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Height and weight in children with vesicoureteric reflux and renal scarring

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Abstract. Height standard deviation scores (HSDS) and weight-for-height index (WHI) at diagnosis were evaluated in 156 children aged 2 months to 10.8 years (mean 3.7 years) with vesicoureteric reflux (VUR) and normal creatinine clearance, and in 156 age- and sex-matched healthy controls. Forty-three patients had bilateral VUR with scintigraphic signs of renal scarring (B SCAR+), 25 had bilateral VUR without renal scarring (B SCAR–); 40 had unilateral VUR with (U SCAR+) and 48 unilateral VUR without (U SCAR–) renal scarring. B SCAR+ patients had an average HSDS of -0.5 ± 1.4 (SD) which was significantly ($P = 0.02$) below that of controls (0.05 ± 1 HSDS) and an average WHI of $100.6\% \pm 16\%$ which was significantly ($P = 0.007$) below that of controls ($108\% \pm 12\%$); 14% of B SCAR+ patients had a height below –2 HSDS. B SCAR–, U SCAR+, and U SCAR– patients had heights near to O HSDS which was not different from that of controls, as well as WHI between 104% and 107.9%, which was not different from that of controls. HSDS and WHI were significantly ($P = 0.00001$) correlated in patients but not in controls. B SCAR–, U SCAR+, and U SCAR– patients are similar to healthy controls in weight and in height growth and have, on average, some excess weight as do the latter. In contrast, B SCAR+ subjects have a significant decrease of the relative height and normal WHI.

Key words: Stature – Weight – Vesicoureteric reflux – Renal scarring

Introduction

Few reports have examined the effect of vesicoureteric reflux (VUR) on the physical growth of children. Merrell and Mowad [1] and Sutton and Atwell [2] reported a significantly better post-operative height and weight increase in respectively 35 and 22 children with VUR and normal serum creatinine. Smellie et al. [3] found no significant difference in statural growth among children suffering from urinary tract infections with and without VUR. However, in the latter study very few children with VUR and normal kidneys were on or below the 10th percentile for height, whereas 20% of those with VUR associated with renal scarring or another abnormality were below the 10th percentile.

Recently, Seidel et al. [4] reported height of two standard deviations (SD) or more below the mean of controls in 5 of 54 patients with various urinary tract malformations and normal creatinine clearance. No data on the relative weight-for-height of the patients – which roughly reflects the nutritional status – are available in the quoted studies, and a separate analysis of growth in children with unilateral or bilateral VUR was not performed. In the present paper we report stature and weight-for-height at diagnosis of our patients with VUR, analyzed separately according to the presence of unilateral or bilateral VUR, with or without signs of renal scarring.

Patients and methods

We studied the weight and height at diagnosis of 156 children (39 males, 117 females) with ≥2 grade VUR admitted to our institute between January 1989 and December 1994. All had urinary infections at entry. VUR was diagnosed by micturating cystourethrography and grading of VUR was assessed following the International Reflux Study Committee criteria [5]. Micturating cystourethrography was always performed after recovery from urinary infection. The presence of renal scarring was assessed by 99 m technetium-dimercaptosuccinic acid or -mercaptoacetyl triglycine scintigraphy. Scarring was defined as one or more areas of focal defect in cortical uptake of the isotope. Creatinine clearance was calculated using the Schwartz equations [6, 7] and all subjects having values below 80 ml/min per 1.73 m^2 (i.e., 12 patients) were excluded from the study. The patients having VUR associated with more complex malformations (Turner syndrome, Klippel-Feil syndrome, myelomeningocele) were excluded. The data from 5 patients who had VUR diagnosed following the pre-natal sonographic finding

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of urinary tract dilatation, and who were followed in our institute from birth, were analyzed separately. This was because they received early antibacterial prophylaxis, thus possibly reducing the effect of urinary infection on their somatic growth.

We analyzed the somatic growth of these 5 patients just before antireflux surgery or at the end of our follow-up period, when VUR still presisted. At the time of writing, they are aged 3–27 months (mean 13 months). During follow-up, 4 had one to two febrile urinary infections which were treated within 24 h of the onset of fever; 4 had bilateral and 1 unilateral VUR; none had signs of renal scarring.

Weight was measured by a counterweight scale. Height was measured by a wall-mounted stadiometer in subjects aged >2 years, while a Wunder infantometer was used for those aged <2 years. Height measurements were converted to height standard deviation scores (HSDS) according to the standards of Tanner and Whitehouse [8]. Weights were converted to weight-for-height index (WHI = weight/median weight for the height age ×100).

The control group consisted of age- and sex-matched normal children seen by one of us in a Public Health Service office. Matching was blindly performed by a person unaware of the clinical status of patients. They were weighed and measured in the same way as the patients.

Average values of HSDS and WHI of the patients were compared with those of controls.

Statistical analysis was performed using the paired *t*-test, chi-squared or Fisher's exact test, and Spearman's rank correlation test. *P* values <0.05 were considered significant.

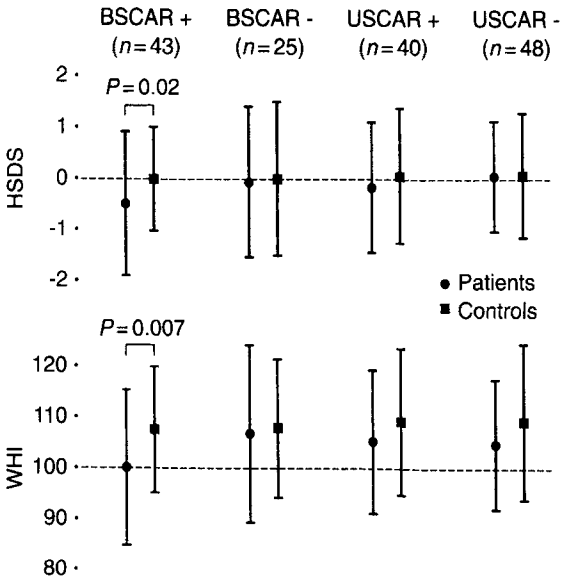

Fig. 1. Comparison of height standard deviation score (*HSDS*) and weight-for-height index (*WHI*) of children with vesicoureteric reflux (VUR) and age- and sex-matched healthy controls. Only significant differences are reported. *B SCAR+*, bilateral VUR with renal scarring; *B SCAR–*, bilateral VUR without renal scarring; *U SCAR+*, unilateral VUR with renal scarring, and *U SCAR–*, unilateral VUR without renal scarring

Results

Patients were divided into the following groups: bilateral VUR with (B SCAR+) and without (B SCAR–) renal scarring, and unilateral VUR with (U SCAR+) and without (U SCAR–) renal scarring. The B SCAR+ group included 43 patients aged 2.9±2.5 (SD) years, B SCAR– 25 patients aged 3.4±3.2 years, U SCAR+ 40 patients aged 4.9±3.3 years, and U SCAR– 48 patients aged 3.8±2.6 years.

Of the 43 BSCAR+ patients, 2 had bilateral renal scarring, while the others had unilateral scarring. Of the 40 USCAR+ patients, 2 had bilateral renal scarring while the others had unilateral scarring. Creatinine clearance was 96.9±22 ml/min per 1.73 m² in B SCAR+, 93.8±18 in B SCAR–, 93.2±9 in U SCAR+, and 98.7±19 in U SCAR– patients.

Average height was –0.5±1.4 HSDS in B SCAR+, –0.04±1.4 in B SCAR–, –0.12±1.2 in U SCAR+, and 0.11.3 in U SCAR– patients. Height below –2 HSDS was recorded in 6 of 43 (14%) B SCAR+, 2 of 25 (8%) B SCAR–, 4 of 40 (10%) U SCAR+, and 2 of 48 (4%) U SCAR– patients. There was no significant difference in the percentage of subjects with height below –2 HSDS between the groups of patients.

Average WHI was 100.6±16% in B SCAR+, 107.9±17% in B SCAR–, 105.5±13% in U SCAR+, and 104±12% in U SCAR– patients. Only 1 patient, who had B SCAR+ VUR, had WHI below 80%. WHI above 120% was recorded in 2 of 43 (5%) B SCAR+, 8 of 25 (32%) B SCAR–, 4 of 40 (10%) U SCAR+, and 6 of 48 (12%) U SCAR– patients. The percentage of B SCAR+ patients with WHI above 120% was significantly ($P = 0.003$) lower than in the B SCAR– group. The 2 BSCAR+ patients with bilateral scarring had WHI of 110% and 108% and HSDS of –0.14 and – 0.06. The 2 USCAR+ patients with bilateral scarring had WHI of 123% and 115% and HSDS of 1.2 and 0.13.

Figure 1 shows the HSDS and WHI of patients and controls. All groups of patients and controls except the B SCAR+ group had an average height near to 0 HSDS. B SCAR+ patients had a HSDS significantly below that of controls, while there was no significant difference in HSDS between the other groups of patients and controls (Fig. 1).

All groups of patients and controls, except the B SCAR+ group, had a rather high average WHI (between 104% and 107.9%). B SCAR+ patients had an average WHI near to 100% but significantly lower than controls (Fig. 1), while there was no significant difference in WHI between the other groups of patients and controls.

The 5 patients who had VUR diagnosed following the pre-natal sonographic finding of urinary tract dilatation had an average WHI of 103.7% (range 94%–120.5%) and an average HSDS of 0.44 (range –1.4 to +2.8).

HSDS and WHI correlated significantly in all the VUR patients as well as in all the SCAR+ patients, while there was no significant correlation in all the controls as well as in all the SCAR– patients (Fig. 2). No significant relationship was found between age and HSDS or between age and WHI in all the VUR patients taken together or in the subgroups.

Discussion

The main finding of our study is a significant decrease in the relative height at diagnosis only in patients with B

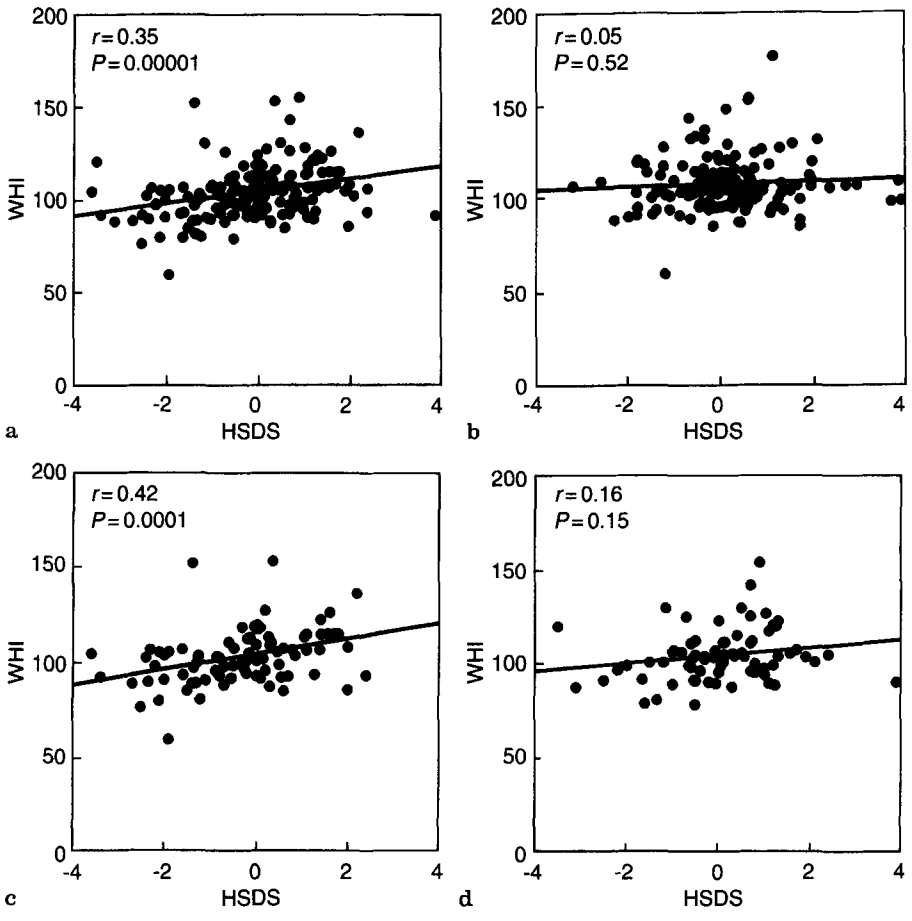

Fig. 2. Relationship between HSDS and WHI in all patients with VUR (**a**), all healthy controls (**b**), all patients with renal scarring (**c**), and all patients without renal scarring (**d**)

SCAR+ VUR. In this group, 14% of subjects had a height below –2 HSDS and average HSDS were significantly below those of controls. VUR produces a decrease in the renal concentrating ability [9] which in turn may interfere with normal growth [10]. It is conceivable that the decrease in renal concentrating ability is mostly present in SCAR+ subjects due to the more widespread renal parenchymal damage. In addition, more serious and long-lasting urinary infections (with concomitant poor appetite) are usually associated with renal scarring. Some association between renal scarring and short stature has already been noted by Smellie et al. [3].

It is noteworthy that the 4 patients in our study with bilateral renal scarring (2 of the BSCAR+ and 2 of the USCAR+ group) had WHI and HSDS values which were not clearly below the averages of their own group. It is likely that body growth is better related to the percentage of total renal parenchyma which is scarred rather than to the presence of unilateral or bilateral scarring.

The number and duration of urinary infections, the delay in starting treatment, and the age at which the infections occurred may have played a role in determining the relatively short stature. Unfortunately, we were unable to obtain data on previous urinary tract infections and we were unable to establish whether recurrent urinary tract infections contributed to the scarring or poor growth. Nevertheless – although too limited to draw any definite conclusion – our data on VUR patients diagnosed following the pre-natal sonographic finding of urinary tract dilatation and given antibacterial prophylaxis from birth suggest that the prevention of severe urinary infections and of renal scarring may allow normal somatic growth. In the present series, there was no significant relationship between age and growth. This is not very surprising because while older children may have suffered longer-lasting effects of VUR (infection, urinary loss of water, and solutes), younger children (i.e., those diagnosed early) may have suffered more serious effects because of early and more apparent symptoms.

The WHI of our control subjects is higher than expected (Fig. 1). In the present study we utilized the standards by Tanner and Whitehouse [8] which are roughly equivalent to those obtained in normal children from our region [11]. However, some anthropometric differences between British children and children from our region might account for the excess weight we found in most of the groups of subjects studied. However, the finding of some weight excess in controls as well as in three groups of patients is in keeping with the finding of weight excess in normal children in Italy [12] and in other countries [13]. It is noteworthy that B SCAR–, U SCAR+, and U SCAR– patients had similar increases in weight and height as controls (and had a similar weight excess), while B SCAR+ subjects had significant statural delay and normal WHI. Since WHI and HSDS are significantly related in our patients, it appears that in VUR patients the weight excess is associated with a normal statural growth and that the absence of weight excess is associated with some short stature. It is possible that the derangements associated with renal scarring affect both height and WHI and prevent B SCAR+ subjects from

gaining the excess weight which is usually observed in normal children in western countries.

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Literature abstract

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The nonoperative management of unilateral neonatal hydronephrosis: natural hystory of poorly functioning kidneys

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During the last 5 years we have followed nonoperatively all neonates with unilateral hydronephrosis and suspected uretropelvic junction obstruction, regardless of the degree of hydronephrosis, shape of the diuretic renogram washout curve or initial degree of functional impairment. Of 104 patients 7 (7%) ultimately required pyeloplasty for obstruction, which was defined as a greater than 10% reduction in differential glomerular filtration rate and/or progression of hydronephrosis. Pyeloplasty returned renal function to pre-deterioration levels in all kidneys. In 16 patients with profound hydronephrosis and initial differential renal function less than or equal to 40% all traditional diagnostic tests for assessing obstruction, including diuretic renography washout pattern, were inaccurate in diagnosing obstruction and predicting which kidney would deteriorate. In 15 of 16 poorly functioning hydronephrotic kidneys rapid improvement in absolute and per cent differential renal function was observed, and the level of initial differential renal function served as a useful guide for timing of further diagnostic studies.

Unilateral neonatal hydronephrosis appears to be a relatively benign condition and the risk of developing renal obstruction appears relatively slight. Because of diagnostic inaccuracy, the low risk of developing obstructive injury and the fact that many newborn kidneys with hydronephrosis rapidly improve function and dilation, it appears safe to follow neonatal unilateral hydronephrosis closely and nonoperatively.