Uroepithelial thickening improves detection of vesicoureteral reflux in infants with prenatal hydronephrosis

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Summary

Introduction

Postnatal evaluation of prenatal hydronephrosis (PNH) often includes a voiding cystourethrogram (VCUG) for VUR assessment. Despite limited supporting data, VCUG is currently recommended if postnatal renal and bladder ultrasound (RBUS) reveals moderate/severe hydronephrosis (HN) or hydroureter (HU). Recent studies have shown VUR is more accurately diagnosed by using certain sonographic findings as criteria for obtaining VCUG. Uroepithelial thickening (UET) of the renal pelvis is a finding associated with high-grade vesicoureteral reflux (HGVUR); however, the clinical significance of UET with PNH has not been studied.

Objective

We sought to determine if the presence of UET implies increased risk for VUR, and to investigate whether UET can improve the test characteristics of RBUS for VUR.

Study design

We retrospectively analyzed postnatal RBUS and VCUG findings in infants ≤30 days undergoing evaluation for "prenatal hydronephrosis" over an 11-year period. We used logistic regression to identify factors associated with VUR. Test characteristics of RBUS for HGVUR were compared based on the presence of UET and two criteria sets to define abnormal RBUS. Criteria set 1 consisted of HN SFU grade 3—4 and/or HU; criteria set 2 was defined by the presence of two of following: UET, HU, duplication, and/or renal dysmorphia.

Results

Of 135 patients, 39 (29%) had VUR, of whom 16 (41%) had HGVUR. UET was significantly associated with VUR ($p < 0.001$), and the sensitivity for HGVUR based on UET alone was 94%. On multivariable analysis, UET, HU, duplication, and renal dysmorphia remained significant independent predictors of HGVUR. Compared to criteria 1, using criteria 2 resulted in 43 fewer VCUGs, and significant improvement in sensitivity and specificity for HGVUR (Table).

Discussion

Consistent with previous studies, HN alone on postnatal RBUS has little value in predicting the presence or severity of VUR. This study is the largest known series to evaluate UET in the setting of PNH, and our results demonstrate that UET, as well as HU, duplication and renal dysmorphia, are independent sonographic findings predicting HGVUR. Using our proposed criteria, the probability of HGVUR is fourfold more than the prevalence described in the literature, and importantly, when compared to the criteria recommended by the SFU and AUA, would have resulted in 53% fewer VCUGs while missing zero cases of HGVUR.

Conclusion

In infants with PNH, the sonographic findings of UET, HU, duplication and renal dysmorphia independently indicate greater risk of HGVUR, and the sensitivity and specificity of RBUS for HGVUR is markedly improved when at least two of the four are present.

Table RBUS findings predicting HGVUR and test characteristics of RBUS for HGVUR.

High-grade VUR	Multivariable analysis		
	OR	95% CI	p
Uroepithelial thickening	54.45	4.97−597.0	0.001
Hydroureter	5.35	1.24−22.99	0.024
Duplication	10.78	2.21−52.57	0.003
Renal dysmorphia	14.23	2.17−94.37	0.006
	Presence of VUR	Absence of VUR	Total
Criteria 1[a]			
Positive RBUS	24	57	81
Negative RBUS	15	39	54
Totals	39	96	135
Criteria 2[b]			
Positive RBUS	21	17	38
Negative RBUS	18	79	97
Totals	39	96	135
Test characteristics of RBUS for HGVUR	Criteria 1	Criteria 2	UET
Sensitivity	88%	100%	94%
Specificity	44%	82%	57%
PPV	17%	42%	23%
NPV	96%	100%	99%
LR+	1.57	5.41	2.19
LR−	0.27	0	0.11
OR (95% CI)	5.43 (1.18−24.97)	143.00 (8.27−2473.74)	20.00 (2.56−156.38)

[a] Criteria 1: presence of HN SFU grade 3−4 or HU.
[b] Criteria 2: presence of at least two of the following: UET, HU, duplication, renal dysmorphia.

Introduction

Postnatal radiographic evaluation of prenatal hydronephrosis (PNH) often includes voiding cystourethrogram (VCUG) to assess for vesicoureteral reflux (VUR). Both the 2010 Society for Fetal Urology (SFU) consensus statement on PNH and the 2010 American Urological Association (AUA) Clinical Practice Guideline (CPG) on screening for VUR in infants with PNH recommend VCUG if postnatal renal bladder ultrasonography (RBUS) reveals either moderate/severe (SFU grade 3−4) hydronephrosis (HN), or hydroureter (HU) [1,2]. However, there continues to be ongoing debate regarding who may benefit from VCUG and whether detection of VUR in asymptomatic patients will ultimately be clinically significant. Several studies correlating the degree of HN with VUR prevalence suggest that only higher grades of HN may warrant evaluation. However, results have been inconsistent and trend toward no association between HN grade and VUR prevalence [3−5]. Nevertheless, in the setting of PNH, VCUG is still performed at a high rate with a large number of negative examinations.

A recent study using the findings of hydroureter (HU), renal dysmorphia and/or duplication on postnatal RBUS as criteria for obtaining a VCUG has shown that VUR can be detected more specifically in this population [6]. Uroepithelial thickening (UET) of the renal pelvis is a sonographic finding that has been associated with inflammation, prior distention, urinary tract infection (UTI), urolithiasis, rejection after renal transplantation, VUR, and obstruction [7−16]; however, the clinical significance and implications of this finding in the setting of PNH have not been studied. As our previous work has demonstrated that UET is strongly associated with HGVUR in the setting of first febrile UTI in young children [17], we hypothesized that UET might also be a significant independent predictor of HGVUR in the postnatal evaluation of PNH. We sought to determine if the presence of UET on initial postnatal RBUS in the setting of PNH is an additional finding that implies a greater risk for VUR, and to investigate whether UET can improve the test characteristics of RBUS for high-grade VUR (HGVUR).

Patients and methods

Following institutional review board approval, we identified all infants ≤30 days who had undergone RBUS for the indication of "prenatal hydronephrosis" at our institution from December 2002 to December 2013. RBUS studies with the non-specific indication of "hydronephrosis" were excluded. Cases were limited to those who had a VCUG obtained within 90 days of RBUS, and whose images from both studies were available for review within our institution's medical records. Prenatal RBUS were not evaluated given the limited accessibility to these studies performed elsewhere. Patients with spina bifida, posterior urethral valves, or history of UTI were excluded. Both a senior pediatric radiologist and urologist reviewed all imaging and radiology reports. Age at RBUS and presence of UET, HN, HU, duplication, renal dysmorphia, and VUR were recorded.

UET was defined as wall thickening measuring ≥1 mm, appearing as a hypoechoic rim within the renal pelvic wall