The Egyptian Journal of Hospital Medicine (April 2023) Vol. 91, Page 4697-4700

Ultrasound in Neonatal and Childhood Hydronephrosis: Is It Reliable Pediatric Tool to Guide the Management?

Maged Elsayed Affifi*, Khaled Kamal Ahmed
Departments of Pediatricand Radiology, Faculty of Medicine, Ain Shams University, Egypt
***Corresponding author:** Maged Elsayed Afifi, **Mobile:** (+20)1277128984, **E-Mail:** maged_elsayed@yahoo.com

ABSTRACT

Background: The pelvicalyceal system distension and dilatation are referred to as hydronephrosis.

Objective: The goal of the current study was to use ultrasonography to identify newborns and young children at risk for renal scarring and assess whether they would require additional surgical intervention.

Subjects and Methods: This retrospective study was conducted from January 2008 to February 2012 and comprised 320 infants and newborns, who were diagnosed with hydronephrosis by US standards (200 boys, 62.5%; 120 girls, 37.5%), unilateral or bilateral. 130 of them were newborns, and 190 were kids. An algorithm for managing and treating hydronephrosis based on the Society of Fetal Urology (SFU) grading system for US can be created. Further imaging tests such as voiding cystourethrogram and isotope scanning were applied.

Results: Using the SFU grading system, 150 patients (46.8%) were classified as I and II-degree hydronephrosis and 170 cases (53.2%), as III- and IV-degree hydronephrosis. Without any risk of UTI, Grade I and II spontaneously cleared (P <0.001). With a significant risk of recurrent UTI, all 170 instances of hydronephrosis in grades III and IV required isotope scanning and a voiding cystourethrogram (P <0.001).

Conclusions: It could be concluded that the SFU grading system developed by the US is a helpful diagnostic tool for hydronephrosis.

Keywords: Ultrasound, Neonatal and childhood, Hydronephrosis.

INTRODUCTION

The pelvicalyceal system distension and dilatation are referred to as hydronephrosis. Only a percentage of newborns with hydronephrosis later demonstrate actual restriction of urine flow from the kidney due to anatomical or functional problems, and this disease is not the same as obstruction of the urinary tract [(1,2)]. While infants or early children with hydronephrosis may rarely appear with a palpable abdominal mass or obstruction-related problems such urinary tract infection or hematuria, hydronephrosis is often identified on prenatal ultrasonography (US) [(3)].

For verifying hydronephrosis and assessing the degree of dilatation and amount of blockage in newborns and early children, ultrasound (US) continues to be the primary imaging modality [(2)].

The Society for Fetal Urology (SFU) grading method for hydronephrosis should be used, and it should be rated as follows: Grade 1: Little renal pelvic dilatation; Grade 2: Mild renal pelvic dilation with some but not all calices dilated; Grade 3: Almost all calices dilated; Grade 4: Parenchymal thinning. Good intra-observer reliability and limited inter-observer dependability characterize this grading method [(4, 5)].

The categorization of hydronephrosis by the Society of Fetal Urology is seen on a postnatal ultrasonography: Grade 1: Mildly dilated renal pelvis without calyceal dilatation. Renal pelvis is more dilated in, Grade 2; some calyces may be seen. Grade 3: Although the renal parenchyma is normal in thickness, the renal pelvis and minor calyces are diffusely dilated. Grade 4 is the same as Grade 3, except the renal parenchyma has thinned over the dilated calyces. Because isolated dilatation of the renal pelvis in the neonatal period frequently resolves on its own, patients are typically monitored with further US scans when the initial postnatal sonograms reveal modest dilation [(6)].

98% of patients with moderate hydronephrosis (SFU grade 1 or 2) had spontaneous remission, improvement, or stability at follow-up, according to a systematic study [(7)].

However, it has been observed that by 12 to 14 months of age, more than 90% of instances of mild dilatation of the renal pelvis (anteroposterior diameter, 10 to 15 mm) resolve on their own [(8)].

Further testing is often advised if the postnatal ultrasonography reveals moderate to severe hydronephrosis or dilated ureter(s) [(6, 9)].

To find vesicoureteral reflux and lower urinary tract blockage, voiding cystourethrography is advised. A diuretic renal scan can be useful to diagnose the kind of blockage and establish whether surgery is necessary by evaluating renal perfusion, differential renal function, and excretion if there is no vesicoureteral reflux or lower urinary tract obstruction. Surgery is often only advised when the hydronephrosis is getting worse or when there is a sizable disparity in kidney function. Vesicoureteric reflux, pelviureteric junction blockage, and vesicoureteric junction obstruction are among the causes of newborn hydronephrosis. Many cysts in the kidney, neurogenic bladder, ureterocele, prune-belly syndrome, ureteral atresia, posterior urethral, obstructive, and non-obstructive megaureter [(10)].

Our goal was to use US to identify newborns and young children at risk for renal scarring and assess whether they would require additional surgical intervention.

Received: 26/11/2022
Accepted: 28/01/2023

SUBJECTS AND METHODS

This retrospective study included a total of 320 children and newborns who had hydronephrosis, treated at Department of Pediatric, Faculty of Medicine, Ain Shams University Hospitals. This study was conducted between January 2008 to February 2012.

The included 320 patients were aged 2 days and 9 years, 200 (62.5%) were boys and 120 (37.5%) were girls; all of them had hydronephrosis, according to US standards (Unilateral or Bilateral). Out of 130 newborns (0 to 28 days old, 40.6%), 110 instances of renal masses caused by hydronephrosis of the posterior urethral valve were detected prenatally by ultrasound, and 20 cases were discovered postnatally. According to their symptoms, 190 children (29 days and older, 59.4%) underwent ultrasonography, of them 80 cases (42.1%) had recurrent stomach discomfort and 110 cases (57.9%) had recurrent UTI). An algorithm for managing and treating hydronephrosis based on the SFU grading system for US can be created. For a limited group of patients, additional imaging techniques such as isotope scanning and voiding cystourethrogram were employed, along with various laboratory testing.

All patients were subjected to the following investigations: Urine analysis and urine culture and sensitivity, serum creatinine, BUN and CBC.

Imaging studies:

- Ultrasound (US) with follow up done from 4 to 6 weeks later of initial study.
- Cystourethrogram (CUG).
- Isotopic Scan.

Features evaluated by US:

- Kidney size, contour, echogenicity and cortical thickness.
- Hydronephrosis (Unilateral or bilateral), and Grading.
- Hydroureter.
- Bladder size, thickness.
- Posterior urethral dilatation.
- Urinary flow.

Treatment of UTI was given for patients with grade III and grade IV hydronephrosis by SFU. Antibiotics were given according to culture and sensitivity.

***Ethical Consideration*:**

This study was ethically approved by Ain Shams University's Research Ethics Committee. Written informed consent of the participants' parents was obtained. The study protocol conformed to the Helsinki Declaration, the ethical norm of the World Medical Association for human testing.

Statistical analysis

SPSS version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD), Qualitative data were expressed as frequency and percentage, tests were done. The internal confidence level was set at 95%, with a 5% margin of error acceptable. A P value of 0.05 or above was considered significant.

RESULTS

Table (1) and figures 1,2, & 3 show that patient's age ranged between 2 days to 9 years with a mean±SD (5±4.6). The result and the US SFU grade system for hydronephrosis were significantly correlated. Without any risk of UTI, Grade I and II spontaneously cleared (P <0.001). The majority of Grade III and IV patients (120 out of 170 cases, (70.6%) required surgical intervention, whereas the remaining cases (50 out of 170 cases, (29.4%) were treated with suppressive medications for urinary tract infections. Whether surgically repaired or managed medically, all patients of grade III and IV hydronephrosis required extra in-depth testing, such as an isotope scanning voiding cystourethrogram, due to the increased risk of recurring UTIs (P < 0.001).

Table (1): Distribution of total number of cases (320).

Male	Female
200 (62.5%)	120(37.5%)
Neonates	Children
130(41.6%)	190(59.4%)

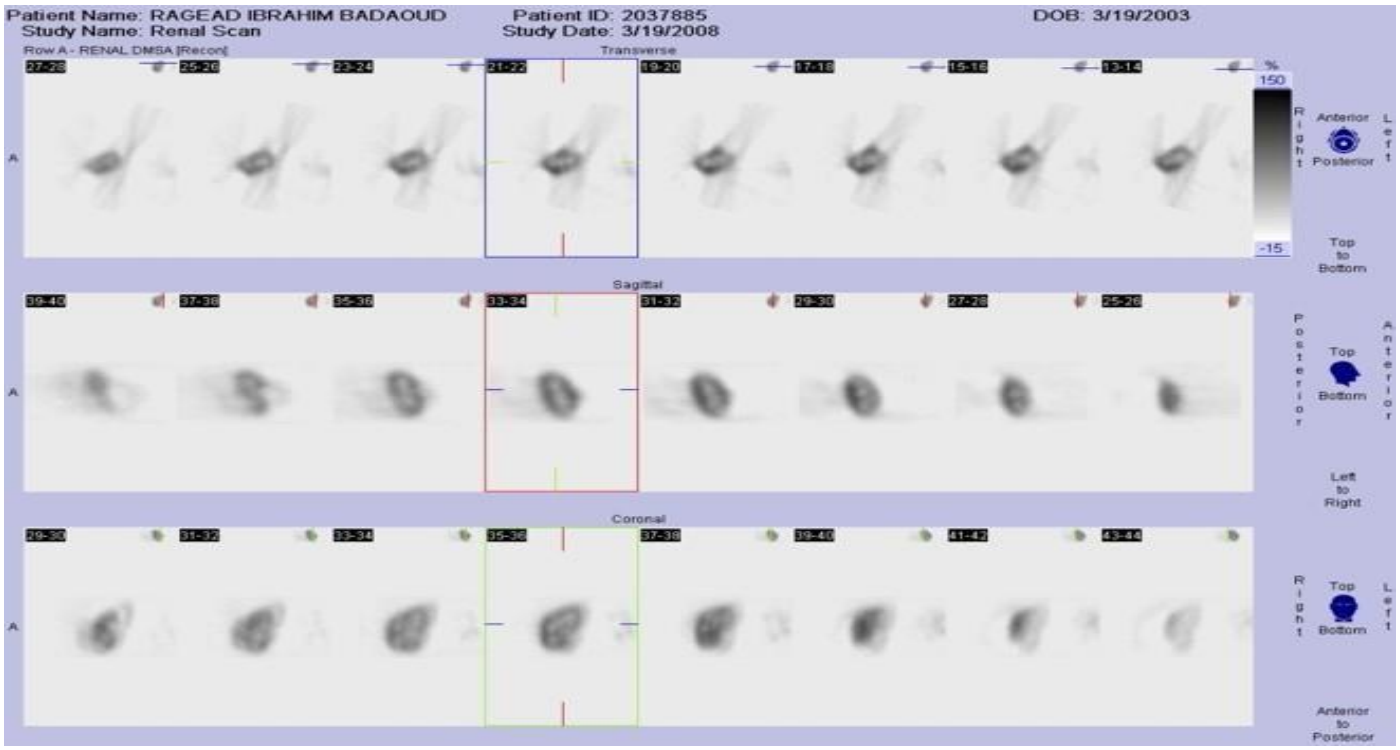

Figure (1): Renal scarring of grade III and IV hydronephrosis.

Figure (2) risk of UTI increased with increased grade of hydronephrosis P<0.001.

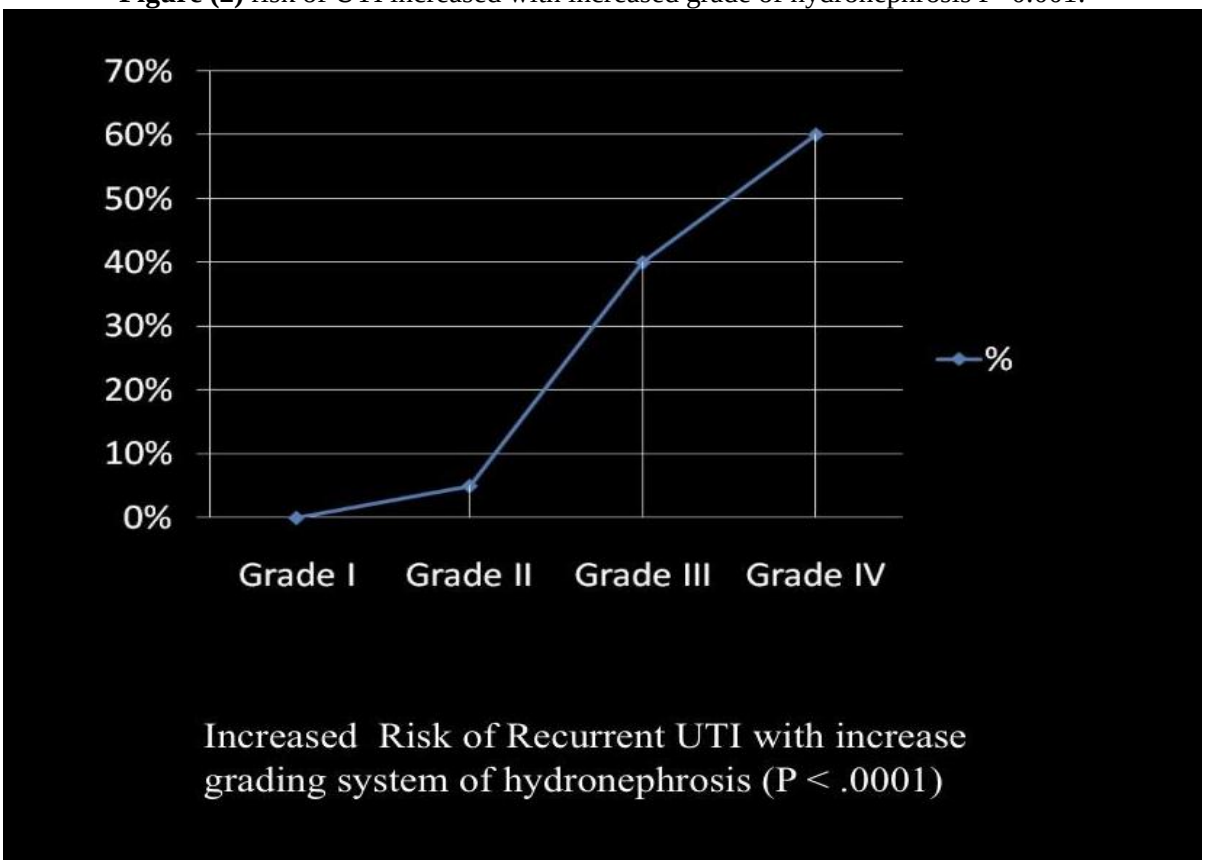

Figure (2): Increased risk of recurrent UTI with increase grading system of hydronephrosis (P<.0001) HS.

Figure (3) shows that most of our cases were high grades.

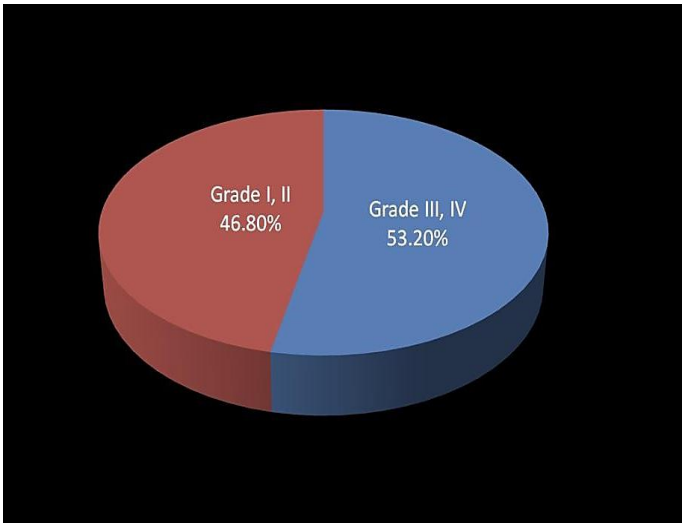

Figure (3): Distribution of cases according to grading system of SFU.

DISCUSSION

In this study, an ultrasound was done at 2 days of age when there was bilateral hydronephrosis antenatal or suspicion of posterior urethral value. This was in coincidence with **Nguyen *et al.*** [9]. Other patients that had antenatal hydronephrosis did the ultrasound after 4 days. This was agreed with **Wiener and O'Hara** [11] **and Laing *et al.*** [12] who stated that after delivery, relative dehydration and a lowered glomerular filtration rate may cause ultrasound measurements of the degree of hydronephrosis to provide false-negative results. During this study, follow-up ultrasound was done 4-6 weeks later of initial study. Grade I or grade II renal ultrasound can safely exclude obstructing hydronephrosis and vesico-ureteric reflux. This was agreed by **Lidefelt and Herthelius** [13] who reported the same results. Patients with grade I and grade II hydronephrosis by SFU (150 patients, 46.8%) did not need any treatment or intervention. The result was nearly agreed with **Sidhu *et al.*** [7] who stated that (SFU grade I or II) had spontaneously improved or stabilized at the follow-up visit.

Our patients with grade III and IV by SFU needed further evaluation by voiding cystourethrography to detect vesicoureteric reflux (VUR) and its degree. If no VUR was seen, a diuretic renal scan was required to establish the kind of blockage and whether surgery was necessary by evaluating renal perfusion and excretion. These results were the same as those of **Sinha *et al.*** [6] **and Nguyen *et al.*** [9].

In this study, grades III and IV of hydronephrosis were associated with high risk of UTI with a significant value P<0.001. This was also approved by **Matsui *et al.*** [14] who showed high risk of UTI with high grades of hydronephrosis and VUR. Renal scarring also was noticed in grades III and IV hydronephrosis which was secondary to repeated UTI. These results also agreed with **Matsui *et al.*** [14] who documented the same results. Also blood urea and serum creatinine increased among 70 out of 320 patients (21.8%). All these patients had grade III and IV hydronephrosis which were complicated by other conditions like UTI or VUR or both. This was agreed by **Coelho *et al.*** [15] who showed that high degrees of SFU may progress to renal failure.

CONCLUSION

It could be concluded that the SFU grading system developed by the US is a helpful diagnostic tool for hydronephrosis. It can identify kids who require additional in-depth testing to lower their risk of chronic kidney disease and recurring urinary tract infections.

Supporting and sponsoring financially: Nil.
Competing interests: Nil.

REFERENCES

1. **Riccabona M (2004):** Assessment and management of newborn hydronephrosis. World J Urol., 22:73–78.
2. **Epelman M, Victoria T, Meyers K *et al.* (2012):** Postnatal imaging of neonates with prenatally diagnosed genitourinary abnormalities: a practical approach. Pediatr Radiol., 42: 124–141.
3. **Siegel M (2011):** Urinary tract. In: Siegel M, editor. Pediatric sonography. Philadelphia: Lippincott Williams & Wilkins; pp. 384–460. https://www.scribd.com/document/359254935/Pediatric-Sonography#
4. **Fembach S, Maizels M, Conway J (1993):** Ultrasound grading of hydronephrosis: introduction to the system used by the Society for Fetal Urology. Pediatr Radiol., 23:478–480.
5. **Keays M, Guerra L, Mihill J *et al.* (2008):** Reliability assessment of Society for Fetal Urology ultrasound grading system for hydronephrosis. J Urol., 180:1680–1682.
6. **Sinha A, Bagga A, Krishna A *et al.* (2013):** Revised guidelines on management of antenatal hydronephrosis. Indian J Nephrol., 23:83–97.
7. **Sidhu G, Beyene J, Rosenblum N (2006):** Outcome of isolated antenatal hydronephrosis: a systematic review and meta-analysis. Pediatr Nephrol., 21:218–224.
8. **Mami C, Paolata A, Palmara A *et al.* (2009):** Outcome and management of isolated moderate renal pelvis dilatation detected at postnatal screening. Pediatr Nephrol., 24: 2005–2008.
9. **Nguyen H, Herndon C, Cooper C *et al.* (2010):** The Society for Fetal Urology consensus statement on the evaluation and management of antenatal hydronephrosis. J Pediatr Urol., 6: 212–231.
10. **Gatti J, Broecker B, Scherz H *et al.* (2001):** Antenatal hydronephrosis with postnatal resolution: how long are postnatal studies warranted? Urology, 57: 1178. doi: 10.1016/s0090-4295(00)00933-x.
11. **Wiener J, O'Hara S (2002):** Optimal timing of initial postnatal ultrasonography in newborns with prenatal hydronephrosis. J Urol., 168(4 Pt 2):1826–1829.
12. **Laing F, Burke V, Wing V *et al.* (1984):** Postpartum evaluation of fetal hydronephrosis: optimal timing for follow-up sonography. Radiology, 152: 423–424.
13. **Lidefelt K, Herthelius M (2008):** Antenatal hydronephrosis: infants with minor postnatal dilatation do not need prophylaxis. Pediatr Nephrol., 23: 2021–2024.
14. **Matsui F, Shimada K, Matsumoto F *et al.* (2008):** Late recurrence of symptomatic hydronephrosis in patients with prenatally detected hydronephrosis and spontaneous improvement. J Urol., 180:322– 325.
15. **Coelho G, Bouzada M, Pereira A *et al.* (2007):** Outcome of isolated antenatal hydronephrosis: a prospective cohort study. Pediatr Nephrol., 22:1727–1734.