU (Fig. 5) and/or diuretic renal scan (mean half-time 9.6 min, mean improvement in renal function 12%).

COMPARISON WITH ENDOPYELOTOMY AND LAPAROSCOPIC PYELOPLASTY

We reported our intermediate term (1-year) results for endopyeloplasty and retrospectively compared it with endopyelotomy and laparoscopic pyeloplasty in 44 patients with primary PUJO [9]. At two institutions, 44 consecutive, unrandomized patients with primary PUJO had either percutaneous endopyeloplasty (15, group 1), percutaneous endopyelotomy (15, group 2) or laparoscopic dismembered pyeloplasty (14, group 3). The inclusion criteria were a short segment (<1 cm) stenosis, no previous surgery for PUJO, and no crossing vessel in groups 1 and 2. The mean age in the three groups was 30.3, 38.6 and 38.9 years, and duration of symptoms 5.5, 6 and 6.6 months, respectively. Success was evaluated from symptoms, IVU and/or diuretic renography. The mean operative duration was 119, 52 and 243 min in groups 1–3, respectively ($P < 0.001$). Complications occurred in three patients in group 1 (fever in two, fluid extravasation in one), two in group 2 (one each bleeding and urinoma) and none in group 3. The duration of JJ stenting was 2, 6 and 4 weeks in groups 1–3, respectively. There was resolution of symptoms and unobstructed drainage on IVU and/or diuretic renography in all patients in group 1 (mean follow-up 11.6 months), 14 and 13 in group 2 (mean follow-up 31.4 months), and 13 and all in group 3 (mean follow-up 20 months).

FUTURE DIRECTIONS

We recently reported the initial technical feasibility of a completely dismembered endopyeloplasty in an animal model [10], which may further increase the role of percutaneous intrarenal reconstructive surgery. Also, further refinements in design of the suturing device and development of a finer suture are underway.

CONCLUSIONS

Percutaneous endopyeloplasty is technically feasible and safe. The animal data suggest functional superiority over endopyelotomy in the treatment of PUJO. Our limited initial clinical experience with percutaneous endopyeloplasty is encouraging. However, these preliminary data need to be validated by further studies from more centres in more patients and with a longer follow-up. With further refinement in technology, percutaneous intrarenal reconstructive surgery may expand in scope and application.

REFERENCES

1 **Motola JA, Badlani GH, Smith AD.** Results of 212 consecutive endopyelotomies: an 8 year follow-up. *J Urol* 1993; **149**: 453–6
2 **Van Cangh PJ, Wilmart JF, Opsomer RJ, Abi-Aad A, Wese FX, Lovge F.** Long term results and late recurrence after endoreteropyelotomy: a critical analysis of prognostic factors. *J Urol* 1994; **151**: 934–7
3 **Gupta M, Tuncay OL, Smith AD.** Open surgical exploration after failed endopyelotomy: a 12 year perspective. *J Urol* 1997; **157**: 1613–8
4 **Bauer JJ, Bischoff JT, Moore RG, Chen RN, Iverson AJ, Kavoussi LR.** Laparoscopic versus open pyeloplasty: assessment of objective and subjective outcome. *J Urol* 1999; **162**: 692–5
5 **Oshinsky GS, Jarrett TW, Smith AD.** New technique of managing ureteropelvic junction obstruction: percutaneous endoscopic pyeloplasty. *J Endourol* 1996; **10**: 147–51
6 **Desai MM, Gill IS, Carvalhal EF *et al.*** Percutaneous endopyeloplasty: a novel technique. *J Endourol* 2002; **16**: 431–43
7 **Gill IS, Desai MM, Kaouk JH, Wani K, Desai MR.** Percutaneous endopyeloplasty: description of a new technique. *J Urol* 2002; **168**: 2097–102
8 **Andreoni C, Lin HK, Olweny E, Ovrby A, Landman J, Clayman RV.** Evaluation of healing after electrosurgical endopyelotomy in a porcine model. *J Endourol* 2000; **15** (Suppl): A13
9 **Desai MM, Gill IS, Desai MR.** Endopyeloplasty versus endopyelotomy versus laparoscopic pyeloplasty for primary ureteropelvic junction obstruction. *Urology* 2005; in press
10 **Sharp DS, Desai MM, Molina WR *et al.*** Dismembered percutaneous endopyeloplasty: a new procedure. *J Endourol* 2005; in press

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Abbreviation: **PUJO**, PUJ, obstruction.

