Prenatal Diagnosis of Congenital Cystic Adenomatoid Malformations: Evolution and Outcome

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SUMMARY

Objective: The aim of this study was to describe the natural history and outcomes of fetal congenital cystic adenomatoid malformation (CCAM) of the lung in three antenatally diagnosed cases.

Case Report: Three women whose fetuses had CCAM of the lung between 2004 and 2006 chose to continue their pregnancies. We followed up these fetuses every 2 weeks and observed whether there were CCAM-related complications, such as polyhydramnios, mediastinal shifting, and even hydrops fetalis. We also used three-dimensional ultrasound using the VOCAL (Virtual Organ Computer-aided Analysis) rotational technique to calculate CCAM volume serially until delivery. At presentation, the three cases of fetal CCAM were all unilateral and microcystic. Two were complicated by mediastinal shift, but none had hydrops fetalis. Serial ultrasound volumetry demonstrated a trend toward a decreasing CCAM volume, despite an initial increase in volume. Complete resolution was noted in two cases by antenatal sonography. However, persistent lung lesions were found in two cases by postnatal chest radiography and in all cases by postnatal computed tomography scans.

Conclusion: The outcomes of the prenatally detected CCAMs were good in our cases. If the CCAM is not complicated by hydrops fetalis, maintaining the pregnancy with continuing management seems to be a reasonable recommendation. Despite antenatal resolution of CCAM on ultrasound, postnatal examination with chest radiography and computed tomography scan is necessary. [*Taiwan J Obstet Gynecol* 2009;48(3):278–281]

Key Words: congenital cystic adenomatoid malformation, fetal monitoring, pregnancy outcome

Introduction

Congenital cystic adenomatoid malformations (CCAMs) are benign hamartomatous or dysplastic lung tumors characterized by an overgrowth of terminal bronchioles. CCAMs have been classified histologically into three types, mainly based on cyst size as reported by Rosado-de-Christenson and Stocker [1]. Adzick et al [2] differentiated CCAMs diagnosed antenatally with ultrasound into macrocytic and microcystic lesions. The majority of cystic adenomatoid malformations of the lung decreased in size *in utero*. An acknowledged poor prognosis has been associated with the presence of hydrops. Polyhydramnios is another sign suggesting a poor outlook and is considered by some practitioners to be an indication for shunt insertion [3]. The reported perinatal mortality rate of cases with antenatally diagnosed CCAMs has varied greatly, ranging from 9% to as high as 49%. The discrepancies may be because some mothers terminated their pregnancies as a result of antenatal predictors of poor prognoses, such as hydrops or significant mediastinal shift [4]. However, the outcomes of prenatally recognized CCAMs have been better in recent reports than in the past.

Here, we present three cases of prenatally diagnosed CCAM. We used the VOCAL (Virtual Organ Computer-aided Analysis) modality for three-dimensional (3-D) sonographic volume measurement to determine the CCAM volume.

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Case Report

From 2004 to 2006, we collected information on three fetuses with CCAM diagnosed prenatally. Cases 2 and 3 were referred to our obstetric outpatient department at 22 and 18 weeks' gestation, because congenital fetal anomaly was suggested by the local health care provider. The woman in Case 1 had regular prenatal examinations at our obstetric outpatient department from the first trimester, and CCAM type II was suggested at 19 weeks' gestation. All women chose to continue their pregnancies after counseling. We followed up these pregnancies with 3-D ultrasound every 2 weeks until delivery. A commercially available GE Voluson 730 Expert ultrasound system scanner (GE Medical Systems, Milwaukee, WI, USA) equipped with a multifrequency transabdominal volumetric probe (3–9 MHz) was used. The characteristics of the three cases are presented in Table 1. We also analyzed the postnatal outcomes of these three babies.

Ultrasonography showed CCAM type II in Cases 1 and 3, and CCAM mixed type II and III in Case 2. The perinatal outcomes are listed in Table 2. There were no hydrops fetalis or other fetal anomalies noted in the three cases. Therefore, all three mothers decided to continue their pregnancies. Two fetuses had a mediastinal shift at the initial presentation, which improved after the CCAM volume decreased with advancing gestational age. Peak CCAM volume occurred at 22–27 weeks' gestation. In all three cases, CCAM volume decreased with advancing gestational age, despite the slight initial increase (Figure). Prenatal ultrasonography showed complete resolution in Cases 1 and 2, in which postnatal imaging with both chest X-ray and computed tomography (CT) scan demonstrated persistent lesions. Although there was a small CCAM lesion before birth in Case 3, the postnatal chest X-ray revealed no evidence of airspace consolidation. However, the CT scan showed multiple cystic lesions with areas of solid tissue in the right lower lobe.

The infant in Case 1 was admitted because of atypical pneumonia at 1 year of age. At that admission, she underwent surgery with lobectomy, and the histologic report showed extralobar sequestration and CCAM.

Table 1. Characteristics of the fetal congenital cystic adenomatoid malformations (CCAMs) in our study

	Case 1	Case 2	Case 3
Fetal sex	Female	Male	Female
GA at diagnosis (wk)	19	22	18
Type of CCAM by Stocker's criteria	Type 2	Mixed type 2 and type 3	Type 2
GA at peak volume (wk)	22	24	27
Complete resolution as determined by ultrasonography	Yes, at 35 weeks	Yes, at 36 weeks	No
Site of lesion	Right	Left	Right
Mediastinal shifting	N	Y	Y
Polyhydramnios	N	N	N
Ascites	N	N	N
Hydrops fetalis	N	N	N

GA = gestational age; N = negative finding; Y = positive finding.

Table 2. Perinatal outcomes of the cystic adenomatoid malformations (CCAMs) in our study

	Case 1	Case 2	Case 3
Site of lesion as determined by postnatal CT scan	Right lower lobe	Left upper lobe	Right lower lobe
Delivery age (wk)	38	40	34†
Type of delivery	Cesarean section*	Vaginal delivery	Vaginal delivery
Postnatal outcome	Status post lobectomy at 1 year old; alive	Bilateral pneumothorax at neonatal stage; status postlobectomy at 6 months of age; alive	Normal growth; one pneumonia attack at 2 years old; alive
Histologic diagnosis	Extralobar sequestration and CCAM	CCAM, type 2	Surgery not performed

**Indication for cesarean section was previous cesarean section; †preterm labor with full cervical dilatation at admission. CT = computed tomography.*

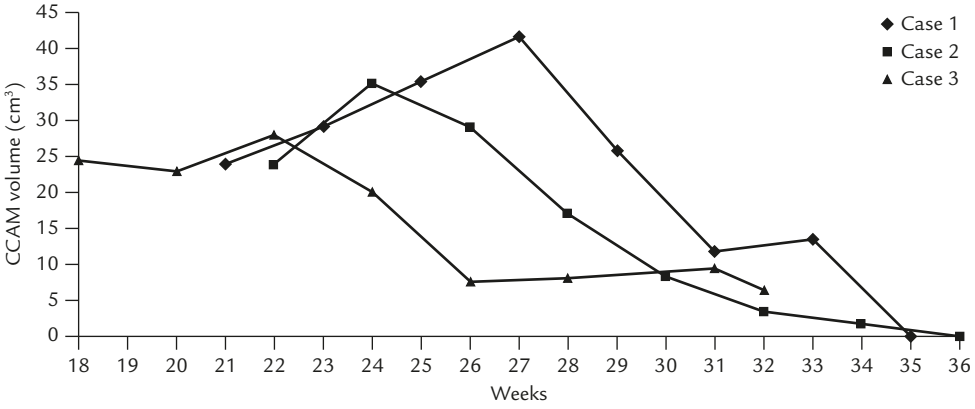

Figure. Records of cystic adenomatoid malformation (CCAM) volume by serial prenatal three-dimensional ultrasonography. Peak CCAM volume occurred at 22–27 weeks; CCAM volume decreased with advancing gestational age, despite a slight increase initially.

After the operation, she had a smooth recovery and was discharged. At the time of writing, she had had one more admission for bronchopneumonia. The infant in Case 2 had bilateral pneumothorax during the neonatal stage. He underwent a lobectomy at 6 months of age, and the histologic diagnosis was CCAM type II. Both infants had a good recovery and progressed well. The infant in Case 3 had no emergency perinatal intervention and no respiratory distress at birth. She had normal growth and never had pneumonia. At the time of writing, surgical intervention had not yet been arranged.

Discussion

CCAM is usually restricted to a single lobe and occurs in isolation. The CCAMs in all our cases were located in a single lobe. Associated anomalies are rare, according to published reports [5,6], which is compatible with the results of our study. Males and females are equally affected. Invasive testing is not indicated if a precise diagnosis can be made using ultrasonography. Ultrasonographic examinations at least every 2 weeks seem to be appropriate for detecting early evidence of hydrops or polyhydramnios [3].

Prognostic factors associated with CCAM of the lung have always been an issue. The most common advanced prenatal ultrasonographic findings suggestive of poor prognosis included polyhydramnios, mediastinal shifting, ascites, microcystic lesion (CCAM type III), hydrops fetalis, and bilateral lung involvement [5,7]. De Santis et al [8] and Teodoro et al [9] affirmed that only hydrops fetalis has negative prognostic significance. Adzick and Harrison [10] also reported that fetuses with CCAM, but without hydrops, have good chances of survival with maternal transport, planned delivery, and immediate neonatal resuscitation and surgery. In accordance with the reports of Ierullo et al [4] and Illanes et al [6], the presence of a mediastinal shift is not a marker of a poor prognosis. Two of our cases with CCAM had mediastinal shifting. The infants had normal growth and were healthy at the time of writing. Furthermore, in the study by Ierullo et al [4], approximately 50% of fetuses with hydrops did survive with continued management. None of our three cases had hydrops, so continuing the pregnancies was suggested. Their outcomes had been good at the time of this report.

Most of the researchers used the cystic adenomatoid malformation volume ratio (CVR), which is defined as the estimated volume of the CCAM divided by the head circumference, as an index to predict the development of hydrops and the perinatal survival rate. When the CVR was greater than 1.6, the prognosis was poorer [11–13]. Increased fetal head circumference accompanies fetal growth, so decreased CVR may not represent the regression of CCAM volume. We adopted the VOCAL technique, a new modality for 3-D sonographic volume measurement, to calculate CCAM volume in this study. Peak CCAM size occurred at 22–27 weeks' gestation, and then decreased with advanced gestational age.

Some researchers observed that asymptomatic babies may have normal postnatal chest radiographs, but persistent lesions on CT scans [7,14,15]. Calvert and Lakhoo [16] even recommended CT scans as the first line of postnatal investigation for asymptomatic babies diagnosed antenatally with suggested CCAM. In our study, complete prenatal resolution was found in Cases 1 and 2, but their postnatal imaging with both chest X-rays and CT scans presented persistent lesions. Although there was a persistent small CCAM lesion in Case 3 prenatally, postnatal chest X-ray revealed no

evidence of airspace consolidation. However, CT scans showed multiple cystic lesions with areas of solid tissue in the right lower lobe. Prenatal magnetic resonance imaging was not arranged in our cases, because the cost was high and it would not change our obstetric diagnosis.

There have been few reports regarding recommendations for timing of surgery in asymptomatic CCAM. Most researchers agree that elective surgery should be performed because of the long-term risks, particularly of infection, pneumothorax and, more rarely, malignancy [7,16]. Calvert and Lakhoo [16] found that 13 of 19 cases with antenatally diagnosed CCAM were asymptomatic. They suggested that surgery should be arranged at around 3–6 months of age in asymptomatic cases with significant lesions present on the postnatal CT scan; 50% of the asymptomatic cases which underwent surgery at more than 6 months of age had infections [16]. However, in our study, Cases 1 and 3 were asymptomatic, and elective surgery at 1 year of age, at least, was suggested by the pediatric surgeon. The procedure itself was well tolerated by the infants, and compensatory lung growth occurred with normal respiratory function.

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