

## Pneumomediastinum caused by foreign body aspiration in children\*

E. M. Burton<sup>1, 2</sup>, W. Riggs, Jr.<sup>1</sup>, R. A. Kaufman<sup>1, 2</sup> and C. S. Houston<sup>2</sup>

<sup>1</sup> Department of Radiology, LeBonheur Children's Medical Center and

<sup>2</sup> Department of Radiology, University of Tennessee Health Sciences Center, Memphis, Tennessee, USA

**Abstract.** In a retrospective review of 155 children with tracheobronchial foreign body aspiration (FBA), there were ten patients who had pneumomediastinum (PM) on an initial chest radiograph. Nine of ten presented with PM and one patient had PM noted after bronchoscopy. In a child less than two years of age with no history of trauma, the radiographic finding of PM should prompt further investigation for FBA.

In 1939, Macklin [1] demonstrated that during hyperinflation, overdistended alveoli may rupture, causing air to dissect along perivascular sheaths into the pulmonary hilus and mediastinum. Excluding neonates, PM in older infants or children has been described as a consequence of a variety of disorders. McSweeney and Stempel [2] described 41 cases of PM in infants and children associated with asthma, respiratory infections, cystic fibrosis, diabetes mellitus, leukemia, and trauma. One patient had foreign body aspiration.

In a review of 155 cases of tracheobronchial foreign body aspiration (FBA) from 1952 through 1987 at the Le Bonheur Children's Medical Center [3], we found 10 patients whose initial chest x-ray showed PM. The purpose of this report is to describe the radiographic findings and emphasize early recognition of tracheobronchial aspiration as a treatable cause of PM.

### Patients and methods

The medical records of all patients with foreign body aspiration from 1952 through January, 1988 were reviewed. All patients who had chest radiographs and tracheobronchial foreign bodies

proven at bronchoscopy were included. Ten patients with tracheobronchial foreign body aspiration had PM and constitute the study group. These patients were evaluated for foreign body location and type, chest radiographic findings, and duration and type of symptoms.

### Results (Table 1)

There were seven boys and three girls. Eight children were less than two years of age. Three children had a previous history of asthma. The onset of symptoms in these 3 patients was abrupt and occurred in the absence of preceding upper respiratory infection (URI). One child presented with respiratory arrest. The duration of symptoms was brief (1-4 days, mean = 2.6 days) prior to the development of PM with FBA. All children recovered completely following bronchoscopic removal of the foreign body.

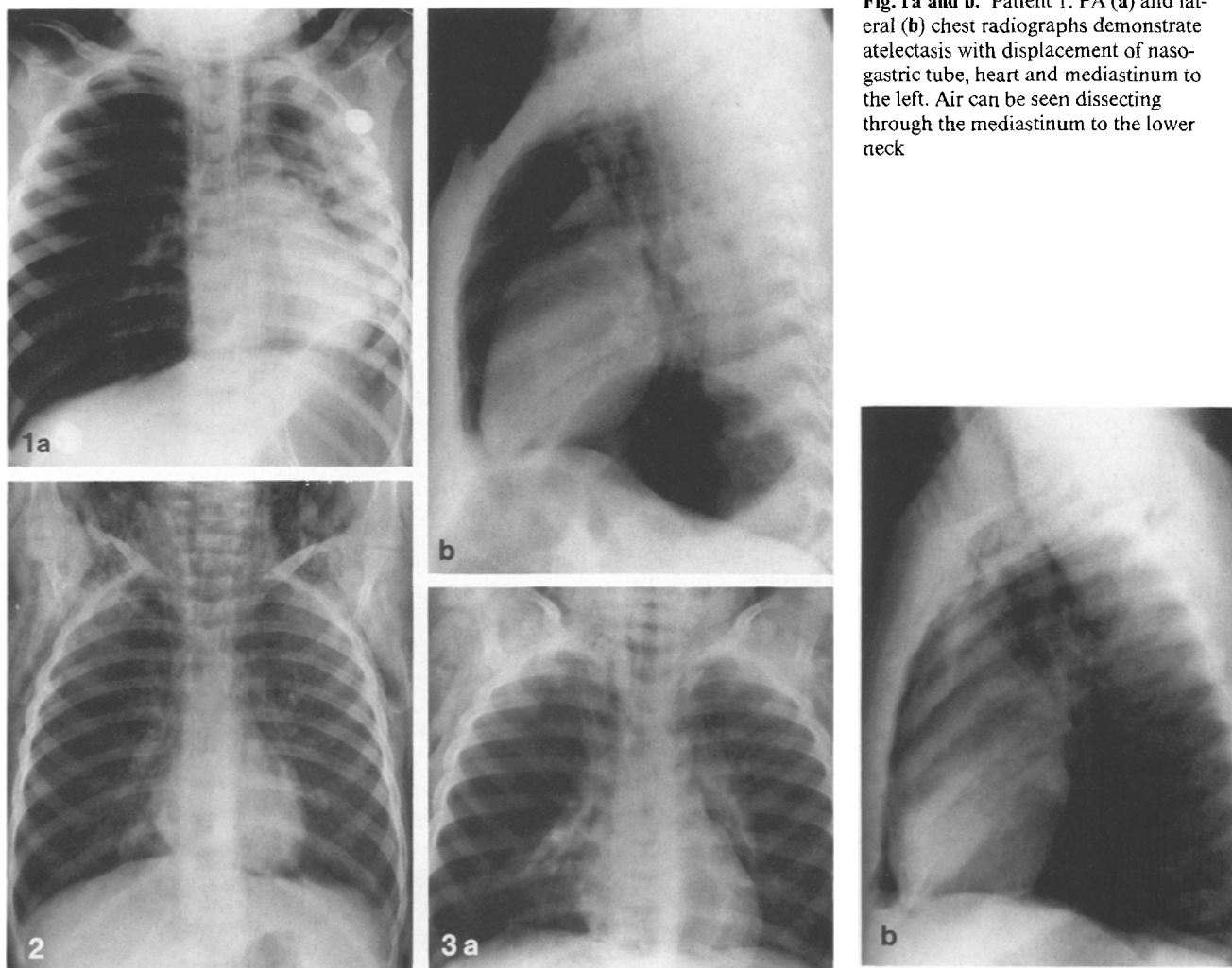
Pneumomediastinum was obvious radiographically in all. In nine patients, subcutaneous dissection

**Table 1.** Clinical and radiographic findings in ten children with pneumomediastinum and foreign body aspiration

Patient no.	Age(yrs)/sex	FB loc	FB type	Xray
1	2/M	L	Walnut	PM, atel LLL
2	1.3/M	R	Pinto bean	PM, atel RLL,RML
3	2/F	R	Peanut	PM, hyper RT
4	1.3/F	R	Peanut	PM, PTX, atel RT
5	1.3/M	R	Peanut	PM, atel RML
6	6/M	R	Peanut	PM, hyper RT
7	1.1/F	L	Peanut	PM, hyper LT
8	3/M	L	Peanut	PM post-bronch
9	2/M	L	Peanut	PM, atel LT
10	1.2/M	R	Pecan nut	PM, hyper RT

Sex; M = male; F = female. Location; R = right, L = left. Xray; PM = pneumomediastinum, atel = atelectasis, hyper = hyperinflation, PTX = pneumothorax, RT = right lung, LT = left lung, RML = right middle lobe, RLL = right lower lobe, LLL = left lower lobe

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**Fig. 1 a and b.** Patient 1. PA (a) and lateral (b) chest radiographs demonstrate atelectasis with displacement of nasogastric tube, heart and mediastinum to the left. Air can be seen dissecting through the mediastinum to the lower neck

**Fig. 2.** Patient 3. PA chest radiograph demonstrates extensive pneumomediastinum, subcutaneous and interstitial emphysema. Intercostal spaces on the right are widened and right hemi-diaphragm is flattened, indicating unilateral hyperinflation

**Fig. 3 a and b.** Patient 5. PA (a) and lateral (b) chest radiographs demonstrate right middle lobe atelectasis, best seen on the lateral projection. Pneumomediastinum separates the left lobe of the thymus, which simulates the left pulmonary artery

of air into the axilla or neck could also be seen. Associated findings included atelectasis (Fig. 1) ( $N=5$ ), unilateral hyperinflation (Fig. 2) ( $N=4$ ), and pneumothorax ( $N=1$ ). One patient developed PM after bronchoscopy.

## Discussion

Pneumomediastinum is thought to occur by extension of interstitial air from alveolar rupture along perivascular sheaths toward the mediastinum.

Macklin and Macklin [4] postulated that a pressure gradient between the alveoli and interstitium was necessary for air dissection to occur. A pressure gradient may develop when atelectatic lung is accompanied by hyperinflation of adjacent lung, and is associated with reflex vasoconstriction [4, 5]. These factors may explain the occurrence of PM due to bronchial obstruction from FBA or mucous plugging. In addition to the airblock phenomenon of PM, bronchial obstruction may also produce lobar collapse and focal pneumothorax [6].

In our series, vegetable matter was the inciting agent in all instances of PM, and was slightly more common in the right main bronchus. Peanuts are the most frequently aspirated foreign bodies in children. Blazer et al. [7] and Reed [8] reported that peanuts were inhaled in 46% and 42%, respectively, in their series of childhood tracheobronchial aspirations. In our series [3], we found 46% (53 of 114) of children less than 2 years of age aspirated peanuts and other nuts; of the total (155 patients), 71 (46%) aspirated

nuts. Therefore, in our series, the risk of PM following nut aspiration in children less than 2 years of age is 13% (7 of 53).

The most common cause of non-traumatic PM in children is asthma [2, 9, 10]. Generally, PM associated with asthma is preceded by one to three days of increasing cough and wheezing. Although an established history of asthma preceding PM is usually present, McSweeney and Stempel [2] noted that three of 13 asthmatic patients initially presented with PM. Abramson et al. [11] and Norman [12] described PM associated with asthma in two children 1.3 and 2.2 years of age, respectively. Each of these patients had a previous history of asthma of at least six weeks duration prior to the development of PM during an asthmatic attack. No patient reported by McSweeney [2], Eggleston et al. [9], or Jorgenson et al. [13] with asthma and PM was less than two years of age. In contrast to PM due to asthma, children with PM due to FBA are generally *younger*. In our series, eight of ten patients with PM and FBA were 1–2 years of age, the most frequent age distribution for FBA.

In McSweeney's series [2], eight patients had PM associated with pneumonia, bronchiolitis, or upper respiratory infection. Since the radiographic finding of PM following aspiration may be indistinguishable from PM due to respiratory infection and/or asthma with mucous plugging, clinical information is necessary. The abruptness of onset of respiratory distress and lack of preceding symptoms and signs of URI in child less than 2 years of age with PM emphasize consideration of FBA.

The presence of right middle lobe atelectasis (RML) on chest x-ray should not distract the physician from considering foreign body aspiration. One patient in our series had right middle lobe atelectasis associated with PM (Fig. 3). Following aspiration in the child, the parent may place the child prone in order to dislodge the foreign body from the airway by clapping on the child's back. A maneuver such as this allows the right middle lobe bronchus to be dependent in position, promoting RML atelectasis.

In summary, in a child less than two years of age, PM due to foreign body aspiration (often vegetable matter) is important to recognize. PM may be associated with atelectasis or unilateral hyperinflation and is obvious on chest radiograph. Right middle lobe atelectasis does not exclude foreign body aspiration. The clinical presentation of cough, wheezing, short-

ness of breath and/or fever, simulating asthma and/or respiratory infection, may be due to foreign body aspiration with associated PM. In a child less than two years of age with no history of trauma, the radiological finding of PM should prompt further investigation of possible FBA.

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E. M. Burton, M. D.  
Le Bonheur Children's Medical Center  
Department of Radiology  
848 Adams Avenue  
Memphis, TN 38103  
USA