EFFICACY AND SAFETY OF LAPAROSCOPIC PYELOPLASTY IN CHILDREN

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بسم الله الرحمن الرحيم

‘‘وفوق كل ذي علمٍ عليم’’

صدق الله العظيم

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ABSTRACT

Objective: Laparoscopic pyeloplasty has become a viable option for the treatment of patients with ureteropelvic junction (UPJ) obstruction. We report on the safety and efficacy of this technique by reviewing the results of laparoscopic pyeloplasty in infants and children in 2 centers. We evaluated the rate and type of complications, as well as using subjective and objective measures for the improvement of UPJ obstruction.

Patients and Methods: We did a retrospective chart review for 181 infants and children under 18 years of age suffering from UPJ obstruction requiring surgery in a total of 193 kidneys. All underwent laparoscopic transperitoneal pyeloplasty. The mean age at operation was 7.7 years. All patients had a ureteric stent placed intraoperatively. The measures of outcome included operative time, perioperative complications, length of hospital stay, postoperative symptoms, and follow up imaging. All patient had follow up ultrasonography at least 2 weeks after the stent removal, and 45 children had follow up MAG-3 renal scan 3 to 9 months after surgery Criteria of success included completion of the procedure laparoscopically, absence of symptoms, and radiological improvement in follow up ultrasonography or renal scan.

Results: Mean operative time was 226 minutes and the average postoperative hospital stay was 1.7 days. We had no major intraoperative complications. We had mild post-operative complications in the form of transient fever or hematuria, and port site infection in 5 patients, persistent drainage in 5 (which stopped spontaneously in 2 to 6 days), and ileus for 3 to 6 days in 6 children. On follow up, success was achieved in 96.4% of all cases, or 96.9% of cases completed laparoscopically. Improvement in renal scan parameters was observed in 88.9% of the 45 patients who had follow

up renograms. Success rate was 93% among the 41 infants under 12 moths of age that we had.

Conclusion: Laparoscopic pyeloplasty is effective and safe in infants and young children with UPJ obstruction, providing good outcome with minimal complications, a reasonable operative time and short hospital stay.

Key Words: Laparoscopic, Transperitoneal, Dismembered Pyeloplasty, Ureteropelvic Obstruction, infants.

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LIST OF ABBREVIATIONS

APD	: Antero-posterior diameter
CT	: Computerized tomography
DS	: Doppler sonography
DTPA	: Diethylene triamine penta acetic
GFR	: Glomerular filtration rate
HAL	: Hand-assisted laparoscopy
hpf	: High power field
IRB	: Institutional review Board
IVU	: Intravenous urography
LP	: Laparoscopic pyeloplasty
MAG3	: Mercapto-acetyl-triglycine
MRI	: Magnetic resonance imaging
MRU	: Magnetic resonance urography
PUJO	: Pelvi-ureteric junction obstruction
PUV	: Posterior Urethral Valves
RALP	: Robot assisted laparoscopic pyeloplasty
RI	: Resistivity Index
RSS	: Renal scintigraphic success
SFU	: Society of Fetal Urology
TLDP	: Transperitoneal laparoscopic dismembered pyeloplasty
UPJ	: Ureteropelvic junction
VCUG	: Voiding Cysto Urethrogram

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INTRODUCTION

Ureteropelvic junction obstruction (UPJO) is recognized as the most common cause of hydronephrosis in newborns and young child. According to the severity and the progression of the disease, surgical repair may be indicated. Traditionally, open pyeloplasty has been considered the gold standard for the treatment of UPJO with success rates of up to 95% [1-3]. Even though open standard repair can be performed through a relatively small subcostal incision, it is still associated with significant postoperative pain, and potentially esthetically displeasing scarring.

Since the introduction of laparoscopic pyeloplasty as an alternative to open surgery in adults in 1993 by Schuessler et al and Kavoussi et al [4, 5] and in pediatrics in 1995 by Peters et al [6] it has been gaining popularity as it provides a way to avoid the potential complications of open surgery. In a similar way to open surgery, the procedure allows the identification of crossing vessels, excision of the diseased pelvi-ureteric junction with or without reduction pyeloplasty and a watertight anastomosis. In addition, the analgesic requirements, hospital stay and recovery period are considerably reduced compared to the open procedure [7, 8]. Success rates are reported to be between 87-100% [9].

Different techniques of standard pyeloplasty can be applied laparoscopically, although the best results were seen with dismembered pyeloplasty (Anderson-Hynes Technique) [10-13]. Both retroperitoneal and

transperitoneal approaches [14, 15]for this operation were used, depending on the surgeon's preferences.

On the other hand, the procedure requires considerable skill, has a marked learning curve, initially required longer operative time compared to open technique [12, 16]. A ureteric stent is used more often than in open surgery, which needs to be removed in another setting.

When we first started our study we were looking to answer questions regarding the safety and efficacy of laparoscopic pyeloplasty, as it was still emerging as a new tool in the pediatric world. Since its introduction there were debates about whether it was wise to consider it a valid substitute, in select cases, to the highly successful and safe open surgery. As time passed it was obvious that laparoscopic pyeloplasty was here to stay. We therefore tried to present a large series of patients and evaluate the technique as the new gold standard.

AIM OF THE WORK

The aim of this study was to evaluate the efficacy and safety of laparoscopic pyeloplasty in our pediatric population, discussing its success rate and possible complications, and to shed further light on this procedure as an important tool with increasing popularity in upper urinary tract surgery.

REVIEW OF LITERATURE

A. ANATOMY OF URETERO-PELVIC JUNCTION:

The study of embryology and anatomy of the upper urinary tract provides a useful foundation for the understanding of various congenital diseases of the kidney and the ureter. The classical descriptive embryology is an important reference point to solve various clinical problems of congenital origin.

During embryological development, the nephrons, which end with the connecting tubules, develop from the metanephric blastema. The collecting duct system, starting from the initial collecting tubules and throughout the cortical and medullary collecting ducts, the papillary ducts, the calyces, the pelvis and the ureter, develop from the ureteric bud. The collecting tubules converge and drain into papillae; minor calyces surround groups of two or three papillae. The minor calyces unite to form three major calyces. The major calyces fuse to form a single funnel-shaped renal pelvis, which is continuous with the ureter ***(Figure 1)*** [17]. It is worth emphasizing that the UPJ region develops from the same origin (the ureteric bud) as the adjacent pelvis above and ureter below, so it does not represent a developmental junction [18].

In a normal kidney, the transition between the renal pelvis and the ureter is usually subtle and not well demarcated. This area of junction,

the uretero-pelvic region, is usually extrahilar in location and normally lies adjacent to the lower part of the medial border of the kidney. In some individuals, however, the entire renal pelvis lies inside the sinus of the kidney and as a consequence, the uretero-pelvic region is situated either in the vicinity of the renal hilum or completely within the renal sinus. The internal diameter of the UPJ is the second narrowest point of the ureter, the ureterovesical junction being the first [1, 18].

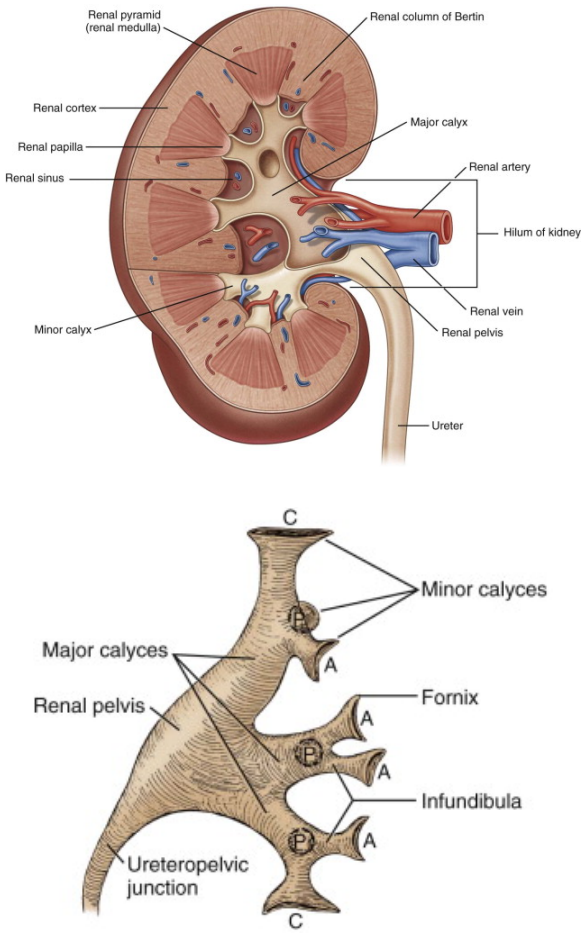

Figure 1: Above: internal structure of the kidney; Below: Renal collecting system of left kidney (A, Anterior minor calyx, P, posterior minor calyx, C, compound calyx at the pole. (From Anderson, J.K.C., J A, Surgical anatomy of the retroperitoneum, Adrenals, Kidneys and Ureters, in Campbell-Walch Urology, K. Wein, Novick, Partin, Peters, Editor. 2011, Saunders.[17])

B. PATHOPHYSIOLOGY OF UPJ OBSTRUCTION:

Multiple theories were suggested to explain the pathogenesis of UPJ obstruction, including structural disorders (intrinsic and extrinsic factors -***Figure 2***) or functional ones (smooth muscle dysfunction).

An aperistaltic segment of the ureter is often the cause of congenital ureteropelvic junction obstructions. In these cases abnormal longitudinal muscle bundles or fibrous tissue, seen as excess collagen on electron microscopy, replace the normal spiral musculature. This results in failure to develop a normal peristaltic wave for propagation of urine from the renal pelvis to the ureter. This segmental defect is often responsible for uretero-pelvic junction obstruction. This is of clinical importance, because although such ureters may appear grossly narrow or atretic at the time of surgery [19], at other times they may appear normal while having poor function [20].

Intrinsic obstruction at the uretero-pelvic junction may also result from kinks or valves produced by infoldings of the ureteral mucosa and musculature. In these cases, the obstruction may actually be at the level of the most proximal ureter. This phenomenon appears to result from retention or exaggeration of the fetal folds of Ostling, normally found in the ureter of developing fetuses and by themselves are non-obstructing. In some of these cases, the defects are bridged by ureteral adventitia, this can manifest as external bands or adhesions that appear to be causing the obstruction. In the majority of cases, however, these

bands or adhesions are likely to be a secondary phenomenon associated with intrinsic obstruction. The presence of these kinks, valves, bands, or adhesions may also produce angulation of the ureter at the lower margin of the renal pelvis in such a manner that the pelvis dilates anteriorly and inferiorly. The ureteral insertion is carried further proximally. In these cases, the most dependent portion of the pelvis is inadequately drained and the apparent **"high insertion"** of the ureteral ostium is actually a primary obstructing lesion [21, 22] ***(Figure 3)***. Another opinion adopted by Koff [23] is not to consider these high insertion ureters as an intrinsic defect, but rather a sign of an external original obstruction, whether stenosis or a crossing vessel, that cause dilatation and rotation, altering the way the uereteric insertion looks, and hence the way it functions.

The presence of aberrant vessels supplying the lower pole of the kidney may be the cause of Uretero-pelvic junction obstruction. This has been noted in up to one third of cases of UPJ obstruction. These vessels may be branches from the main renal artery or arise directly from the aorta. In a minority of patients, they cross the ureter posteriorly and, as such, truly have an aberrant course. However, it was suggested that an intrinsic lesion at the UPJ or proximal ureter causes dilatation and ballooning of the renal pelvis over these vessel [20]. A precise understanding of vascular anatomy is of utmost importance when evaluating the obstructed ureteropelvic junction. The presence of crossing vessels is problematic for the surgeon treating

UPJ obstruction. The crossing vessels may be either causative or anatomically associated with the obstruction. In either case, the vessels are important because they can cause surgical complications. In fact the most significant complication of endopyelotomy is vascular injury associated with severe hemorrhage or the formation of an arteriovenous fistula. Therefore, an arteriogram to diagnose this condition is highly indicated, because the intravenous pyelogram is inadequate for this purpose. It is possible that many of the vessels seen close to the UPJ during angiography and described as anomalous are, in fact normal segmental arteries. They may not cause the obstruction but rather increase the dilatation of a redundant renal pelvis previously obstructed by a primary muscular defect at the UPJ. In such situation, the dilated renal pelvis balloons over the anterior crossing vessel, and the resulting angulation appears to worsen the obstruction. Also it has been found that anomalous renal development, such as incomplete rotation of the kidney, is often associated with vascular anatomical variations. Therefore, in patients with kidney malrotation, the obstruction could be caused by an anteriorly displaced renal pelvis associated with a crossing vessel [20, 24].

UPJ obstruction may also be secondary to other lesions. In children, vesicoureteral reflux can lead to upper tract dilatation with subsequent elongation, tortuosity, and kinking of the ureter. In some cases, these changes may only mimic the radiographic findings of true UPJ obstruction. However, true UPJ obstruction may definitely

coexist with vesicoureteral reflux, although in most cases it may be difficult to determine whether the anomalies are merely coincidental or whether the upper tract ureteral obstruction has resulted from the reflux [1, 21, 25].

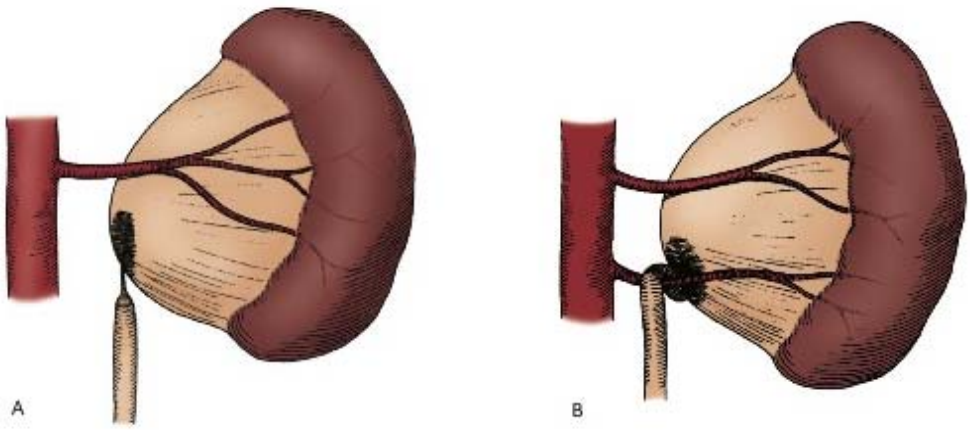

Figure 2: The 2 most common gross pictures of UPJ pathologies, A:Intrinsic narrowing, B:Lower pole crossing vessel *(From Carr MC,Casale P. Anomalies and Surgery of the Ureter in Children. In: Wein Kavoussi, Novick and Partin, editors. Campbell-Walsh Urology. 4. 10 th ed: Saunders; 2011. p. 3212-35. [19])*