



# Outcomes after Robotic-assisted Pyeloplasty in Patients Presenting with Pain Versus Nonpain Presenting Symptoms

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<b>OBJECTIVE</b>	To assess the impact of presenting symptom or incidental finding on symptomatic and radiographic outcomes after robotic-assisted pyeloplasty (RAP).
<b>METHODS</b>	We retrospectively reviewed the records of 143 patients at our institution who received pyeloplasty from 2001-2017. Patients without both pre- and postoperative radiographic data were excluded. Patients were grouped by primary presenting symptom into either pain at presentation (pain) or nonpain primary presenting symptom, including incidental findings (nonpain). Primary outcomes were persistence of postoperative symptoms and improvement in diuretic renogram half-times.
<b>RESULTS</b>	The study inclusion criteria was met by 105 patients. Pain was the most common presenting symptom (70.0%), followed by incidental finding (10.5%), infection (7.6%), hematuria (4.8%), hypertension (2.8%), elevated creatinine (2.8%), and nausea (1.0%). Patients with nonpain presentations were significantly more likely to have postoperative symptoms ( $P = .04$ ), and less likely to improve on diuretic renogram ( $P = .03$ ). Incidental presentation was found to be associated with greater likelihood of persistent postoperative symptoms compared with other presentations (36.3% vs 8.5%, $P = .02$ ).
<b>CONCLUSION</b>	Ureteropelvic junction obstruction (UPJO) patients presenting with pain, experience better symptom and radiographic improvement following RAP compared with patients presenting without pain. Incidental UPJO was the most common nonpain presentation and is associated with less symptomatic and radiographic benefit after RAP. These findings will help reconstructive urologists counsel patients with UPJO regarding outcomes of RAP. UROLOGY 125: 111–117, 2019. © 2018 Elsevier Inc.

Ureteropelvic junction obstruction (UPJO) classically presents with flank pain, often after consumption of diuretic inducing agents.<sup>1</sup> However, many patients do not present with these classic findings. Other reported nonpain presenting symptoms for UPJO include: hematuria, infection, nausea, hypertension, elevated creatinine, and early satiety.<sup>2-4</sup> Also, due to increased use of imaging modalities followed by diuretic renogram (DRG), incidental finding of UPJO as well as other urologic diagnoses is becoming more common.<sup>5</sup> Patients are categorized on DRG as obstructed (half-time > 20 minutes), equivocal (10-20 minutes), or not

obstructed (<10 minutes).<sup>6</sup> Equivocal DRG results complicate counseling for UPJO patients, particularly those with nonpain presenting symptoms.

Historically, reconstructive surgery has been offered for obstructed patients with reasonable kidney function in the affected kidney.<sup>7</sup> When a surgical approach is pursued, options include endopyelotomy, open pyeloplasty, and laparoscopic or robotic-assisted pyeloplasty (RAP).<sup>8</sup> While the least invasive, endopyelotomy has the highest failure rate up to 15%.<sup>9</sup> Open pyeloplasty and RAP require inpatient hospitalization and both have success rates reported at over 90%.<sup>9</sup> Due to the high success rate and shorter hospital stay, RAP is rapidly becoming the standard of care for UPJO.<sup>10-13</sup> Although RAP has high reported success rates, the operation still carries known risks including hematoma, urine leak, urinary tract infection, ileus, and requirement for reoperation.<sup>14</sup> Further, it has been suggested that RAP success rates may have been over-estimated due to limited follow-up.<sup>15</sup> Also, it remains unknown how patients with incidental UPJO

Abbreviations Used: UPJO, ureteropelvic junction obstruction; RAP, robotic-assisted pyeloplasty; DRG, diuretic renogram

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Submitted: June 29, 2018, accepted (with revisions): October 11, 2018

should be counseled regarding surgical outcomes compared with those who present symptomatically. For these reasons, management decisions for atypical, including incidentally diagnosed UPJO, are complex. In this study, we retrospectively review our institutional cohort of patients with UPJO treated with RAP to identify both, patients presenting with pain and patients presenting without pain and investigate whether presenting complaint is related to postoperative radiographic improvement and postoperative symptoms.

## METHODS

This research study was reviewed and approved by our institutional review board. A retrospective review was conducted on 143 patients at our institution receiving RAP performed by a single surgeon (PMK) from 2001-2017. Electronic medical records and paper charts were reviewed and data recorded. Information collected included patient demographics, preoperative studies, and postoperative outcomes (Table 1). To be included in the study, patients were required to have both pre- and

postoperative DRG data and a documented primary presenting symptom.

Subjects were grouped by primary presenting symptom into either pain at presentation (pain) or nonpain primary presenting symptom (nonpain). Nonpain presenting symptoms included infection, hematuria, hypertension, elevated creatinine, nausea, and incidental findings. Patients were considered to have an incidental UPJO if they were originally imaged for a nongenitourinary complaint and UPJO was identified. Primary presenting symptoms were determined by chart review of the most concerning symptom upon the initial referral to the urologist for workup of UPJO. Pain (both pre- and postoperative) was determined by reviewing chart notes for any mention of flank pain on the side of UPJO from initial presentation of UPJO to 1 year postoperatively. Success of the surgical procedure and postoperative symptoms were recorded and compared between groups. Surgical success was defined as improvement in obstruction without need for any additional procedures. Chart review was conducted to identify potential surgical complications and/or persisting preoperative symptoms present at a minimum of 1 year and up to 2 years postoperatively, with symptoms reported at the furthest clinic follow-up visit after surgery recorded for analysis

**Table 1.** Demographic and surgical characteristics in patients with pain versus nonpain primary presenting symptoms

	Pain (n, %) (74, 70.5)	Nonpain (n, %)* (31, 29.5)	P Value
Age mean $\pm$ SD	44.5 $\pm$ 17.3	46.5 $\pm$ 20.0	.74
Body mass index kg/m <sup>2</sup> mean $\pm$ SD	25.4 $\pm$ 6.0	25.9 $\pm$ 6.0	.58
Smoker n (%)			
No	60 (81.1)	28 (90.3)	.38
Yes	14 (18.9)	3 (9.7)	
Gender n (%)			
Male	33 (44.6)	12 (38.7)	.67
Female	41 (55.4)	19 (61.3)	
Side n (%)			
Left	33 (44.6)	13 (41.9)	.83
Right	41 (55.4)	18 (58.1)	
Robot operative time minutes mean $\pm$ SD	155.8 $\pm$ 53.2	157.3 $\pm$ 38.0	.28
Estimated blood loss mL mean $\pm$ SD	46.9 $\pm$ 32.0	38.3 $\pm$ 18.1	.27
Preoperative creatinine mg/dL mean $\pm$ SD	1.0 $\pm$ 0.2	1.0 $\pm$ 0.2	.24
Prior abdominal operation n (%)			
No	50 (67.6)	21 (67.7)	1.00
Yes	24 (32.4)	10 (32.3)	
Prior endopyelotomy n (%)			
No	66 (89.2)	31 (100)	.10
Yes	8 (10.8)	0 (0)	
Presenting renogram category n (%)			
Obstructed	46 (62.2)	18 (58.1)	.45
Equivocal	20 (27.0)	6 (19.4)	
Not obstructed	8 (10.8)	7 (22.6)	
Stones treated at pyeloplasty n (%)			
No	71 (95.9)	28 (90.3)	.36
Yes	3 (4.1)	3 (9.7)	
Crossing vessel present n (%)			
No	34 (45.9)	8 (25.8)	.08
Yes	40 (54.1)	23 (74.2)	
Redo pyeloplasty n (%)			
No	70 (95.9)	31 (100)	.55
Yes	3 (4.1)	0 (0)	
Endourologic intervention n (%)**			
No	68 (91.9)	26 (83.9)	.29
Yes	6 (8.1)	5 (16.1)	

\* Nonpain presenting symptoms: incidental, hematuria, infection, nausea, hypertension, and elevated creatinine.

\*\* Includes: ureteroscopy, retrograde pyelogram, stone operations, ureteral stent, and endopyelotomy.

radiologic obstruction was determined by classifying DRGs into 3 categories: unobstructed (Lasix half-time of less than 10 minutes), equivocal (Lasix half-time between 10 and 20 minutes), and obstructed (Lasix half-time over 20 minutes). Lasix half-times were radiotracer clearance half-times, determined from the radiology reports. Improvement was considered to be any change after surgery from a higher to a lower DRG category. When multiple DRG were performed, the DRG closest in time prior to the surgery date was chosen as the preoperative DRG measurement. For postoperative DRG measurements, the DRG performed closest to 1 year after surgery was chosen.

Robotic Anderson-Hynes dismembered pyeloplasty was the surgical approach used for all patients. For occurrence of a crossing vein or artery, the collecting system was repositioned anterior with respect to the vessel. The anastomosis was robotically sewn over a stent with a 4-0 Vicryl suture. Patients with renal calculi received flexible pyeloscopy with laser lithotripsy and basket retrieval at the time of repair. Stent removal occurred routinely 6 weeks after surgery, according to surgeon preference. At approximately 8 weeks and 6-12 months following removal of the stent, postoperative DRGs were obtained. For this study, the DRG closest to the 1 year postoperative time point was used. Endourologic interventions performed after RAP were also recorded.

Statistical analysis compared demographics, postoperative symptoms, and radiologic obstruction between groups. Chi-square and Fisher exact tests were utilized to compare distributions of categorical variables between groups. The *t* tests were used for continuous variables. In addition to comparisons between the group presenting with pain versus nonpain presentation, a 3 group analysis was performed to compare pain at presentation, incidental presentation, and other presenting symptoms. R statistical software<sup>16</sup> was used for these analyses and statistical significance was assessed at the 0.05 level.

## RESULTS

A total of 143 patients underwent RAP, performed by a single surgeon, from 2001-2017, and 105 patients met the study inclusion criteria. Of these 105 patients, 74 presented with pain and 31 presented with a nonpain symptom, including 11 incidental findings. Table 1 lists demographic and operative characteristics for these 2 groups. There were no significant differences between groups on any variable (all *P* > .08, Table 1). Median preoperative DRG was 63.0 days overall, 65.5 days in the pain group, and 62.0 days in the nonpain group. Pyeloplasty was performed for 8 patients presenting with pain and 7 patients presenting with nonpain symptoms when preoperative DRG was unobstructed, based on surgeon assessment and determination of suspected UPJO. Pain was the most common presenting symptom (70.5%) followed by various nonpain presentations (total 29.5%), including incidental finding (10.5%), infection (7.6%), hematuria (4.8%), hypertension (2.8%), elevated creatinine (2.8%), and nausea (1.0%), Table 2. For the 11 patients identified incidentally, 10 were obstructed on preoperative DRG and 1 was equivocal, however a computerized tomography scan showed UPJO and a decision was made to proceed with surgery. The overall surgical success rate was 97%. There was no difference in repeat procedures between the 2 groups. A total of 3 patients required additional procedures, including 2 in the pain group (1 endopyelotomy and 1 endopyelotomy and subsequent open pyeloplasty) and 1 patient in the nonpain group (endopyelotomy), Supplemental Table 1.

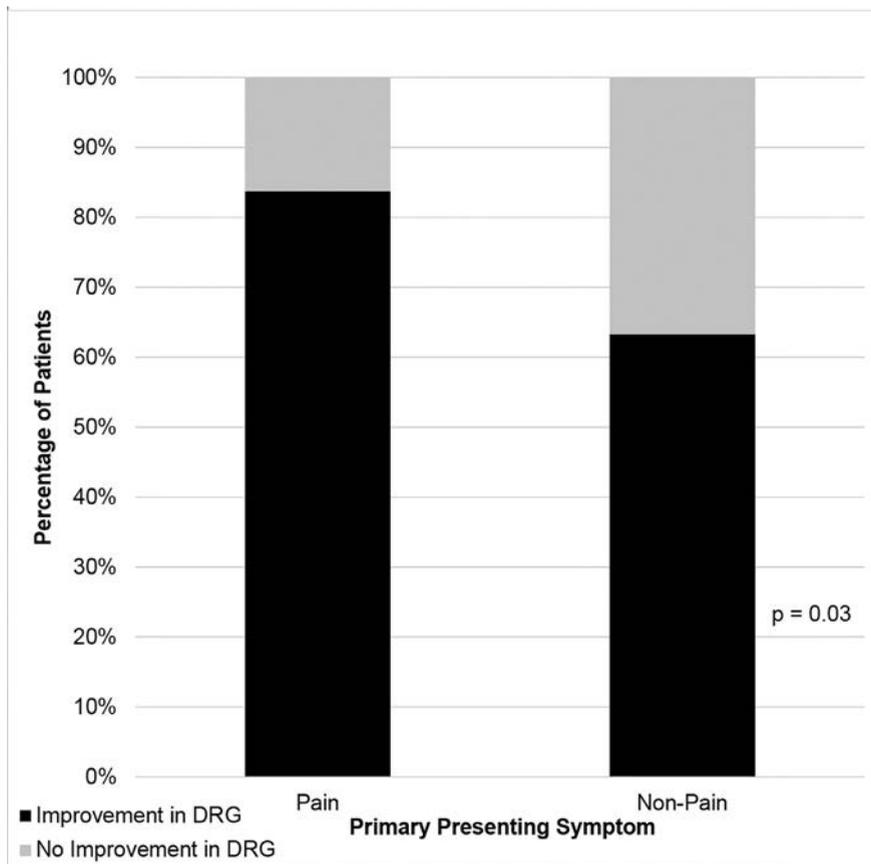
**Table 2.** Nonpain presenting symptoms

Presenting Symptom	No. of Patients (%)
Incidental	11 (10.5)
Infection	8 (7.6)
Hematuria	5 (4.8)
Hypertension	3 (2.8)
Elevated creatinine	3 (2.8)
Nausea	1 (1.0)
Total	31 (29.5)

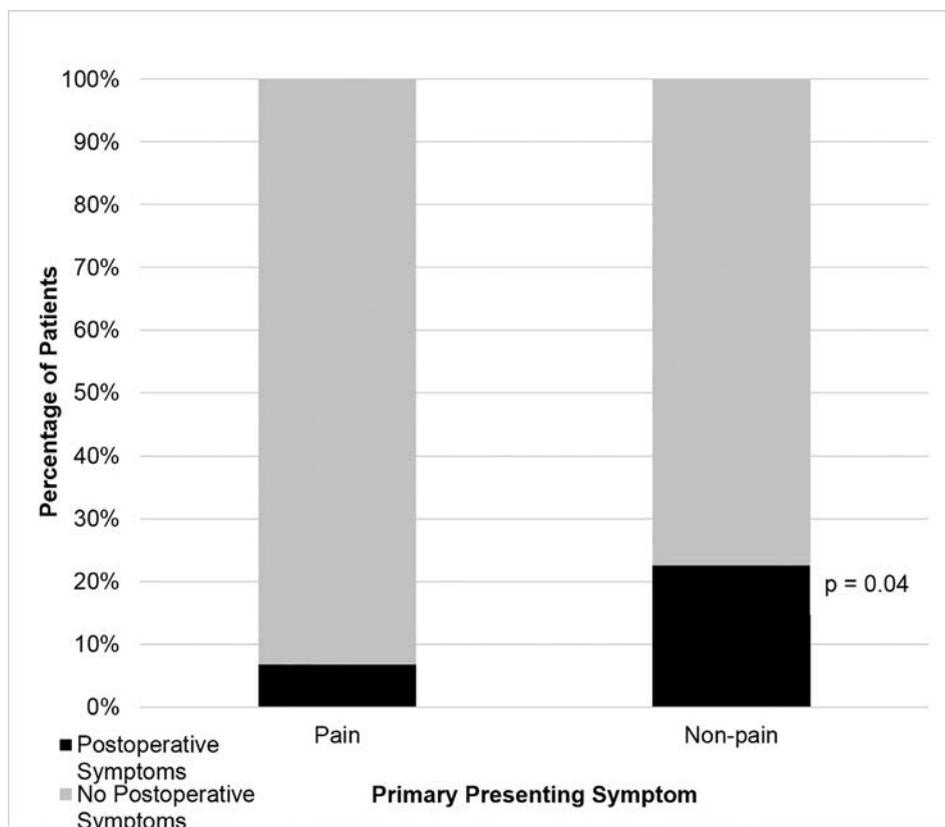
Median postoperative follow-up was 136.0 days overall, with 232.0 days in the pain group and 132.5 days for the nonpain group. Both the pain presentation group and the nonpain primary presentation group showed postoperative improvement in DRG, (median postoperative DRG for pain group occurred at 108.5 days; for nonpain group 110.5 days; and for total cohort 110.0 days). Improvement in the pain group was greater than the nonpain group (83.3% vs 64.5%, *P* = .03, Fig. 1, Supplementary Table 1). However, this difference was no longer statistically significant when patients with incidental presentation were removed from the nonpain group (*P* = .11). A total of 12 patients experienced postoperative symptoms (Supplementary Table 2). Postoperative symptoms were more frequent in patients with nonpain presentations (*P* = .04, Figure 2). However, similar to the DRG improvement analysis, this difference was no longer significant when patients with incidental presentation were removed from the analysis (*P* = .36). To further investigate the association of incidental presentation with postoperative symptoms, patients with incidental presentation were compared to both patients with pain and symptomatic nonpain patients. Incidental presentation was found to be associated with a greater likelihood of postoperative symptoms, compared with all other patients combined (36.4% vs 8.5%, *P* = .02). A total of 4 of 11 patients presenting with incidental UPJO (36.4%) exhibited postoperative symptoms, compared with 3 of 20 (15.0%) nonpain patients and 5 of 74 (6.8%) patients initially presenting with pain. Descriptions of the postoperative symptoms identified are shown in Supplementary Table 2. Several cases required repeat intervention involving endopyelotomy, stone treatment, and in 1 instance, open pyeloplasty.

## DISCUSSION

Counseling UPJO patients regarding outcomes of surgical intervention is complex, due to variation in surgical procedure success rates, diversity of presenting complaint, occurrence of incidental presentation, and uncertainty surrounding equivocal radiographic results. This study provides data to address these challenges by comparing symptom and radiographic outcomes of 105 cases of RAP, stratified by presenting symptom. Clinical success rate in our series was 97%, consistent with prior literature.<sup>9</sup> Also similar to previous research, pain was the most common presenting complaint (70.0%).<sup>4,7,10,13,17</sup> Interestingly, incidental presentation was the second most common presentation in our series. Other nonpain symptoms such as hematuria, infection, hypertension, elevated creatinine, and nausea were less common primary presentations.



**Figure 1.** Improvement on diuretic renogram (DRG) for pain versus nonpain presenting symptom.



**Figure 2.** Postoperative symptoms for pain versus nonpain primary presenting symptoms.

Incidental findings of surgical conditions are an increasing clinical dilemma in urology.<sup>5</sup> The rate of UPJO incidental finding in our study was 10.5% and has been reported to be as high as 26%.<sup>13</sup> This is in stark contrast to older literature in which incidental presentation is not mentioned.<sup>17</sup> Historically, UPJO treatment decisions were based on DRG findings and severity of symptoms.<sup>4</sup> While this is still the case for most UPJO patients, an increasing number are asymptomatic on presentation but found to be clinically obstructed on DRG. There are limited data to support the role of RAP in patients with incidental UPJO, other than the patient's level of obstruction on DRG. Many UPJO studies include only patients presenting with pain and do not consider atypical nonpain and/or incidental findings.<sup>18,19</sup> This has created clinical uncertainty regarding how to counsel patients with atypical and incidental presentation of UPJO.

In our cohort, almost 3 quarters of UPJO patients initially presented with pain. To explore whether pain might represent a different pathophysiology compared with other presenting symptoms, we analyzed postoperative DRG improvement and presence of postoperative symptoms for patients presenting with pain compared with patients presenting with atypical nonpain, including incidental findings. Our data show that patients with pain at presentation had superior improvement on DRG after RAP compared to patients initially presenting with nonpain symptoms. Also, patients with atypical nonpain primary presentations were more likely to have postoperative symptoms after RAP compared with patients who initially presented with pain. This suggests a possible difference in the pathophysiology of UPJO for patients who present initially with pain versus those presenting with atypical nonpain symptoms, potentially resulting in the differences in DRG improvement and postoperative symptoms observed between these 2 groups.

To further understand atypical UPJO presentation, we examined the impact of isolating incidental presentation from the larger nonpain group by comparing pain presentation with incidental presentation and with all other nonpain presenting symptoms. When patients with an incidental finding of UPJO were removed from the analyses, neither DRG improvement, nor postoperative symptoms were significantly different between the pain and nonpain groups. This may reflect the relatively larger proportion of nonpain presentations that were incidental but also may highlight a specific lack of therapeutic benefit for surgery in patients with incidental UPJO. Additionally, incidental presentation accounted for one-third (4 of 12) of patients experiencing postoperative symptoms (Supplementary Table 1). One possible explanation is that the UPJO had not "matured" in these patients prior to surgery, and therefore was more likely to continue to stricture postoperatively. This pathophysiology has not been explicitly described in UPJO to date and suggests a

focus for future research, particularly as this pathophysiology is well known in urethral stricture disease.<sup>20</sup>

Another possible explanation for the relatively larger proportion of postoperative symptoms observed with incidental diagnosis of UPJO may relate to the psychological impact of operating on asymptomatic patients. For example, when comparing donor versus radical nephrectomies, donors have been found to have a prolonged hospital stay and increased pain.<sup>21</sup> It is possible that in operating on asymptomatic patients with UPJO, a similar phenomenon occurs. Regardless, these findings can be used to inform how patients are counseled regarding outcomes of RAP. Patients with atypical nonpain UPJO presentations can be informed that surgical success rates are less well-understood compared with UPJO patients presenting initially with pain. Further, patients presenting incidentally may be at higher risk for less radiographic improvement as well as the development of postoperative symptoms.

Limitations of this study include both the small number of patients and the retrospective design. In addition, multiple radiologists conducted and interpreted DRG studies over the 17 year study period, which may have led to imperfect standardization of Lasix half-time values. This was addressed by grouping DRG results into 3 clinically established categories of unobstructed (Lasix half-time of less than 10 minutes), equivocal (Lasix half-time of 10 to 20 minutes), and obstructed (Lasix half-time of more than 20 minutes).<sup>13</sup> In future research, change in DRG half-time would provide a more precise value for radiographic outcome after RAP.<sup>15</sup> In addition, a meta-analysis or multicenter approach to future studies would allow collection of a larger sample size, allowing a more granular comparison of UPJO presenting symptoms.

One strength of this study is that RAPs were performed by a single surgeon, providing uniformity in technique over time. Additionally, these data encompass 17 years, capturing a timespan when incidental presentation of UPJO has been increasing. Inclusion of patients with atypical nonpain, including incidental presentations, represents a realistic clinical cohort compared with studies including only patients presenting with pain.

## CONCLUSIONS

In summary, our findings suggest that presenting symptom may be a key factor in outcome following RAP, in terms of both symptomatic benefit and improvement on DRG. In this study, UPJO patients presenting with pain experienced superior symptom resolution and radiographic improvement on DRG following RAP compared with patients presenting with atypical nonpain UPJO. However, when patients with incidental presentation were removed from the nonpain presentation group, symptom resolution and radiographic improvement were not significantly different compared

with UPJO patients presenting with pain. In our population, incidental presentation was a common atypical UPJO presentation and may be associated with lower success rates after RAP. These findings will help reconstructive urologists counsel UPJO patients regarding outcomes after RAP, particularly those patients presenting with atypical UPJO.

**Acknowledgment.** The authors appreciate the contributions of Jing Xie, Ph.D., during the early stages of this project.

## SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.urology.2018.10.046>.

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## EDITORIAL COMMENT

Proper patient selection and meticulous suturing were the keys to success in my experience with pyeloplasty. The attraction of the present publication is the presentation of both aspects. Are there good reasons to treat uretero pelvic obstruction different from what is proposed by the authors?

I never believed in endopyelotomy which followed the principle of intubated ureterotomy and offered an unsatisfying, non-physiological view already at the end of the procedure.

In 2006 Dimarco et al.<sup>1</sup> reviewed their 20 years' experience with open pyeloplasty and endopyelotomy: the 3- and 10-year recurrence-free rates for endopyelotomy were 23 % and 34 % lower than those for open pyeloplasty. They concluded: "In view of these results of endopyelotomy, laparoscopic pyeloplasty may prove to be the preferred minimally invasive approach to repair ureteropelvic junction (UPJ) obstruction." These views were further confirmed in 2009 in a literature review<sup>2</sup> 7 years after the publication of the first robot assisted pyeloplasty:<sup>3</sup> "robot-assisted pyeloplasty seems to be emerging as the new standard of care in the patients with ureteropelvic junction obstruction." Finally, recently the still very popular use of endopyelotomy in the US has been questioned in view of the high failure rate: "Future research should examine to what extent patients and physicians are driving the use of endopyelotomy." and "... minimally invasive pyeloplasty, this approach may supplant open pyeloplasty as the "gold standard in the near future."<sup>4</sup> Another puzzling aspect is that in the US correction of UPJ obstruction in children by endopyelotomy (1.4%)<sup>5</sup> has never been as popular as in adults (41%).<sup>4</sup> The proper size equipment is available. Do pediatric surgeons and urologist think different than those treating adults?

The present paper helps to address these questions and critical points and to guide the reader to a responsible handling of patients.

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<https://doi.org/10.1016/j.urology.2018.10.047>  
UROLOGY 125: 116–117, 2019. © 2018 Elsevier Inc.

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## AUTHOR REPLY



We appreciate the editor's commentary in placing our study within the larger context of management of this disease process. In particular, we agree that issues when comparing endopyelotomy with pyeloplasty warrant further discussion.

We were motivated to perform this research due to the growing number of consultations for incidentally discovered UPJ obstructions. Our goal was to assess how these patients fared symptomatically and radiographically after pyeloplasty. We found that patients with incidental UPJ obstruction had worse symptomatic and radiographic outcomes compared with those presenting with pain. We agree with the editor's comment that patient selection is therefore critical to success in this operation.

Several anatomic features have been associated with poor outcomes from endopyelotomy, that is impaired renal function, large renal pelvis and presence of a crossing vessel. It is these findings that make the patient an ideal candidate for dismembered pyeloplasty. While endopyelotomy has been reported to have high success rates in select patients, as a tertiary referral center, we see few patients who are candidates for this procedure. In our series, 8 of 105 patients (7.6%) underwent endopyelotomy at an outside institution prior to being referred for pyeloplasty at our institution. Interestingly, all 8 of these patients were in the group who presented with pain as the primary complaint. Of 105 patients in our series, only 3 required endopyelotomy postoperatively for persistent obstruction. Further research will help us better understand this dynamic disease process in both adult and pediatric populations.

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<https://doi.org/10.1016/j.urology.2018.10.048>  
UROLOGY 125: 117, 2019. © 2018 Elsevier Inc.