Eur J Pediatr (1998) 157: 508–511 © Springer-Verlag 1998

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Antenatally detected urinary tract abnormalities: changing incidence and management

Received: 16 April 1997 and in revised form: 10 November 1997 / Accepted: 10 November 1997

Abstract To define the incidence of urinary tract abnormalities detected by antenatal ultrasound and assess changes in postnatal management we conducted a retrospective survey using data bases of the nephro-urology unit, obstetric ultrasound and perinatal pathology departments. The birth population (105,542) of the two Nottingham teaching hospitals between January 1984 and December 1993 was divided into two 5-year cohorts, 1984–1988 and 1989–1993. Detailed fetal scanning at 18–20 weeks gestation was introduced in 1989. During this 10-year period, 201 abnormalities of the urinary tract were noted with a 2:1 male to female ratio. The incidence of abnormalities in the first 5 years was 1 in 964 compared to 1 in 364 in the last 5 years. There was a significant increase in the number detected before 20 weeks gestation (12% in 1984–1988 compared to 62% in 1989–1993). Despite the increased incidence of abnormalities detected, the termination rate remained static between the two 5-year cohorts. Only 3 fetuses had intra-uterine intervention and 173 were live-born. Eight infants subsequently died in association with other major congenital abnormalities. The incidence of transient abnormalities (antenatal dilatation with no abnormality noted on postnatal ultrasound) increased from 6% in 1984–1988 to 18% in the 1989–1993 cohort. A more conservative approach to postnatal management is reflected by 71% of infants having operations between 1984 and 1988 compared to 35% in 1989–1993.

Conclusion The advent of detailed fetal scanning at 18–20 weeks gestation has significantly increased the detection rate of urinary tract abnormalities with no significant increase in pregnancy termination rates. The need for antenatal intervention is a rare event and most problems can be managed conservatively both pre- and postnatally.

Key words Ultrasound · Urinary tract abnormalities · Antenatal

Abbreviations *AUTA* antenatally detected urinary tract abnomalily · *MCDK* multicystic dysplastic kidney · *MCUG* micturating cystourethrogram · *RPD* renal pelvic diameter · *VUR* vesico-ureteric reflux

Introduction

In the early 1980s the majority of pregnant women had an abdominal ultrasound scan as part of the routine booking procedure at 12–16 weeks gestation. The improved resolution of the ultrasound equipment combined with the experience of the staff led to increased recognition of fetal abnormalities including those of the urinary tract [11, 18]. Initially such abnormalities were mainly detected on scans performed late in pregnancy for obstetric reasons. Since the natural history of many

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of these urinary tract abnormalities was undefined, their detection posed many problems in terms of antenatal counselling and postnatal management [20, 21].

In 1989 the routine booking antenatal ultrasound scan in Nottingham was supplemented and subsequently replaced by detailed fetal scanning at 18–20 weeks gestation. Our impression is that this has led to the increased detection of antenatal urinary tract abnormalities (AUTA).

We have reviewed our experience over a 10-year period 1984–1993 to define the incidence of AUTA in the Nottingham birth population and to examine the impact of the introduction of detailed fetal scanning over the last 5 years. We also report the spectrum of abnormalities detected and outline the changes in management.

Subjects and methods

Between January 1984 and December 1993 information was gathered on AUTA in the birth population of the two Nottingham teaching hospitals (approximate annual birth rate 10,500) from three sources: computer registry of the paediatric nephro-urology unit, records of the obstetric ultrasound units and perinata1 pathology records (for still births and terminations). Since 1987 many cases have been discussed at our monthly perinatal discussion group which includes pathology, radiology, genetic, obstetric and paediatric staff.

Ultrasound scans were initially performed by trained radiographers with referral to a radiologist if there was significant abnormality detected or if there was persistent significant dilatation of the renal pelvis in one or either kidneys (> 5 mm dilatation at 18 weeks; > 7 mm at > 28 weeks gestation) [2]. In 1989 a detailed fetal scan was offered to pregnant women at 18–20 weeks gestation. There is no routine scanning in late pregnancy unless requested for obstetric indications.

Statistics

Chi-square analysis was undertaken where appropriate.

Postnatal investigations

All live-born infants have undergone a standard protocol of investigations. Unless clinically indicated (severe bilateral hydronephrosis or palpable mass at birth) a postnatal ultrasound can be delayed beyond the first 48 h after birth to ensure that the infant is well hydrated and urine flow established. If early discharge of the mother is planned then the postnatal ultrasound scan be arranged in the first few weeks following birth.

Prophylactic antibiotics have not been routinely prescribed unless the antenatal ultrasound has strongly suggested gross vesico-ureteric reflux (VUR) (variable renal pelvic and/or ureteric dilatation) or there was bilateral obstructive uropathy such as posterior urethral valves. However, all infants are given trimethoprim cover (2 mg/kg/day twice daily) for 2 days at the time of the micturating cystourethrogram (MCUG) which is performed without sedation. If severe VUR is demonstrated at the time of the MCUG then a urine culture is taken and 48 h cover with full doses of a cephalosporin is prescribed while the urine culture result is awaited.

Unless clinically indicated (palpable mass at birth or gross pelvic and calyceal distension and cortical thinning on initial ultrasound) the radionuclide imaging is usually delayed until the child is approximately 3 months of age. A technetium −99m (^{99m}Tc) dimercaptosuccinic acid scan is performed to confirm non function in the usually unilateral multi-cystic dysplastic kidney (MCDK) and to define differential function in children with VUR. ^{99m}Tc mercaptoacetyltriglycine has replaced the ^{99m}Tc diethylenetriaminepenta-acetic acid scan as the radionuclide of choice for demonstrating differential function and excretion in infants with hydronephrosis due to suspected pelviureteric junction or vesicoureteric junction obstruction. An intravenous urogram is only requested if the anatomical definition is still uncertain e.g. duplex systems and after discussion at a combined meeting with the radiologists.

Since 1988 many parents have been referred for counselling antenatally. Written information has been produced to supplement the explanation given to the parents. More importantly they also have an opportunity to meet the day case co-ordinating nurse in the clinic who arranges the postnatal investigations.

Results

Two hundred and one abnormalities of the urinary tract were noted over the 10-year period when there were 105,542 total live births. Fifty-four abnormalities were noted in the 5-year period 1984–1988, and 147 between 1989 and 1993. The sex distribution was 121 male, 52 female and one was of ambiguous gender. In 27 the gender was unrecorded, usually in association with termination, stillbirth or early neonatal death when no necropsy was performed. The overall incidence of AUTA (including terminations and stillbirths with a urinary tract abnormality as the major lesion) was 1 in 525 total births. Divided into the two 5-year cohorts, the incidence was 1 in 964 between 1984 and 1988 but increased to 1 in 364 over the last 5 years (1989–1993) with the introduction of detailed fetal scanning in 1989.

An accurate gestational age of detection of the AUTA was recorded in 155 cases. The percentage of abnormalities detected before 20 weeks gestation increased from 12% (5) (1984–1988) to 62% (71) in the last 5 years ($P < 0.0001$). Termination of pregnancy accounted for 9% of the group overall with two thirds of these having a severe oligohydramnios sequence (Potter syndrome). The renal problem was the main reason for termination in all but one fetus where mild hydronephrosis was seen in a child terminated for ectodermal dysplasia. Despite the increased incidence of abnormalities, the termination rate remained static between the two 5-year cohorts (5/54 1984–1988, 13/147 1988–1993).

Three fetuses had intra-uterine intervention with vesico-amniotic shunts for presumed obstructive uropathy at 20, 21 and 30 weeks respectively. One fetus has prune belly syndrome and along with one child with proven posterior urethral valves survived but both have chronic renal failure. One fetus with bilateral cystic kidneys and posterior urethral valves spontaneously aborted at 22 weeks. Ten infants (5%) were stillborn and in 5 the abnormality was posterior urethral valves.

The diagnosis and outcome in the 173 live-born infants is shown in Table 1. Eight infants subsequently died usually in association with other major congenital abnormalities.

Overall 14% of the AUTA detected were subsequently labelled as a transient abnormality. We defined this group as those with significant renal pelvicalyceal dilatation (> 5 mm at 18 weeks; > 7 mm > 28 weeks)

Table 1 Diagnosis and outcome in 173 infants born alive (*Op* operated upon, *Cons* conservative management)

Diagnosis	No. Patients	Bilateral disease	1984–1988		1989–1993	
			Op	Cons	Op	Cons
Pelvi-ureteric Junction Obstruction	52	6	14	1	19	18
Multicystic Dysplastic Renal Disease	29	7	5	6	0	18
Vesico-ureteric Junction Obstruction	16	2	3	3	1	9
Vesico-ureteric Reflux	14	10	1	1	3	9
Duplex Systems	12	0	2	0	7	3
Posterior Urethral Valves	3	–	2	0	1	0
Transient Conditions	29	26				
Miscellaneous e.g. Single or ectopic kidney, Dysplasia or prune belly syndrome	18	0	0		0	

which usually persists on serial ultrasound scanning but in whom the postnatal ultrasound scan is reported as normal. Such transient abnormalities accounted for 6% (3 in 54) of abnormalities in the 1984–1988 cohort but increased to 18% (26 in 147) in the 1989–1993 cohort ($P < 0.05$).

In only 27 (15%) of those live-born was the renal abnormality clinically apparent at birth with a palpable abdominal mass. In 157 cases the family history was available and this was positive for urinary tract abnormalities in 10%.

The trend towards a more conservative approach to management over the 10-year period of observation is also illustrated in Table 1 with 27 (71%) infants having operations between 1984 and 1988 compared to 31 (35%) in 1989–1993 ($P < 0.001$).

Discussion

The study confirms a significant increase in the detection rate of urinary tract abnormalities with the advent of detailed fetal scanning in the second trimester of pregnancy in 1989. This increase has largely been in the abnormalities detected before 20 weeks gestation because late pregnancy scans are still only currently carried out for obstetric reasons such as investigation of bleeding, concerns about fetal size etc. Other recent series which have incorporated routine ultrasonography in the last trimester has shown incidence figures for AUTA of 1:200 to 1:70 births [7, 10, 13, 17].

However all these series, including our own, emphasise that the incidence of significant renal abnormalities is much less than the quoted overall incidence. Only 45% of the 92 babies with an abnormal antenatal scan reported by Livera et al. [13] in a prospective study of ultrasound screening at 28 weeks gestation had an abnormality confirmed postnatally. There was a 39% false-positive rate in 736 notifications of fetuses with suspected urological abnormalities to the Northern Region Fetal Abnormality Survey between January 1985 and December 1990 [16]. The majority of the false-positive diagnoses were associated with pelvic dilatation and this appears to be a widespread problem.

Currently there is no consensus on the degree of dilatation on the antenatal ultrasound that should result in full investigation of the infant including MCUG postnatally. Some authors have suggested an anteroposterior renal pelvic diameter (RPD) of >7 mm on late scans as being significant [2, 4, 6]. In a recent study Gunn et al. [10] chose to measure the length of the visible fluid filled system in the sagital plain and used 15 mm as a baseline. However 62% of fetuses with a dilated renal pelvis after 28 weeks gestation in their series had normal postnatal ultrasound by 6 weeks. Currently our local protocol states that infants in whom there has been significant (>7 mm RPD at >28 weeks gestation) dilatation of the renal pelvis should be referred for postnatal ultrasound in the first instance. This has resulted in a significant increase in the number of infants categorised in the past 5 years as having a 'transient' abnormality on the basis of a normal postnatal ultrasound. It appears that our threshold of >7mm RPD at >28 weeks gestation is set too low at present and further evaluation is required.

It is important that the ultrasound is performed at least 48 h after birth when the child has established a diuresis. Unless there is a clinically palpable mass at birth or a bilateral lesion such as posterior urethral valves or severe VUR is suspected, then the ultrasound can be performed a few weeks after birth. Discharge of mother and child from the hospital need not be delayed. If this postnatal ultrasound is entirely normal we no longer proceed with an MCUG unless there is a family history of vesicoureteric reflux. Such infants are discharged from follow up with instructions to the parents that they should be referred back if a urinary tract infection is proven or suspected.

However the contrary view is that all infants with any degree of antenatal hydronephrosis should have an MCUG even if the postnatal ultrasound is normal. Several authors have recently demonstrated that gross

degrees of VUR can be associated with minimal or no dilatation on postnatal ultrasound scan [14, 19, 22]. However, conservative management has also shown resolution of even severe grades of reflux over the first 2 years of life [3, 5]. We have also become aware that some infants are born with globally small 'dysplastic' kidneys in association with VUR without any evidence of urinary tract infection. The VUR population with 'scarred' kidneys may therefore be divided into the congenital and acquired reflux groups. The former are usually recognisable on ultrasound criteria and have full investigations to document the degree of damage. We have to balance our concern for detecting VUR with the potential to prevent infection and damage to growing kidneys with the concerns increasingly expressed by parents about invasive tests in their asymptomatic infants. Only a controlled trial of urinary prophylaxis against observation only will resolve the value of detecting VUR in 'normal' kidneys at birth.

Antenatal intervention in fetuses with obstruction of the urinary tract is still controversial. It may not be possible to define the cause of the obstructive uropathy precisely, biochemical indices on bladder urine may not reflect damage to both kidneys and percutaneous vesico-amniotic shunts have a complication rate of 25% [8]. The need for such intervention is rare as illustrated by three cases in 10 years in our series. In specialist centres fetal cystoscopy has recently been used to define the cause of the lower obstructive uropathy with attempts made to create a direct drainage procedure [15].

The management of many of these antenatally detected urinary tract abnormalities has become increasingly conservative as emphasised by the two 5-year periods in our study when the operation rate fell from 71% to 35%. The commonest abnormality of pelviureteric junction obstruction is assessed by postnatal ultrasound and currently ^{99m}Tc mercaptoacetyltriglycine scan. Each child's investigations are discussed at a combined nephrourology and radiology meeting and only if there is a significant pelviceal calyceal dilatation on the ultrasound combined with poor washout of radionuclide and decreased differential function on the affected side ($<40\%$) is surgery contemplated [9]. A similar situation pertains to vesico-ureteric junction obstruction [12]. Management of MCDK disease in our unit has been entirely conservative in recent years [1]. Although concerns have been expressed about hypertension, infection and possible rare tumour formation in association with MCDK kidneys, serial ultrasounds show progressive involution with time.

The current study emphasises that dilemmas still exist with the antenatal detection and postnatal management of antenatally detected urinary tract abnormalities. Adequate explanation and support for prospective parents remains a cornerstone of good practice, especially as we are mainly dealing with asymptomatic conditions. Our postnatal plan of management is increasingly conservative but evolving as the natural history of many abnormalities continues to be defined.

Acknowledgements We thank Dr. J Padfield, Dr. D. Rose, Dr. A. Manhire, Dr. N. Broderick, Dr. J. Somers and the staff of the obstetric ultrasound departments for their co-operation.

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