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The Value of Ultrasonography as a Screening Procedure of the Neonatal Urinary Tract: A Survey of 1021 Infants

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In 1021 children, aged several hours to 21 days, sonographic investigations of kidneys and bladders were performed. 1001 children without any urinary tract abnormality were divided into 7 body weight-dependent groups. The kidney volume was correlated to somatometric data including body weight and body length, breadth of thorax, and head circumference. Regression line for the dependence of renal volume on body weight was calculated. The remaining 20 children with urinary tract abnormalities were described separately. During ultrasonic screening examination, bladder or renal disorders found in those 20 children were as follows: mild hydronephrosis in 6 cases, and severe hydronephrosis in 4 cases; of the latter 1 case was caused by ectopic ureterocele, 1 by simple ureterocele, 1 by obstruction of the distal ureter (primary megaureter) and 1 by vesicoureteral bilateral reflux. In 2 cases unilateral multicystic kidneys were found, 2 infants had an ultrasound pattern with hyperechoic medulla, in 4 cases unilateral non-obstructed renal duplication was suspected, and in 2 cases only a single kidney was found.

Introduction

Ultrasonography is a safe and accurate imaging method in the evaluation of the urinary tract in neonates. It helps select cases requiring further investigation or urological treatment, and makes radiological examination unnecessary. In combination with other uroradiological methods, it is helpful in establishing correct diagnosis in the majority of cases. Ultrasonography, being independent of organ function, has been shown to be an effective alternative imaging procedure in many conditions [1, 16].

Material and methods

During nine months (March–November 1987), 1021 examinations of the urinary tract in newborns, aged several hours to 21 days (mean 3 days), were performed at the Neonatal Clinic of the Silesian School of Medicine in Katowice. All examinations were performed by a real-time linear scanner, using a 5 MHz transducer (Picker 3000 M/B.). No sedatives were used. The neonatal urinary tract was examined in supine and prone positions. It is

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important to start by scanning the bladder, as there is more chance of it being full at the beginning rather than at the end of the examination. On urine examination none of the infants had any disorders, and only in one case abdominal abnormalities were found on palpation. Morphometric data, such as kidney length, width, depth and the prolate ellipsoid volume were documented. Measurements of the kidneys were performed as described by Dinkel and Ertel [3]. Renal volume was calculated using the ellipsoid formula: length × width × depth × 0.523 [10].

Table 1

Newborns divided into body weight (BW) dependent groups (G)

G	BW (g)	Male	Female	Total
1	up to 2000	16	5	21
2	up to 2500	31	29	60
3	up to 3000	78	111	189
4	up to 3500	192	192	384
5	up to 4000	166	109	275
6	up to 4500	39	17	56
7	over 4500	14	2	16
	Total	536	465	1001

Those 1001 children without any urinary tract abnormalities were divided into 7 body weight-dependent groups: the first up to 2000 g, and the last over 4500 g (Table 1). The kidney volume was correlated to somatometric parameters such as body weight, body length, breadth of thorax and head circumference. Regression line of the interrelationship between renal volume and body weight was calculated.

The 20 children with urinary tract abnormalities excluded from comparative morphometric studies were described separately.

Results

No significant differences in computed mean volumes of the left and right kidneys, and of the male and female kidneys in body weight groups were

Table 2

Correlation coefficient (R) between renal volume (RV) and body weight (BW), body length (BL), head circumference (HC), and breadth of thorax (BT)

	BW	BL	HC	BT
RV	R = 0.970	R = 0.597	R = 0.523	R = 0.512

found. However, male and right kidneys were slightly bigger. Kidney volumes were correlated to somatometric parameters (Table 2). For the neonatal renal size, the closest correlation was found between renal volume and body weight (correlation coefficient R = 0.97). For this reason the regression line for the dependence of renal volume on body weight was calculated (Fig. 1).

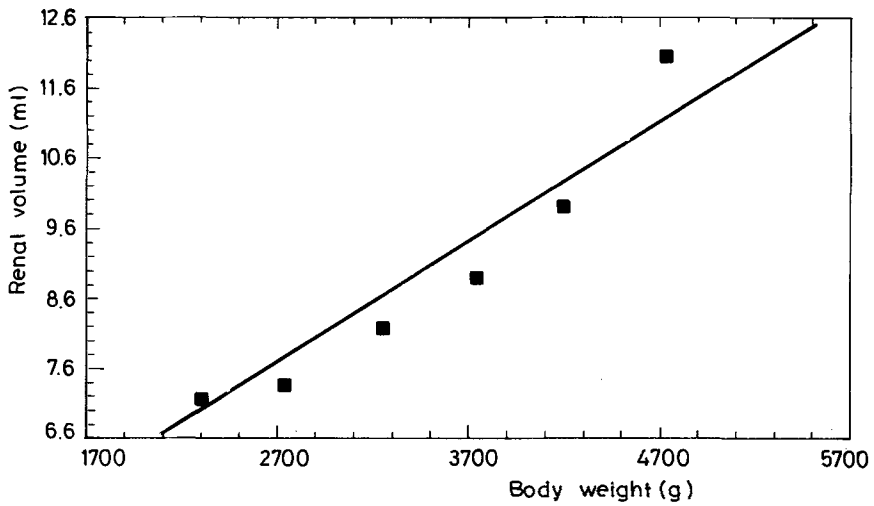

Fig. 1. Regression line for the dependence of renal volume on body weight

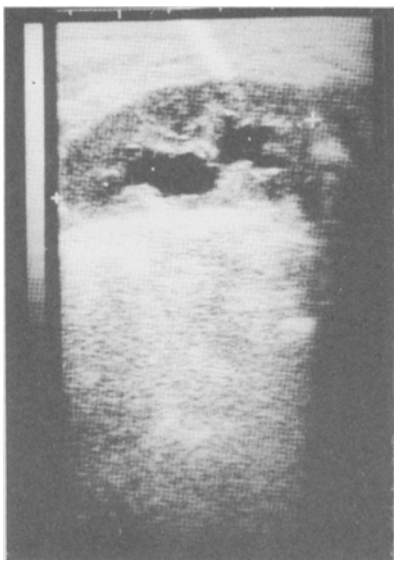

Fig. 2. Mild hydronephrosis

Fig. 3. Severe hydronephrosis

Of 1021 scanned infants 20 (2.05%) were found to have abnormal scans.

Six newborns had mild uni- or bilateral hydronephrosis according to Troger [15] (Fig. 2). These infants were referred to follow-up scans, and within 4 to 12 weeks their kidneys returned to normal.

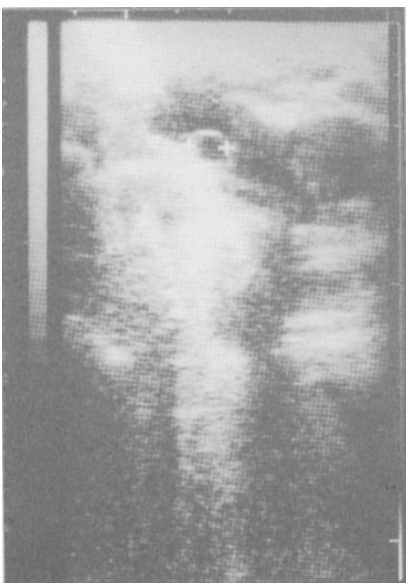

Fig. 4. Simple ureterocele

Four infants (0.38%) had severe hydronephrosis (Fig. 3) caused:

– in the first case by ectopic ureterocele operated on at the 6th months of life (hemi-ureteronephrectomy superior and anti-reflux ureterocystoneostomy inferior);

– in the second case by simple ureterocele (Fig. 4) operated on at 7 months of age (excision of ureterocele and anti-reflux ureterocystoneostomy);

– in the third case by obstruction of the distal ureter ("primary megaureter") (Fig. 5) operated on at the age of 3 months (ureteronephrectomy);

– in the fourth case by bilateral reflux grade 4 (Fig. 6) operated on at the age of 7 months (anti-reflux bilateral cystoureteroneostomy).

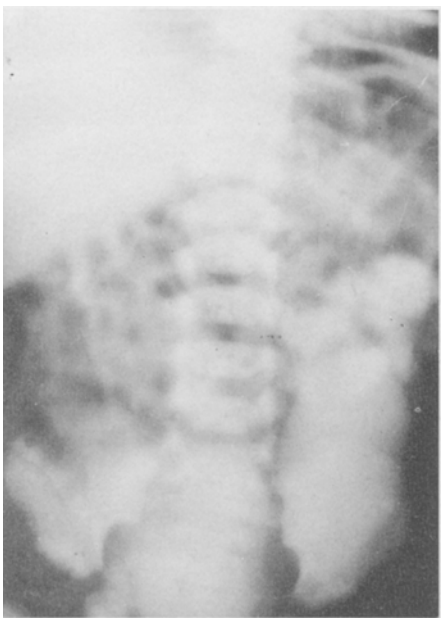

Fig. 5. Obstruction of the distal ureter

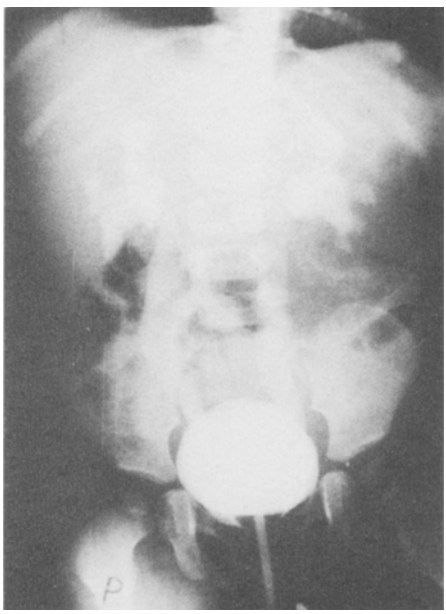

Fig. 6. Bilateral reflux (grade 4)

Two infants (0.19%) operated on within 2–4 months of life were found to have unilateral multicystic renal dysplasia (Fig. 7); in one case an abdominal mass was noted at the first physical examination. Nephrectomy was done because of the pressure exerted by the kidney upon the abdominal organs.

Two neonates had a characteristic hyperechoic renal medulla (Fig. 8). This condition was found in asphyxiated babies (treated conservatively), resulting from dehydration and metabolic acidosis. Four children were suspected of unilateral renal duplication without dilatation of the pelvi-calyceal

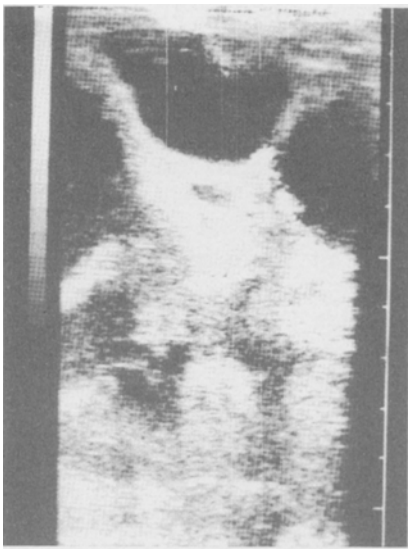

Fig. 7. Multicystic renal dysplasia

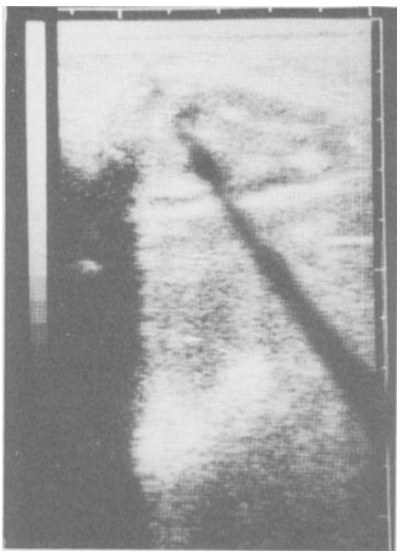

Fig. 8. Hyperechoic renal medulla

system (Fig. 9). No further investigations were undertaken in those healthy infants.

Two newborns had solitary kidney, not significantly large. No further investigations were carried out in those neonates, either.

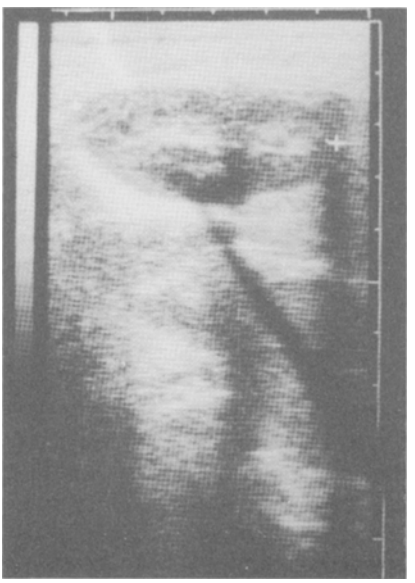

Fig. 9. Renal duplication (suspitio)

Discussion

Our results obtained in 1001 children show that renal volume correlated better with body weight. This is in accordance with other reports [5, 9, 11]. We did not find any sex-related differences in renal size; it is also in accord with the findings of Holloway [11] and others [2, 5]. Ultrasonography provides another approach to kidney size determination. It is known that renal disease may augment or decrease organ size with or without simultaneous alteration in renal architecture [4, 5, 11, 13]. Dinkel [3, 4] reports that any changes in organ size due to renal pathology are better expressed by volume than by outer kidney diameters. The earlier the urinary tract abnormality is detected and treated, the less damage is done to the kidneys [7]. Correct preoperative diagnosis and immediate reconstructive surgery may salvage a hydronephrotic kidney. Many authors [8] report that a newborn kidney has great recuperative potential. Ectopic or simple ureterocele is usually diagnosed by excretory urography [14]. Our report advocates application of ultrasound in the first and early asymptomatic diagnosis of the urinary tract abnormalities.

For ethical reasons, intravenous urograms cannot be performed in healthy children only to provide evidence for solitary kidney or renal duplication with non-obstructive collecting system [1]. Gonzales [6] reports that the volume of a solitary kidney is not significantly larger in neonates. We are of the same opinion.

Avni [1] described asphyxiated newborns with hyperechoic renal medulla treated conservatively, too.

Ultrasound in the neonate has been proved to be a reliable, cheap and non-invasive screening method and is clearly an important, initial investigation to complement physical examination. The vast majority of renal abnormalities diagnosed in the survey were clinically unsuspected. This points to the importance of ultrasonography as a postnatal screening test in all infants.

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