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How Reliable Are Imaging Study Reports in Assessing Pediatric Ureteropelvic Junction Obstruction? A Real-World Experience

Pediatrik Üreteropelvik Bileşke Darlıklarının Değerlendirilmesinde Görüntüleme Raporları Ne Kadar Güvenilir? Gerçek Dünya Deneyimi

Ali Sezer[1], **Emre Kandemir**[2], **Bilge Türedi**[1]

[1] *Department of Pediatric Urology, Konya City Hospital, Konya, Türkiye*
[2] *Department of Urology, Karamanoğlu Mehmetbey University, Karaman, Türkiye*

ABSTRACT

Objective: Serial ultrasonography (US) and nuclear scintigraphy imaging are sufficient in the decision-making process in most ureteropelvic-juntion obstruction (UPJO) patients. Contrast-enhanced cross-sectional imaging (CE-CSI) can be used in uncertain indications or the presence of additional anatomical anomalies. We evaluate the effectiveness and reliability of pre-operative US and CE-CSI reports of UPJO patients who underwent pyeloplasty.

Material and Methods: The data of pediatric patients under the age of 18 who underwent CE-CSI with suspicion of UPJO between March 2020-2024 and who subsequently underwent pyeloplasty were reviewed retrospectively. The patients were divided into two groups. Primarily, ultrasound and CE-CSI reports were compared, and secondarily, the initial and re-evaluated CE-CSI report findings were compared in terms of the reporting of crossing vessels (CV).

Results: The data of 44 patients (23 boys and 21 girls) with a mean age of 8.1 years were reviewed. Ultrasound and CE-CSI reports were compared, and it was seen that significantly more parenchymal thickness information was reported in the CE-CSI group than in the US group (CE-CSI:31(70.5%), US:18(40.9%), p=0.007). Crossing vessels were reported in 10 patients (41.6%) in initial CE-CSI reports. After re-evaluation of images by a radiologist who cooperated with the pediatric urologist, CV was reported in 21 patients (87.5%), and the difference was statistically significant (p=0.003)

Conclusion: Despite its disadvantages in the pediatric age group, the success of CE-CSI in revealing detailed anatomical information, particularly vascular anatomy, cannot be ignored. Our study demonstrated that investigating the presence of CV in pediatric patients with UPJO is crucial, particularly in older and symptomatic children. In CE-CSI, the results should be evaluated by an experienced uroradiologist.

Keywords: cross-sectional imaging, pyeloplasty, ureteropelvic-junction obstruction, ultrasound

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Corresponding Author : *Ali Sezer, Konya City Hospital, Department of Pediatric Urology, Konya, Türkiye*
e-mail: alisezer21@gmail.com
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ÖZET

Amaç: Seri ultrasonografi (US) ve nükleer sintigrafi görüntüleme, çoğu üreteropelvik bileşke darlığı (ÜPBD) hastasında karar verme sürecinde yeterli olmaktadır. Kontrastlı kesitsel görüntüleme (KKG), belirsiz endikasyonlar veya ek anatomik anomalilerin varlığında kullanılabilir. Bu çalışmada, pyeloplasti uygulanan ÜPBD hastalarının preoperatif US ve KKG raporlarının etkinliği ve güvenilirliği değerlendirilmiştir.

Gereç ve Yöntemler: Mart 2020 ile 2024 arasında ÜPBD şüphesiyle KKG yapılan ve ardından pyeloplasti operasyonu geçiren 18 yaş altındaki pediatrik hastaların verileri retrospektif olarak incelenmiştir. Hastalar iki gruba ayrılarak, birincil olarak ultrasonografi ve KKG rapor bulguları karşılaştırılmış, ikincil olarak ise çaprazlayan damar basısı (ÇDB) bildirimi açısından ilk ve yeniden değerlendirilen KKG rapor bulguları karşılaştırılmıştır.

Bulgular: Ortalama yaşları 8.1 yıl olan 44 hastanın (23 erkek, 21 kız) verileri incelenmiştir. Ultrason ve KKG raporları karşılaştırıldığında, parankimal kalınlık bilgisi, KKG grubunda US grubuna göre anlamlı derecede daha fazla rapor edilmiştir (KKG: 31 (%70,5), US: 18 (%40,9), p=0,007). İlk KKG raporlarında 10 hastada (%41,6) ÇDB bildirilmiştir. Bir pediatrik ürolog ile iş birliği yapan deneyimli bir radyolog tarafından yapılan yeniden raporlama sonrasında ÇDB, 21 hastada (%87,5) bildirilmiş ve fark istatistiksel olarak anlamlı bulunmuştur (p=0,003).

Sonuç: Pediatrik yaş grubunda bazı dezavantajlarına rağmen, KKG'nin özellikle damar anatomisini ortaya koymadaki başarısı göz ardı edilemez. Çalışmamız, ÜPBD olan pediatrik hastalarda ÇDB'nin varlığını araştırmanın, özellikle büyük ve semptomatik çocuklarda önemli olduğunu göstermiştir. KKG sonuçları, deneyimli bir üro-radyolog tarafından değerlendirilmelidir.

Anahtar Kelimeler: kesitsel görüntüleme, piyeloplasti, üreteropelvik bileşke darlığı, ultrason

INTRODUCTION

Ureteropelvic junction obstruction (UPJO) is among the most common causes of upper urinary tract obstruction. With the help of antenatal imaging, the incidence of UPJO has been increasing in recent years (1). The most common causes include extrinsic compression, intrinsic stenosis, and ureteral insertion abnormalities. Crossing vessels (CV) originate from the abdominal aorta or iliac artery, supply the lower pole of the kidney, and can cause obstruction due to the compressive effect on the ureteropelvic junction. Patients with UPJO due to CV are more commonly diagnosed in late childhood, accounting for approximately 29-65% of UPJO cases (2). Diagnosing the presence of CV in the pre-operative period is important, as it may influence the surgical approach. Failure to identify CV during surgery can result in unfavorable outcomes and may necessitate redo-pyeloplasty (3). Additionally, endoscopic endopyelotomy should not be performed in the presence of CV.

Serial ultrasonography (US) and nuclear scintigraphy are sufficient imaging modalities for decision-making in most UPJO patients (4). Ultrasonography provides valuable information on kidney size, echogenicity, parenchymal thickness, and the degree of hydronephrosis. Although it is easily accessible and applicable, its accuracy largely depends on the operator's experience. Furthermore, it may be insufficient for detecting CV (5). Computed tomography urography (CTU) is a fast and non-invasive method used to diagnose CV. However, exposure to ionizing radiation is one of the major disadvantages of CTU, particularly in children. Magnetic resonance urography (MRU) is preferred in children due to its radiation-free nature; however, it may require anesthesia in younger children for the procedure (6). In addition to imaging quality, proper reporting of findings and the evaluator's expertise are crucial for guiding the clinician. Several studies in the literature have focused on improving both the quality of imaging techniques and the reporting process by using detailed checklists (7,8).

This study aims to assess the reliability of preoperative US, CTU, and MRU imaging reports in patients with UPJO who underwent pyeloplasty. The secondary objective is to compare the frequency of CV reporting, as identified during surgery, in the initial and re-evaluated contrast- enhanced cross-sectional imaging (CE-CSI) reports. This will provide a real-world assessment of the consistency between preoperative imaging reports and intraoperative findings.

MATERIAL AND METHODS

The institutional ethical committee has approved this study protocol (2023/28). Written and verbal consent were obtained from the parents of all participants. The data of pediatric patients under the age of 18 with UPJO who underwent pyeloplasty between March 2020 and 2024 were retrospectively reviewed, including those who had undergone CE-CSI prior to surgery. Patients who underwent non-contrast imaging, had unsuitable imaging protocols or low quality images, or whose images were unavailable were excluded.

Contrast-enhanced cross-sectional imaging was not routinely performed, except for those conducted at external centers, and was only used in selected instances. Magnetic resonance urography was primarily performed when there were inconsistencies between scintigraphy results and serial US findings, or when it was needed to help determine surgical indications. Computed tomography urography, which had very limited use in our practice for pediatric patients, was preferred in addition to the suspicion of UPJO if stone formation was also suspected. All CE-CSIs were initially reported by a general radiologist and then subsequently re-evaluated and reported by an experienced radiologist preoperatively. Surgical indications were determined through the collaborative decision of two pediatric urologists, following the European Association of Urology guidelines (4).

The patients' demographics, complaints, preoperative US findings, dynamic scintigraphy results, CTU and MRU reports, and operative data were recorded. Ultrasound and initial CE-CSI reports were compared based on the grading of hydronephrosis, anterior-posterior pelvic diameter (APD), and parenchymal thickness. Additionally, the initial and re-evaluated CE-CSI reports of patients with and without CV, as identified intraoperatively, were compared in terms of preoperative CV reporting.

The Statistical Package for the Social Sciences (SPSS) was used for data analyses. Quantitative data are expressed as mean ± standard deviation. Categorical data were expressed in n (frequency) and percentages (%). Categorical parameters between US/CE-CSI groups were compared with the chi-square and Fisher's exact tests. The results were considered statistically significant if the p-value was <0.05.

RESULTS

The data of 44 patients (23 boys and 21 girls), with a mean age of 8.1 years, were reviewed. Magnetic resonance urography was performed in 30 patients, nine of whom underwent the procedure under anesthesia, while CTU was performed in 14 patients. In addition to UPJO, kidney stones were identified in three children who underwent CTU. The demographic and preoperative data are presented in Table-1.

It was observed that significantly more information regarding parenchymal thickness was reported in the CE-CSI group compared to the US group ($p=0.007$), while no significant difference was found in the reported data for APD and hydronephrosis grading ($p=1.000$)(Table-2).

Crossing vessels were detected intraoperatively in 24 patients (54.5%). When the data of patients with and without CV were compared, the age was found to be significantly higher in the CV group (CV=11.5±4.3, non-CV=2.5±2.0 $p<0.001$). While the majority of patients in the CV group were symptomatic (58% experiencing pain), most patients in the non-CV group were asymptomatic, with this difference being statistically significant ($p = 0.048$). Initial CE-CSI reports identified a CV in only 10 patients (41.6%). After re-evaluation of images by a experienced radiologist a CV was reported in 21 patients (87.5%), and the difference was statistically significant ($p=0.003$) (Figure-1).

Table 1. Patient Demographics and Preoperative Data

Gender, n (%)	
Male	23 (52.3)
Female	21 8(47.7)
Age (year)*	8.1±5.7
Side, n (%)	
Left	27 (61.4)
Right	17 (38.6)
Symptoms, n (%)	
Asymtomatic	20 (45.5)
Pain	18 (40.9)
Hematuria	6 (13.6)
CE-CSI method, n (%)	
MRU	30 (68.2)
CTU	14 (31.8)
Parenchymal thickness (mm) *	5.5±1.9
APD (mm) *	30.2±10.9
Hydronephrosis Grading n (%)	
G1	0
G2	1 (2.3)
G3	18 (40.9)
G4	25 (56.8)
Separated renal function (%)*	37.5±3.2

*mean±standart deviation

Table 2. Comparison of Cross-Sectional Imaging and Ultrasound Report Data

	CE-CSI	US	p
Reported parenchymal thickness, n (%)	31 (70.5)	18 (40.9)	0.007
Reported APD, n (%)	37 (83.8)	37 (83.8)	1.000
Reported Hydronephrosis, n (%)	41 (93.2)	41 (93.2)	1.000

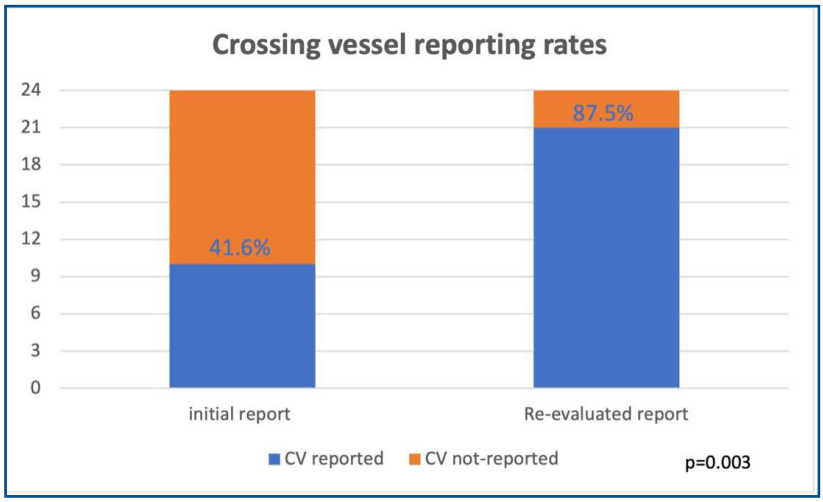

Figure 1. Comparison of crossing vessel reporting rates in initial and re-evaluated reports

DISCUSSION

Distinguishing patients who will require surgical intervention is of significant importance, as spontaneous resolution is observed in the majority of cases of antenatally diagnosed hydronephrosis (4). In most cases, evaluation with US and scintigraphy alone is typically sufficient. Although US is a fast, cost-effective, easily accessible, and repeatable examination, it has the drawbacks of being operator-dependent and inadequate for assessing dynamic urinary drainage, detecting CV and evaluating the condition of the middle and lower ureter. Renal scintigraphy is another method used to make treatment decisions for UPJO, offering a functional evaluation of kidney performance (4). Since Tc-99m mercaptoacetyltriglycine (MAG-3) is cleared mainly by tubular secretion, the elimination half-life of the substance from the kidney provides valuable ideas in follow-up (9). However, its main disadvantages are radiation exposure, low anatomical resolution, and the inability to provide information about vascular variations. Therefore, CE-CSI is still required in cases where the diagnosis remains uncertain. Computed tomography urography effectively identifies the cause of obstruction and evaluates the presence of CV (10). However, its use in children is limited due to the use of contrast agents and exposure to high doses of ionizing radiation. Although MRU provides detailed information about the collecting system and surrounding organ tissues compared to conventional methods, its use is recommended only in specific indications due to its high cost and the need for anesthesia in young children (11).

Real-world challenges have led to an increased reliance on cross-sectional imaging. Factors such as high patient volume, particularly in tertiary care settings, limit the time available for adequately evaluating these specialized patient groups. Additionally, the limited number of pediatric radiologists, with many centers lacking this expertise, further exacerbates the problem. The involvement of multiple radiologists in interpreting imaging studies results in significant variability in reports, making reliable comparative analyses nearly impossible. Consequently, CE-CSI is used more frequently than ideally recommended, as it provides a more consistent and accessible method for diagnosis under these constraints.

Our findings show that in the CE-CSI group, significantly more parenchymal and vascular findings were reported compared to US. Beyond mere reporting, cross-sectional imaging allows both radiologists and the surgical team to review the images, providing valuable insights for decision-making. Since urolithiasis is not uncommon in patients with UPJO, computed tomography may offer distinct advantages in those suspected of having nephrolithiasis. Rarely, CTU may be helpful in differentiating whether the cause of the obstruction is a stone or UPJO. In our series, 9 patients had CTU performed at external centers. CTU was performed on 5 patients in our center with suspected UPJO, in addition to a concomitant suspicion of kidney stones. Kidney stones were detected in three of these patients, allowing for the successful performance of concurrent laparoscopic-assisted endoscopic stone surgery in these cases. Considering disadvantages such as radiation exposure, CTU should be used judiciously. If the presence of UPJO is confirmed by US and scintigraphy, and there is suspicion of stones, it should be kept in mind that non-contrast computed tomography may be sufficient for detecting kidney stones, rather than CTU.

Crossing vessels account for approximately one-third of the causes of UPJO, and the need for surgery is higher in these patients (12). One study found that a CV was present in 11% of patients diagnosed antenatally, while it was observed in 49% of symptomatic children (13). Similarly, in our study, the patient group with CV had a significantly higher age ($p<0.001$). Additionally, the rate of symptomatic admissions was significantly higher in the CV group ($p<0.048$). Distinguishing these patients is crucial, as they benefit significantly from surgery. However, the imaging methods used to achieve this distinction remain a subject of debate, and a widely accepted algorithm has yet to be established. Crossing vessel compression may be overlooked in surgeries performed through retroperitoneal or dorsal lumbotomy approaches. In our series, a 1-year-old male patient underwent laparoscopic transperitoneal pyeloplasty instead of open retroperitoneal surgery after CV were detected on preoperative MRU.

In a study highlighting the importance of the evaluator's experience, the sensitivity of MRU in detecting the presence of crossing vessels (CV), initially 60-65%, increased to 88.2%, and specificity was 91.2% when evaluated by an experienced uroradiologist (14). Our study supports similar findings; CE-CSI reports provided more detailed information; however, the reporting of crossing vessels (CV) remained low in the initial reports, with CV detected in

41.6% of cases, and in 87.5% after re-evaluation by an experienced radiologist. Based on our clinical observations, another reason for the deficiencies in imaging reports is the lack of certain necessary findings in the report template. Studies show that preparing some checklists for the US and voiding cystourethrography is helpful in improving the quality of imaging protocols and reports (7,8). For CTU and MRU imaging, sharing detailed clinical information with the radiologist, along with face-to-face or telephone consultations when necessary, will facilitate a thorough evaluation and comprehensive reporting of the findings.

Besides reporting and evaluation, it is crucial to remember that failing to implement the necessary procedures can result in unnecessary time and labor loss. A study on this subject evaluated 14 patients planned for endopyelotomy after MRU, and re-imaging was performed using the correct protocols, which revealed the presence of CV in 4 patients (15). In our series, despite evaluation by an experienced radiologist, 12.5% of CV cases were not detected preoperatively. These findings highlight the importance of accurate imaging.

Our study has several limitations. The first is its retrospective design and small sample size. Secondly, the quality of the reports varied, as they were evaluated by multiple radiologists due to the high workload at the training and research hospital. Since cross-sectional imaging was performed only in selected pediatric patients, the results should not be generalized to all children with UPJO. To draw more definitive conclusions, prospective studies with larger patient populations are needed.

CONCLUSION

Despite its disadvantages in the pediatric age group, the ability of CE-CSI to reveal detailed anatomical information, particularly regarding vascular anatomy, should not be overlooked. Our study demonstrated that investigating the presence of CV in pediatric patients with UPJO is crucial, especially in older and symptomatic children. Furthermore, the results from CE-CSI should be evaluated by an experienced uroradiologist.

Conflict of İnterest: There is no conflict of interest in our study.

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