ORIGINAL PAPER

TRAUMA AND RECONSTRUCTIVE UROLOGY

Renal function recovery after laparosocopic pyeloplasty

Juan Gómez Rivas[1], Sergio Alonso y Gregorio[1], María Portilla Eastmond[1], Angel Tabernero Gómez[1], Luis Hidalgo Togores[1], Jesús Díez Sebastián[2], Jesús Javier de la Peña Barthel[1]

[1]*Department of Urology, Hospital Universitario La Paz, Madrid, Spain*
[2]*Department of Biostatistics, Hospital Universitario La Paz, Madrid, Spain*

Article history
Submitted: Dec. 11, 2013
Accepted: March 4, 2014

Correspondence
Juan Gómez Rivas
Hospital Universitario
La Paz
261, Paseo La Castellana
28034 Madrid, Spain
phone: +34 661 190 028
juangomezr@gmail.com

Introduction To observe the renal function recovery measured by diuretic renography in short and medium follow–up of patients with transperitoneal Anderson–Hynes laparoscopic pyeloplasty.
Material and methods We performed a retrospective review from our series of laparoscopic pyeloplasties, and we applied the following selection criteria: 1) to have at least two MAG3 diuretic renography during the follow–up, performed with a gap of 4–6 months between them; 2) to have at least one year follow–up. Fulfilling these criteria, we have selected 35 patents of 62.
Results During follow–up, statistically significant improvement comparing with the pre–surgical value has been observed in diuretic renography in the operated kidney in all selected patients during the time of follow up in terms of: functional uptake ratio (FUR), furosemide excretion and total excretion. No statistically significant differences were found in excretion time and spontaneous excretion parameters. By dividing patients in two age groups <40 years and >40 years we found no statistically significant differences between them in relation to the improvement of the FUR
Conclusions Laparoscopic pyeloplasty not only corrects the UPJO, it also may recover renal function demonstrated after one year follow up with diuretic renography. Laparoscopic pyeloplasty should be procedure of choice even in those patients with poor renal function at diagnosis, whenever there are chances of recovering renal function, regardless patients age.

Key Words: diuretic renography ‹› laparoscopic pyeloplasty ‹› functional uptake ratio ‹› follow–up

INTRODUCTION

The ureteropelvic junction obstruction (UPJO) in adults is defined as a functional disorder of the transport of urine from the renal pelvis into the ureter, producing pyelic and calyceal dilatation of the affected kidney. Although the most common cause is a congenital alteration of the ureteropelvic junction, in which the obstruction is due to intrinsic fibrosis of a ureteral segment that becomes aperistaltic, other causes have been described from a ureteral origin (ureteral valves, anomalies in the insertion of the ureter) to extraureteral (adhesions, fibrosis, abnormal vessels) [1].
Multiple surgical techniques have been described, having evolved considerably over the past 20 years with the advance of new technologies. Traditionally, treatment of UPJO was based on surgical open pyeloplasty [2]. Anderson and Hynes open pyeloplasty consists mainly of the ablation of the ureteral stenosed segment, the removal of part of the dilated pelvis and the performance of a ureteral muco–mucosal anastomosis. The effectiveness of open pyeloplasty approaches 90%, but carries with it significant postoperative pain and a prolonged hospital stay [3].
In recent years, many minimally invasive techniques have been developed; the laparoscopic and endoscopic approaches of UPJO have reduced the morbidity of open surgery. Laparoscopic pyeloplasty obeys the same rules as the open surgery described by Anderson–Hynes, benefiting from the advantages of minimally invasive surgery. The intervention may be performed by transperitoneal or retroperitoneal approach with similar results to open surgery according to several published series [3].

Nowadays the assessment of overall renal function, the ureteropelvic anatomy and physiology is considered essential in the diagnostic process of UPJO, since these parameters determine the appropriate choice of the surgical technique to use. Diuretic renography is the most commonly used diagnostic tool to assess for UPJO [4]. Technetium Tc 99m MAG3 is the radiopharmaceutical agent of choice for this purpose and has largely replaced Tc 99m diethylenetriamine pentaacetic acid (DTPA), because it has a better gamma image than DTPA, as well as a faster clearance rate and lower background activity. One advantage of DTPA is that it may be used to measure the glomerular filtration rate, but MAG3 scanning may provide differential renal function by comparing isotope uptake in both kidneys, which, in turn, is a reflection of renal blood flow.

The aim of this study is to observe the renal function using diuretic renography in short and medium follow–ups of patients after laparoscopic pyeloplasty.

MATERIAL AND METHODS

We conducted a retrospective review of our series of laparoscopic pyeloplasties [5], and applied the following selection criteria: 1) perform MAG3 diuretic renography at least twice during the follow–up, with a gap of 4–6 months between each; 2) have at least a one year follow–up. Having fulfilled these criteria, we selected 35 of the 62 patients.

Data analysis: Data was analysed at our hospital biostatistics section. Analyses were performed with SAS 9.1 and Enterprise Guide 3.0. Quantitative data were described by mean and standard deviation, and qualitative data by absolute frequencies and percentages.

To analyse the average change of all the measures over time (pre–surgery, at 6 months, one year, two years if possible), a mixed linear regression model was adjusted. Ninety–five percent confidence intervals (CI) were used. The statistical analyses were performed and p <0.05 was considered significant.

RESULTS

Demographic and surgical data for selected patients are shown in Table 1. During follow–up, statistically significant improvement compared with the pre–surgical value was observed in diuretic renography of the operated kidney in all patients selected during the time of follow–up in terms of: 1) functional uptake ratio (FUR): pre–surgery: 41.17%, at 6 months: 45.15%, at 1 year: 47.42%, at 2 years: 55.50% (p <0.003); 2) furosemide excretion: pre– surgery: 21.23%, at 6 months: 53.35%, at 1 year: 56.35%, at 2 years: 51.6%, (p <0.006) and 3) total excretion: pre surgery: 46.69%, at 6 months: 65.27%, at 1 year: 61.75%, 2 years: 62.20%; (p <0.002) (Table 2).

No statistically significant differences were found in the excretion time (p = 0.820) and spontaneous excretion (p = 0.708) parameters of the surgical–treated kidney compared with the contralateral kidney, after certifying the correction of the UPJO) (Table 2).

By dividing patients in two age groups: <40 years and >40 years we found no statistically significant differences between them in relation to the improvement of the FUR; in both groups it improved equally (Table 3).

The FUR prior to surgery in the operated kidney was divided and analyzed in two groups: <40% and >40%, finding significant improvement in the group with greater functional impairment (FUR <40%): pre–surgery: 32.22%, at 6 months: 36.50 %, at 1

Table 1. *Patients data*

Patients Number	35		
Mean age	39.03[a] ±12.4[b]		
		Number of patients (N)	Percentage (%)
Sex	Female	19	54.2
	Male	16	45.7
Diagnosis	Pain	22	62.8
	Radiologic finding	10	28.5
	Others	3	8.5
Side	Right	21	60
	Left	14	40
Crossing Vessels	Yes	20	57.1
	No	15	42.8
Hospital Stay	3.50[a] days ±1.27[b]		

[a]Mean, [b]Standard deviation

Table 2. *Diuretic renography parameters*

	Pre–surgery	6 months	1 year	2 years	p value
Functional uptake ratio	41.17%	45.15%	47.42%	44.80%	0.003*
Spontaneous excretion	29.54%	31.00%	35.83%	35.14%	0.708
Furosemide excretion	21.23%	53.35%	56.35%	51.60%	0.006*
Total excretion	22.52%	54.25%	56.07%	52.20%	0.002*
Excretion time	4.38 mins	5.92 mins	5.29 mins	2.95 mins	0.820

year 41.75%; (p <0.002) vs FUR >40%: pre–surgery: 45.81%, at 6 months: 47.82%, at 1 year 47.28% (p = 0.07) (Table 4).

DISCUSSION

The first laparoscopic pyeloplasty was described by Schuessler et al. [6] in the early 90s. During the last decade, laparoscopic pyeloplasty has evolved in order to achieve the same results as open surgery, with lower rates of morbidity and complications [7].

Our department has extensive experience in reconstructive surgery [5, 8] and laparoscopic pyeloplasty has become the technique of choice for the treatment of UPJO since 2004. The aim of this study was to observe the evolution of diuretic renography in patients undergoing this procedure and to measure the renal function recovery using diuretic renography in short and medium follow–ups.

Limited data is available to create guidelines to justify the long–term monitoring of patients undergoing laparoscopic procedures for UPJO, especially in adult patients. O'Reilly and colleagues considered that if kidney drainage is normal, demonstrated by renography a year after the surgery, patients can be discharged [9]. Soulie et al. [10], in their study, proposed follow–up of patients at the first and third months after surgery with intravenous urography (IVU) and diuretic renography, and then yearly with ultrasound for at least three years. In another study, Doo CK et al. [11] recommended performing any imaging test during 2 or 3 years to find the rare situation of re–obstruction of the ureteropelvic junction. Dimarco et al. [12] conclude in their study that failures continue to appear after 5 and 10 years, and patients should be followed accordingly.

Renogram curves of uptake and drainage of MAG3 have been defined by O'Reilly et al. [13]. Normally, the time required for clearance of 50% (t½) of the accumulated radionuclide is <10 min, while a t½ of >20 min is suggestive, but not diagnostic, of obstruction. The protocol for this test should be carefully observed, hydrating the patient before the injection of radioisotope and setting the necessary time between injection and imaging [14].

Table 3. *Functional Uptake Ratio in patients <40 years and >40 years*

	Pre–surgery	6 months	1 year	2 years	p value
Functional uptake ratio <40 years	40.50%	44.22%	49.52%	52.62%	0.593
Functional uptake ratio >40 years	41.20%	44.93%	47.31%	47.52%	

Table 4. *Functional uptake ratio divided <40% and >40%*

	Pre–surgery	6 months	1 year	p value	p value
Functional uptake ratio <40%	33.22%	36.50%	41.75%	0.002*	0.593
Functional uptake ratio >40%	45.81%	47.82%	47.28%	0.07	

Our results have shown that MAG3 diuretic renography is the best tool in the follow–up of patients with UPJO treated by laparoscopic pyeloplasty, because it diagnoses the presence of pre–surgery obstruction; and also shows the success of surgery in all patients, since the first diuretic renography is performed in the follow–up (within 6 months) demonstrated by the statistically significant improvements in the different excretion parameters. The most important finding of our study is that after one year of follow–up, a statistically significant improvement of the FUR is shown compared with the pre–surgery value, which means that there is a functional recovery of the affected kidney. The recovery of the FUR is evident in those kidneys with FUR lower than 40%, because if the FUR is worse, we may expect a greater improvement.

We have investigated whether age is an independent factor for renal function recovery by dividing the patients into two groups (<40 years and >40 years). We have not found a significant difference between the groups, so we recommend performing this procedure regardless of the patient's age. There are multiple articles that have described the success of different surgical approaches to UPJO, and therefore the preservation of the renal function. However, a description of a record of improvement of renal function after the UPJO treatment has never been published before in the literature. We think that these findings provide enough evidence to choose laparoscopic pyeloplasty over laparoscopic nephrectomy in "limit patients", such as the elderly or those with kidneys with reduced FUR.

This study has several limitations to consider. Although it is a retrospective analysis, the cohort is small and there are other "candidates" to determine renal function recovery after laparoscopic pyeloplasty, such as the measurement of the glomerular filtration rate and imaging tests, including intravenous urography or ultrasound, this study may be a call for making larger and prospective studies to validate our findings and to compare different tools.

CONCLUSIONS

Laparoscopic pyeloplasty is currently the gold standard for UPJO in our department. The MAG3 diuretic renography is the diagnostic tool of choice for patients with suspected UPJO and also for assessing the success or failure of surgical treatment.

Laparoscopic pyeloplasty not only corrects the UPJO, it may also recover renal function, demonstrated after a one year follow–up with diuretic renography. Laparoscopic pyeloplasty should be the procedure of choice even in those patients with poor renal function at diagnosis.

References

1. Woodward M, Frank D. Postnatal management of antenatal hydronephrosis. BJU Int. 2002; 89: 149–156.
2. Sutherland DE, Jarrett TW. Surgical options in the management of ureteropelvic junction obstruction. Curr Urol Rep. 2009; 10: 23–28.
3. Mei H, Pu J, Yang C, Zhang H, Zheng L, Tong Q. Laparoscopic versus open pyeloplasty for ureteropelvic junction obstruction in children: a systematic review and meta–analysis. J Endourol. 2011; 25: 727–736.
4. Hashim H, Woodhouse CRJ. Ureteropelvic Junction Obstruction. Eur Urol Suppl. 2012; S11: 25–32.
5. Rivas JG, Gregorio SA, Eastmond MA, Gómez AT, Ledo JC, Togores LH, Barthel JJ. Transperitoneal laparoscopic pyeloplasty in the treatment of ureteropelvic junction obstruction. Cent European J Urol. 2013; 66: 361–366.
6. Schuessler WW, Grune MT, Tecuanhuey L, Preminger GM. Laparoscopic dismembered pyeloplasty. J Urol. 1993; 150: 1795–1799.
7. Arun N, Kekre NS, Nath V, Gopalakrishnan G. Is open pyeloplasty still justified? Br J Urol. 1997; 80: 379–381.
8. Gómez Rivas J, Alonso Y Gregorio S, López Sánchez D, Pons Viver J, Tabernero Gómez A, Cisneros Ledo J, et al. Iatrogenic ureteral stricture: Laparoscopic ureteral reimplantation. Eur Urol Suppl. 2013; 12: e556.
9. O'Reilly PH, Brooman PJ, Mak S, Jones M, Pickup C, Atkinson C, Pollard AJ. The long term results of Anderson–Hynes pyeloplasty. Br J Urol Int. 2001; 87: 287–289.
10. Soulié M, Salomon L, Patard JJ, Mouly P, Manunta A, Antiphon P, et al. Extraperitoneal laparoscopic pyeloplasty: a multicentre study of 55 procedures. J Urol. 2001; 166: 48–50.
11. Doo CK, Hong B, Park T, Park HK. Long–term outcome of endopyelotomy for the treatment of ureteropelvic junction obstruction: how long should patients be followed up? J Endourol 2007; 21: 158–161.
12. Dimarco DS, Gettman MT, McGee SM, Long–term success of antegrade endopyelotomy compared with pyeloplasty at a single institution. J Endourol. 2006; 20: 707–712.
13. Mitterberger M, Pinggera GM, Neururer R, Peschel R, Colleselli D, Aigner F, et al. Comparison of contrast–enhanced color Doppler imaging (CDI), computed tomography (CT), and magnetic resonance imaging (MRI) for the detection of crossing vessels in patients with ureteropelvic junction obstruction (UPJO). Eur Urol. 2008; 53: 1254–1262.
14. O'Reilly PH, Lawson RS, Shields RA, Testa HJ. Idiopathic hydronephrosis – the diuresis renogram: a new non–invasive method of assessing equivocal pelvioureteral junction obstruction. J Urol. 1979; 121: 153–155.