SPONTANEOUS SURGICAL EMPHYSEMA IN CHILDREN

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(With Special Plate)

Spontaneous surgical emphysema in children is uncommon, and Rolleston¹ has stated that in thirty years' experience of fever hospital practice he has seen "barely half a dozen cases" with this complication. It most often occurs in association with whooping-cough, measles, diphtheritic laryngeal obstruction, and bronchopneumonia, the last-named occurring along with the above or independently of them. Other conditions with which it has been described are asthma and bronchopneumonia²—a combination which would appear to favour its production, but which is nevertheless uncommon—and in the forced respiratory efforts in a diabetic air-hunger.³

Spontaneous surgical emphysema in children may be grouped as follows: (1) congenital—a rarity occurring at birth or shortly afterwards⁴; (2) infective—in association with gas-forming organisms; (3) associated with laryngeal or bronchial ulceration,⁵ as by laryngeal diphtheria or foreign body; and (4) associated with lung diseases, especially bronchopneumonia.

Illustrative Cases

It is the last-named variety with which we are concerned, as the following cases illustrate.

CASE I

A girl, aged 4½ years, was admitted to hospital with a four-days history of spasmodic cough and fever. A few hours before admission her parents had noticed a swelling on the left side of the neck, which was rapidly spreading on to the face. When examined her general condition was fairly good; surgical emphysema was present over the left side of the neck and face, and extended a little way on to the chest wall. Signs of bronchopneumonia were present in the left lung. The next day the emphysema had spread to the other side of the neck and further up the face and down the chest wall, but there did not appear to be any undue distress or dyspnoea. Signs of a left-sided pneumothorax were definitely present, and this was confirmed radiologically. Whooping-cough was suspected, but she never whooped, and a negative pertussis plate was obtained; the leucocytes numbered 11,500 per c.mm., of which 67 per cent. were polymorphs. The Mantoux reaction was negative.

The emphysema gradually subsided as the signs in the chest cleared, and by the sixteenth day the child appeared perfectly well. Subsequent clinical and radiological examinations revealed a normal chest, and the girl is now in excellent health.

CASE II

A girl, aged 5 years, was admitted to hospital with the history that for the previous three days she had been sneezing continually in spite of all efforts to stop it. The left side of her face was noticed to be swollen a day before admission, and the swelling had spread rapidly over the face and chest wall. She had been in contact with whooping-cough at school, and the fact that she herself whooped subsequently would appear to be sufficient evidence that the paroxysmal sneezing was a whooping-cough variant. Examples of this are well recognized and not uncommon in the literature.⁶

On admission she was collapsed, with considerable cyanosis and dyspnoea and a rapid, feeble pulse. Short explosive sneezes occurred about every half-minute, and the child was distressingly ill. She was "blown up" with surgical emphysema extending from the scalp to half-way down the thighs; both eyes were closed, and the skin appeared to be

lifted about an inch from the chest wall (Fig. A). It was difficult to determine with any accuracy the underlying signs in the lungs; there was no cardiac displacement, but signs of bronchopneumonia were found at the right base, and this was subsequently confirmed radiologically. There was a leucocytosis of 30,000, with 80 per cent. polymorphs.

Considerable difficulty was encountered in controlling the sneezing. Adrenaline and cocaine nasal sprays were given, but most relief was obtained with morphine and atropine, though the cyanosis made one sparing in the use of morphine at the onset. The sneezing gradually ceased about four days after admission, with one short return, and the girl's condition improved. The temperature remained up for three weeks, and the chest signs showed considerable delay in resolution. By the end of a month all signs of emphysema had gone (Fig. B). Unfortunately she developed chicken-pox at this stage, but, apart from this and the delayed resolution referred to, she made an excellent recovery.

FIG. A.

FIG. B.

CASE III

A boy, aged 5, was admitted with the following history. He had been in good health until a week before admission, when he developed what the mother called a heavy cold, with headache and abdominal and limb pains. Five days later he vomited, complained of a sore throat, and became noisy and restless. His bowels had been regular. When first seen he looked toxic, was inclined to be drowsy, and showed signs of pneumonia at the right base. There was a short dry cough, but not violent or severe. The signs in the chest persisted, and the boy began to look more toxic; his temperature remained between 104° and 105°, and his pulse was 150 to 160. He became more drowsy, though there were no meningeal signs, and there was incontinence of urine and faeces.

Four days after admission surgical emphysema was noticed around both supraclavicular areas and extending a short way on to the chest wall. This appeared in the night, without any severe spasm of coughing. When first seen it was bilateral, though it subsequently became most marked on the right side without ever becoming at all extensive. A leucocyte count of only 8,400 per c.mm. with 73 per cent. polymorphs was taken to indicate a very poor response to infection.

Fourteen days after admission he died. At the necropsy, much to the clinician's surprise and to the pathologist's delight, the true cause of his illness was revealed in the presence of typhoid ulcers in the small intestine. Both lungs showed some bronchopneumonia, especially at the right base, where the majority of signs were present during life. Beneath the pleura of both lungs, especially on the medial aspect, were chains of small bullae, and at the hila these extended into the mediastinal tissue. The latter was honeycombed with bullae, which could be plainly seen in the fresh specimen dissecting their way up the mediastinal fascial planes to the neck (Fig. 1 on Plate).

CASE IV

A boy, aged 4 years, was admitted as an emergency case during the night, after an illness of thirty-six hours. His symptoms were those of extreme dyspnoea, with a violent

paroxysmal cough. He was said to have had four similar attacks during the past year. On admission he was collapsed, semi-conscious, and ashen-grey in colour, with severe dyspnoea but no stridor. The chest was full of moist sounds, but no definite localized signs could be determined. He died two hours after admission. The post-mortem examination showed a diffuse haemorrhagic bronchopneumonia, with a small bronchiectatic area at both bases. The most striking finding, however, was an extensive interstitial emphysema. The bullae were most prominent at the interlobar margins and along the interlobular septa, and appeared to be tracking towards the mediastinum, where small bullae were found in the mediastinal tissues surrounding the hila (Fig. 2 on Plate).

Mechanism of the Condition

Study of these cases serves to illustrate the mechanism by which spontaneous surgical emphysema arises. An acute inflammatory lesion of the lung may be accompanied by a variable amount of interstitial emphysema. If to this damaged lung an explosive force is superadded—for example, whooping-cough or sneezing—there will be a tendency for the emphysematous bullae to track towards the periphery of the lung and/or the mediastinum. This may be observed if the lung of a stillborn baby is forcibly inflated; bullae will appear at the edge of the lungs and extend along the interlobular septa. Further dissection of these bullae along mediastinal fascial planes will lead to the ultimate escape of air by rupture into the subcutaneous tissues at the root of the neck. In the majority of cases this appears first on the left side in the supraclavicular region, and this suggests that the path of least resistance is along the tissues around the thoracic duct.

In the first case described there was an associated pneumothorax, which presumably arose in consequence of the rupture of an emphysematous bulla into the pleural cavity. The immediate effect is, of course, collapse of the underlying lung, with consequent reduction in the intrapulmonary pressure. Further coughing in such a case would not increase the spread of emphysema.

It would appear, therefore, that to account for the presence of the two conditions one must postulate the simultaneous occurrence of subcutaneous and intrathoracic rupture. This fortuitous happening may well account for the extreme rarity of the combination. Berkley and Coffen⁷ report two such cases in adults with influenzal pneumonia, but no case has been found recorded in children.

An alternative theory to the above, to account for the presence of subcutaneous air, is that bronchial ulceration occurs and that the air escapes along the peribronchial or perivascular channels to the mediastinum. That this may happen in laryngeal and bronchial diphtheria is feasible, but a study of the foregoing cases would appear to show that bullae first appear away from the bronchi at the periphery of the lung, and no signs of bronchial ulceration were discovered. One would imagine, too, that, if this was the true explanation, such a condition as bronchiectasis in its more acute exacerbations would be not uncommonly complicated by surgical emphysema; this, however, is not so.

Treatment

There would appear to be five available methods of treatment—namely, (1) subcutaneous needling; (2) collar incision; (3) tracheotomy; (4) artificial pneumothorax; and (5) the *vis medicatrix naturae*.

(1) Needling has been practised on several occasions,⁸ but has the definite risk of sepsis. Moreover, there is no doubt that the air can be, and is, ultimately absorbed, and one cannot consider this a method of choice.

(2) Grey Turner, in *Modern Operative Surgery*,⁹ refers to the operation of releasing the air through a transverse incision at the suprasternal notch, thus opening up the space of Burns, which is in communication with the superior mediastinum. An amusing corollary to this was described by Silvester¹⁰ before the Royal Academy of Science in 1885. He advocated the following "simple" method of saving oneself from drowning. This was to puncture the floor of the mouth close to the base of the gums with any sharp instrument (where this is to be obtained is not related), and to force the finger through the incision until the superficial fascia of the neck is reached. Then, with the mouth and nostrils closed, expiratory effort forces air into the subcutaneous tissues, and so produces sufficient surgical emphysema for the body to be kept afloat!

(3) Tracheotomy has been performed with the idea of relieving pressure on the trachea, which Cook¹¹ reported in his case to be flattened. Rolleston⁵ reports "considerable relief" from a tracheotomy done in a case of diphtheria with emphysema, but here the result may have been modified by the tracheotomy relieving any associated laryngeal obstruction.

(4) In view of the mechanism by which spontaneous surgical emphysema is believed to arise, the most rational treatment would appear to be collapse of the lung by an artificial pneumothorax. Birch¹² has shown a case so treated with an excellent result. One practical difficulty is to determine which side to collapse, because extensive emphysema makes localization of the underlying lung condition very difficult, and in such cases a radiograph is of considerable help. In Case II, where the need for active treatment was most urgently felt, the child was so desperately ill that one hesitated to introduce any measure which might increase shock.

(5) In the cases reported above no active measures were taken to relieve the emphysema. In each instance the air was gradually absorbed and without difficulty. In Case III the boy died from typhoid and not from the emphysema complication.

It is my opinion, therefore, that the best treatment is to leave well alone and to let the air be absorbed naturally, although it is agreed that, if active measures are contemplated, artificial pneumothorax is the method of choice.

Summary

(a) Spontaneous surgical emphysema is a rare condition in children.

(b) Three cases are reported, together with a further case illustrating the mechanism by which the condition arises.

(c) It is postulated that emphysematous bullae track up the mediastinum, mainly along the lymphatic planes, to the subcutaneous tissues of the neck.

(d) No special treatment is urged, but artificial pneumothorax may be performed.

(e) The prognosis of any case is not made worse by the complication of emphysema.

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- ¹⁰ Silvester: *Lancet*, 1885, ii, 418.
- ¹¹ Cook: *Ibid.*, 1935, i, 547.
- ¹² Birch: *Proc. Roy. Soc. Med.*, xxviii, No. 6, 662.

H. B. STALLARD: GLIOMA RETINAE TREATED BY RADON SEEDS

FIG. 1.—Antero-posterior view. Four radon seeds *in situ* from 2 to 6 o'clock, 7-8 mm. apart.

FIG. 2.—Lateral view. Head moved.

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FIG. 1.—Case III, showing bullae in mediastinal tissue and medial aspect of lung.

FIG. 2.—Case IV, showing interstitial emphysema.