

# Agreement between static magnetic resonance urography and diuretic renal scintigraphy in patients with ureteropelvic junction obstruction after pyeloplasty

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## Abstract

**Background:** Ureteropelvic junction obstruction (UPJO) is the most common cause of hydronephrosis within childhood that usually treat by surgery. According to anatomical variations in different individuals, scheduling similar procedures for all patients is not suitable, and thus the best decision for an appropriate surgical technique should be considered separately for each patient. Regardless of the type of applied technique, creating a funnel-shape UPJ with a suitable size is a successful treatment. In this context, the assessment of a successful surgical treatment in a short-term follow-up means repairing revealed anatomical defects. The present study aimed to compare the diagnostic value of static magnetic resonance urography (MRU) and diuretic-based renalscintigraphy (DRS) in patients with UPJO after pyeloplasty.

**Materials and Methods:** A total of 30 consecutive patients with UPJO, who underwent unilateral pyeloplasty between 2012 and 2013 were assessed. All subjects underwent DRS and also MRU about 1-month after the former procedure.

**Results:** The Kendall's tau correlation showed a very strong correlation between results of MRU and diuretic renal scintigraphy ( $r = 0.932$ ,  $P < 0.001$ ). This strong correlation was also shown by Somers'd test ( $r = 0.932$ ,  $P < 0.001$ ) similarly.

**Conclusions:** Our study shows a strong agreement between DRS and MRU to assess UPJO. MRU static fluid has a high accuracy for assessment of renal system anatomy. Due to the lack of dangerous consequences of contrast materials, MRU can be the best option instead of DRS.

**Key Words:** Accuracy, pyeloplasty, scintigraphy, ureteropelvic junction obstruction, urography

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## INTRODUCTION

Ureteropelvic junction obstruction (UPJO) is the most common cause of hydronephrosis within childhood.<sup>[1]</sup> This benign abnormality is manifested by anatomical or functional obstruction in urinary flow leading to renal function deterioration or renal dysfunction in untreated patients.<sup>[2]</sup> In this regard, preventing

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progression of renal dysfunction is a major reason for surgical operation as pyeloplasty.<sup>[3]</sup> Despite recent development of imaging studies in the assessment of UPJO, the main etiological features of this defect and also beneficial effects of surgical interventions in affected patients remained controversial. However, correct anatomical evaluation of collecting system and vascular pedicle in each patient are now considered as the main hallmarks for managing the patients, determining the criteria for surgical treatment, and also as an index for assessing postoperative consequences.<sup>[2]</sup>

According to anatomical variations in different individuals, scheduling similar procedures for all patients is not suitable, and thus the best decision for an appropriate surgical technique should be considered separately for each patient. Regardless of the type of applied technique, creating a funnel-shape UPJ with a suitable size is a successful treatment.<sup>[4,5]</sup> In this context, the assessment of a successful surgical treatment means repairing revealed anatomical defects followed by long-term following-up for assessment of renal functional state. The common methods for short-term follow-up of treated patients include sonography, Urography, and scintigraphy. Because hydronephrosis may be resolved slowly due to prolonged expansion of renal calyces and pelvis, more than half the patients may suffer from this complication, even 6 months after repairing and thus sonographic assessment of the presence of hydronephrosis, but not assessment of UPJ status cannot be an acceptable tool for assessing surgery successfulness.<sup>[6-8]</sup> Diuretic-based renalscintigraphy (DRS) is the selective imaging method for ruling out of renal obstruction and also assessing renal function in children who affected by hydronephrosis. However, besides of the risk for radiation-related complications, this method achieved little anatomical information.<sup>[9]</sup> This method had a weak spatial and contrast resolution.<sup>[10,11]</sup> Moreover, its technique is directly dependent to radioactive materials secretion and thus if renal dysfunction occur, the secretion of this materials reduce and thus anatomical assessment of the kidney system may be assessed with lower contrast. Thus, applying other modalities with higher resolution concomitant with lower renal function involvement is more appropriate for assessment of patients who are undergoing pyeloplasty.

Magnetic resonance urography (MRU) is a common technique for anatomical assessment of renal complex achieving three-dimensional-images from this system. This procedure can be used as its static or dynamic capabilities for the assessment of liquid containing structures and parenchyma, respectively.<sup>[9-14]</sup> This

procedure has no limitations of DRS and thus can be more applicable for assessment of renal structure anatomical features. In addition, because of its high resolution, its diagnostic sensitivity can be reached to 96% for evaluation of urogenital anomalies.<sup>[15-18]</sup> The present study aimed to compare the diagnostic value of static MRU and DRS in patients with UPJO after pyeloplasty.

## MATERIALS AND METHODS

In a cross-sectional study, 30 consecutive patients with UPJO who underwent unilateral pyeloplasty between 2012 and 2013 were assessed. Those with some anatomical anomalies including duplex kidney or ectopic kidney were not included into the study. All subjects underwent DRS and MRU at most 1-month after the former procedure.

For the assessment by DRS, the patients were initially hydrated with normal saline 500 ml, then <sup>99m</sup>Tc-diethylenetriamine pentaacetate (DTPA) 5 mCi/1.73 m<sup>2</sup> (minimum dose 1 mCi) were injected. 20 min after <sup>99m</sup>Tc-DTPA injection, Lasix 1 mg/kg with the maximum dose of 40 mg was injected intravenously.<sup>[19]</sup> Renal regions of interest was assessed manually and perirenal background regions of interest was assessed using camera's software automatic technique<sup>[19]</sup> and washout amount of contrast material after Lasix injection was considered as the index for presence or absence of obstruction in pyelocaliceal system.

Static MRU was performed using a scanner 1.5 tesla and phased array torso surface coil by half-Fourier single shot fast spin echo technique. In this method, ringer lactate 500 ml and Lasix 20 mg were injected intravenously 15 min before scanning and then images of two-dimensional T2-weighted (repetition time = 5500, echo time [TE] = 210, echo train length [ETL] = 29) and heavily three-dimensional T2-weighted (TE = 600, ETL = 109) were prepared.<sup>[11]</sup>

Visualization of fluid containing UPJ at least in one plane considered as nonobstructed UPJ (either normal or dilated pelvicaliceal system).

The patients were finally subdivided to three groups according to the presence or absence of obstruction (nonobstructed, dilated nonobstructed and obstructed). The findings of the two diagnostic systems were blindly assessed by a radiologist and a nuclear medicine specialist. UPJ anatomy was the criterion for obstruction in MRU; if UPJ was not visualized in MRU images, it took obstructed score and if UPJ was visualized, but pelvicaliceal system was dilated, it took

dilated-nonobstructed score, and finally visualization of UPJ without dilatation of pelvicalyceal system took nonobstructed score. Kendall's tau correlation and Somers'd test were used to determine the association between these two procedures. For the statistical analysis, the statistical software SPSS version 20.0 for windows (SPSS Inc., Chicago, IL) was used.

## RESULTS

The characteristics of the study subjects assessing by the two DRS and MRU methods are summarized in Figure 1. The mean  $\pm$  standard deviation age of participants was  $31.86 \pm 19.95$  years ranged 8–70 years that among them, 17 were males. Regarding coefficient between DRS and MRU, the reports of the two procedures were normal in nine patients and obstruction in five patients. Dilated nonobstructed pelvis was also similarly reported in two modalities. However, diagnostic discrepancy between the two procedures was revealed in two patients so that MRU reported obstruction, whereas the diagnosis in DRS for these cases was dilated nonobstructed pelvis. In this regard, assessing by the Kendall's tau correlation showed a very strong correlation between the two procedures ( $r = 0.932$ ,  $P < 0.001$ ). This strong correlation was also shown by Somers'd test ( $r = 0.932$ ,  $P < 0.001$ ) similarly.

## DISCUSSION

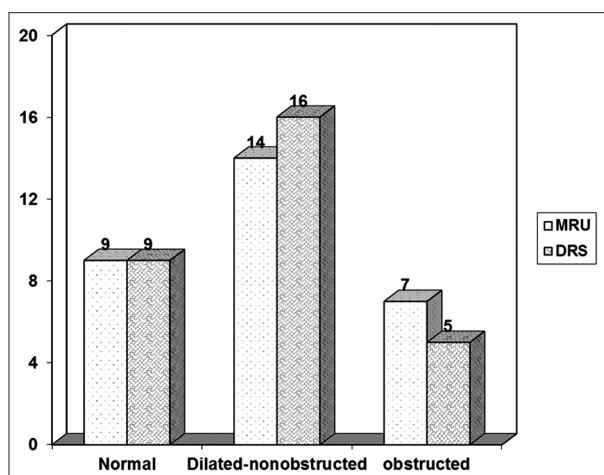
Similar to our study regarding strong correlation between the two diagnostic procedures of DRS and MRU to assess UPJO, some previous studies had similar observations. Shokeir *et al.* similarly concluded that static MRU could be a minute modality for determining the cause and level of renal system obstruction.<sup>[20]</sup> The results of the study

by El-nahas *et al.* were in the line of replacing radioisotope venography by MRU for assessing differential renal function and probable obstruction.<sup>[14]</sup> Some studies also confirmed the value of MRU for assessing causes of hydronephrosis.<sup>[1,6,16,17]</sup> Little *et al.* suggested that because of the difference in the type of UPJ obstructions, managing protocol, and therapeutic decision should be specific for each affected patients. On the other hand, because MRU is able to determine pathophysiological differences across patients with UPJO, it can have a potential role in selecting patients for surgical management.<sup>[10]</sup>

In addition to anatomic changes in UPJO, functional obstruction due to insufficient peristaltism can be either cause and effect of prolonged obstruction and therefore in short-term follow-up of surgical reconstruction; DRS by assessing washout of contrast and urine from renal pelvis is deficient method for evaluation of obstruction.

In total, according to this fact that static fluid MRU has a high accuracy for assessment of renal system anatomy and also due to the lack of dangerous consequences of contrast materials and radiation, and because the goal of short-term follow-up is detection of corrected anatomy (renal functional repair needs more time), static fluid MRU can be the best option instead of DRS for short-term follow-up of patients after pyeloplasty.

Disagreement between MRU and DRS observed in two patients may be due to visualization disability of UPJ in MRU images related to artifactual causes. Furthermore, explanation of the results of DRS may be incorrect in some intermediate conditions. In total, the purpose of surgery in UPJO is anatomical reconstruction of the defects, no improving renal functional state, and therefore, static fluid MRU can appropriately show postoperative anatomical repair.



**Figure 1:** Frequency of normal, dilated-nonobstructed and obstructed report in magnetic resonance urography and diuretic-based renalscintigraphy imaging

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