



Is renal scintigraphy necessary after heminephrectomy in children?

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Summary

Introduction

Heminephrectomy remains an excellent option for a poorly functioning moiety in a duplicated collecting system. A primary concern during heminephrectomy is the potential for a significant functional loss in the remaining ipsilateral moiety. As the gold standard for the assessment of differential renal function, renal scintigraphy is often used in the postoperative evaluation of children undergoing heminephrectomy. However, this imaging modality is costly, invasive, and associated with exposure to radiation. Doppler renal ultrasound (RUS) avoids these concerns and is able to evaluate for structural and functional abnormalities.

Objective

The present study sought to compare Doppler RUS to renal scintigraphy in determining the viability of the remaining ipsilateral moiety in children who underwent heminephrectomy for a poorly functioning moiety in a duplicated collecting system.

Materials and Methods

The institutional database of children who underwent open heminephrectomy for a poorly functioning moiety in a duplicated collecting system between 2006 and 2013 was reviewed. Only children who underwent both a postoperative Doppler RUS and renal scan were included. A blinded pediatric radiologist independently reviewed all Doppler RUS. Vascular flow on Doppler RUS was correlated with the preservation of renal function in the remaining ipsilateral moiety on renal scintigraphy.

Results

A total of 29 children were identified for inclusion. Demographic and operative data are provided in Table. The average pre-operative and postoperative differential renal function in the ipsilateral kidney was 41.6% and 38% on renal scintigraphy, respectively, for an average decrease of 3.6% (–18% to +12%). Doppler RUS demonstrated the presence of vascular flow to the remaining ipsilateral moieties of all children after heminephrectomy. Renal scintigraphy confirmed the viability of these moieties in all children.

Discussion

The first study comparing Doppler RUS to renal scintigraphy was performed to determine the viability of the remaining ipsilateral moiety after heminephrectomy. While no cases of complete functional loss were observed, an average decrease of 3.6% in the ipsilateral renal function favorably compared with other series of children undergoing open heminephrectomy. The limitations of the study included its retrospective design at a single institution. The interpretation of Doppler RUS by an individual pediatric radiologist may also have lead to interobserver variability and impacted the reproducibility of the study, while the absence of any cases of complete functional loss may have impacted its generalizability.

Conclusions

Doppler RUS is an accurate imaging modality for determining the viability of the remaining ipsilateral moiety after heminephrectomy and may obviate the need for renal scintigraphy.

Introduction

Heminephrectomy remains an excellent option for a poorly functioning moiety in a duplicated collecting system. While its advantages include the removal of pathology and initial avoidance of lower urinary tract surgery, a primary concern during heminephrectomy is the potential for a significant functional loss in the remaining ipsilateral moiety. Several mechanisms have been proposed for losing the remaining ipsilateral moiety, including: a vascular injury; vasospasm; vascular torsion due to excessive mobilization of the kidney; and decreased renal vascular flow due to CO₂ insufflation during a laparoscopic approach [1–5].

The incidence of losing the remaining ipsilateral moiety after heminephrectomy is not well established. Complete functional loss of the remaining ipsilateral moiety has never been previously reported after open heminephrectomy. However, Gundeti et al. observed a significant functional loss (>10%) in 8.3% of children undergoing open heminephrectomy [6]. Loss of the remaining ipsilateral moiety has been reported in several laparoscopic series, with an incidence ranging from 0 to 7.1% [1–5,7–10].

As the gold standard for the assessment of differential renal function, renal scintigraphy is often used in the postoperative evaluation of children undergoing heminephrectomy. However, this imaging modality is costly, invasive, and associated with exposure to radiation. Doppler renal ultrasound (RUS) avoids these concerns and is able to evaluate for structural and functional abnormalities.

The present study sought to compare Doppler RUS to renal scintigraphy in determining the viability of the remaining ipsilateral moiety after heminephrectomy.

Materials and methods

After approval from the Institutional Review Board at Indiana University School of Medicine, the institutional database of children who underwent open heminephrectomy for a poorly functioning moiety in a duplicated collecting system between 2006 and 2012 was reviewed. All children underwent a pre-operative gray-scale RUS, VCUG, and Tc^{99m}-labeled mercaptoacetyl-triglycine (MAG3) or DMSA renal scan. Only children who also underwent a postoperative color Doppler RUS and renal scan were included. Both imaging studies were routinely performed by one of the pediatric urologists (MPC), which comprised the majority of children included in the study. The remaining pediatric urologists performed these imaging studies as clinically indicated. Doppler RUS was typically performed at 1 month after surgery, while renal scintigraphy was performed at 3 months postoperatively.

Due to the variable reporting of differential renal function between upper and lower pole moieties on renal scintigraphy performed at other institutions, the renal function of all removed moieties could not be uniformly determined. In cases where a differential renal function was not provided on renal scintigraphy, the removed moieties were determined to be poorly functioning based on their appearance on gray-scale RUS and renal scintigraphy. Therefore, the pre-operative renal function in the entire kidney was compared to the postoperative renal function in

the remaining ipsilateral moiety on renal scintigraphy. A blinded pediatric radiologist independently reviewed all Doppler RUS and determined the qualitative presence of vascular flow to the renal parenchyma of the remaining ipsilateral moiety. Resistive indices were not routinely calculated. The presence of vascular flow on Doppler RUS was correlated with the preservation of renal function in the remaining ipsilateral moiety on renal scintigraphy.

Results

Twenty-nine children were identified for inclusion in the study. Their demographic and operative data are provided in Table 1. The average pre-operative and postoperative differential renal function in the ipsilateral kidney was 41.6% and 38% on renal scintigraphy, respectively, for an average decrease of 3.6% (–18% to +12%).

Fig. 1 includes the pre-operative and postoperative imaging of a 4-year-old boy who presented with pyelonephritis and was found to have a left duplicated collecting system with a poorly functioning upper-pole ectopic ureter. He initially underwent the placement of a left percutaneous nephrostomy tube and was appropriately treated with antibiotics. He ultimately underwent a left upper-pole heminephrectomy with partial ureterectomy and had an uncomplicated postoperative course. Postoperative Doppler RUS demonstrated the presence of vascular flow to his remaining left lower-pole moiety, which was confirmed on renal scintigraphy.

Doppler RUS demonstrated the presence of vascular flow to the remaining ipsilateral moieties of all children after heminephrectomy. Renal scintigraphy confirmed the viability of these moieties in all children.

Discussion

Loss of the remaining ipsilateral moiety is a relatively uncommon, but significant, complication after heminephrectomy. Its incidence may be under-reported due to the inconsistent use of renal scintigraphy in the postoperative evaluation of children undergoing heminephrectomy [4,7,10]. The timing of functional loss is also unknown due to the relative rarity and likely under-reporting of this complication, but would be assumed to occur early from an unrecognized vascular injury or vasospasm. Several authors have advocated the routine use of

Table 1 Demographic and operative data.

Number of participants	29
Median age at surgery, months (range)	5 (2–131)
Female, <i>n</i> (%)	23 (79.3)
Prenatal hydronephrosis, <i>n</i> (%)	20 (69.0)
Indications for heminephrectomy:	
Ectopic ureter, <i>n</i> (%)	21 (72.4%)
Ureterocele, <i>n</i> (%)	3 (10.3%)
VUR, <i>n</i> (%)	3 (10.3%)
Secondary UPJ obstruction, <i>n</i> (%)	2 (6.9%)
Upper-pole heminephrectomy, <i>n</i> (%)	25 (86.2%)
Median follow-up, months (range)	26 (1–80)

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