CHEST SURGERY IN WAR

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CLOSED WOUNDS OF THE CHEST, AND THE PHYSICIAN'S PLACE IN A CHEST TEAM*

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Intrathoracic Injuries

We may now pass to a consideration of the intrathoracic injuries pure and simple. The distress caused by an open thorax is usually very great, and until the opening has been closed it is difficult to estimate the extent to which the symptoms are due to injury of the thoracic contents. Auscultation and percussion will add little or nothing to the information obtained by seeing the hole in the chest wall. Active haemorrhage may be visible externally and be recognizable by the colour of the blood, which continues bright and arterial. The leakage of a haemothorax which is not increasing from fresh haemorrhage is usually darker and resembles venous bleeding; moreover, the blood does not clot outside the body as fresh blood does. Injuries to the thoracic duct cause rapid and uncontrollable wasting. With closed thorax the examination of the chest resolves itself into a combination of the ordinary methods (inspection, palpation, percussion, and auscultation) with radio-scopic and radiography.

Inspection.—The presence of surgical emphysema almost always means the presence of either partial or complete pneumothorax. If the heart's apex beat is visible an alteration of its position may depend on the heart's being pushed over by air or fluid, or on its being pulled over by collapsed lung. Visible distension of one side of the chest may depend on air or fluid. An overdistended chest will generally be immobile. The degree of movement in a chest is not, however, always proportionate to the intrathoracic injury. On the one hand there may be, for instance, a considerable amplitude of respiratory movement with a large haemothorax if the lung remains partly expanded; and, on the other hand, a chest which has been struck without material intrathoracic damage may remain immobile for two or three days even though the lung is not collapsed, and even in the absence of haemothorax or pneumothorax. Cases of this kind are seen in which the injured side remains resonant, slightly retracted, without inspiratory or expiratory sounds, but with normal vocal fremitus and normal radiographic appearance. This condition persists for one or two days and recovers completely. In cases of collapsed lung (without haemothorax or pneumothorax) the side may appear greatly retracted, with indrawing of the interspaces on inspiration.

Palpation.—Surgical emphysema is the first sign to be felt for. If extensive it obliterates or distorts every other physical sign except the position of the heart. Displacement of the heart may be determined by palpation. Exocardial friction fremitus may be felt. It does not always indicate haemo-pneumopericardium or pericarditis: sub-sternal surgical emphysema may cause a similar friction fremitus. Fractured ribs or a missile lying under the skin may be discovered by palpation. An ecchymosis on the chest wall should be carefully palpated, as it is often due to a missile which has penetrated as far as the skin

without making its exit. Tactile vocal fremitus is not always diminished and is occasionally increased over haemothorax. It is not even invariably lost over pneumothorax. The value of palpation can scarcely be over-emphasized.

Percussion.—Percussion is apt to be misleading when the chest has been injured. The resonance of the normal chest depends to some extent on the tension of the chest wall, in the same way as the resonance of a drum depends on the tension of the drum-head. If the chest wall becomes abnormally lax (as when ribs are extensively smashed) the resonance and the pitch of the percussion note are thereby altered. Surgical emphysema will yield a resonant note even over a large haemothorax. Resonance may be impaired over a collapsed lung even if there is no haemothorax. The level of dullness does not indicate the size of a haemothorax. Alteration in the position of the mediastinum may be detected by percussing out the anterior limits of resonance of the uninjured lung. The position or size of the cardiac dullness may be found changed. The liver dullness or stomach resonance is sometimes found to rise unduly high in chest wounds owing to relaxation or paralysis of an apparently uninjured diaphragm. This may mean that the diaphragm is paralysed or that the lung above it is collapsed. Particular attention should be paid to percussion of the base of the opposite (and apparently uninjured) lung. Abnormal dullness of this base may be due to an abnormally high diaphragm, to consolidation, collapse, or compression of the lung, or to a haemothorax. A missile may have passed through both lungs. The diaphragm may be pushed up by subphrenic injuries or by tympanites and cause abnormal dullness at the pulmonary base or bases.

Auscultation.—The positive sign of good air entry with normal vesicular breathing is the most valuable of all auscultatory sounds. It is evidence that the lung in that area is expanding. Absent and altered breath sounds are less reliable. Breath sounds may be diminished or totally absent in haemothorax and pneumothorax; they may be equally absent in any case in which the lung is not expanding—for example, when a bronchus is blocked or when the respiratory movements are too feeble (as in shock) to produce any audible sound. Altered breath sounds do not follow the same general rules in injuries as in diseases of the lungs. Bronchial breathing is not uncommon over haemothorax, whilst it may be absent in haematoma of the lung if the haematoma is superficial and wide in extent. Bronchial or amphoric breathing is often heard over pneumothorax even when closed. The coin sound is sometimes absent even in a large pneumothorax.

Mucous and Crepitant Rales.—It is very difficult to assign particular values to mucous rales and crepitations in the same way as has hitherto been customary in disease. When it is remembered that, in the majority of cases where the lung has been struck, three changes almost invariably occur which are capable of producing mucous or crepitant rales, the difficulties of exactly interpreting these physical signs will be appreciated. The three constant changes are collapse of air vesicles, haemorrhage into the alveoli and bronchioles, and haematoma of the lung. Whatever other accidents may have occurred these three may be confidently assumed to be present when a missile has struck the chest with enough force to penetrate

its wall. Mucous rales will give practically no information of diagnostic value. Crepitations are occasionally useful, particularly in two conditions. In collapse of the lung (either homolateral or contralateral) widespread coarse dry crackling is a valuable physical sign. In compression of the opposite lung by a large haemothorax or pneumothorax on the injured side fine crepitations are often heard over the base of the compressed lung. On the second or third day (and at any later time) the appearance of crepitations where none were previously heard may indicate the occurrence of pneumonia or bronchopneumonia, or that extremely rare condition gas gangrene of the pulmonary tissue.

Friction Sounds.—Pleural friction must be carefully watched for. It is often the first sign of intrathoracic infection. But a small haemothorax almost always at an early stage produces friction which is of no great moment. Pericardial friction is not uncommon, but pericarditis is not necessarily a fatal or even a serious complication of gunshot wounds of the chest. A heart beating in surgical emphysema of the substernal tissues may give rise to a friction sound indistinguishable from pericarditis or to a remarkable churning sound mistakable for haemo-pneumopericardium. An adjacent pneumothorax will give to the normal heart sound an exaggerated resonance or reverberation, and if friction is present either from pericarditis or surgical emphysema, or from haemo-pneumopericardium, the noises which may result are astonishing, although with experience they become unmistakable. As a rule the exocardial friction sounds which appear immediately after wounding are due to surgical emphysema, and are very loud and coarse. They begin faintly over a limited area and spread gradually with increasing loudness. Hernia of the stomach or intestines may cause gurgling sounds to be heard in the chest, but these sounds are not diagnostic of a lacerated diaphragm. Intestinal gurgling is sometimes transmitted very distinctly through a pneumothorax when the diaphragm is intact, and it is also heard when the diaphragm is raised abnormally high. It is very difficult to interpret changes in the heart sounds and rhythm correctly. Bruits which are mistaken for endocardial murmurs are produced by displacement of the mediastinum with dislocation or torsion of the heart and great vessels. Irregularities in rhythm may be similarly caused. Speaking generally, a heart which has been hit, with or without penetration, takes on a rapid and irregular action, especially if struck on the posterior aspect or near the auriculo-ventricular junction. I have, however, seen in one case a shrapnel ball lodged in the ventricular muscle near the apex, and in another a fistulous opening through the chest wall into the right auricle, yet in neither was there any interference with the heart's action. But as a rule true delirium cordis indicates that the heart has been struck by the missile. Physical signs suggesting involvement of the pericardium or heart do not constitute a contraindication to operation. They are exceedingly fallacious.

Succussion Splash.—It may be possible to elicit this sign in haemo-pneumothorax. It is never justifiable to attempt to do so in the early stages, and with *x* rays at hand it is never necessary.

Metallic Tinkling.—I thought that I had never met with this sign in gunshot wounds of the chest, but recently I found a note of it in one of my cases at Heilly (in 1916).

Voice Sounds.—Modifications of vocal resonance are apt to be misleading. The most constant and reliable sign is aegophony, which I have not met with except when there was fluid in the chest. It is usually best heard at or near the upper level of the fluid, and may be localized to a very restricted area there. Diminished vocal resonance

does not always accompany even a large haemothorax; it may be considerably increased. Occasionally the vocal resonance is increased without any obvious intrathoracic change even on *x*-ray examination. I do not know what is the explanation of this sign occurring in a chest which has been hit or penetrated. I have often met with it in the first few hours, and have not been able to attach any importance or diagnostic significance to it. Possibly it is due to a partial deflation of the lung that is not sufficient to produce the physical signs of collapse. In pneumothorax the voice sounds and the cough may acquire a characteristic metallic ring. This metallic ring is also sometimes heard with the inspiratory souffle in a closed pneumothorax, and indicates that a large opening communicates with the pneumothorax from the bronchus.

Auscultation is made very difficult when surgical emphysema is present. If the surgical emphysema is considerable and obvious, it will be recognized at once that auscultation can be of little assistance. Often, however, the emphysema is not evident, and the auscultatory sounds become very puzzling, particularly when the surgical emphysema is mediastinal, substernal, or subpleural, and does not extend to the subcutaneous tissues. Under all circumstances auscultation should reveal the approximate position of the heart, and this is a point which requires to be determined in every case of gunshot wound of the chest.

Value of Radiography

It is impossible to treat chest wounds adequately without radiographs. From the time a case comes within reach of surgical assistance to the time the patient is finally discharged as cured, and even long after if untoward sequelae are suspected, radiographs are constantly required. At the outset it is only with radiographs that the probable track of a missile and its position, if retained, can be ascertained. The position of the heart and diaphragm, their movements, damage to the lung, collapse of the lung, haemothorax, and pneumothorax can only be accurately determined by radiographs interpreted in conjunction with physical signs. Radiography alone is insufficient; the cases must also be radioscopically examined and the parts be seen in movement with the fluoroscopic screen, in a sitting-up position if possible. It must be remembered that pieces of clothing can never, and fragments of bone only rarely, be revealed by radiographs.

Some Other Considerations

One of the most reliable signs of a haemothorax becoming septic is an increased respiration rate and even apparent dyspnoea without any corresponding change in physical signs or increase in the amount of fluid. Air in the pleural cavity plays little or no part in preventing a collapsed lung from expanding unless there is a valve pneumothorax constantly pumping air into the pleural cavity. The rapidity with which a collapsed lung can re-expand if free from adhesions is not generally known. I had accidental proof of this during the last war. A patient on whom complete thoracotomy had been performed was by mistake radiographed within two hours of his operation. The lung, which had been fully collapsed at the operation, was found both by screening and by a photographic plate to be almost completely re-expanded. The thoracic wound had been hermetically closed and covered with glue.

"Pleural shock" is a terror to some minds. But the pleura is not a delicately sensitive membrane. Opening the pleural cavity and handling the lung can be done with impunity if care is exercised not to allow displacement of the mediastinum and contents.

If the mediastinal contents are gently held in place with tenaculum forceps a patient under local anaesthesia experiences very little discomfort and no shock when the thorax is opened, the cavity explored with the hand, and the lung even "delivered" outside the chest for examination and repair. If, however, the heart is allowed to swing out of position grave shock may occur immediately. I have seen a patient whose heart was pinned in position by a small fragment of metal which attached the pericardium to the diaphragm almost die on the operating table when the heart was released and allowed to swing to the opposite side of the chest, although a total pneumothorax had caused him little discomfort either at the time of wounding or after the thorax had been widely opened at the beginning of the operation. It is very striking to find how little is the distress caused by sudden pneumothorax when the heart is retained in position by old adhesions. In 1921 I saw an example of this in a soldier who was wounded in 1915: his pneumothorax, dating from that time, was discovered only by accident in 1921. His heart was held in position by adhesions which were probably present before he was wounded. In cases showing extreme distress relief is instantaneous when, after opening the chest for thoracotomy, the heart is gently drawn back into position.

The heart is a strange organ. It appears to resent blows on its posterior aspect more than on the anterior; it also resents anything like torsion during an operation. If the heart impinges on a foreign body during its beating the rhythm and rate may be totally disordered even when the heart itself is quite uninjured. Never diagnose haemopericardium until you have seen the pericardium exposed either during life or after death.

Breathing exercises are apt to be overvalued. With a well-cleaned pleural cavity a lung expands perfectly without exercises. The toilet of the pleura is what matters. Lockwood and I eventually abandoned exercises altogether, as they only fatigued the patient uselessly. Mr. Tudor Edwards in his memorandum E.M.S. Gen./326 says he is doubtful if blowing exercises have the slightest value in the re-expansion of a lung bound down by pleural adhesions. I have often demonstrated what happens radioscopically. The good lung overdistends, the mediastinum bends convexly into the damaged side, and the harder the patient blows the greater is the mediastinal displacement.

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The thirty-fourth annual medical report of the King Edward VII Sanatorium, Midhurst, is almost entirely statistical. It analyses the admissions and discharges (142 and 172 respectively) of the past year and also the after-history of the Midhurst cases since 1906. Of the 149 patients discharged in the first year of the sanatorium's existence, 27 were still alive in 1940. The more astonishing thing is how few are lost sight of—something under 5%. The treatments given are also analysed; thus during the last fifteen years artificial pneumothorax has been attempted in 303 cases, and has been successful in 240. Of these 240 patients, some of them dating back to 1925, 182 (or 76%) are known to be still living. Eighteen patients out of 15 severe cases and 23 less severe in which thoracoplasty was done were known to be working or fit for work, 6 to be well though not working, and 5 to be keeping in fair health. On the outbreak of the war, half the sanatorium was taken over by the Ministry of Health for the treatment of surgical chest cases among the officers of the three Services. These cases are not discussed in the present report, but it is proposed at the end of hostilities, or earlier if the number of cases requires it, to give a full analysis of the cases treated.

THE PREPARATION AND COOKING OF GREEN VEGETABLES

The following note on the preservation of the vitamins and salts in the processes of preparing green vegetables for the table has been drawn up by the Medical Research Council's Accessory Food Factors Committee.

Conservation of Vitamins

Vitamins are lost or destroyed in the preparation and cooking of greenstuffs by many of the methods now in common use. As it is of special importance at the present time to secure the maximum nutritive value from all the foods available, it is desirable to employ methods of preparation and cooking of foodstuffs which conserve their nutrients to the utmost.

The following generalizations summarize our knowledge of the behaviour in greenstuffs of the vitamins most likely to be affected in the course of preparing green vegetables for the table. Some simple rules based on these generalizations are given and cooking methods for greenstuffs are recommended.

Fat-soluble vitamin A is unlikely to suffer damage; water-soluble vitamins B and C are the most likely to be lost on preparation and cooking. This is so for the following reasons:

- (i) Because they are water-soluble, they are dissolved out by soaking or cooking water, they also run out in the watery juice.
- (ii) Raw vegetables contain enzymes which are active in destroying the vitamins, particularly if the raw foodstuff is left lying about after being bruised or cut up. These substances which destroy the vitamins become more active as the temperature rises during cooking up to a point at which they themselves are destroyed. This point of destruction is only a few degrees below boiling temperature.
- (iii) The water-soluble vitamins are themselves also destroyed by heat to an extent which depends on the length and severity of the heating.
- (iv) The water-soluble vitamins are found to diminish in amount in foods left standing after they are cooked.
- (v) Salt or sugar added to vegetables before cooking lessens the amount of destruction under conditions described in (iii) and (iv) above.
- (vi) Vitamins B and C are more stable in the presence of acid, which is sometimes added as vinegar. The addition of alkali (carbonate or bicarbonate of soda) will, on the other hand, hasten the destruction of the vitamins.

Practical Rules for treating Green Vegetables

- (1) Obtain as fresh as possible.
- (2) Keep in a cool damp place in order to reduce wilting.
- (3) Take precautions to avoid damage due to crushing or bruising during transport or handling.
- (4) If vegetables are soaked use salt water (two teaspoonfuls to one pint).
- (5) If vegetables are to be shredded or finely chopped for salads, prepare immediately before serving.
- (6) Use the smallest possible amount of water for cooking.
- (7) Have water boiling before adding vegetables.
- (8) Add salt to water before adding vegetables.
- (9) Add vegetables gradually or in small amounts at a time, in order to prevent water going off the boil.
- (10) Cook vegetables no longer than is necessary to render them tender.
- (11) Plan cooking arrangements so that vegetables are dished up and served immediately after they are cooked. On no account allow to stand for a long time on a hotplate.
- (12) If there is water left after cooking, drain off and use in the preparation of soups and gravies; alternatively, if successive batches are being cooked on the same day, use the same water again, adding more if necessary.

Methods resulting in Least Loss of Vitamin C

Method I.—Boil for the shortest time in a small quantity of boiling salted water. Use water left over for boiling other batches and for addition to soups and gravies.