Paediatric Respiratory Reviews 13 (2012) 162–171

Contents lists available at SciVerse ScienceDirect

Paediatric Respiratory Reviews

CME article

Antenatal and Postnatal Management of Congenital Cystic Adenomatoid Malformation

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EDUCATIONAL AIMS

- To review diagnostic terminology for congenital cystic thoracic lesions
- To discuss the clinical course of congenital cyst adenomatoid malformations (CCAMs) and its related condition pulmonary sequestration from the time of diagnosis to resection or spontaneous resolution
- To discuss the limited evidence for prophylactic surgery versus conservative management of asymptomatic CCAMs in infants
- To underline the importance of longitudinal clinical follow-up of all patients with CCAMs

ARTICLE INFO

Keywords:
Congenital thoracic malformation
Congenital lung malformations
Pulmonary sequestration
Pleuropulmonary blastoma
Bronchial atresia

SUMMARY

Congenital thoracic malformations (CTMs) are a heterogeneous group of rare disorders that may involve the airways or lung parenchyma. The authors have focused on the condition that causes the most controversy, namely, congenital cystic adenomatoid malformation (CCAM). The reported incidence is 3.5 and 0.94 per 10,000 live births for CTMs and CCAMs respectively. Ultrasound is the antenatal imaging modality of choice for screening for CCAMs whilst magnetic resonance imaging is complimentary for morphological and volumetric evaluation of the foetal lung. Most CCAMs are detected antenatally with only a small proportion presenting postnatally. Only a few CCAMs cause foetal problems, with foetal hydrops being the best predictor of death. Although many CCAMs regress during pregnancy, most remain detectable postnatally by CT scans. Surgical excision of symptomatic lesions is relatively straightforward, but management of asymptomatic lesions is controversial. Some surgeons adopt a "wait and see" approach operating only on those patients who develop symptoms, but others operate on asymptomatic patients usually within the first year of life. Due to the potential of malignant transformation, children should have long term follow up. There is an urgent need to delineate the natural history of antenatally detected CCAMs to guide future management.

INTRODUCTION

Congenital thoracic malformations (CTMs) are a heterogeneous group of rare disorders that may involve the upper and lower airways or the lung parenchyma. Although CTMs are rare, they may

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doi:10.1016/j.prrv.2012.01.002

lead to considerable morbidity and mortality. While the availability of new imaging modalities such as ultrasound (US) scanning and magnetic resonance imaging (MRI) have improved antenatal and postnatal diagnosis, they have also introduced complexities to the classification and management of CTMs. Although antenatally diagnosed lesions may spontaneously regress before birth, evidence-based information to advise parents about management options is lacking. Due to the complexity of congenital thoracic malformations, we have focussed on the condition that causes the most controversy, namely, congenital cystic adenomatoid malformation (CCAM), and the related malformation pulmonary sequestration (PS) although it is accepted that some conditions such as bronchogenic cysts and bronchial atresia may be difficult to distinguish until resection. We have reviewed antenatal presentations, the antenatal and postnatal therapeutic options, and prognosis. We have reviewed the problems of congenital diaphragmatic hernia elsewhere.[1]

NOMENCLATURE

The nomenclature of CTMs is confusing with clinicians often trying to make a pathological diagnosis on grey scale imaging. However, the introduction of antenatal scanning necessarily involves attempts to identify the most likely diagnosis (Table 1) to guide management especially antenatally. There are excellent recent reviews covering classification and nomenclature of CTMs.[2,3] It is suggested that the following principles should be adhered to when looking at clinical images, either ante- or postnatally[3]:

a) What is *actually seen* should be described, without embryological or pathological speculation, which may later be proved wrong. A simple 'catch-all' term, congenital thoracic malformation (CTM) should replace the old nomenclature in *clinical* discussions.[3]
b) The description should be in clear language, not Latin, avoiding ambiguity. Thus a CTM could be described (ante- or postnatally) as solid or cystic; if cystic, the cysts should be described as single or multiple, whether large or small (ideally with the size measured rather than estimated), thin or thick walled, and whether the contents are purely fluid or (postnatally) contain air should be noted.
c) The CTM should be described in the context of the rest of the respiratory system, and also any relevant extrathoracic features. Thus the rest of the respiratory system should as far as possible be described in a systematic manner. The lung is formed from six ''trees'': bronchial, arterial (systemic and pulmonary), venous (systemic and pulmonary) and lymphatic. There are no known abnormalities of bronchial venous drainage, so in practice, only five trees are considered.
d) Important associated organs (in particular, the heart, great vessels, chest wall, and abdominal contents) should be considered in a systematic manner, because abnormalities are often multiple, and associated lesions will be missed unless carefully sought.

Table 1
Differential diagnosis of CTMs

Congenital cystic adenomatoid malformation	
Congenital diaphragmatic hernia	
Tracheo-oesophageal fistula	
Pulmonary sequestration	
Cysts	- bronchogenic
	- foregut
Tumours	- neuroblastoma
	- mediastinal teratoma
	- rhabdomyoma
Atresia	- bronchial with distal degeneration
Congenital lobar emphysema	
Congenitally small lungs	
Lung agenesis	
Vascular abnormalities	- vascular rings
	- pulmonary artery slings

EPIDEMIOLOGY

Epidemiology of CTMs needs unbiased population-based reporting which is not always available: in 1979, the European Community established the European Surveillance of Congenital Anomalies (EUROCAT), whose aim was to establish a network of population-based registers for the epidemiological surveillance of congenital anomalies including CTMs. The robustness of the data depends on that (a) all pregnant women had an antenatal ultrasound scan, and (b) the scans were of diagnostic quality and properly interpreted. The data were collected from 43 European registries in 20 European countries.[4] The individual registers were regional and not national in most cases, with EUROCAT capturing approximately 29% of Europe's birth population.[4]

In 2008, EUROCAT reported 222 fetuses with CTMs giving an incidence of 4.44/10,000 (i.e. including live births, foetal deaths and terminations of pregnancy). Of the 222 fetuses, 52 had CCAM alone i.e. an incidence of 1.04/10,000. The incidence was 3.52 and 0.94 per 10,000 live births in 2008 for all CTMs and CCAMs respectively in EUROCAT countries. The reported annual incidence of pulmonary sequestration ranges between 0.15% and 6.45% of all CTMs.[5–9]

PATHOLOGY

Diagnostic terminology for congenital cystic lung lesions has varied considerably over the 20th century. Several unifying proposals have been made, such as 'malinosculation' and types 0-4 CCAM, but without universal uptake of usage.[10–12] There is also increasing recognition of overlap between 'entities', for example features of CCAM in both sequestrations and bronchial atresia.[12–14] Finally, recent advances in understanding how blastematous neoplasms behave in terms of regression have also influenced proposed classifications.[15] Table 2 shows two proposals; discussion below follows that of Langston,[12] other than reviewing sequestrations as a separate group.

BRONCHIAL ATRESIA

This anomaly (Figure 1) typically takes the form of a membrane, fibrous cord or gap in a bronchus, with the distal airway showing dilatation, often saccular or cyst-like, and the lumen filled with mucus or purulent exudate if infected. Atresia is most commonly seen in segmental bronchi. There may also be distal hyperinflation probably due to collateral ventilation and/or air trapping.

PULMONARY SEQUESTRATION

Pulmonary Sequestration (PS), divided into intralobar (Figure 2) and extralobar types, are localised lesions comprising lung parenchyma receiving their blood supply via aberrant systemic arteries and lacking continuity with the upper respiratory tract.[12,13] Extralobar sequestrations have their own covering visceral pleura, whilst intralobar are localised lesions within otherwise normal lung. Intralobar sequestrations are typically located in the posterior basal segment of the left lower lobe and extralobar sequestrations beneath the left lower lobe. Microscopically, they show dilated airspaces, some lined by bronchiolar-type epithelium, with or without inflammation and fibrosis.[13] Features of type 2 CCAM are seen in up to 60% of cases.[13,14] Rarely,