SHORT COMMUNICATION

Outcome of fetal cerebral posterior fossa anomalies

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Introduction  Limited data exist on the outcome of Dandy–Walker malformation (DWM), Dandy–Walker variant (DWV) and mega-cisterna magna (MCM). We report the first population-based study of posterior fossa anomalies from the northern region of England.

Methods  Cases were identified from the Northern Congenital Abnormality Survey (NorCAS) and regional Fetal Medicine Unit databases for the period 1986–2004 for DWM/V and 1995–2004 for MCM (defined as a cisterna magna ≥ 10 mm). Outcome data was obtained from pediatric records and/or general practitioner/health visitor questionnaires for all survivors.

Results  A prenatal diagnosis of a posterior fossa abnormality was made in 91 cases, with a further 12 cases of DWM/V diagnosed postnatally, giving incidences of DWM/V and MCM of 1/11574 and 1/8268 births respectively. In five cases where DWM/V was suspected prenatally, the diagnosis was not confirmed. Of the 47 with DWM/V, 41 (87%) had additional anomalies. There were three survivors, all with neurodevelopmental disability. Of the 39 cases of MCM, 24 (62%) had additional anomalies. There were 30 survivors; one child died at 3 months and the outcome was normal in 25 children including 12/13 (92%) with isolated MCM.

Summary  Posterior fossa anomalies are relatively common. The outcome is very poor in DWM/V owing to the high rate of associated anomalies. The outcome appears better with MCM, especially if this is an isolated finding.

INTRODUCTION

Examination of the posterior fossa is part of routine ultrasound screening for fetal anomaly. Posterior fossa anomalies can be divided into Dandy–Walker malformation (DWM), comprising cystic dilation of the fourth ventricle, enlarged posterior fossa, complete or partial agenesis of cerebellar vermis, and elevated tentorium, Dandy–Walker variant (DWV), comprising variable hypoplasia of the cerebellar vermis with or without enlargement of the cisterna magna and mega-cisterna magna (MCM) with normal cerebellar vermis and fourth ventricle (Ecker et al., 2000; Pilu, 2000; Pilu et al., 2000; Bernard et al., 2001). However, recent evidence from MRI imaging suggests DWM, DWV and MCM represent a continuum and should be referred to as the Dandy–Walker complex (Barkovich et al., 1989). Previous studies of the prenatal detection and outcome of posterior fossa anomalies have all come from referral centers. The aim of this population-based study is to describe the outcome of posterior fossa anomalies in the northern region of England.

The Northern Congenital Abnormality Survey (NorCAS) collects data on all major congenital abnormalities in fetuses (including spontaneous abortions and terminations of pregnancy), stillbirths and liveborn infants of mothers resident in the former Northern Region. The population of approximately 3 million is stable, with little migration (Atkins and Hey, 1991; Rankin, et al., 1999; Sparey et al., 2000). The register is voluntary but has a high notification rate and has collected data since 1984 (1992).

Guidelines for screening for cerebral anomalies at the 18–20 week scan were standardized in 1995 to include routine measurement of the cisterna magna and notification to NorCAS if ≥ 10 mm. All cases of DWM and DWV notified to NorCAS between 1986 and 2004, and MCM between 1995 and 2004 were identified and the outcomes reviewed. The Fetal Medicine Unit in Newcastle provides a regional referral service; the unit database was also searched for the same period, and any additional cases identified. Outcome information was obtained from pediatric records where available and a questionnaire sent to general practitioners and health visitors. Formal neurodevelopmental assessment was not performed. The outcome was designated normal if the child had normal routine developmental checks. Barkovich’s classification of posterior fossa anomalies was used (Barkovich et al., 1989).
RESULTS

A prenatal diagnosis of a posterior fossa anomaly was made in 91 cases, and a further 12 cases were diagnosed postnatally. In five cases where DWM/V was suspected prenatally, the diagnosis was not confirmed (false-positive rate 5%); one was reclassified as normal at a subsequent scan 14 weeks later and the remaining four had ventriculomegaly associated with other intracranial pathology at postmortem (cytomegalovirus infection [1], agenesis of corpus callosum [1] and Arnold Chiari malformation [2]). In one case diagnosed postnatally on ultrasound imaging, the diagnosis was revised to an arachnoid cyst after CT imaging.

There were 47 cases of confirmed DWM/V diagnosed prenatally (incidence 1/11574 births); of these 15 were DWW and 32 were DWM. The mean (SD) gestation at diagnosis was 20.0 (3.3) weeks and the male:female ratio was 1.5:1. Outcomes are shown in Table 1. Associated structural anomalies were present in 39/47 (83%) cases; of these 86% were detected by prenatal ultrasound. Karyotyping was performed in 32 cases with 13 anomalies (3 unbalanced translocations, 2 deletions, 3 trisomies [18,18,21], 1 triploidy and four sex chromosome anomalies [47.XXY, 47.XXX, 49.XXXX, 45X0/46XX]) of which 11 had additional structural anomalies. Thirty-eight (81%) families opted for termination of pregnancy (TOP). Five infants were liveborn and three survived (median [range] follow-up 36 [12–96] months). Postmortem examination was available in one neonatal death (age 1 day), which showed a left frontal lobe hemorrhage due to alloimmune thrombocytopenia.

DISCUSSION

We report the first population-based study of posterior fossa anomalies diagnosed in the north of England over an 18-year period. Although formal neurodevelopmental assessment was not undertaken, we obtained follow-up information on all cases. Although there is evidence that DWM/V and MCM represent a continuum (Barkovich et al., 1989), we report the outcome data separately because they were so different; no fetus with DWM/V had a normal outcome in contrast to 92% of fetuses with isolated MCM.

The incidences of DWM/V and MCM in our series were 1/11574 and 1/8268 births respectively. There is no data on the prenatal incidence of posterior fossa anomalies. DWM is usually quoted as having an incidence of 1/25 000–35 000 based on the series of (Hirsch et al., 1984). However, this figure was indirectly derived from a postnatal population with hydrocephalus. It has

Table 1—Outcome of posterior fossa anomalies

<table>
<thead>
<tr>
<th>Category</th>
<th>N seen in</th>
<th>Outcome</th>
<th>Neurodevelopment outcome (LB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>FMU</td>
<td>TOP</td>
</tr>
<tr>
<td>DWM/V</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Prenatal diagnosis</td>
<td>Isolated</td>
<td>6</td>
<td>5</td>
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<tr>
<td></td>
<td>Associated abnormalities¹</td>
<td>41</td>
<td>31</td>
</tr>
<tr>
<td>Postnatal diagnosis</td>
<td>Isolated</td>
<td>3</td>
<td>0</td>
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<tr>
<td></td>
<td>Associated abnormalities</td>
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<tr>
<td>MCM</td>
<td>Isolated</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Associated abnormalities²</td>
<td>26</td>
<td>24</td>
</tr>
</tbody>
</table>

N, number; FMU, fetal medicine unit; TOP, termination of pregnancy; FD, fetal death; NND, neonatal death; LB, live birth; DWM/V, Dandy–Walker malformation/variant; MCM, mega-cisterna magna.

¹Fifteen cases involved one organ system (cerebral [n = 7—all ventriculomegaly], cardiac [n = 2], renal [n = 1], facial [n = 1] and skeletal [n = 1]), while 26 cases had multiple anomalies (including 20 with cerebral anomalies [12 with ventriculomegaly and five with agenesis corpus callosum]).

²Age 13—left hemiplegia from right-sided CVA (following repair of defect) because of different intellectual development. Age 7—mild developmental delay, epilepsy, behavioral problems; Age 4—severe expressive speech delay.

³Twenty-two cases involved one organ system (cerebral [n = 12—ventriculomegaly in 11, agenesis of corpus callosum in 1], renal [n = 8], cardiac [n = 1], liver [n = 1], while two cases had multiple anomalies (both included cerebral anomalies [1 with ventriculomegaly]).

⁴Age 4—delayed motor development (poor feeding and delayed walking [29 months]).

⁵One death at 3 months.

⁶Age ten months—VP shunt, HC 98th centile, delayed motor development; Age 3—delayed speech/language and deafness; Age 8—delayed cognitive and speech/language development (diagnosis congenital cerebral ataxia).
been previously reported that there is a slight female preponderance (Hirsch et al., 1984; Klein et al., 2003) for DWM, whereas we found a male preponderance of 1.5:1 for DWM/V and 3.75:1 for MCM.

Excluding terminations, the mortality of DWM/V in our series was 66%, slightly higher than the figures of 35–55% previously reported (Russ et al., 1992; Estroff et al., 1992). This partly reflects the high rate of associated anomalies (87%), the majority of which were detected prenatally. Normal neurodevelopmental outcome in prenatal series has ranged from 20–50% (Estroff et al., 1992; Aletshi and Fung 1999; Ecker et al., 2000; Kolble et al., 2000) with higher rates of 60–75% in postnatal series (Hirsch et al., 1984; Golden et al., 1987). We are unable to draw meaningful conclusions about neurodevelopmental outcomes in the DWM/V group, as only three survived, all with handicaps.

Associated structural anomalies were less common in the MCM group. The majority involved the brain with ventriculomegaly being present in 12/22 (54.5%) of cases. Although termination rates were low (7.6%), there was still a high fetal/neonatal mortality rate in the MCM group (16.7%), mostly related to associated anomalies. MCM is reported to be associated with aneuploidy, in particular, trisomy 18 (Steiger et al., 1995; Ek et al., 1998). In our series, there were only two known karyotype abnormalities, both of which had additional anomalies and neither were trisomy 18. Neurodevelopmental outcome was normal in 25/29 survivors, and this was more likely where the MCM was isolated (12/13). Thus, it would appear that isolated MCM carries a favorable prognosis. This is supported by one small series of 15 cases diagnosed in the third trimester, which resulted in a normal pregnancy and neonatal outcome (Haimovicci et al., 1997).

There was a high concordance between postmortem and prenatal ultrasound diagnosis of DWM/V (91.6%) in our series, which compares well with previous studies where the concordance has been as low as 43% (Carroll et al., 2000). In our series, no diagnosis was made prior to 18 weeks when development of the cerebellar vermis may not have been complete (Bromley et al., 1994). The diagnosis of DWM/V was not confirmed in five cases but in two cases visualization of the posterior fossa was recorded as ‘suboptimal’. Four of the five cases had other significant intracranial pathology (ventriculomegaly and agenesis of corpus callosum) and the fifth had a karyotype abnormality.

This series predates the introduction of fetal MRI, which may be a useful adjunct to prenatal diagnosis, especially in the third trimester (Yuh et al., 1994; Adamsbaum et al., 2005). Use of half-Fourier acquisition single-shot spin echo (HASTE) sequences allows optimal visualization of the posterior fossa (Stazzzone et al., 2000). MRI may be of prognostic value; abnormal lobulation of the cerebellar vermis has been associated with abnormal development (Boddaert et al., 2003; Klein et al., 2003).

In summary, posterior fossa anomalies are relatively common. The majority of DWM/V had associated anomalies and termination rates were very high. Although associated anomalies are also common with MCM (66.7%), the outcome appears better, being apparently normal in 92% of survivors with isolated MCM and in 81% with associated anomalies.

REFERENCES


