The sensitivity of antenatal ultrasound for predicting renal tract surgery in early childhood

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ABSTRACT

Objective To establish the sensitivity of antenatal ultrasound for identifying the need for renal tract surgery in infancy and early childhood.

Methods A retrospective analysis of the surgical records in children under 5 years of age undergoing renal tract surgery in a regional pediatric urological surgery referral unit was carried out. All records between May 1997 and July 2002 were examined to assess the relationship between prenatal ultrasound findings and postnatal surgical pathology.

Results A total of 106 operations had been performed. The detection rate of multicystic renal dysplasia was 100% (17/17). The equivalent detection rates for pelviureteral junction obstruction, duplex renal system and vesicoureteral reflux were 82.8, 67 and 26.1%, respectively. None of the babies with renal tumors had abnormal antenatal ultrasound findings. The diagnosis of postnatal renal surgical pathology was made on the basis of prenatal scan findings in 59.6% of cases, while recurrent urinary tract infection led to the diagnosis in 26.0%.

Conclusions Approximately 40% of children requiring surgery for renal tract pathology will have a normal antenatal ultrasound examination. The prevalence of abnormal antenatal ultrasound findings varies depending on the type of renal tract pathology. Despite these findings, the commonest indicator for surgery remains abnormal prenatal scan findings, followed by recurrent urinary tract infections. Copyright © 2005 ISUOG. Published by John Wiley & Sons, Ltd.
of the local ethics committee to carry out the study was obtained.

The Chi-square test for trend was used to explore whether sensitivity is dependent on the diagnosis, and the Cox regression method was used to ascertain the probability of surgery with increasing age. Statistical significance was set at 0.05. All statistical analysis was carried out using SPSS for windows 10.0.5 (SPSS Corporation, Chicago, Illinois).

RESULTS

During the study period 106 surgical urological procedures were performed and 104 surgical records were available for study. All the mothers underwent a prenatal ultrasound scan at 19–23 weeks of pregnancy in keeping with the current practice. In 59.6% (62/104) of cases, prenatal ultrasound findings revealed an abnormality of the urinary tract of the fetus, resulting in scheduled periodic surgical surveillance in the postnatal period. In the remaining 42 cases no renal abnormalities were detected on prenatal ultrasound examination.

The sensitivity of prenatal ultrasound scanning for postnatal surgical pathology is shown in Table 1. Multicystic renal dysplasia was diagnosed prenatally in all cases where it was found postnatally, but the detection rates were lower for other renal abnormalities. The reasons for referral to the regional pediatric surgical unit are shown in Table 2. The majority of referrals (59.6%) were made because of abnormal antenatal scan findings, followed by recurrent urinary tract infection (26%).

Table 1 Sensitivity of prenatal ultrasound examination for detecting specific renal problems

<table>
<thead>
<tr>
<th>Final diagnosis</th>
<th>Antenatal detection n (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelviureteral junction obstruction or hydronephrosis</td>
<td>24 (82.8)</td>
<td>29</td>
</tr>
<tr>
<td>Vesicoureteral reflux</td>
<td>6 (26.1)</td>
<td>23</td>
</tr>
<tr>
<td>Multicystic renal dysplasia</td>
<td>17 (100)</td>
<td>17</td>
</tr>
<tr>
<td>Duplex renal system</td>
<td>10 (66.7)</td>
<td>15</td>
</tr>
<tr>
<td>Renal tumor</td>
<td>0 (0)</td>
<td>7</td>
</tr>
<tr>
<td>Vesicoureteral junction obstruction</td>
<td>1 (25.0)</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>4 (44.4)</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>62 (59.6)</td>
<td>104</td>
</tr>
</tbody>
</table>

P < 0.0001 (Chi-squared test for trend).

Table 2 Reasons for pediatric surgical referral

<table>
<thead>
<tr>
<th>Reason for referral</th>
<th>Number of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal antenatal scan findings</td>
<td>62</td>
<td>59.6</td>
</tr>
<tr>
<td>Recurrent urinary tract infection</td>
<td>27</td>
<td>26.0</td>
</tr>
<tr>
<td>Abdominal mass</td>
<td>6</td>
<td>5.8</td>
</tr>
<tr>
<td>Non-renal</td>
<td>9</td>
<td>8.7</td>
</tr>
<tr>
<td>Total</td>
<td>104</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 1 The cumulative probability of undergoing surgery on the urinary tract with increasing age of the child; data included from all the cases studied.

Figure 2 The cumulative probability of undergoing surgery on the urinary tract with increasing age of the child, according to prenatal (dashed line) or postnatal (continuous line) diagnosis. Log rank statistic −9.36, P = 0.0022.

The cumulative probability for renal tract surgery increases with the child’s age in a linear fashion (Figure 1).

The data were divided into two groups depending on whether or not a prenatal diagnosis was made. The cumulative probability for renal tract surgery was recalculated for each group (Figure 2). When the log rank test was used to assess the difference between the two groups, it was found that prenatally diagnosed children undergo surgery earlier than the ones with a postnatal diagnosis (P = 0.0022). However, the cumulative probability for renal tract surgery increases in both groups with increasing age.
DISCUSSION

This study demonstrates that prenatal ultrasound examination identifies approximately 60% of infants who require renal tract surgery within the first 5 years of life. Furthermore, the detection rate varies according to the type of renal pathology and the length of postnatal follow-up. Previous studies attempting to assess the reliability of antenatal ultrasound examination for surgical pathology are limited. Levi et al. reported a sensitivity of prenatal ultrasound scanning of 85% for major urinary tract abnormalities1. However, postnatal examination was carried out within 6 days of birth if there were abnormal antenatal ultrasound findings, and longer follow-up of infants with normal antenatal ultrasound findings was not reported. Given the increasing likelihood of late diagnosis shown in Figure 1, the sensitivity reported in the latter study is likely to be an overestimate. In contrast, Rosendahl10 reported on routine ultrasound screening for renal abnormalities in infants up to 4 years of age. He also reported a sensitivity of antenatal scans of 85% for renal abnormalities. However, this was based on 27 cases of renal tract abnormality, with only 60% undergoing renal surgery. Furthermore, in the latter study fetuses underwent ultrasound screening at up to 34 weeks’ gestation, when detection of progressive abnormalities is more likely.

Diagnosis-specific detection

In the present study 10 (66.7%) of the cases requiring an operation for a duplex renal system had abnormal prenatal ultrasound findings. In a study correlating prenatal scan findings with postnatal radiological investigations, Whitten et al. reported the correct identification of a duplex renal system in 75% of cases11. In the latter series cases of duplex renal systems with normal prenatal ultrasound findings did not have postnatal urological work-up, and the number of cases requiring surgery was not reported.

Prenatally diagnosed vesicoureteral reflux tends to be bilateral and high-grade, with an overwhelming male preponderance. Chen et al. compared reflux nephropathy in the group diagnosed prenatally as opposed to that arising from infections12. Out of 202 infants with reflux nephropathy, 56 (27.7%) were prenatally diagnosed, a figure that is very similar to the frequency of 26.1% with abnormal antenatal ultrasound findings in the present study. The low sensitivity for reflux-related surgical disease is supported by the study of Farhat et al. on a series of 260 women with antenatal hydrenephrosis13. Their postnatal ultrasound findings correlated poorly with the presence or absence of vesicoureteral reflux. They concluded that even a normal postnatal ultrasound scan should not be a basis for excluding the use of cystography to eliminate reflux disease.

Length of postnatal follow-up

The cumulative probability of surgical intervention increases with time in a linear fashion regardless of the availability of prenatal diagnosis. This suggests that studies reporting the sensitivity of prenatal ultrasound scanning for the detection of renal abnormalities need a long-term follow-up. The major conclusion to be drawn regarding this finding is that prenatal ultrasound examination may not be as reliable as previously assumed. An alternative explanation is that postnatal events may be responsible for the development of renal surgical pathology. In a prospective study of 309 infants, Hoberman et al. reported a normal ultrasound scan in 88% of cases, but the presence of reflux on cystourethrogram in 39% of the cohort14. The implications of the latter study are firstly that even postnatal ultrasound examination is inaccurate in identifying renal pathology (specifically reflux) and that recurrent postnatal infection may be responsible for renal scarring and permanent renal damage.

CONCLUSIONS

Approximately 40% of children requiring surgery for renal tract pathology will have had a normal antenatal ultrasound examination. The prevalence of abnormal antenatal ultrasound findings varies depending on the type of renal tract pathology. Despite these findings, the most common indicator for surgery remains abnormal prenatal scan findings, followed by recurrent urinary tract infections. The probability of surgery being necessary increases with time in an almost linear fashion whether or not an antenatal diagnosis has been made. Long-term follow-up will be needed to assess the need for surgical intervention in infants with congenital renal tract abnormalities.

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REFERENCES