

## PNEUMOMEDIASTINUM IN THE NEWBORN PERIOD AND EARLY CHILDHOOD

H.P. LIN  
R.O. JOHNSON  
K.L. LAM  
T.H. ONG  
J. SINGH

### SYNOPSIS

**Pneumomediastinum may be asymptomatic but when associated with severe respiratory distress it should be recognised promptly so that decompression can be instituted. Five such cases in the newborn period and early childhood are presented with a discussion on diagnosis and management.**

### INTRODUCTION

Pneumomediastinum is common in the newborn period. Routine chest radiographs done within two hours of birth showed an incidence of 2.3% among infants born vaginally; 2% among premature babies; 1% among those born by Caesarean section and 8% among those who had been intubated at birth (Steele et al, 1971). However most such cases are asymptomatic, often noted as an incidental finding on chest Xray and spontaneous resolution can be radiologically demonstrable within a week (Steele et al, 1971). Infrequently larger volumes of air may be associated with severe respiratory distress and may impede venous return and interfere with cardiac filling. It is important to promptly diagnose these cases as mediastinal decompression can be life-saving. In the older child mediastinal emphysema is occasionally associated with a severe attack of bronchial asthma (Williams and Phelan, 1975) but may complicate bronchopneumonia. We report here 5 cases, 3 occurring in the newborn period and the other 2 in early childhood.

### Case 1

Indian female, 2730 gms, was born at term after an uncomplicated pregnancy and delivery. At birth the condition was excellent and at no time was positive pressure applied to the airway.

At age 21 hours she developed respiratory distress with grunting respiration, tachypnoea, cyanosis and subcostal recession. There was no history of regurgitation or aspiration of feeds. The breath sounds were poorly heard particularly on the right. There was no surgical emphysema in the neck and no evidence of cardiac failure, though the heart sounds were scarcely audible.

Departments of Paediatrics, Surgery and Radiology,  
University of Malaya Medical Centre,  
Kuala Lumpur, Malaysia.

H.P. Lin, M.B., B.S. (Malaya), M.R.C.P. (U.K.),  
D.C.H. (Eng.)  
Lecturer in Paediatrics.

R.O. Johnson, M.B., B.S. (N.S.W.), F.R.A.C.P.  
Lecturer in Paediatrics.

K.L. Lam, M.B., B.S. (S'pore), F.R.C.P. (G),  
Professor in Paediatrics.

T.H. Ong, M.B., B.S. (S'pore), F.R.A.C.S.  
Associate Professor of Surgery.

J.Singh, M.B., B.S. (Bom), D.M.R.D. (Eng)  
Associate Professor of Radiology.

The chest radiograph showed a large pneumomediastinum and a small right pneumothorax. Arterial blood gases (in 40% oxygen) revealed PaO<sub>2</sub> 94 mmHg and mild metabolic acidosis which was subsequently corrected with intravenous sodium bicarbonate.

The respiratory distress worsened and at age 25 hours after onset, 60% ambient oxygen was needed to maintain a pink colour. An 10 French intercostal drain was inserted into the large central air-sac via the second right intercostal space anteriorly and connected to an underwater seal. There was prompt radiological improvement but only modest clinical improvement. It was also noted that there was a fair amount of haemorrhagic fluid escaping via the drainage tube. She remained ill and was given kanamycin 20 mg intramuscularly 12-hourly and cloxacillin 100 mg intravenously 8 hourly.

The condition remained unchanged in 60% oxygen for the next 30 hours, with persistent respiratory distress of moderate severity. Adequate oxygenation throughout was shown by blood gas monitoring, though mild metabolic acidosis recurred and was controlled with further intravenous sodium bicarbonate.

A shocklike state with irregular and laboured respiration developed 40 hours after onset of illness and complete apnoea promptly followed. Initial resuscitation (intubation, IPPR with 100% O<sub>2</sub>, sodium bicarbonate intravenously) was successful but one hour later a more severe, and this time fatal, episode of respiratory arrest occurred. Chest x-ray was not available before death. Permission for autopsy was not given. Post mortem chest x-ray disclosed a large right pneumothorax, presumably the immediate cause of death. We believe the cause of the deterioration in this case was probably the result of clot blockage of the intercostal drainage tube as a fair amount of haemorrhagic fluid was noticed after the tube was inserted.

### Case 2

Chinese male, 2570 gms, was born at term after induction with prostaglandin E<sub>2</sub>. Pregnancy was uneventful with no history of foetal distress and the baby was well at birth, requiring no resuscitation.

At age 6 hours, he was noticed to be bottle feeding poorly and at 19 hours was noticed to be in respiratory distress with cyanosis, tachypnoea, grunting and intercostal and subcostal recession. There was no history of regurgitation or aspiration of milk. The chest was hyperinflated with poor breath and heart sounds and indistinctly localised apex beat. Subcutaneous emphysema was not detected in the

neck or chest and there were no signs of cardiac failure.

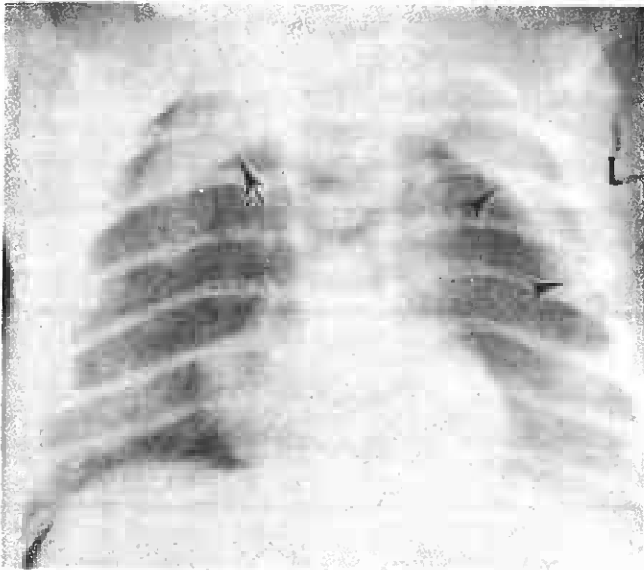
Chest radiograph showed a large tense pneumomediastinum with a displaced thymus (the "Spinnaker-Sail" sign, Figure 1 and 2) and the lateral view demonstrated an area of hypertranslucency in the superior retrosternal space (Figure 3). There was no demonstrable pneumothorax or subcutaneous emphysema.

The cyanosis and respiratory distress rapidly worsened. A chest drainage tube was inserted at the second right intercostal space about 1 cm away from the midline, this being connected to an underwater seal and continuous suction. A hissing sound was heard when the trocar was removed from the cannula before insertion of the drainage tube. The colour rapidly improved; the distress lessened considerably; the chest radiograph repeated soon after showed disappearance of the pneumomediastinum (Figure 4); the arterial gases showed that PaO<sub>2</sub> was 195 mmHg on 30% oxygen and the pH was 7.12 with a base excess of -16 mmol/L and PaCO<sub>2</sub> was 37 mmHg. This acidosis was subsequently corrected with 8.4% sodium bicarbonate. The baby was given i.v. cryst. penicillin 125,000 i.v. 8 hourly and gentamycin 6 mg intramuscularly 12 hourly. Dilute heparin was also used initially to flush the chest tube to prevent clot blockage as quite a lot of haemorrhagic fluid was drained out together with air.

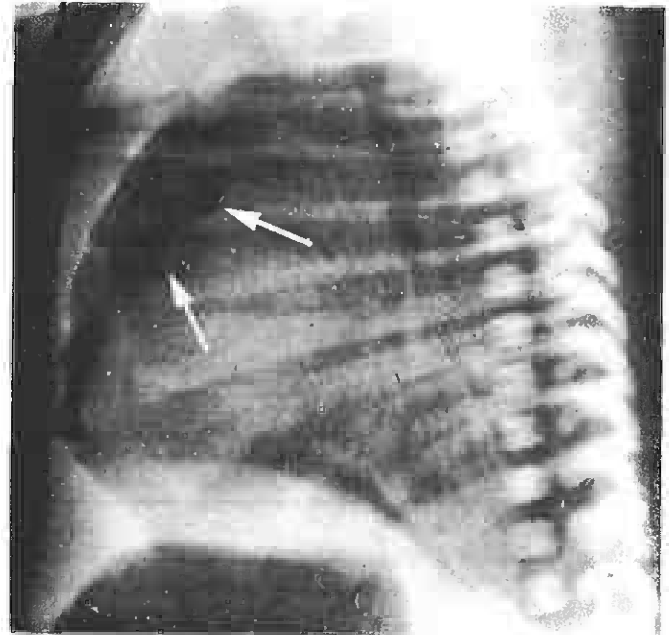
The respiratory distress worsened about 24 hours after insertion of the chest tube. The associated signs of mediastinal displacement to the right suggested a left pneumothorax which was confirmed on a chest radiograph. This cleared with left intercostal drainage.

### Case 3

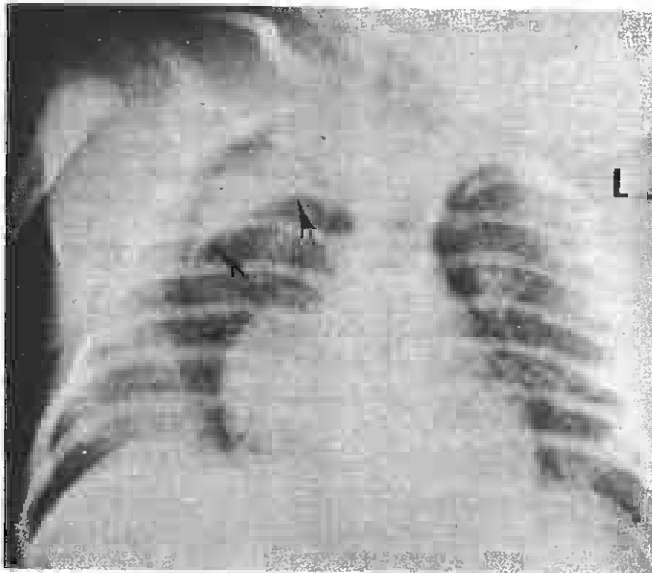
A Chinese girl with a birth weight 3.42 Kg, was asphyxiated at birth as a result of foetal distress associated with meconium-stained liquor. Endotracheal intubation was performed and intermittent positive pressure respiration with oxygen undertaken briefly. On extubation she was tachypnoeic, respiratory rate rising from 70 to 90/min. She was pink in 30% oxygen and breath sounds were well heard bilaterally with a localized area of crepitations over the precordium. Chest radiograph showed a moderately large mediastinal emphysema but no evidence of meconium aspiration. No surgical drainage was attempted as she was not severely distressed. PaO<sub>2</sub> was 80 mmHg, pH 7.24, PaCO<sub>2</sub> 46 mmHg, base excess -6 mmol/L, bicarbonate 19 mmol/L while on 30% oxygen.



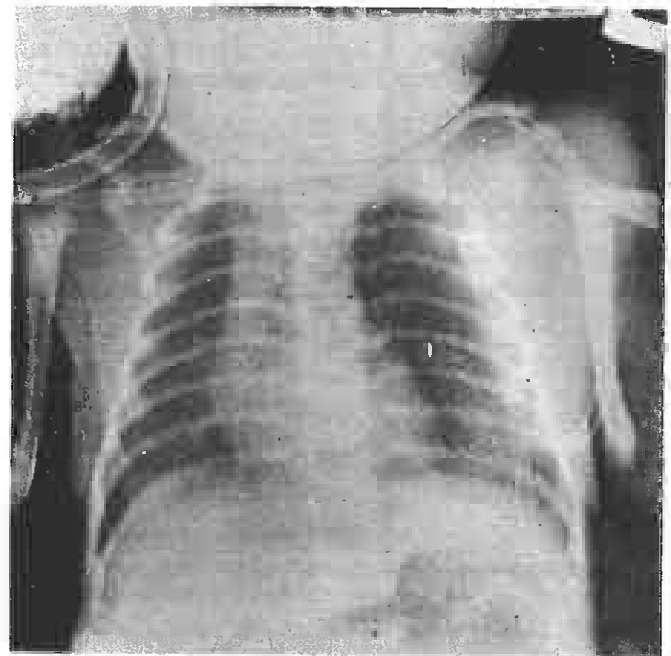
**Fig. 1** Pneumomediastinum Frontal View. Shows in the left hemithorax the mediastinal pleura indicated by means of two 'arrows' and a hyperlucent region around the cardiac shadow. The 'arrow' at the right upper zone shows the elevated lobe of the thymus which resembles an 'angel wing' appearance.



**Fig. 3** Pneumomediastinum. The lateral view shows an area of extreme hypertranslucency in the superior retrosternal space as shown by 'arrows'. The lateral view provides confirmatory evidence of the presence of pneumomediastinum.



**Fig. 2** Pneumomediastinum Frontal View. Shows a hyperlucent area around the cardiac shadow (lower 'arrow'). The air has elevated the thymus on the right (shown by two 'arrows'). This at times has been referred to as 'spinnersail' sign.



**Fig. 4** Normal frontal view of chest after effective treatment.

The mediastinal emphysema gradually resolved over 5 days without active treatment and the baby had an uneventful recovery.

**Case 4**

12 days prior to admission, a 19-month old Malay girl developed measles complicated soon after by bronchopneumonia for which intramuscular penicillin was given. A week later she was noticed to have

subcutaneous emphysema in the neck and axillae as a result of extension of mediastinal emphysema seen on the chest radiograph. Although initially she was not unduly tachypnoec, she developed severe respiratory distress when the emphysema rapidly progressed over several hours. A right intercostal drainage tube inserted at a peripheral hospital did not relieve the respiratory distress. She was then referred to the University Hospital where she was noticed to

have marked subcutaneous emphysema over the side of the chest, axillae, the face, including the eyelids and the scalp. She was moderately dyspnoeic but was not cyanosed. Oxygen was given via a nasal catheter and the arterial blood gases were: PaO<sub>2</sub> 69 mmHg, PaCo<sub>2</sub> 24 mmHg, pH 7.31, base excess -8 mmol/L, bicarbonate 12 mmol/L.

A needle-catheter (Braunula) was inserted into the mediastinum via the subxiphisternal approach and connected to an underwater drainage. Bubbling was noticed during decompression of the mediastinum and the emphysema gradually resolved completely clinically and radio-logically after 10 days. She was initially given cloxacillin 200 mg intravenously 6-hourly and gentamycin 20 mg intramuscularly 12-hourly but cloxacillin was discontinued when the bronchial secretions cultured *Klebsiella aerogenes*. Gentamycin was continued for 2 weeks.

The patient was discharged well.

**Case 5**

A 8-month old Chinese boy, diagnosed as having Hirschsprung's Disease at age 2 months and on whom a colostomy was done at that time, was admitted for a Duhamel operation. On the 4th post-operative day he developed bronchopneumonia. The next day he became restless as the respiratory distress worsened. Subcutaneous emphysema was noted to extend from the anterior chest wall to the axillae, shoulders and the neck and crepitations were heard in both lungs. The chest radiograph confirmed the consolidation in both lungs but in addition, also showed a mediastinal emphysema which was better demonstrated on the lateral film. There was no pneumothorax. He was given cloxacillin 200 mg intravenously 6-hourly and gentamycin 20 mg intramuscularly 12-hourly. The anterior mediastinum was decompressed by the subxiphisternum approach with a needle-catheter (Size 2 Braunula) which was

connected to an underwater seal. There was much symptomatic relief and the mediastinal and subcutaneous emphysema disappeared after 5 days. However one day after removing the mediastinal tube, mild respiratory distress was observed. A repeat chest radiograph showed the presence of a small right pneumothorax. This however did not require any drainage. The child was discharged well.

A summary of the above 5 cases is presented in the Table.

**DISCUSSION**

Macklin (1939) experimentally demonstrated that pneumomediastinum resulted from alveolar rupture and the subsequent tracking of air along perivascular sheaths to the mediastinum. From there the air may extend to the pleural cavity causing pneumothorax or along the great vessels of the neck to the head or to the axillae or to the peritoneal tissues causing pneumoperitoneum. It had also been shown that pulmonary interstitial emphysema, mediastinal emphysema and pneumothorax frequently followed pneumomediastinum but not vice versa (Thibeault et al, 1973). In many cases the alveolar rupture is due to a buildup of pressure secondary to a valve-like airway obstruction (as in meconium aspiration) or to the direct effect of positive pressure ventilation. This is borne out by the higher incidence of pneumomediastinum (8%) among babies intubated at birth and its association with meconium aspiration (Steele et al, 1971; Tan, 1972).

Although said to be a common radiological finding in the newborn period, pneumomediastinum is an uncommon cause of respiratory distress (Steele et al, 1971). It may be suspected when there is an associated history of foetal distress with meconium aspiration especially in a dysmature baby or one who had to be resuscitated with intubation and positive pressure ventilation. Very often, the respiratory

**Summary of the 5 Reported Cases of Pneumomediastinum (P.M.) in the Newborn Period and Early Childhood**

	Age at onset	Aetiology/Associated Underlying Condition	Pneumothorax (PTX) appearing after P.M.	Outcome
Case 1	First day	Spontaneous	Right PTX	Died
Case 2	First day	Spontaneous	Left PTX	Well
Case 3	First day	Meconium aspiration Positive-pressure ventilation	Nil	Well
Case 4	19 months	Measles broncho-pneumonia	Nil	Well
Case 5	8 months	Post-operative bronchopneumonia	Right PTX	Well

distress is due more to the underlying meconium aspiration or pneumonia than to the pneumomediastinum. Tan (1972), in a report of 5 such cases in dysmature babies with meconium aspiration and a history of foetal distress, showed the relatively asymptomatic nature of the pneumomediastinum where in two survivors it could still be demonstrated radiologically although the dyspnoea had ceased. Other suggestive clues to the diagnosis are the hyperinflated chest and the presence of subcutaneous emphysema. Hamman's sign, a crunching noise synchronous with the heartbeat audible over the anterior chest, is rarely observed. Subcutaneous emphysema is hardly ever seen in the newborn period. Avery and Fletcher (1974) observed that air rarely dissects into the soft tissues of the neck when pneumomediastinum occurred in the newborn period. This is borne out in the first three cases reported here and also in earlier reports (Forbes et al, 1943; Lowman et al, 1945; Keefe, 1951; Mosley, 1961; Morrow et al, 1967; Tan, 1972). However in the two older children reported here, aged 8 and 19 months respectively, the air tracked up into the neck and the face. There is no satisfactory pathophysiological explanation for this phenomenon in the newborn although it is possible that this may be due to pocketing of air in the loose connective tissues of the mediastinum in the newborn, as suggested by Forbes (1943). It is speculative as to when the tendency to such pocketing disappears. Evidently it must disappear before the age of 8 months since the extension of air to the neck occurred in a patient (Case 5) of that age. It is possible that the air in the newborn may be trapped in the pericardial sac and not in the mediastinal space.

Essentially, the diagnosis remains a radiological one. The appearance on anterior-posterior chest radiograph in the newborn is classically described as that of the "Spinnaker-Sail" or "angel-wing" sign due to the displaced lobe of the thymus (Figure 1 and 2). On the lateral view a hypertranslucent area in the anterior mediastinum is diagnostic of pneumomediastinum (Figure 3).

Whether mediastinal decompression is necessary or not depends on the severity of the respiratory distress. In mild cases no decompression is necessary, as in Case 3, and treatment is directed at the associated underlying cause. Where the distress is severe the mediastinum should be decompressed. One method consists of using a needle-catheter (Braunula) introduced under-local anaesthesia into

the anterior mediastinum via the subxiphisternal approach the other end draining to an underwater seal. Experience here showed that the symptomatic relief was dramatic, this being associated with a hissing sound of escaping air obtained on initial decompression. The mediastinal tube should be left in situ until clinical and radiological improvement is obtained and air leak has stopped for at least 24 hours. It is worthwhile bearing in mind that very often, as in Case 1, 2 and 5, a pneumothorax may follow or be associated with significant symptoms it will require a separate decompression via a pleural catheter. This is shown in Case 1, where there was moderate improvement after mediastinal decompression but subsequent death from a large tension pneumothorax. As mentioned earlier, we suspected that this is the result of the blocked drainage tube by blood clots so that the mediastinal air escaped into the right pleural cavity. Use of heparin to prevent clot blockage of the drainage tube where there is a bloody discharge may be helpful.

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