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Commentary

Unravelling the anatomico-vascular correlates of haemoptysis in children using CT angiography

Haemoptysis, although comparatively rare in the paediatric population, can be potentially life threatening. Grading the severity of haemoptysis is paramount in assessing its clinical significance and this is usually estimated by the volume of blood lost[1]. Scant haemoptysis is classified as <5 ml of blood loss, mild-to-moderate haemoptysis refers to 6-240 ml loss and massive haemoptysis usually signifies more than 240 ml of blood loss[1].

Not only is it important to establish the severity of the haemoptysis, but it is equally important to find the cause of haemoptysis, so that appropriate therapeutic measures can be instituted. A detailed history, focused physical examination, chest radiograph in at least two views followed by fibre-optic bronchoscopy and high-resolution computed tomography (CT) are often helpful in establishing the cause of haemoptysis.

Especially in children, where the most common causes of haemoptysis are infection, tracheostomy-related complications, aberrant bronchial circulation, aspiration of foreign bodies and bronchiectasis associated with cystic fibrosis (CF), a comprehensive history is illuminative. In paediatric patients, the bronchial arterial system is the main source of bleeding in 90 per cent of the cases of massive haemoptysis, and in 5-10 per cent cases, pulmonary arteries and non-bronchial systemic arteries may be responsible[2]. In such cases, the role of imaging like CT angiography (CTA) assumes importance.

In this issue of the IJMR, the authors Shera *et al*[3] assessed the role of single-phase split-bolus dual-energy contrast-enhanced multi-detector row computed tomography angiography (DECTA) in the evaluation of haemoptysis in children and analyzed the patterns of abnormal vascular supply in the various aetiologies encountered[3]. In a retrospective study of 86 patients (45 males; age: 0.3 - 18 yr; mean: 13.88 yr) with haemoptysis who underwent split-bolus DECTA, the diagnoses were categorized as: (*i*) normal CT, active tuberculosis (TB), post-infectious sequelae, non-TB active infection, CF, non-CF bronchiectasis, congenital heart disease (CHD), interstitial lung disease, vasculitis, pulmonary thromboembolism, idiopathic pulmonary haemosiderosis, *etc*; and (*ii*) abnormal bronchial arteries (BAs) and non-bronchial systemic collateral arteries (NBSCs) were assessed for number and site and their correlation with underlying aetiologies.

The most common cause of haemoptysis reported was active infection (n=30), followed by bronchiectasis (n=18), post-infectious sequelae (n=17) and CHD (n=7). Out of the 86 children studied, 56 (65.1%) had detectable abnormal arteries; a total of 165 abnormal arteries were identified (108 BA and 57 NBSC) and were more marked in the bronchiectasis group. The authors conclude that active infections and bronchiectasis are the most frequent causes of haemoptysis in children, while post-infectious sequelae are less common. They suggest that in patients with haemoptysis, presence of any abnormal arteries correlates with a more frequent diagnosis of bronchiectasis and NBSCs are more common in post-infectious sequelae and CHD.

An important limitation of this study is that only two patients were less than five years and there were no patients in the 2-5 yr age groups. This could perhaps be due to the obvious reason that haemoptysis is uncommon in children below the age of five years, but it would be interesting to note the result in a larger series that includes younger children too. Surprisingly, while in patients with no identifiable abnormal arteries, the most common finding was active infection, even amongst those with identifiable abnormal arteries,

the most common finding was active infection. This indicates the considerable overlap between these two groups, an issue that warrants further study.

Congenital heart disease was detected in 7/86 (8%) cases in the present study and was the fourth most common cause. Furthermore, all CHD patients in this study with abnormal arteries had both BA and NBSC hypertrophy due to pulmonary oligemia. However, it should be noted that even CHD with pulmonary hypertension and/or Eisenmneger's syndrome may result in haemoptysis although the latter may be rare in children. Hence, cardiac evaluation including echocardiography is mandatory in paediatric patients with haemoptysis unexplained by pulmonary causes, even in the absence of overt cardiac symptoms.

It is also relevant to note that BAs have an inherent plasticity and can potentially increase their flow to 30 per cent of the cardiac output in response to a pulmonary infectious or vascular injury. Therefore, bronchial artery hypertrophy, recruitment of new vessels and dilatation of the thin-walled bronchial-to-pulmonary artery anastomosis may occur, predisposing to bronchial artery rupture and pulmonary haemorrhage[4]. Hence, this study adds to the existent literature on haemoptysis and abnormal bronchial vasculature and NBSCs in children with haemoptysis[3]. In non-diseased states, the BAs are thin and difficult to detect on contrast-enhanced computer tomography examinations.

The merits of the study by Shera *et al*[3], include utilization of dual-energy CT scanners that can help reduce the contrast dose because of better contrast visualization at lower keV images, a split-bolus protocol and an exhaustive anatomico-vascular correlation of the abnormal vasculature in cases of haemoptysis. In patients with no identifiable abnormal arteries, the most common finding was active infection (43.3%), followed by a normal CT scan (30%). In patients with identifiable abnormal arteries, the most common finding was active infection (33.9%), followed by bronchiectasis (32.1%).

Haemoptysis can be distressing and concerning to a child and the parents and on occasion may present a diagnostic dilemma to the paediatrician. Although a thorough history and physical examination is necessary, it can be challenging in children and imaging using dual-energy CT scanners has an important role in identifying the source of bleeding and its underlying cause. This non-invasive and multi-dimensional visualization of the tracheobronchial and pulmonary vasculature and parenchyma has the potential to provide a complete diagnosis and may often obviate the need for invasive bronchoscopic procedures. A thorough understanding of the judicious use of various imaging modalities in a child presenting with haemoptysis is likely to yield a maximum diagnostic and therapeutic benefit.

***Conflicts of Interest*:** None.

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