

# Clinical Aspects of Blunt Chest Injuries in Childhood

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The number of accidents in childhood is continuously increasing all over the world. The incidence of thoracic injuries among all the injured children is 3.4 per cent in DAMJE's material, and 2.8 per cent among the 5580 patients admitted to our hospital after having suffered some accident. In the majority of this 2.8 per cent the bones and the soft tissues of the thorax were affected. Owing to the flexibility of bones in young age, the ribs are fractured less often than in adults. On the other hand, young bones being easily compressible they provide less protection against injuries. Therefore, direct trauma or a contrecoup effect may sooner injure the intrathoracic organs in children than in adults [6, 18]. — The flexibility of children's bones does not exclude the possibility of multiple rib fractures even in premature infants, sometimes without damaging the intrathoracic organs.

## OBSERVATIONS

Multiple rib fractures may arise also in consequence of certain medical manipulations, as shown by the following case.

*Case 1.* K.T., a 3-month-old infant was admitted with bilateral pneumonia, in a critical condition. At night, apnoea occurred and the patient was resuscitated with external thoracic massage. This was effective in a few minutes but two days later X-rays revealed fractures of the seventh to ninth ribs on the right side. Later X-rays showed callus formation at the sites of the fractures (Fig. 1A). Apart from the pneumonic ones no other pulmonary symptoms developed and recovery was uneventful.

*Case 2.* N.L. Healed multiple rib fractures as an additional finding were found beside a subarachnoid haematoma following skull injury in a 5-month-old infant. No pulmonary symptoms had ever been noted by the parents, but X-rays (Fig. 1B) showed callus formation at the site of fractures on the third to eighth ribs on the left side.

Synchondrolysis of the sternum is a rare injury which occurs only in children. Two such cases have been published from our hospital [10]. One of them was that of

*Case 3.* S.S., a 12-year-old boy who had fallen from a tree. On admission he was complaining of chest pain. On physical examination a tender swelling was felt over the sternum. A lateral X-ray film (Fig. 2), showed synchondrolysis between the first and second segments of the corpus sterni, with the proximal part dislocated

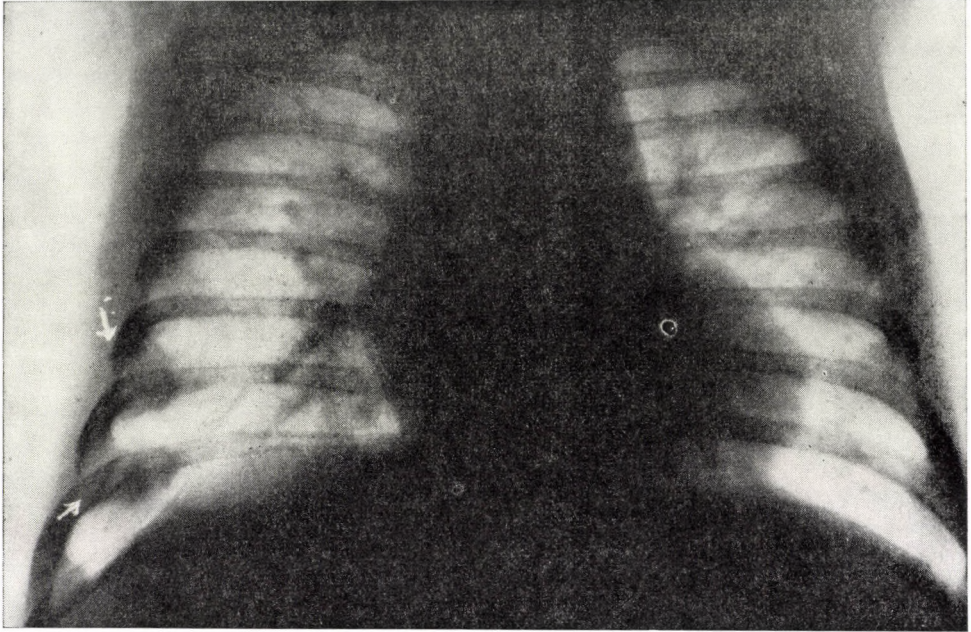


FIG. 1A. Case 1. Fractures healed with callus formation of the seventh to ninth ribs on the right side

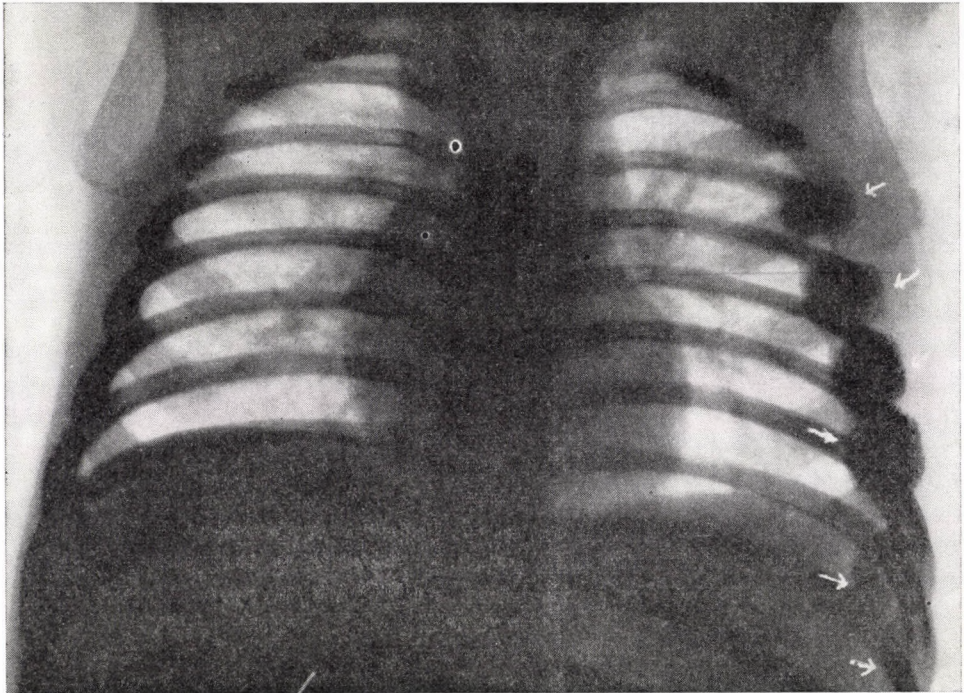


FIG. 1B. Case 2. Intensive callus formation at fracture sites on the third to eighth ribs on the left side

backwards. — On conservative treatment the patient became free of complaints in 12 days. A radiograph taken 19 months after the accident showed normal conditions.

Pulmonary, pleural and mediastinal injury suffered without costal injury or in association with unimportant rib fractures in children have scarcely been mentioned in the literature. SCHWARTZ and BORMANN [17] published four such cases, BRÜGGER and SPÄNGLER [2] one case. Of the six patients of GREENING et al. [8], two were children. In adults this kind of injury is much more frequent [6, 8, 11, 14, 16]. In our patient material the following types have been observed:

pulmonary haematoma of pneumonic character;

cystic pulmonary lesion;

pulmonary haematoma accompanied by pneumothorax, haemothorax or haemopneumothorax;

mediastinal haematoma and/or emphysema.

Pulmonary lesion (haematoma) of pneumonic character develops either immediately or shortly after the injury. The first physical examination and radiogram sometimes fail to reveal any change but in a few hours extensive lesions may be observed. The physical and X-ray findings correspond to pneumonia. The course, however, is different from that of inflammatory disease. Haematoma develops and also disappears more rapidly than the pneumonia. At necropsy or in surgical cases an extensive intra-pulmonary haematoma is found

[8, 15]. — The lesion is not identical with the traumatic atelectasis observed in De TAKATS' animal experiment [4] which was the result of reflex bronchospasm. It cannot be excluded, however, that the same injury which

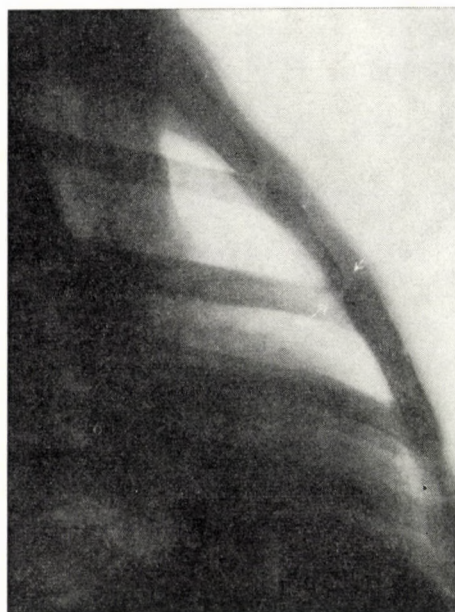


FIG. 2. Case 3. Synchondrolysis between the first and second segments of the corpus sterni

causes haematoma produces also bronchospasm and the atelectasis brought about in this way may contribute to the development of the radiological findings.

*Case 4.* S. L., a 12-year-old boy had fallen from a swing and hit the left side of his chest. A few hours later he was admitted in a serious condition. On the chest wall there was no external injury, but the patient complained of pain presenting in the epigastric area. Breath sounds were weak, on palpation some tenderness was felt below the right costal margin. X-rays

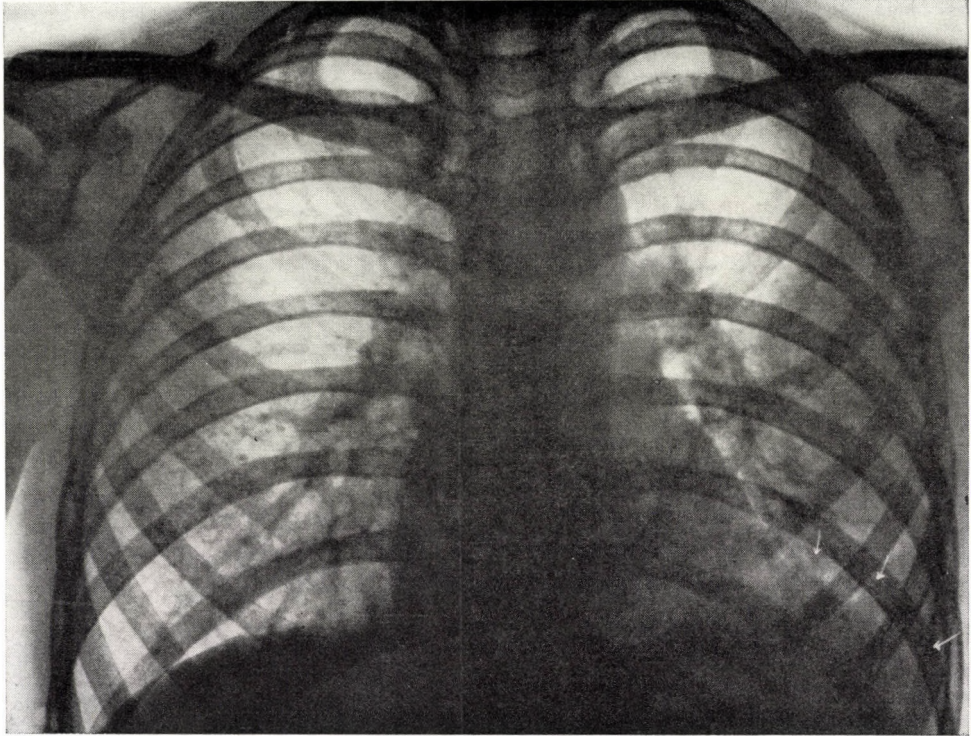


FIG. 3

(Fig. 3) showed a blurred margin of the left diaphragm with an inhomogeneous opacity of a finger's breadth above it. A week later the opacity was found to have cleared up completely with only a small adhesion over the diaphragmatic dome on the left side. At this time the patient presented no symptoms and had no complaints.

Thoracic haemorrhage is induced either by direct traumatic action or by crushing produced by a contrecoup mechanism [15, 16]. It has been supposed that a blow to the chest causes the lung to rupture if it is filled with air and deflation is hindered by the simultaneous reflex glottis spasm caused by the injury (*éclatement par compression*) [6]. Development of haematoma has also been

explained by a rupture of the vessels lying close to the bronchi which are made to kink by the trauma.

Lung lesions of the cystic type develop when the trauma causes compression of the lung to such an extent that a tear results in the parenchyma. The damaged area is filled with blood from the injured vessels and thus a collection of blood occurs in the elastic lung tissue and the radiograph reveals a round opacity [11]. If from the injured alveoli air escapes into the haematoma cavity, a fluid level appears in it.

*Case 5.* L. J., an 11-year-old boy had fallen in a ditch and hit his back. Following the fall he had complained of chest

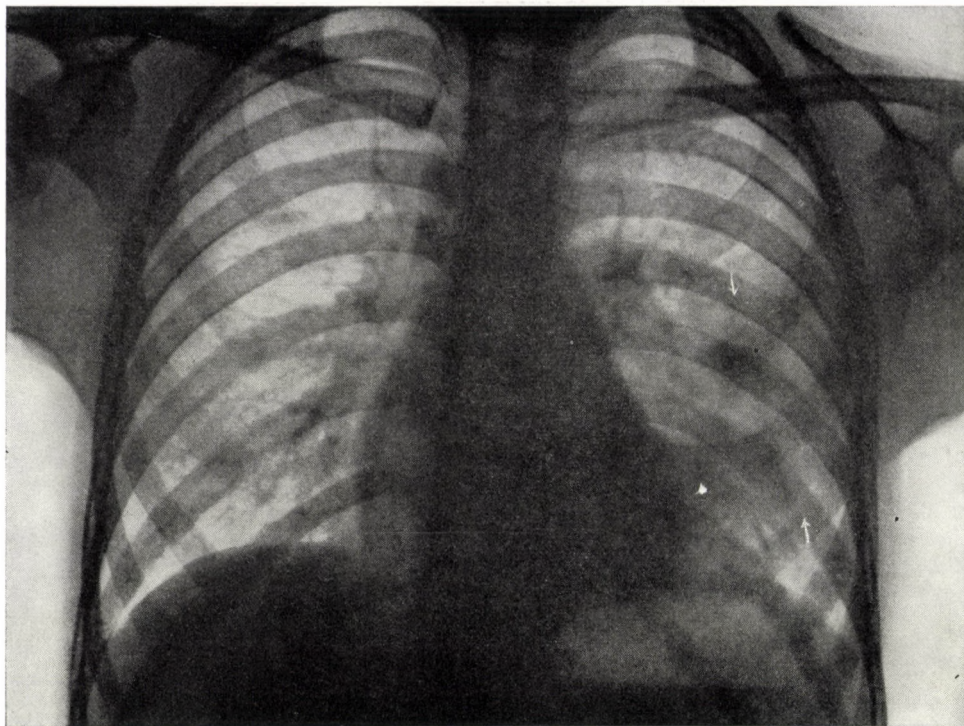


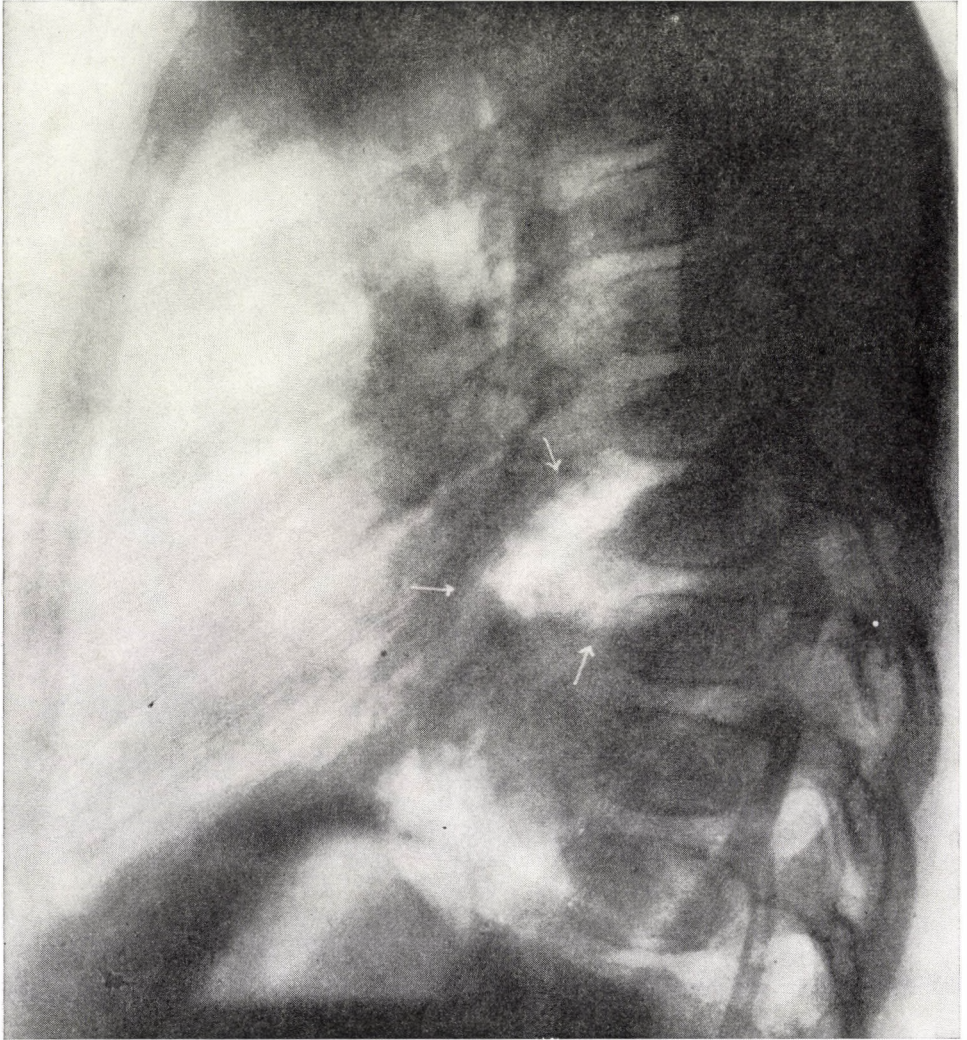
FIG. 4A. Case 5. Inhomogeneous opacity in left lower lung field

pain. At admission a bluish tender swelling, about the size of a palm, was felt on palpation below the right scapula. Over the diaphragm the breath sounds were weak, the radiograph (Fig. 4A) revealed a normal thoracic wall with an intensive inhomogeneous opacity in the left middle and lower lobes. A lateral film (Fig. 4B) showed a circumscribed clear field in the upper part of the roughly round opacity. A tomograph in 3 cm depth dorsally (Fig. 4C), taken ten days later, showed within the opacity irregular clear areas about the size of an apple. Recovery was uneventful. At a follow-up four months later the pulmonary picture was completely normal.

Beside the pulmonary and pleural injuries following blunt chest trauma, mediastinal lesions (emphysema,

haematoma) also occur. In one of our cases a mediastinal haematoma was observed in association with an insignificant rib fracture and haemopneumothorax.

*Case 6.* A. G., a 6-year-old boy had been struck by a car. He was admitted in shock, the skin was pale, the extremities were cold and cyanosed and there was considerable tachycardia. Over the lower part of the right chest the percussion note was flat, breath sounds were weak with scattered rales. The abdomen was diffusely tender on palpation. The radiograph (Fig. 5A) revealed fractures of the sixth to tenth ribs on the right side and an intensive inhomogeneous opacity in the right middle and lower lung fields. The lower part of the right side of the mediastinum was bulging, forming a convex arc with sharp contours.



4B. Case 5. Clearing up of upper part of the opacity

Along the right chest wall a narrow pneumothorax was observed, the lateral part of the horizontal fissure was widened. The lateral film showed an opacity in the long fissure. During the following six days the mediastinal opacity and the pneumothorax disappeared completely and the only remaining change was a blurring of the diaphragmatic surface and pleural thickening (Fig. 5B).

Following a blunt chest injury, congenital malformations may become suddenly manifest.

*Case 7.* S.J., a 4-year-old boy had fallen and hit his left side. This slight trauma was followed by grave general symptoms associated with dyspnoea, intensive abdominal pain and hiccough. The patient was admitted in a state of shock.

On the X-ray film (Fig. 6) the left leaf of the diaphragm could not be isolated from the surroundings. The lower 3/4 part of the left chest was filled by the stomach, the mediastinum was displaced to the right. Thoracotomy was performed and in the lateral and posterior part of the left diaphragmatic dome a hole about the size of a child's palm, surrounded by a membrane with torn edges was found. After replacing the abdominal organs the diaphragmatic hole was closed. Recovery was uneventful. The membrane over the muscle hiatus had presumably been torn by the trauma, and thus a diaphragmatic hernia developed.

### DIAGNOSIS

Diagnosis often presents some difficulty if the injury is slight, the symptoms are not marked and of a transitory character. Thus no radiograph is made in every case and therefore part of the pulmonary lesions remains undetected. Sometimes the clinical picture is not characteristic, particularly in infants. Cough is not always present, dyspnoea may be absent or disappear before the patient comes to examination. Haemoptysis is rare in children, it occurred in none of our cases. Abdominal tenderness, on the other hand, is often present, sometimes associated with muscle rigidity.

In cases of pulmonary haematoma, physical examination often reveals a dullness on percussion, diminished breath sounds and sometimes rales. The excursion of the diaphragm is limited on the affected side. The most constant alteration seems to be the radiological one. The picture is

similar to that of bronchopneumonia, displaying mottled opacities with vague contours. Sometimes within the infiltrated area characteristic round opacities containing air, some



4c. Case 5. Tomogram in 3 cm depth, dorsally

of them with a demonstrable fluid level, may be seen. Blood in the pleural cavity (haemothorax), haemopneumothorax, pneumothorax, mediastinal emphysema, or an intensive mediastinal shadow due to haematoma may occur. Thus, radiography is diagnostically indispensable and must be performed in every case suspicious of thoracic injury, even if there are no clinical symptoms.

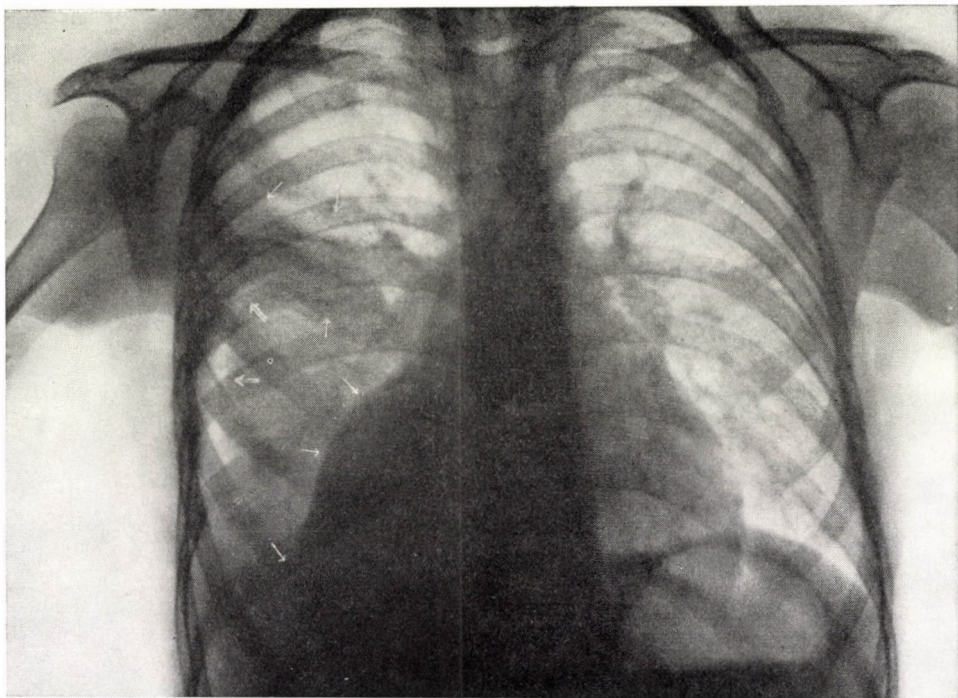


FIG. 5A. Case 6. Greenstick fractures of the sixth to tenth ribs on right side extensive opacity in right lung field, mediastinal and interlobar haematoma, pneumothorax

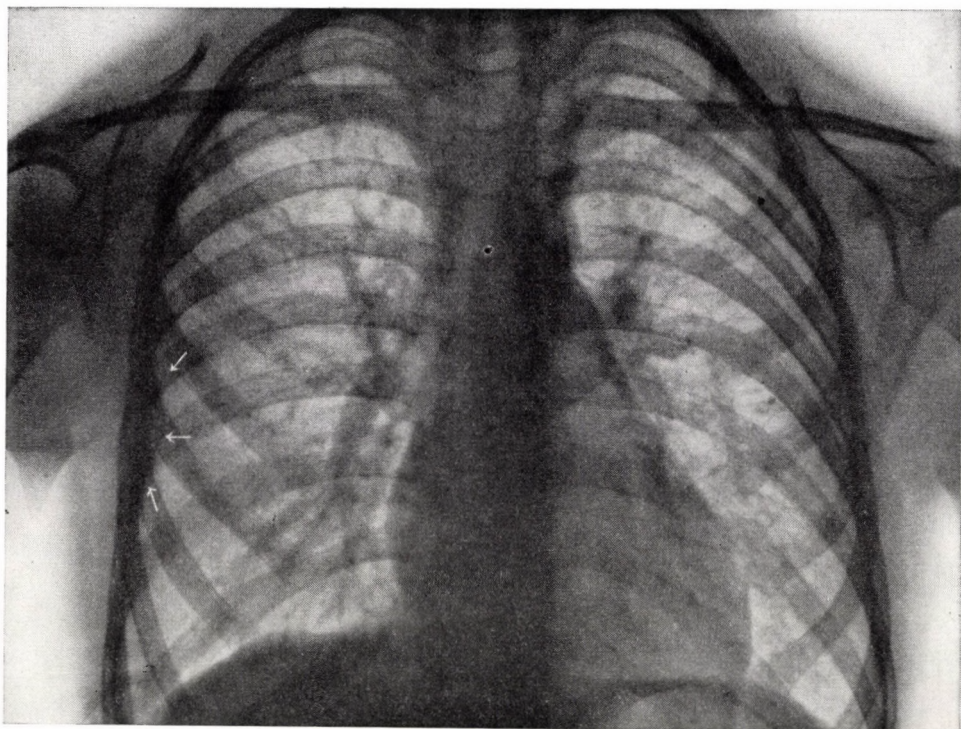


FIG. 5B. Minimal pleuritic residuum 6 days later



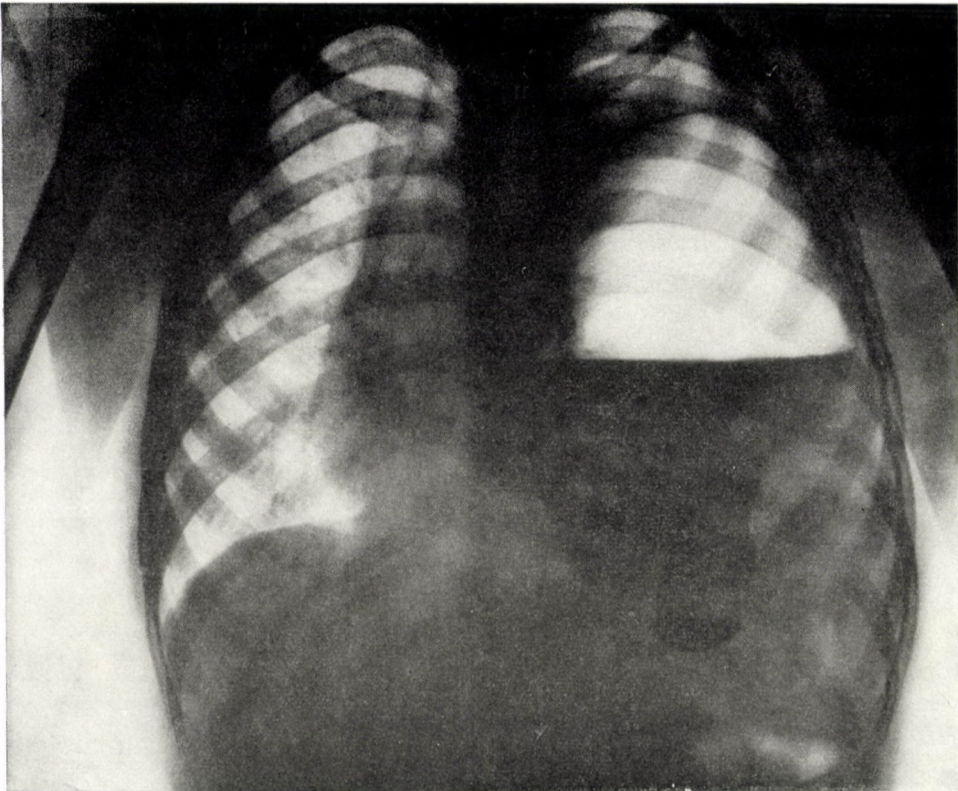


FIG. 6. CASE 7. The left diaphragm cannot be differentiated. The stomach is in the left half of the thorax

#### TREATMENT

Pulmonary haematoma, even those of a considerable extent usually disappear spontaneously in a week. Sometimes, however, recovery may take several months, but in these cases, too, it is mostly complete and without residuum. As the haematoma predisposes to infection, antibiotic treatment must be applied in the first days. It is to this that we ascribe the fact that in none of our cases had pneumonia developed. Some authors, assuming a reflectory broncho-

spasm induced *via* the vagus by the trauma, recommended the administration of some parasympatholytic compounds [14]. No similar drug has been applied by us.

An intrapleural blood collection must be aspirated. The procedure may be repeated several times if required. A considerable haemorrhage or one that fails to subside, is an indication for thoracotomy. This was necessary in none of our similar patients.

In cases of unilateral pneumothorax treatment should be conservative. Continuous aspiration must be done

only when symptoms of tension pneumothorax appear. In our case of bilateral pneumothorax continuous suction was performed, which resulted in a rapid reexpansion of the lungs and ensured satisfactory gas exchange.

Traumatic diaphragmatic hernia is an emergency condition calling for immediate surgery.

#### SUMMARY

The clinical and radiological characteristics of thoracic, pulmonary, pleural and mediastinal injuries due to blunt chest trauma in children have been discussed on the basis of a large material, and pertaining cases (rib fractures, synchondrolysis of sternum, pulmonary haematoma, haemothorax, haemopneumothorax, mediastinal haematoma, traumatic diaphragm hernia) have been presented. It is emphasized that seemingly slight injuries may also cause lesions in the intrathoracic organs. Radiological examination therefore is indispensable in every case of blunt chest injury.

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