

TECHNIQUE OF PERCUTANEOUS ENDOPYELOTOMY

MATTHEW T. GETTMAN, JOSEPH W. SEGURA

Department of Urology, Mayo Clinic, Rochester, Minnesota, USA

ABSTRACT

Percutaneous endopyelotomy is an effective treatment for patients with ureteropelvic junction obstruction. This report describes the clinical presentation and preoperative evaluation for a patient with a UPJ obstruction. We describe the technical aspects of antegrade endopyelotomy in detail. The controversies regarding surgical technique and contraindications to treatment are presented. With percutaneous endopyelotomy, patients can expect up to a 90% success rate with little morbidity and minor disability.

Key words: ureteropelvic junction, stenosis, endopyelotomy, percutaneous surgery
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INTRODUCTION

Since the introduction of percutaneous techniques initially for the treatment of stones, the management of ureteropelvic junction (UPJ) obstruction has radically changed. Dismembered pyeloplasty remains the gold standard for treatment of UPJ obstruction, however minimally invasive procedures in the properly selected patient can provide excellent success rates with little patient morbidity. In comparison to other endoscopic treatments for UPJ obstruction, percutaneous endopyelotomy has consistently achieved success rates closest to those observed with open procedures (1-4). Patient selection, however, is paramount to the success of any treatment for UPJ obstruction (5). In this report we address patient selection, surgical technique, possible complications, success rates, and controversies associated with percutaneous pyelotomy.

The clinical presentation for patients with UPJ obstruction is varied. Classically, patients with UPJ obstruction present with flank pain often exacerbated by increased fluid intake and evidence of obstruction on excretory urogram. In this situation, we proceed to definitive treatment without additional

investigation. For less straightforward cases, we recommend additional testing that can include diuretic renograms, diuretic urograms, or Whitaker pressure-perfusion tests. Retrograde pyelography is sometimes obtained as the initial imaging test for patients with contrast allergies. In other instances, retrograde pyelography is completed as a confirmatory test prior to definitive treatment. We do not routinely assess patients with a primary UPJ obstruction for presence of crossing vessels. We do carefully review the imaging studies and laboratory reports for other abnormalities such as marked hydronephrosis and poor renal function as these factors can influence treatment outcome (1).

Other considerations, besides high-grade hydronephrosis and poor renal function, can also influence treatment of UPJ obstruction with percutaneous endopyelotomy. Long avascular strictures, total obliteration of the UPJ, and severe periureteral fibrosis are contraindications not only for percutaneous endopyelotomy but also for other endourologic techniques (6). Other contraindications include an uncorrected bleeding diathesis or untreated urinary tract infection. Patient age is not a contraindication to treatment, although the patient must be

a suitable candidate for either regional or general anesthesia. Patient size also does not preclude use of the procedure, however percutaneous endopyelotomy is less frequently used in the pediatric age group for treatment of a primary UPJ obstruction. Body habitus should be evaluated; the patient's anatomy should be such that percutaneous access is practical and safe. Furthermore, while presence of a horseshoe kidney may not preclude an attempt at antegrade endopyelotomy, (7) presence of a UPJ obstruction in other types of anomalous kidneys is sometimes best treated with open techniques. In fact, little information currently exists regarding use of any endourologic techniques for treatment of a patient with a UPJ obstruction in a duplicated or ectopic kidney (8). Use of antegrade endopyelotomy for patients with a secondary UPJ obstruction is also not a contraindication, but details of the previous procedure should be carefully reviewed prior to repeat surgery. Indeed, treatment of secondary UPJ obstruction has been associated with success rates at least equal to those observed with primary UPJ obstruction in prior reports (9).

Clinical history and results of imaging ultimately guide selection of the ideal patient for percutaneous endopyelotomy. In our experience, we believe percutaneous endopyelotomy is the best treatment when the UPJ is relatively dependent and no gross anatomic abnormalities are present (5).

SURGICAL TECHNIQUE

Percutaneous Access

Percutaneous endopyelotomy is completed with the patient in the prone position. To minimize risk of infection, all patients are given intravenous antibiotics prior to the procedure. Percutaneous access to the renal pelvis is completed optimally through an upper pole or middle pole calyx to aid visualization of the UPJ. After obtaining access, a wire is placed in antegrade fashion under fluoroscopic guidance across the UPJ obstruction, down the ureter, and into the bladder. Alternatively, in situations where antegrade guidewire placement is difficult, a guidewire can initially be placed in retrograde fashion. The guidewire, placed in retrograde

fashion, is then ultimately exchanged for a percutaneous wire after dilation of the percutaneous tract.

Placement of a guidewire across the UPJ obstruction is of critical importance since direct endoscopic vision of the renal pelvis is often unreliable to identify a pinpoint UPJ that not uncommonly is in an aberrant position. The percutaneous tract is dilated to 28-F in preparation for nephroscopic examination of the renal pelvis. During nephroscopic examination, the UPJ obstruction is inspected and all blood clots are removed. If any stones are present, they are removed prior to incision of the UPJ obstruction. If the guidewire was placed initially in retrograde fashion, this wire is grasped with the forceps and pulled through the nephroscope sheath. The wire is pulled out only a sufficient distance to allow placement of an open-ended catheter over the wire, across the UPJ, and down the ureter so that the open-ended catheter extends from above the nephroscope sheath to about the midureteral position. The original wire is then removed, and a new relatively rigid wire is passed down the catheter through the ureter and into the bladder. The wire that we prefer is a Lunderquist-Ring 0.038 torque wire. Since the endopyelotomy is completed over this wire, careful attention should be undertaken to prevent the wire from bending or kinking. In addition, the wire should be positioned well into the bladder so that a double-J stent is easily placed after endopyelotomy.

Endopyelotomy

At our institution, the endopyelotomy is completed with the cold cutting knife. This endopyelotomy knife is commercially available from Richard Wolf, Inc. and is designed for use in conjunction with standard nephroscopy equipment. While the endopyelotomy knives are sharp when they arrive from the supplier, we recommend that the knives be sharpened in the hospital machine shop prior to each use. The endopyelotomy knife is passed over the working wire and is seen under direct vision through the percutaneous nephroscope (Figure-1).

Before proceeding with the incision it is important to determine if the UPJ is wide enough to accommodate the knife. If the UPJ is not wide enough to accept the knife, the UPJ is balloon-dilated so the

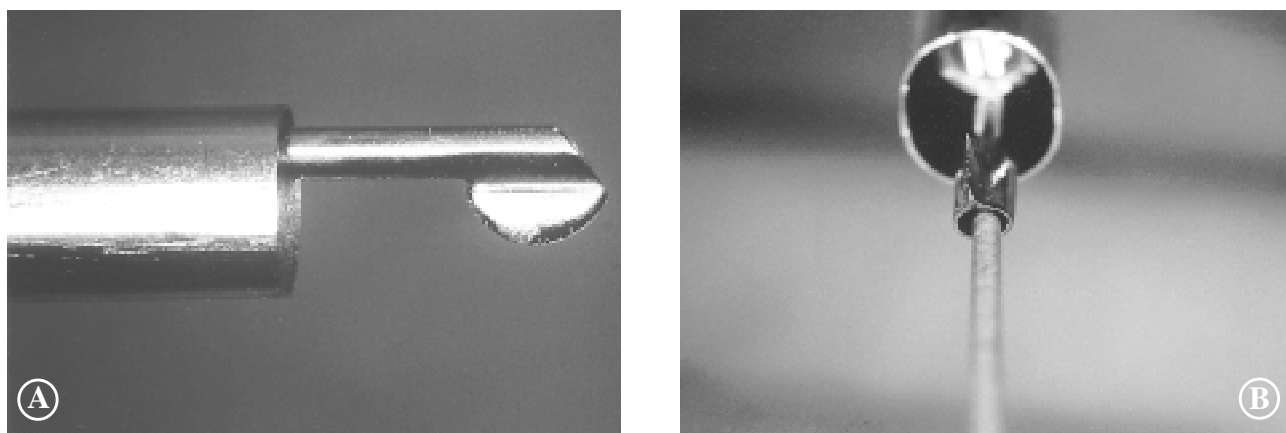


Figure 1 – A) Side view of commercially available endopyelotomy knife.
 B) The endopyelotomy knife is passed over the guidewire and used under direct vision.

knife can easily be passed through the UPJ. Gentle dilation of the UPJ in this situation is critical so that ultimately the knife cuts the UPJ smoothly rather than pushing the UPJ away. To decrease the likelihood of tearing the UPJ during dilation, a 12F ureteral dilation balloon is used rather than the larger 15F to 18F dilation balloons.

Placement of the endopyelotomy knife is then completed to allow incision of the UPJ in the due-lateral position. The lateral position is determined by orienting the knife to the lateral position of the patient's flank while referencing the position of the kidney on the excretory urogram or CT scan. The orientation of the cut is relatively easy to complete; however, in situations where the kidney is malrotated the orientation of the cut can be more challenging. The cut should also be made cautiously in patients that have previously undergone a failed UPJ repair. In this situation the vascular supply of the kidney relative to the UPJ may have changed. For example, if a patient previously underwent a dismembered pyeloplasty, the vessels are usually transposed posterior to the UPJ and the new cut should be made anteriorly.

After proper orientation, the knife is engaged under direct vision along the curve of the guidewire to allow a smooth, clean cut (Figure-2). Not uncommonly the guidewire will straighten as the cut is made. The incision should extend down the ureter at least one centimeter beyond the area of UPJ obstruction and should be continued laterally up into the renal

pelvis an additional one or two centimeters. By performing the incision under direct vision, the operator can identify the exact location and depth of the cut. In addition, extrapelvic structures such as aberrant vessels, often visualized by pulsation, can be identified and avoided. If significant bleeding is encountered at the time of the incision, allowing clot to form in the renal pelvis with subsequent vascular tamponade, typically controls hemorrhage. If arterial bleeding were to persist despite these measures, embolization may be required.

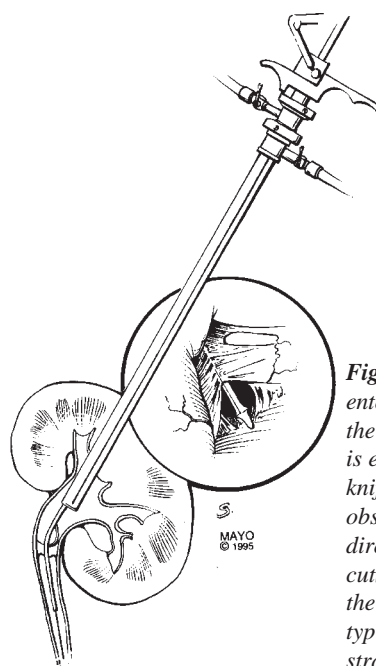


Figure 2 – The nephroscope enters the kidney through the upper pole and the UPJ is easily visualized. The knife will incise the UPJ obstruction laterally under direct vision. As the knife cuts the UPJ, the curve of the wire is followed and typically the wire is straightened in the process.

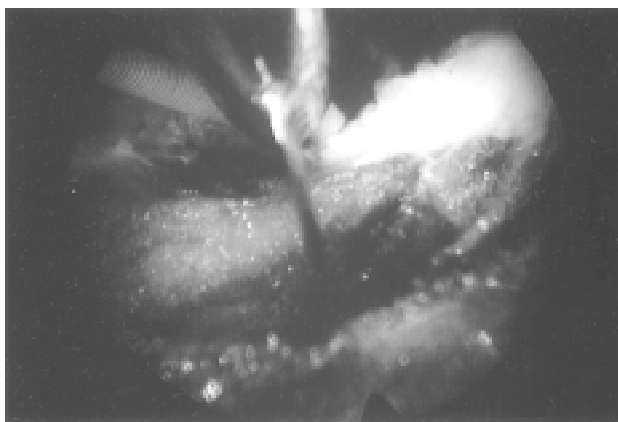


Figure 3 – The endopyelotomy should be completed so that peripelvic fat, seen in the lower half of the photo, is visualized.

The antegrade technique also allows for the endopyelotomy incision to be extended under direct vision with excellent precision. This ability is in contrast to blind techniques where the location of a repeat cut cannot be exactly determined. A full thickness incision of the renal pelvis and ureteral wall must be completed prior to removal of the endopyelotomy knife. Fat or wispy retroperitoneal tissue is visual-

ized after completion of a full thickness cut (Figure-3). In patients undergoing a second procedure, however, previous scarring can make determination of the proper incision depth more challenging. While balloon dilation is sometimes required to gently dilate the UPJ prior to endopyelotomy, balloon dilation is not indicated following endopyelotomy.

Stent Placement

Following completion of endopyelotomy, the knife is carefully removed to prevent inadvertent removal of the guidewire. Over the guidewire a double-J stent is placed. At our institution, we use an 8.0/8.5F standard stent. The stent is placed over the guidewire with a combination of fluoroscopic and visual control until the distal curl is clearly seen within the bladder. We use a 26-cm stent for increased flexibility in positioning the stent so that the distal curl is clearly seen in the bladder.

Postoperative Management

After placement of the double-J stent, a 22F nephrostomy tube is positioned in the renal pelvis.



Figure 4 – A) Preoperative excretory urogram for a middle-aged woman that presented with left flank pain. B) Excretory urogram of the same patient one year after endopyelotomy. The patient's flank pain has completely resolved.

The nephrostogram should reveal excellent drainage of the renal pelvis and some extravasation. While the nephrostomy tube is commonly left indwelling for 48 hours, a trial of tube clamping is completed prior to removal. If significant bleeding is encountered upon removal of the nephrostomy tube, the nephrostomy tube is immediately replaced and arteriography is arranged. The routine hospitalization for most patients is 2-3 days, however some patients have been dismissed much earlier. Most patients are able to return to normal activity one week after surgery. Patients return six weeks from the time of surgery for cystoscopic stent removal and an excretory urogram is completed three months after surgery to further assess the repair. All patients are then followed at periodic intervals for signs or symptoms of late failure. Percutaneous endopyelotomy is considered successful when the patient is asymptomatic and the excretory urogram shows improved drainage (Figure-4).

COMMENTS

Percutaneous endopyelotomy is a minimally invasive treatment with proven effectiveness for patients with UPJ obstruction. Advantages of antegrade endopyelotomy in comparison to open repair include shorter hospitalization, shorter operating time, decreased disability, and quicker return to work (1-4). While percutaneous endopyelotomy was initially offered to only patients with secondary UPJ obstructions, today the procedure is considered increasingly safe and effective for practically any patient with a UPJ obstruction (1-4,6-9). For patients with primary UPJ obstructions, success rates of 76-90% have typically been reported (1-4). Although intuitively one would expect that the treatment of failed previous repairs would be less successful, the results reported in the literature for secondary UPJ obstruction are similar to those reported for primary UPJ obstruction (8). Factors that undoubtedly influence the success of percutaneous endopyelotomy include the anatomic characteristics of the patient population, the surgeon's comfort level with the procedure, and postoperative surveillance protocols. Indeed, whereas some clinicians gauge success of treatment

on the basis of symptom improvement and appearance of postoperative excretory urography, other clinicians rely on more objective criteria to gauge treatment success (5).

Treatment failure generally becomes evident in the early postoperative period. Gupta et al. have reported only 8% of treatment failures occur after the first postoperative year (1). Kletscher et al. similarly reported all observed treatment failures at our institution occurred within the first 2 months after surgery (3). Long-term surveillance is required, nonetheless, as late failures do occur (5,6). The range of late failure rates and predisposing risk factors are poorly understood. Whereas the importance of crossing vessels is controversial, there is general agreement that marked hydronephrosis and poor renal function impact on the failure rate (1,6). Indeed, for patients with marked hydronephrosis, the physiology of the renal pelvis may still be abnormal and contribute to failure for some of these patients following endopyelotomy.

While antegrade endopyelotomy is associated with little patient morbidity, a variety of complications can be associated with the procedure. As with any surgical procedure, all patients are at risk for bleeding, infection, and anesthesia complications. The urologic complications of antegrade endopyelotomy in general fall into two categories: those related to percutaneous access and those directly related to the endopyelotomy. As with percutaneous stone surgery, the complications related to percutaneous access are frequently more varied and often more severe. Vascular injuries resulting in significant bleeding are the most worrisome complications associated with endopyelotomy (10). These injuries can occur during dilation of the percutaneous tract or during incision of the UPJ. The transfusion rates associated with percutaneous endopyelotomy vary from 1-6% (1-4,6,7,9). As the time required to complete endopyelotomy is shorter, complications related to fluid absorption are typically decreased. The incidence of urosepsis associated with endopyelotomy is 2-4% (10). Other previously reported rare complications unique to endopyelotomy include ureteral necrosis, ureteral avulsion, urinoma, inadvertent incision of the renal pelvis, and stent migration (10).

Despite excellent results and low overall morbidity, controversy does exist regarding various technical aspects of percutaneous endopyelotomy. With the introduction of spiral CT and endoluminal ultrasound, some investigators have stressed a preoperative evaluation for crossing vessels, whereas other investigators have not routinely favored this approach (1-3). In a recently reported series of 401 patients undergoing antegrade endopyelotomy, crossing vessels were attributed to only 4% of treatment failures, while extrinsic fibrosis was the most common cause of failure (1). Additional imaging studies may possibly improve the surgical approach to patients with ectopic or malrotated kidneys and to patients with secondary UPJ obstructions.

The method and orientation of the UPJ incision is also debatable. While we prefer use of the cold knife for endopyelotomy, others have reported equivalent success rates with other techniques including laser and electrocautery (5). We believe the surgeon has less control of the depth of the incision when using the Bugbee electrode rather than the cold knife. Previous reports have also suggested the risk of vascular injury may be increased with use of electrocautery (10). Based on the work of Sampaio et al. regarding the location of crossing vessels, we now advocate use of a lateral incision rather than a posterolateral incision (11). Obviously, the orientation of the incision is even more controversial when faced with treating an ectopic kidney, malrotated kidney, or secondary UPJ obstruction.

The issue of stenting has also been controversial. Initially a 14/7-F endopyelotomy stent was favored following the procedure. These stents were very difficult to place in the previously unstented ureter and did not appear to improve the success rate (3,5). Currently, the trend is to use smaller-caliber stents that are less expensive and easier to place. While many have recommended leaving a stent indwelling for 6 weeks after endopyelotomy, (1-3) other groups have removed stents earlier without untoward results at least in short-term follow-up (4).

Percutaneous endopyelotomy has become a procedure of choice for many patients with UPJ obstruction. Overall success rates up to 90% can be ex-

pected in a wide range of carefully selected patients (1-4,6-9). By avoiding patients with uncorrected bleeding diathesis, untreated infection, and anatomic abnormalities precluding safe access, percutaneous endopyelotomy is a safe, effective treatment for patients with UPJ obstruction that is associated with limited disability and minimal morbidity. As similar results have been noted for patients undergoing endopyelotomy with a variety of subtle technical differences, likely no specific technique of percutaneous endopyelotomy is superior and the primary factors determining success of the procedure are appropriate patient selection and effective release of the UPJ obstruction.

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Correspondence address:

Joseph W. Segura, M.D.
Mayo Clinic, Department of Urology
Mayo Building, East 17A
200 First Street, S.W.
Rochester, Minnesota, USA, 55905
Fax: (0021) 1 507 284-4987
E-mail: segura.joseph@mayo.edu