

bronchial tubes. In some cases a diagnosis has only been made, and has only seemed to be possible, when the foreign body has been actually extruded, either through the mouth or through an abscess in the chest walls.

Cases where foreign bodies have lodged for some time, and have set up suppuration, will probably be overlooked unless the history of the onset of the affection be elicited; unusual localisation or exact limitation of the physical signs, however, should always suggest inquiry as to the possibility of the cause being an impacted foreign body.

There are other cases of injury from foreign bodies getting into the air passages or gullet, viz those due to hot liquids or caustics. In either case the lips, mouth, and tongue may show signs of scalding, or of the caustic effects of acids or alkalies or of carbolic acid. But in other instances the rapid onset of laryngeal obstruction in a child who has shown no previous symptoms is the first and only evidence of the *scald of the larynx*.

CHAPTER X.

THE DIAGNOSIS OF INJURIES OF THE CHEST.

INJURIES of the chest are of very frequent occurrence, and from the great importance of the contained viscera they are of special practical interest. They may be classified into *contusions* and *wounds*, which will be separately considered; and as the sequelæ of these two groups of injuries are to some extent the same, only the immediate and direct effects of contusions and wounds will be considered at first, and in a concluding section of the chapter, the diagnosis of

all the sequelæ or secondary complications of chest injuries will be given. Many of these latter are inflammatory affections, which, when idiopathic, come under the care of physicians, and much fuller information concerning them will be found in works on medicine.

A. Contusions.—A patient having received a contusion of the chest, the diagnosis may be best arrived at by the surgeon's attempting to answer the following five questions:

(1) **Is there a bruise?**—The presence or absence of the well-known ecchymotic discoloration will decide this point. If a purple or yellowish stain appear in the skin after an interval of a few days, it indicates a deep bruise; ecchymosis and blood-staining of the skin or loin appearing after two or more days have been said to be pathognomonic of hæmothorax, but reliance must not be placed on this sign, as blood in the pleural cavity does not always cause ecchymosis in the loins. The extent of the bruise is, of course, an indication of the number and size of the vessels which have been torn, or of hæmophilia.

(2) **Is there rupture of a muscle?**—From a blow or sudden severe strain there may be more or less extensive rupture of a chest muscle, especially of the pectoralis major. If there be inability to raise the arm in front of the body, while on the patient's making the attempt to do this a gap is seen or felt in the pectoral muscle, this lesion is to be at once diagnosed. Similarly, a gap in any other muscle, with pain, and inability to contract the muscle effectively, may enable the diagnosis of ruptures of other muscles to be made.

If contraction of a muscle cause acute pain, and no fracture be present, and pressure on the painful part elicit tenderness, *bruise of the muscle*, with slight rupture, is the probable lesion. The pain of

this injury may continue for some time, and when it implicates the intercostal muscles, the symptoms simulate those of broken rib, as there is pain with all the respiratory movements, and some local tenderness; but the diagnosis is established by recognising the absence of irregularity in the rib, of crepitus or of mobility, by failure to elicit pain by pressure on the rib at a distance from the tender spot, and by the absence of local emphysema.

(3) **Is there a swelling over the ribs?**—The eye, and especially the hand placed flat upon the chest, will decide this question at once. Such a swelling may be due to

(a) *Hæmatoma*; blood outside the chest.

(b) *Emphysema*; extravasation of air in the cellular tissue.

(c) *Pneumatocele*; hernia of the lung.

(a) Notice whether the swelling be well defined, whether it fluctuate or not, if it pit on pressure, or give a soft, crackling sensation to the fingers, whether it be resonant or dull on very light percussion, and whether it vary in size with inspiration, expiration, and coughing. If it fluctuate, or if without fluctuation it be ill-defined, dull on very superficial percussion, unvarying in size with respiration, and non-crepitant, it is a *hæmatoma*. These collections of blood vary much in size; if large and quickly formed, they are due to the rupture of a large vessel, such, for instance, as an intercostal artery near the spine, or a large thoracic branch of the axillary trunk. *Hæmatoma* will be distinguished from abscess by its early appearance after the injury, and the absence of the usual signs of acute inflammation.

(b) If the swelling be ill defined, gradually extending, soft, even pitting on pressure, crepitant, resonant on very superficial percussion, and either unaffected by deep respiration, or if increased by a

deep expiration or a cough not lessened by a deep inspiration, it is *subcutaneous emphysema*, air having escaped from the lung into the cellular tissue of the chest-wall. This may arise in one of three ways: (α) the lung may be ruptured by severe pressure upon the chest while the glottis is closed, the air passing under the pleura to the root of the lung, and thence spreading up to the neck and over the chest; in this case the swelling is first noticed about the neck and at the back, and not at a point which is the seat of considerable pain; (β) or a fragment of a broken rib may lacerate the subjacent lung, and the air escape into the pleural cavity (*pneumothorax*), and thence at each expiration into the superficial cellular tissue; (γ) or should the fracture occur at the seat of an old pleuritic adhesion, the air passes into the subcutaneous tissue without previously filling the pleural cavity. In either of these latter cases the emphysematous swelling appears first over the broken rib, at the seat of an acute stabbing pain, and not at the neck or back. In the one case there will be great dyspnoea, displacement of the heart, absence of breath-sounds, or amphoric respiration, with metallic tinkling, indicating the presence of *pneumothorax*; while in the other case, the vesicular murmur will be plainly audible and quite superficial all over the chest. In either case the presence of this local form of emphysema indicates a fracture of a rib, with wound of the lung. The surgeon must not be misled to the diagnosis of *pneumothorax* by the existence of a tympanitic percussion note, as the presence of air in the superficial tissues may give that sign.

(c) If the swelling be clearly defined in outline, soft, non-crepitant, resonant on percussion, swelling out on expiration or coughing (which latter gives a distinct "impulse" to it), and sinking during a deep inspiration, it is a *pneumatocele* or *hernia of lung*,

and indicates an extensive and serious lesion of the wall of the chest permitting of the protrusion of the lung. This is a very rare complication of contusions, but is a more frequent attendant upon wounds of the chest.

(4) **Is there an injury (fracture or dislocation) of the bony and cartilaginous wall of the chest?**—(a) After viewing the chest carefully, to discover whether there is any obvious deformity, and whether the respiratory movements are general, uniform, and free, pass the hand down the sternum, and then along the ribs from before back, in order from above down, and notice whether there be any irregularity, depression or projection, in them; at the same time any local tenderness will be detected. If there be an abrupt sharp projection across the sternum, the projecting edge being continuous with one part of the bone, usually the upper, it will be from a *fracture of the sternum*, in which the lower fragment is generally displaced backwards beneath the upper. Should the projection be opposite the second costal cartilage, it will be from a *separation of the manubrium from the gladiolus*. Care must be taken not to mistake the normal slight ridge across the bone at this level, which is smoother and more even than in fracture or dislocation; nor the smooth depressions sometimes met with in the lower part of the bone, which have no sharp angles or ridges about them. If there be no local bruising occasioning pain, tenderness, and considerable swelling, such a mistake should hardly be possible.

Similarly an irregularity in the line of a *rib cartilage* may indicate its *fracture*, or a projection where the rib joins the cartilage may show a *separation of the rib from its cartilage*; care must be taken not to mistake for this the nodular enlargement of this part, so common in rickets; the diagnosis will be easily made by

noticing that the rickety swelling is symmetrical, affects many of the ribs, and is smooth and rounded, while the projection from dislocation affects only one or two ribs, is more marked and irregular, and mobility may be detected between the two parts.

A marked depression, or angular projection, in the course of a rib or ribs may clearly establish the presence of *fracture of ribs*.

(b) Should the result of the above be negative, place the hand firmly over the part where the patient experiences pain, and induce him to breathe deeply, and then to cough; should crepitus be felt, it will determine the existence of a *fracture*. Some prefer to place a stethoscope over the most painful part, and to listen for crepitus during movements of the chest.

(c) Should this yield only negative evidence, with one hand over the suspected region, make firm pressure with the other hand along the ribs and over the sternum; in this way crepitus may be elicited; or if it be found that firm pressure on a rib causes a sharp pain at a distance from the point pressed upon, that may be taken as evidence of a *fracture*.

(d) It has already been pointed out that the presence of local emphysema or of a pneumatocele proves a *fracture of ribs*.

(e) In some cases the patient is able to give a clear history of hearing and feeling a bone snap at the time of the accident, and of feeling a grating sensation on taking a full breath; the sharp stabbing pain will always enable him to localise exactly the position of a *fracture*.

(f) The surgeon may be unable to detect any irregularity of a rib, or to elicit crepitus; in such a case, localised sharp pricking or stabbing pain caused by any attempt to take a deep breath or to cough, and by pressure upon the rib at a distance, with spontaneous fixation of that part of the chest, will be the

signs upon which the diagnosis of *fracture* will have to rest.

(5) **Is there a lesion of the thoracic viscera?**—Cases of extensive laceration of the lung with laceration of large vessels, of double pneumothorax, or of rupture of the heart or great vessels, are usually speedily fatal, death occurring before any exact diagnosis can be made.

The observer should look for signs of shock, or of loss of blood (pallor, coldness of the surface, syncope), and should notice the amount of dyspnoea present, as each and all of these signs are important as indicating that the injury is not a simple contusion of the chest-walls, but is complicated with some more serious condition. There are two phenomena which at once enable a diagnosis of *injury of the lung* to be made, and they may, therefore be at once alluded to. One is *subcutaneous emphysema*, showing that a rupture or wound of the lung has been produced, allowing air to escape from the alveoli. The other is *hæmoptysis*; if bright-red, frothy blood be coughed up, it proves beyond all doubt a lesion of some of the pulmonary vessels, the blood escaping into the bronchi; the amount of the hæmorrhage will be some guide as to the extent of the lesion in the lung or the size of the injured vessel.

It may be pointed out here that in some cases a patient will cough up sooty or black sputa a few days after an injury to the chest; this arises from a small *bruise of the lung*, with hæmorrhage into the alveoli, the altered blood only passing slowly into the bronchi, and being expectorated after an interval.

The chest must then be examined thoroughly; the relative size and amount of expansion of the two sides being first noted, then the percussion note, the respiratory murmur, voice sounds, position of the heart's impulse, and character of the heart sounds. This examination is to be conducted to enable the surgeon to

determine whether there is air or fluid in the pleural cavity, laceration of the lung, or deranged action of the heart.

If there be normal resonance all over the pulmonary area, with superficial vesicular respiratory murmur everywhere without r le, and normal voice sounds, with a regular action of the heart, and normal heart-sounds, the surgeon will be justified in deciding against any lesion of the lung or heart in the absence of any positive sign to the contrary, such as emphysema. If shortly after an accident the lower part of the pulmonary area be found to be dull on percussion, the dullness perhaps increasing in extent from hour to hour for a few hours, and over this area the vocal fremitus be weakened or abolished, while auscultation shows the respiratory murmur and vocal resonance to be weak and distant, or absent altogether; and immediately above the dull area the physical signs are normal or indicate compression of the lung, a diagnosis of *hæmothorax* is to be made. If there be much pleural hæmorrhage there will be a corresponding degree of dyspnoea, and the usual signs of loss of blood. After two or three days a dark purple discoloration of the skin over the lower part of the chest behind and in the loins may be noted. The blood will almost certainly come from the lung, and its presence may be accepted as a proof of *laceration of the lung*; where there is also hæmoptysis, this fact is beyond all doubt.

If one side of the chest is found to be expanded with obliteration of the depressions along the intercostal spaces, giving a tympanitic percussion note, the breath-sound being weak, and distant, or inaudible, or amphoric in character with perhaps coarse, crepitant r les, "metallic tinkling" and the "bell-sound" being audible, while the heart is found displaced to the opposite side, and the patient experiences severe dyspnoea or even orthopnoea, it indicates *pneumothorax*

from *rupture of the lung* through the pleura, the air having escaped into the general pleural cavity; this may or may not be combined with fracture of a rib, or with superficial emphysema. Occurring on the left side it may obliterate the normal cardiac dulness, and so displace that viscus as to render detection of the cardiac impulse impossible, and that of the heart sounds very difficult. These signs may be present over a limited area of one side of the chest, the physical signs over the rest of the lung being normal; in that case there is a pneumothorax limited by old pleuritic adhesions.

If a combination of these physical signs be met with, a dull note and loss of voice and breath sound, and of vocal fremitus over the extreme base of the chest, and tympanitic resonance, amphoric respiration, "metallic tinkle," and succussion fremitus over the upper part of the chest, it shows that there is *hæmo-pneumothorax*. In all cases of pneumothorax there will be some amount of blood in the pleural cavity, but it may be so small in quantity as not to give rise to any characteristic physical signs.

In reference to the evidence of pulmonary lesions it may be well to draw the student's attention to the great importance of observing whether a patient the subject of fractured ribs be also the subject of emphysema of the lungs and chronic bronchitis, the barrel-shaped chest, loss of power of expansion of the chest in inspiration, prolonged wheezing expiration, hyper-resonance, diminution of the area of cardiac dulness, prolonged expiratory murmur, and loud sonorous or sibilant râles will be the signs pointing to these conditions, which render serious an accident under other circumstances of small moment.

Lesions of the heart from contusions of the chest are much less common than those of the lung. If, however, immediately after such an injury a murmur

be detected in connection with either of the heart sounds, and there be evidence that this is a sequel of the accident, either by the surgeon's previous knowledge of the patient or the onset from the time of the accident of marked signs of disturbance of the circulation, which find no other explanation, and are explicable upon the theory of interference with the functions of one or other of the cardiac valves, it would be proper to diagnose a *rupture of a semilunar valve, or of chordæ tendineæ*. The signs of circulatory disturbance to be sought in such cases are faintness, a quick, feeble, soft pulse, or the suddenly collapsing pulse of aortic regurgitation, irregular and turbulent action of the heart, palpitation, dyspnoea, venous distension, and the signs of general pulmonary hyperæmia. For fuller information on these subjects reference must be made to works on medicine.

Ruptures of the large vessels of the thorax are very rarely caused by contusions of the chest, and are very rapidly fatal from internal hæmorrhage.

Injuries of the abdominal viscera are treated in chapter xi.

B. Wounds.—Wounds of the chest are of much less frequent occurrence than contusions, and they are usually produced either by stabs or bullets, and therefore they often have a medico-legal as well as a surgical importance. In any given case the surgeon should put to himself and seek an answer to four questions, and we may discuss the diagnosis in the form of answers to these questions.

(1) **Is the wound penetrating or non-penetrating.**—That is, is it limited to the chest walls? or does it extend into one of the three great serous cavities of the chest or into the mediastinum? The surgeon should attempt to show that it is penetrating, and only in the absence of all evidence to the contrary consider it non-penetrating; but in no

case must the wound be explored for this purpose, either by finger or probe, for in so doing penetration may be caused; reliance must be placed upon evidence of lesion of the thoracic contents. In some cases the wound is evidently quite superficial, and the question of penetration can hardly be said to arise.

If there be no emphysema around the wound, no passage of air through it during respiration (traumatopnœa), no pneumothorax, hæmothorax, or prolapse of lung, no hæmoptysis, no disordered action of the heart, and no dysphagia, there is no evidence to warrant the diagnosis of penetration; but even in these circumstances, when the nature of the injury makes penetration probable, it is only when no secondary inflammatory complications (pleurisy, pneumonia, pericarditis, or mediastinal suppuration) arise that an absolute diagnosis of *non-penetration* can be made.

(2) Is the wound attended with hæmorrhage? If so, what is the source of the bleeding?—Blood may escape externally through the wound, or be coughed up mixed more or less thoroughly with air, and in either case its recognition is perfectly simple. But the bleeding may be internal and unrecognised unless a careful examination is made. The constitutional signs of loss of blood (pallor, vertigo, syncope) must be carefully noted, and search should be made for evidence of hæmothorax, hæmopericardium, and hæmomediastinum. The signs of *hæmothorax* have been given already. (See page 131.) If, quickly after a wound, the normal cardiac dulness be increased, the impulse of the heart displaced upwards or lost, the sounds indistinct or inaudible, especially over the lower part of the dull area, with feeble or turbulent action of the heart as shown by the pulse, *hæmopericardium* may be diagnosed. If, with a sense of oppression across the chest and dyspnœa, there be found dulness behind the sternum and reaching outwards on each side, with loss of cardiac

impulse, and extreme weakness of the heart sounds, which may be entirely inaudible, *hæmomediastinum* may be diagnosed. These last two conditions may coexist, or the distinction between them may be very difficult; the position and known direction of the wound may afford some aid in diagnosis; blood in the pericardium leads to much more serious disturbance of the heart's action than when it is extravasated in the mediastinum. It must be remembered that external and internal hæmorrhage may and often do coexist, and although in all cases a careful examination to detect the latter should be made, the necessity for it becomes more urgent when the general signs of loss of blood are greater than can be accounted for by the external flow. Such examination must, however, be conducted with the greatest care, as undue movement or excitement of the patient may lead to a recurrence of hæmorrhage which has been arrested by nature.

The fact of hæmorrhage being established, some attempt must be made to determine its source. The position of the wound, and of the accumulated or flowing blood, are important aids in arriving at a conclusion. The intercostal vessels run along the lower border of the ribs; the internal mammary vessels run vertically down behind the costal cartilages, half an inch from the edge of the sternum; wounds therefore in these situations may involve those vessels, and if the bleeding be solely external, or escapes per saltum, or be moderate in amount, and the blood escape unmixed with air, and if on introducing a folded card into the wound the blood flow over the outside of the card and not within the fold, or if the bleeding can be stopped by pressure with the finger against the upper of the ribs bounding the wound, the hæmorrhage may be considered as coming from a *parietal vessel*. But when the hæmorrhage is excessive, and gives rise to hæmothorax, or when it is thin, of a bright red colour,