Aberrant renal vessel in cases of pelviureteric junction obstruction: Do we need any additional investigation?

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Abstract. Objectives: To evaluate the role of preoperative investigations in the diagnosis of cases of pelviureteric junction obstruction (PUJO) with aberrant vessel. Methods: Retrospective analysis of cases operated for PUJO with aberrant vessel between January 2005 and May 2013 was done. All cases were diagnosed on renal dynamic scan using standard radioisotopes and managed by Anderson-Hynes pyeloplasty using lumbotomy approach. Modalities for the diagnosis (preoperative ultrasound Doppler, CT angiogram or intraoperative) were evaluated. Those with an incomplete data were excluded. Results: Out of 136 cases of PUJO operated, 18 (13.23%) had PUJO with an aberrant vessel. Left to right ratio was 2:1. Pain was the presenting feature in 14 cases and four cases were antenatally diagnosed. Average age at surgery was 3.2 ± 0.9 years (range 1.1 - 6.8 years). Out of total 18 cases thirteen were diagnosed intraoperatively and five had preoperative diagnosis. Preoperative ultrasound Doppler was done in 5 cases and an aberrant vessel was seen in only two (sensitivity 40%). Preoperative CT angiogram was done in three cases and it was able to pick up the aberrant vessels in all (sensitivity 100%). Conclusion: PUJO due to aberrant vessel is seen in a small subset of population. Management of these cases is no way different than any other PUJO except for an extra precaution. It is not justified to subject all the cases to imaging. If at all required CT angiography should be the investigation of choice.

Introduction

Pelvi-ureteric junction obstruction (PUJO) can present in any age group, but with the advent of improved antenatal ultrasound techniques the rate of detection of these cases in the neonatal period has increased. Thus currently there are two distinct groups, one of those where an antenatal diagnosis is there and second where the presentation is due to symptoms at a later age. There is still a predominance of the second group in countries like India. The precise cause of obstruction remains elusive despite investigations. Intrinsic causes such as interruption in the development of the circular musculature of the PUJ, or an alteration of the collagen fibers and composition between and around the muscle cells may lead to muscle fibers becoming widely separated and attenuated, leading to a functional discontinuity of the muscular contractions and ultimately to insufficient emptying.[1] Aberrant renal vessels pass anterior to the PUJ or proximal ureter and contribute to mechanical obstruction. Whether the aberrant vessel causes obstruction or is a co-variable that exists along with an intrinsic narrowing is unclear. These vessels can be diagnosed by a preoperative imaging or else can be an incidental detection on operation table. We tried to compile our results in cases of PUJO due to aberrant vessels and evaluate the need of preoperative imaging in these cases.

Materials and Methods

This was a retrospective study. The case records of operated cases of PUJO due to aberrant vessel between January 2005 and May 2013 were evaluated. All the cases were diagnosed on renal dynamic scan using standard radioisotopes and managed by Anderson-Hynes pyeloplasty using lumbotomy approach. Indications for surgery were function <35% on renal dynamic scan with obstructive pattern of clearance, fall of 10% in the differential renal function on renal dynamic scan, preoperative diagnosis of an aberrant renal vessel. The modalities for the diagnosis were evaluated. These modalities were either preoperative ultrasound Doppler, CT angiogram or intraoperative. Patients diagnosed preoperatively by CT angiography were those who were investigated and referred from other institutes for treatment. Those with an incomplete data were excluded from the study. The sensitivity of preoperative investigations was compared with respect to the intraoperative findings. All the data was analyzed and compiled.
Results

A total of 136 cases of PUJO were operated in this duration out of which 18(13.23%) cases had PUJO due to extrinsic compression by abberent vessel. PUJO was present in 12 cases on the left side while it was present in 6 cases on the right side. Left to right ratio was 2:1. Pain was the predominant presenting feature. Four cases were antenatally diagnosed. The average age at surgery was 3.2 ± 0.9 years (range 1.1 - 6.8 years). Male to female ratio was 3:2. Out of total 18 cases five had a preoperative diagnosis (referred from other institutes) while the remaining 13 were diagnosed intraoperatively. Preoperative ultrasound Doppler was done in 5 cases and an aberrant vessel was seen in only two, in remaining 3 cases this was diagnosed intraoperatively. Preoperative CT angiogram (Fig. 1) was done in three cases and it was able to pick up the aberrant vessel in all of them. The distribution of PUJO and the status of investigations were as shown in table-1.

Table 1. Sensitivity of various imaging modalities used in the diagnosis (n=8)

<table>
<thead>
<tr>
<th>Imaging modality</th>
<th>Intraoperative findings</th>
<th>Right sided</th>
<th>Left sided</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasound Doppler</td>
<td>Correct</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wrong</td>
<td>2</td>
<td>1</td>
<td>40%</td>
</tr>
<tr>
<td>CT angiography</td>
<td>Correct</td>
<td>1</td>
<td>2</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Wrong</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Discussion

An aberrant, accessory or early branching lower pole vessel is one of the common causes of extrinsic PUJO. These vessels pass anterior to the PUJ or proximal ureter and could contribute to mechanical obstruction at the PUJ. The presence of crossing blood vessel as a benign cause of PUJO was first described by Wadsworth in 1983. Sampaio and McClennan stated in 1990 that "a precise understanding of the vascular anatomy is of utmost importance when evaluating patients with PUJO". The incidence of crossing vessels in patients with PUJO varies from 11% to 87% in the published literature though most of the studies have been on the adult population. Crossing vessels might affect the renal blood supply, so they are usually preserved while doing Anderson-Hynes dismembered pyeloplasty. In some patients PUJO might be due to extrinsic obstruction by the crossing vessel with no intrinsic anomaly. The gold standard in the treatment of intrinsic and extrinsic PUJO is dismembered pyeloplasty anyway as described by Anderson and Hynes in 1949. Pyeloplasty can be performed using an open, laparoscopic or robotic approach. We performed pyeloplasty in our cases using open dorsal lumbotomy approach as described previously by the senior author. This approach allows direct visualization of the pelvis and a better delineation of the vascular anatomy. Exploration in general allows visualization of the potential factors associated with obstruction in the lower pole it may be vessels, redundant pelvis or intrinsic ureteral narrowing. Thus dismembered pyeloplasty remains the reference standard for treating PUJO of all pathological origins, including a crossing vessel.

Presence of an aberrant vessel in general does not change the management except for the extra precaution required in these cases. Vascular relocation of lower pole renal vessels on the anterior pelvic wall is a simple technique.

Fig.1. CT angiography image showing aberrant vessel
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In our study, the sensitivity of color Doppler was found to be 40%, this may be due to the lower age of the subjects. Enhanced color Doppler imaging enabled confirmation of 22 of 23 patients with crossing vessels and excluded six of six patients suspected of having crossing vessels; this resulted in a sensitivity of 96% and an overall accuracy of 97% in the study by Frauscher F et al.[17]. We however did not use contrast enhancement due to our concern regarding its safety and high cost. Frauscher F et al.[17] demonstrated that the sensitivity of the detection of veins in particular markedly increased after contrast agent administration. Mitterberger et al.[18] compared contrast-enhanced color Doppler imaging (CDI), computed tomography (CT), and magnetic resonance imaging (MRI) for the detection of crossing vessels in adult population. Contrast-enhanced CDI enabled the identification of 44 of 44 patients with crossing vessels. All four patients without crossing vessels at the PUJ of the 48 patients with surgically confirmed diagnoses were correctly excluded. This procedure yielded sensitivity and a specificity of 100%. Enhanced CT diagnosed 40 of the 44 patients with crossing vessels correctly. Four small veins were missed with enhanced CT. The veins were estimated to be less than 4mm in diameter at laparoscopy and located posteriorly to the UPJ. This procedure yielded a sensitivity of 93% and a specificity of 100%. MRI enabled the identification of all 44 of 44 patients with crossing vessels. Furthermore all 60 vessels were correctly identified. The four patients without crossing vessels at laparoscopy were correctly excluded. This procedure yielded sensitivity and a specificity of 100%.

In our study aberrant vessels could be demonstrated in all three cases those underwent a CT angiography. Most of the studies done and discussed have been done in adult population in specialized centers. The limitation of these studies in our scenario is that most of the cases come from the remote background with limited access to the health care facilities. Their concern is on the immediate solution of the problem with literally no concern on the long term prospects. They require a onetime cost effective solution. Performing a preoperative advanced imaging won’t be a practical approach for them. Thus based on the above observation we feel that the diagnosis of the abberent vessels can be done on table. Whatever may be the cause Anderson-Hynes pyeloplasty is the procedure of choice. But when we have a preoperative diagnosis of the presence of abberent vessels the approach and planning becomes more precise and which is in fact beneficial for the patient. Among the two available studies CT angiography has a better sensitivity as compared to ultrasound Doppler but has the obvious disadvantage of the cost and radiation exposure. Requirement of imaging thus

and was first described in 1951.[15] This involves transposition of the aberrant vessels to a superior, unobstructed position. This technique, involves mobilizing, moving and securing the vessel to a more cephalic position on the renal pelvis. This prevents pelvic herniation and subsequent PUJO. Pesce et al.[16] described a series of 61 paediatric patients, these cases were treated with open crossing vessel transposition and they demonstrated a good outcome in all cases except in one. With appropriate and careful patient selection, this technique could help to achieve a successful outcome in up to 95% of patients however any other paediatric series using this approach is lacking.

Vascular translocation per se is difficult in paediatric age group owing to the presence of delicate vessels and tissue fragility. As accumulating evidence shows, in some cases the pressure of an aberrant crossing vessel is the main cause of PUJO, so treating the intrinsic obstruction alone is insufficient to relieve the obstruction. It has been shown in adult studies that antegrade and retrograde endopyelotomy had worse outcomes in the presence of the crossing vessels; the success rate of endopyelotomy approaches 90% with no crossing vessels, but decreases to ≈60% if there were crossing vessels.[14] However endopyelotomy per se is not a very popular management options in the children. There are, to date, no imaging techniques or intraoperative procedures available to confirm that the crossing renal vessels are the sole etiology for PUJO. The diagnosis of an abberent vessel causing PUJ obstruction is predominantly intraoperative and does not affect the approach and procedure offered.

Numerous imaging modalities have been used in adults to identify crossing renal vessels, such as angiography, endoluminal ultrasound, Doppler ultrasound, spiral CT, and MRI.[13] None of these modalities can assert whether crossing renal vessels are obstructive or are merely incidental findings. Luigi et al.[14] conducted a study to diagnose the sensitivity of the ultrasound Doppler in the diagnosis of aberrant vessels in adult population. They did preoperative ultrasound Doppler in 21 cases and could detect abberent vessel in 11. True positivity and true negativity were 10 and 9 respectively thus showing a sensitivity of 90.4%. Frauscher F et al.[17] used contrast enhanced color Doppler using intravenously administered levovist in adult population to assess the displacement of the vessels relative to the PUJ along with non-contrast color Doppler. Contrast-enhanced Doppler revealed a cranial displacement (mean 1.3 cm) of the crossing vessels from the PUJ in all 23 cases. Non enhanced color Doppler images depicted 15 of the 23 surgically confirmed cases of crossing vessels; the sensitivity was 65% and an overall accuracy was 72% for vessel detection.
depends on the clinical scenario and the background the patient. It is insignificant whether a diagnosis is preoperatively made or not because it does not affects the outcome. For a mere 13% cases of PUJ due to aberrant vessels whole of the remaining population can't be justified to be subjected to additional imaging.

**Conclusion**

PUJO due to aberrant vessels is seen in a small subset of population. Management of these cases is no way different than any other PUJO except for an extra precaution. It is not justified to subject all the cases to imaging to diagnose a small subset. If at all required CT angiography should be the investigation of choice.

**References:**