Review ARticle

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Management of PUJ Obstruction

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Abstract

Pelvi-ureteric junction (PUJ) obstruction is a well-recognized entity that may present at any time – in fetal life, infancy, childhood, or early or late adulthood. As the most common site of obstruction in the upper urinary tract. There has been an improved understanding of the pathophysiology of primary congenital PUJ obstruction that has been reflected in the evolution of surgical options, from open surgical repair to minimally invasive surgery. This article discusses the surgical management of this condition along with the pathogenesis, clinical presentation, and diagnosis of PUJ obstruction.

Keywords: Kidney; Kidney pelvis; Ureteral obstruction; Surgery; percutaneous.

Introduction

PUJ obstruction is defined as an obstruction of flow of urine from the renal pelvis to the ureter. Most cases are congenital, but it may not become clinically apparent until much later in life.

The incidence of PUJ obstruction is less well defined in adults than in children. In the paediatric age group, it is the most common cause of upper urinary tract dilation. The male-to-female predominance is greater than 2:1, and the left kidney is affected about twice as often as the right.[1] PUJ obstruction occurs in adults less frequently than in neonates.

Etiology

PUJ obstruction from congenital causes may result from either an anatomic or a physiologic defect in the upper ureter.

- Primary luminal narrowing caused by an incomplete recanalization process in utero at the cephalad end of the developing ureter.
- Presence of an aperistaltic segment of the ureter. Histopathologic studies reveal the replacement of spiral musculature by abnormal longitudinal muscle bundles, thus normal peristaltic wave cannot be generated for flow of urine.[2]
- Cytokine produced in the urothelium, transforming growth factor-â, epidermal growth factor expression, nitric oxide, and neuropeptide Y have also been found as cause of PUJ obstruction.[3]
- Ureteral kinks or valves produced by infolding of the ureteral mucosa and musculature may also cause obstruction.

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- Abnormal insertion of the ureter results in high-insertion PUJ obstruction.
- Crossing vessels compressing or distorting the PUJ may cause ureteral outflow obstruction.[4]
- Secondary causes can be due to upper tract infection, stones, trauma (e.g., instrumentation) which can cause reactive fibrosis and formation of stricture.

Presentation

PUJ obstruction can present at any time of life. Initial presentation in neonates and infants can be a palpable flank mass. Use of antenatal USG has resulted in increase in number of patients diagnosed with hydronephrosis.

In older children or adults, intermittent abdominal or flank pain, at times associated with nausea or vomiting, is a frequent presenting symptom. A detailed history may reveal that the pain correlates with periods of increased fluid intake associated with swelling in loin which disappears when large amount of urine is passed (Dietl's crisis). Findings of microhematuria, pyuria, or frank urinary tract infection may be present.

Diagnosis

Goal: To determine both the anatomic site and the functional significance of an apparent obstruction.

Ultrasonography (USG) is the initial diagnostic study. It visualizes dilatation of the collecting system & determine the level of obstruction. Parenchymal thickness, degree of hydronephrosis, status of opposite kidney and presence of stones can be diagnosed with accuracy.

Antenatal USG

Detection of antenatal hydronephrosis (ANH) by ultrasound usually occurs in the second trimester with a renal pelvic dilation (RPD) cutoff of greater than or equal to 4 mm. ANH is present if fetal renal antero-posterior diameter (APD) is e"4 mm in the second trimester and e"7 mm in third trimester.[5]

Classification of Antenatal Hydronephrosis, Based on Renal Pelvic Anteroposterior Diameter

	Second trimester	Third trimester
Mild	4-6 mm	7-9 mm
Moderate	7-10 mm	10-15 mm
Severe	>10 mm	>15 mm

If fetal hydronephrosis is detected, the following parameters are evaluated:

1. Severity of hydronephrosis: The likelihood of a congenital kidney or urinary tract anomaly increases with the severity of RPD.
2. Unilateral versus bilateral involvement: Bilateral involvement increases the risk of a significant renal abnormality and the risk of impaired postnatal renal function.

Postnatal USG

The timing depends on the severity of antenatal hydronephrosis and whether there is bilateral involvement or an affected solitary kidney. Examination is avoided in the first 2 days after birth because hydronephrosis may not be detected because of extracellular fluid shifts that under estimate the degree of hydronephrosis. However, in infants with bilateral hydronephrosis and those with a severe hydronephrotic solitary kidney, urgent evaluation on the first postnatal day is done because of the increased likelihood of significant disease and possible need for early intervention. For unilateral hydronephrosis without antenatal bladder pathology, performing postnatal sonography 1-4 weeks after birth is recommended.[5]

Advantages and disadvantages

The main advantages are ease of use, ability to detect other causes of renal disease like polycystic kidney disease, noninvasive, lack of radiation and contrast, low cost & easy availability. Disadvantages are dependence on

operator skills and non-assessment of functional status of kidney.

Excretory urography remains a good option for radiographic diagnosis after USG. Kidney function test should be normal for the test to be done. Classical findings are, delay in function on affected side associated with a dilated pelvicalyceal system. If the ureter is visualized, it is of normal caliber. It asseses function in obstructed kidney and delineates anatomy.

Diuretic renography measures the drainage time from the renal pelvis and assesses total and individual kidney renal function. It is the best test to establish that dilation of the renal collecting system is due to obstruction. A substance (DTPA or MAG-3) that is filtered by glomeruli and not absorbed is given intravenously. ^{99m}Tc- MAG3 is the preferred isotope because of favourable imaging and dosimetry considerations over ^{99m}Tc- DTPA. Diuretic is given 20 minutes into the study to allow time for filling of the collecting system.[6]

Functionally significant obstruction is often diagnosed with diuretic renal scanning with non washout of isotope even after Lasix. Poorly functioning kidneys (< 10%) are often best treated with nephrectomy.

Advantages and disadvantages

The benefits are that iodine-based intravenous contrast is not used, radiation exposure is minimal, and renal function can be better quantified. The disadvantage is that insight into renal anatomy is not obtained.

Dynamic pressure perfusion studies done in cases with equivocal diuretic renograph, that is inability to differentiate obstructive from non-obstructed dilated system by placing a percutaneous nephrostomy tube. First described by Whitaker in 1973, the renal pelvis is continuously perfused at 10mL/min with normal saline solution or dilute radiographic contrast solution under fluoroscopic control. Renal pelvic pressure is monitored during the infusion, and the pressure gradient across the PUJ is determined. During the infusion, the bladder is continuously drained with an indwelling catheter to prevent transmission of intravesical pressures. Renal pelvic pressure ranging up to 15 to 22 cm H_2O are highly suggestive of a functional obstruction.

Helical CT angiography may be used to help establish the anatomy of PUJ obstruction and associated vessels.[7] It is not routinely indicated.

MR Urography offers the advantages of no radiation exposure and excellent anatomical and functional details with a single study, especially in children. The study also provides details of renal vasculature, renal pelvis anatomy, location of crossing vessels, renal cortical scarring, and ureteral fetal folds in the proximal ureter.

Endoluminalultrasonongraphy is a technique in which small- diameter (6F) sonographic probes are placed in the ureter, usually at the same time as endopyelotomy, to evaluate the nature of the PUJ obstruction and to localize any adjacent vasculature before endoscopic incision. On compared with HCTA (35%), it was found that endoluminal ultrasonography identified more crossing vessels in patients with PUJ obstruction (70%).[8] It can identify both arteries and veins. It can approximate vessel size and determine the dynamic location of vessels with respirations. It may be employed immediately before endopyelotomy to delineate the dynamic location of vessels that can change with respirations, thus facilitating the proper placement, depth, and length of endopyelotomy incision.

Surgical Intervention

Indications for intervention are:

- Hydronephrosis
- Bouts of renal colic
- Evidence of parenchymal damage
- Development of infection

Open Operative Intervention

Aim of repair:

- To create a widely patent and funnel shaped uretero-pelvic junction of adequate caliber.
- Dependent drainage
- Watertight anastomosis
- Tension-free anastomosis
- Adequate vascular supply

Dismembered Pyeloplasty

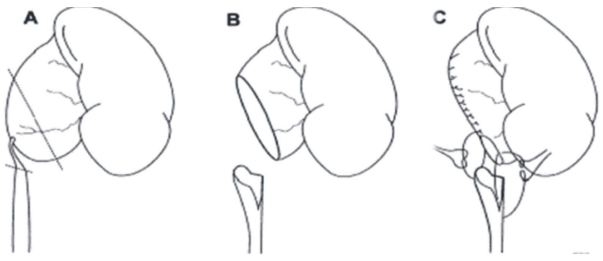
Preferred because it is applicable to the different clinical scenarios.

- Can be used if ureteral insertion is high on the pelvis or already dependent.
- Pemits reduction of a redundant pelvis or straightening of a tortuous proximal ureter.
- Anterior or posterior transposition of the PUJ can be done in obstruction due to accessory or aberrant lower pole vessels.
- It is not suited to a PUJ Obstruction due to multiple or lengthy proximal ureteral strictures or patients with a small intrarenal pelvis.

Method

The proximal ureter is dissected cephalad to the renal pelvis, leaving a large amount of periureteral tissue to preserve the ureteral blood supply. Below the level of the obstruction, a suture is placed on the lateral aspect of the proximal ureter to orient for the subsequent repair. Medial and lateral aspects of the dependent portion of the renal pelvis are marked with traction sutures. The PUJ tissue is excised, and the proximal ureter is then spatulated on its lateral aspect. The apex of this lateral, spatulated aspect of the proximal ureter is brought to the inferior border of the renal pelvis, whereas the medial side of the ureter is brought to the superior aspect.[9] The anastomosis is of ureteral and renal pelvic wall is done in a watertight manner. Anastomosis over an internal stent is done, which is left insitu.

Figure 1: Dismembered pyeloplasty



Advantages

- Good exposure of PUJ
- Ability to tailor renal pelvis
- Watertight anastomosis
- Familiar anatomy for all surgeons

Disadvantages

- Large surgical incision
- Post-operative pain and recovery time more

Flap Procedures

- Can be combined with dismembered pyeloplasty in a dilated extra renal pelvis.
- Creates more funnel shaped PUJ.
- Useful in cases with dependent PUJ despite significant pelvic dilation.
- Interferes less with ureteral blood supply.
- Useful in PUJ obstruction in horse-shoe/ pelvic kidney

Foley Y-V Plasty

- Originally designed for repair of a PUJ obstruction secondary to a high ureteral insertion.[10]
- Generally been replaced by dismembered pyeloplasty
- Contraindicated when transposition of lower pole vessels is necessary

Method