Outcome of antenatally suspected congenital cystic adenomatoid malformation of the lung: 10 years’ experience 1991-2001

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Abstract

Objective: To determine the outcome of antenatally suspected Congenital Cystic Adenomatoid Malformation of the lung (CCAM) over a 10 year period.

Methods: This is a retrospective study of all babies diagnosed antenatally in the Prenatal Diagnosis Unit and delivered in Oxford between 1991 and 2001. Data were obtained from the Oxford Congenital Anomaly Register, theatre records and histopathology reports.

Results: 28 cases of CCAM were diagnosed antenatally. Five pregnancies were terminated. Data are available on all 23 of the pregnancies that continued and resulted in two neonatal deaths and 21 surviving babies. 11 of the 23 cases (48%) showed some regression of the lesion antenatally and four of these cases appeared to resolve completely on prenatal ultrasound. Three of the 23 babies (13%) were symptomatic in the neonatal period and three developed symptoms shortly afterwards. 17 or the 23 babies (74%) were asymptomatic, of whom 12 had abnormalities on CXR or CT scan and had elective surgery. Two babies (8%) had completely normal post-natal imaging and three had abnormalities which resolved in the first year of life. 17 of the 23 babies (74%) had surgery. Histology at surgery was heterogeneous. Of the 23 live births, all 21 survivors (91%) are well at follow-up or have been discharged.

Conclusions: All babies diagnosed antenatally with CCAM require post-natal imaging with CT scan irrespective of signs of antenatal resolution. In asymptomatic infants we would recommend repeat imaging at one year and consideration of elective surgery if the lesion persists. Histology at surgery was heterogeneous and this should be considered when counseling parents.
Background

Congenital Cystic Adenomatoid Malformation of the Lung (CCAM) is a form of congenital cystic lung disease believed to result from an arrest in fetal lung development\(^\text{1,2,3}\). There has been an increase in cases suspected prenatally over the last decade. Antenatal ultrasound findings suggestive of CCAM include an increase in lung echodensity with or without associated cyst formation. Hydrops may occur in the most severe cases. The differential diagnosis includes Lobar Sequestration or Congenital Diaphragmatic Hernia\(^\text{4,5,6}\).

CCAM is usually restricted to a single lobe and occurs in isolation\(^\text{7}\). Associated anomalies are rare. An incidence of 1 in 25000 live births has been suggested\(^\text{8}\) with males and females equally affected. Potential clinical outcomes associated with CCAM are as follows:- Antenatally it can lead to hydrops, polyhydramnios, or regress\(^\text{9}\). Postnatally the baby may have severe respiratory distress, or more commonly be asymptomatic\(^\text{8,10,11,12,13}\). Traditionally surgery is recommended to remove the CCAM because of the long term risks of morbidity from infection, pneumothorax or more rarely, malignancy\(^\text{14-18}\).

The aims of this study were to document the outcome of all babies diagnosed antenatally with suspected CCAM over a 10 year period from 1991 to 2001 in order to facilitate counseling of parents during pregnancy and to allow optimal timing of post-natal management.

Methods

A retrospective audit was carried out of all babies diagnosed in the Prenatal Diagnosis Unit and delivered at the John Radcliffe Hospital, Oxford between 1991-2001. Data were obtained from the Oxford Congenital Anomaly Register, theatre records and histopathology reports, to identify all babies with a diagnosis of CCAM. Information regarding gestation at diagnosis, progression of the lesion during pregnancy, the presence of other anomalies, post-natal features, results of post-natal investigations and outcome were recorded. Ethical permission was not required for this study.

Results

The overall results of this study are illustrated in figure 1. Of the pregnancies that continued, data are available on all 23 babies, two of whom died in the neonatal period and 21 are alive and well. The characteristics of these 23 babies are shown in Table 1. All 21 babies who survived had post-natal imaging with chest radiograph and CT scan.
**Table 1: Characteristics of babies born following antenatal diagnosis of CCAM:**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestation (weeks)</td>
<td>35-42 (median 39)</td>
</tr>
<tr>
<td>Birthweight (g)</td>
<td>2640-4674 (median 3583)</td>
</tr>
<tr>
<td>Sex: Male number of cases (%)</td>
<td>13 (57%)</td>
</tr>
<tr>
<td>Female number of cases (%)</td>
<td>10 (43%)</td>
</tr>
<tr>
<td>Unilateral: Right: no. of cases (%)</td>
<td>9 (39%)</td>
</tr>
<tr>
<td>Left: no. of cases (%)</td>
<td>14 (61%)</td>
</tr>
<tr>
<td>Bilateral: no. of cases (%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Hydrops: no. of cases (%)</td>
<td>2 (8.7%)</td>
</tr>
<tr>
<td>Mediastinal Shift: no. (%)</td>
<td>16 (70%)</td>
</tr>
<tr>
<td>Antenatal Regression: no. (%)</td>
<td>11 (48%)</td>
</tr>
<tr>
<td>Complete antenatal resolution: number (%)</td>
<td>2 (8.7%)</td>
</tr>
</tbody>
</table>

Following delivery, three babies were symptomatic in the neonatal period and three babies developed symptoms later in the first year of life at two weeks, eight weeks and five months respectively. There were two neonatal deaths; one baby previously noted to have massive ascites which resolved, born at 36 weeks gestation with a Type 3 CCAM, on the right, who died at two hours of age and was found at post-mortem to have also right bronchial atresia and a hypoplastic left lung; the second baby was born at 35 weeks gestation and had a large CCAM with hydrops. Despite surgery he died on day nine with complications from multiple air leaks.

17 babies (74%) were asymptomatic following birth. Of these 17, 12 (71%) had abnormalities which were detectable on post-natal imaging and went on to have elective surgery. Two babies had their diagnosis changed on the basis of post-natal imaging to Lobar sequestration and a bronchogenic cyst respectively. Five of the 17 asymptomatic babies (29%) did not require surgery. Of these five babies, two had CXR and CT scans reported as normal in the post-natal period, one baby had a normal CXR and an area of volume loss on the CT scan, but no identifiable abnormality and two babies had normal CXR and changes on CT scan which resolved by nine months of age. Four of these five babies were followed up for between 12 and 17 months and were well at discharge.

Overall 17 babies had surgery. 16 out of these 17 survived. Timing of surgery ranged from two days to 23 months with a median of eight and a half months. Histology from surgery was heterogeneous. There were 9 cases of isolated CCAM, two cases of adenomatoid changes within a sequestered lobe, one bronchogenic cyst which had been
diagnosed on post-natal MRI scan at 5 months of age, three cases of isolated lobar sequestration, one of which was diagnosed on post-natal CT scan, and two cases where the histology was of bronchial malformation, not typical of either CCAM or sequestration, with areas of collapse and air-trapping.

All 21 survivors (91%) are well at follow-up or have been discharged from hospital follow-up at between one and three years of age.

Discussion

CCAM is an important diagnosis that can be suspected on routine antenatal ultrasound. It has implications for both the ongoing pregnancy and the baby, at delivery and later in life. Although the prognosis is generally good, this study illustrates the spectrum of potential outcome for babies with this diagnosis, ranging from hydrops and severe respiratory distress with pulmonary hypoplasia, to resolution of the lesion either antenatally or post-natally. In this study, as noted by others\textsuperscript{13,19} a poor outcome was associated with the presence of hydrops and prematurity. It is important that when this diagnosis is made antenatally, parents are made aware of all potential outcomes and the need for ongoing surveillance in the pregnancy. Ultrasound scanning is subjective and the findings often non-specific and therefore follow-up scanning is important both to confirm a diagnosis and to document any changes in appearances of the lesion.

Although some lesions do resolve antenatally and most babies are asymptomatic at birth, we would recommend that all babies are investigated in the neonatal period with CT scan, even if the lesion appeared to resolve completely antenatally. We document 2 cases of complete antenatal resolution with normal post-natal investigations and 2 cases in which although the CCAM was not seen late in pregnancy, post-natal investigations confirmed the initial diagnosis. It is also important to distinguish where possible CCAM from lobar sequestration on post-natal imaging to ensure optimal management.

The majority of lesions do persist in the first year of life and therefore surgery is recommended. However, we have documented three cases in which abnormalities on post-natal imaging resolved by nine months of age. We would therefore advocate a conservative approach to the management of asymptomatic babies in the first year of life, with follow up and repeat imaging. If the lesion persists we would then recommend surgery at around one year of age. If symptoms develop at any stage, surgery would need to be considered earlier.

The histology at surgery was variable with some babies having their diagnosis changed to lobar sequestration. This should be considered when counseling parents antenatally. The non-specific term congenital lung malformation may be more useful when discussing the diagnosis with parents antenatally as has been suggested previously by Bush\textsuperscript{20}.

In conclusion, this paper provides valuable information for parents and recommendations for timing of surgery in asymptomatic patients diagnosed antenatally with CCAM.
Conflict of interests
none.

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What is already known on this topic
- Congenital Cystic Adenomatoid malformation is a congenital abnormality of the lung believed to result from an arrest in fetal lung development.
- There is a spectrum of outcome associated with this condition.

What this study adds
- The majority of cases persist and are present after birth, although most babies are asymptomatic.
- In those cases where the lesion persists, surgery is required to remove the abnormality due to the long-term risks of infection, pneumothorax and, more rarely, malignancy.

Figure legend

Figure 1
Outcome of antenatal diagnosis of CCAM
Reference List


28 cases of suspected CCAM diagnosed antenatally in Oxford 1991-2002

23 pregnancies continued and delivered in Oxford.

5 TOP:
- 1 trisomy 21
- 1 hydrops
- 3 large CCAM with mediastinal shift

3 (13%) symptomatic in neonatal period

- 2 cases
  - 2 neonatal deaths: 1 trisomy 21 bronchial atresia and hypoplastic lung, 1 35/40 hydrops and died following surgery

- 1 case
  - 3 (13%) resolved

3 symptomatic early in first year

- 15 radiological abnormalities persist
  - 12 elective surgery and survived
  - 3 (13%) resolved

17 (74%) asymptomatic

- 2 (8%) normal
  - No surgery, All 5 survived

2 neonatal deaths: 1 36/40 bronchial atresia and hypoplastic lung, 1 35/40 hydrops and died following surgery

All (4) had early surgery and survived

Figure 1: Outcome of antenatal diagnosis of CCAM
vein PSCs placed over a 13 month period in one neonatal intensive care unit. All had been inserted in the left leg, and the inserting practitioner failed to identify malpositioning of the PSC tip on a frontal abdominal view obtained with contrast (fig 1A). Radiologists later identified the probable abnormal position based on the course of the PSC, and lateral views of the abdomen on the same day of insertion showed the superficial position of the catheter tip in the anterior abdominal wall (fig 1B).

A literature review showed that most of the reported serious complications secondary to malpositioning of saphenous lines occurred with a PSC inserted via the left leg.