

CHAPTER XII

INJURIES OF THE THORAX

DISCUSSION of injuries of the thorax had better be considered from the point of view of actual practice. If called to a patient suffering from an open wound of the thorax, the treatment differs radically from that used in a subcutaneous injury. In the former case we must be prepared for immediate interference, in the latter we may safely wait, for these injuries usually run a much more favourable course, unless immediately fatal.

Especially important is the fact that the lung, heart, great vessels of the thorax, and the arteries of the thoracic wall (internal mammary or an intercostal) may be torn even in *subcutaneous* injuries. Not only these organs, but also the diaphragm, liver, and spleen may suffer considerable damage without any external wound. It is readily understood that such injuries are usually caused by the dislocated fragments of fractured ribs. If the chest is crushed between the buffers of two cars, or the patient run over by a heavily loaded truck, or caught underneath a barrel during unloading, or if in a street fight one of the combatants falls and is kicked and stepped upon, it is evident that these enormous and sudden forces drive the costal fragments deep into the thoracic and abdominal cavities. Thus are caused bruises, tears, rupture, and perforation of

the most important organs. Although rupture of the lung and of the heart not due to an impacting fragment have been observed, such cases are exceptional. Rupture of the organs must then be ascribed to the compression of the thorax. Our observations will be confined to cases due to fracture of the ribs and sternum.

The first question naturally follows: How is a FRACTURE OF THE RIBS recognised? Most easily recognised is a comminuted fracture, in which one or more fragments are broken off from the rib; for in this variety the most important sign of fracture—false point of motion—is visible on inspection. During expiration and inspiration the two sharp, serrated ends of the ribs, respectively anterior and posterior to the site of fracture, raise the skin and threaten to burst through. The intermediate fragment lies in a hollow, and makes much smaller excursions. In such cases, by carefully listening, short, grating, crepitant sounds are audible. The hand can press the fragment, which has been broken out, inward, and also move it upward and downward. If several ribs have been fractured in this fashion, the condition can be recognised from a distance. The thoracic wall at the site of injury is flattened, and the fragments can be felt at this spot.

Simple fractures of the ribs, in which there is a prominence or a depression at the site of fracture, are as readily recognised as the comminuted variety. In cases of simple fracture, a spinelike projection along the line of fracture juts out from the convexity of the thorax, or, if the dislocation is inward, a perceptible hollow results.

No greater difficulty is encountered in the recognition of the condition if the ends of the fragments lie

one in front of the other—that is, a *dislocatio ad longitudinem*. The one end of the rib naturally lies deeper than the other, and the examining finger is arrested by the steplike irregularity, and also by the serrated edge, of the more superficial fragment.

These self-evident cases and their varieties require no further discussion. Let us turn to the most obscure case. The question here is, How is a fracture of the rib to be recognised if no abnormal mobility, crepitus, or displacement can be demonstrated? The following are the points in diagnosis: 1. The patient does not breathe normally; his respiration is superficial. Instead of the distinct inspiratory and expiratory sounds usually heard on auscultation, a more prolonged murmur, which may be compared to the continuous humming obtained by placing a large snail or sea-shell against the ear, is heard. 2. There is a spot painful on pressure. 3. A sudden sharp stitch is felt at the injured spot during deep inspiration. 4. Pressure over the anterior or posterior end of the fractured rib causes pain to be felt at the site of fracture. This symptom, of obtaining pain by *distant* pressure, is omitted from most textbooks. 5. Pleuritic friction sounds heard within a few days near the site of the supposed fracture confirm the diagnosis. In order to determine the *number* of ribs broken, the following will be of service: 1. The scapula covers the second to the seventh ribs; the breast of a virgin overlies the third to the sixth. 2. The tip of the elbow touches the middle of the ninth rib if the upper arm is approximated to the side. 3. The nipple is situated over the fourth rib. With the aid of these fixed points the number of ribs can be determined.

A case in which a physician diagnosed the fracture of a rib was brought into court. He based his diagnosis upon the fact that the patient had felt pain when the anterior and posterior ends of the rib were pressed upon *simultaneously*. I impugned the correctness of his conclusions, because pain would be caused by pressure at the site of injury even in a contusion. The physician should have pressed upon the posterior end alone in order to see if pain was caused anteriorly.

FRACTURES OF THE STERNUM require but little mention. Longitudinal fractures are extremely rare. Transverse fractures and diastases between the manubrium and gladiolus, and between the gladiolus and ensiform can not be recognised if displacement, abnormal mobility, and crepitus are wanting, or if a swelling of some size obscures the line of fracture. The swelling may be due to emphysema, blood, or, at a later stage, to abscess. Fracture has probably occurred if the patient heard a cracking sound at the time of injury, if he feels no discomfort with the head flexed and the body inclined forward in a semi-erect position, but suffers violent pain at a fixed point on raising the head, coughing, or pressure upon one end of the sternum. If malformations—i. e., changes of contour of the sternum—are found, unaccompanied by signs of mobility, they do not in themselves speak in favour of fracture, because other causes may have been at work—e. g., congenital longitudinal fissures. In the cases in which displacement, crepitus, mobility, or at least increased resiliency of one piece is present, the general rules apply, and further discussion becomes superfluous. The objective signs are unmistakable. One thing alone must be remembered: that is, to pay attention to the position of the ribs. If, for instance, one or both of the second ribs are dislocated from their sternal attachment, and

signs of a transverse fracture exist, a diastasis has taken place between the manubrium and gladiolus. In cases of diastasis between the body of the sternum and the xyphoid appendix (which, by the way, frequently is the seat of distortions or anomalies), it has been noticed that the patients vomited when the appendix was pressed inward toward the abdominal cavity.

Subcutaneous injuries to the *heart* and *great vessels* are, as a rule, instantly or rapidly fatal. "A woman was caught between a wall and a heavily loaded truck, and died almost instantaneously. Several ribs were found broken and driven into the lung; the pericardium was distended with blood; the superior vena cava almost completely torn across, and separated from the auricle." This is one of many examples found in the literature. In isolated cases death does not take place until several hours have elapsed.

Theoretically, the following could stand as typical of a ruptured *intercostal artery*: A progressively increasing area of dullness following the injury; a buzzing sound at the site of rupture, and the symptoms of increasing internal hemorrhage. This picture ought to suffice for the diagnosis, but it is purely imaginary. The diagnosis of the rupture of an intercostal artery can be made at a later date if an aneurism, which can be pushed back into the chest, develops. Such a case has occurred.

The recorded cases in which the *diaphragm* was ruptured do not permit us to formulate any rules for their diagnosis. One case, in which the *liver* was injured by a fractured rib, could be diagnosed with certainty, because the fracture was compound and the liver exposed. In another instance the liver was injured in a subcutaneous fracture of the rib. Although the liver suppurated, icterus and chills failed to appear.

Subcutaneous INJURIES OF THE LUNG AND PLEURA are among the commonest accidents which result from the severer forms of violence to the thorax. They admit of fixed rules in diagnosis. If blood is coughed up during the course of several days, in consequence of such

an accident, and if no further symptoms arise, although a rib has been broken, we may assume that the lung parenchyma has been torn or bruised. This may take place without rupture of the visceral pleura; but we can not be positive that the pleura has escaped, because a pneumothorax of slight degree may disappear very rapidly. If *pneumothorax* or hæmo-pneumothorax can be demonstrated, it is evident that the pulmonary pleura has been injured. Has the costal pleura been torn? If a fracture of the ribs has taken place, the costal pleura has been torn. One case, however, is on record, in which the third and fourth ribs on the left side and the third rib on the right were fractured on their outer surfaces only; the costal pleura was intact, and yet pneumothorax of the right side developed, owing to rupture of the lung. In practice we may assume that the costal pleura has been injured by the ribs in cases of pneumothorax. Assurance is made doubly sure if subcutaneous *emphysema* appears. The behaviour of the emphysema varies. If it appears and spreads rapidly, the pulmonary and costal pleura are both usually injured, but commonly no air will be found in the pleural sac. For in those cases in which the pleural cavity is shut off by adhesions at the site of rupture, the emphysema is wont to develop more rapidly; often, in the course of half an hour, extending over the entire body. But no hard-and-fast rule can be laid down. Rapid spread of the emphysema may take place with pneumothorax, which, however, can not be discovered if the emphysematous swelling covers the chest. Sometimes the emphysema appears as a circumscribed swelling which is inflated at every inspiration, and alternately rises and falls, while the emphysema at the

same time continues to spread along the neck, head, arms, scrotum, etc. Injury to the lung and pleura, therefore, causes a great variety of symptoms—hæmoptysis, hæmothorax, pneumothorax, and emphysema variously combined.

A few minor points may be added. It is well known that fracture of a single costal cartilage is a rarity. Rarer even than this is the dislocation of a rib at the sternocostal junction, and also the dislocation of the two lower true and three upper false ribs from their respective costal attachments. There may be uncertainty whether the break is situated at the junction of cartilage and rib—so-called diastasis—or at the end of the bone close to the cartilage, or in the cartilage close to the bone. This point may safely be left in doubt, and attempts to clear the question for the sake of diagnosis, by means of akidopeirastik (investigation with a needle), are unjustifiable. (The callus situated near the end of the cartilage, resulting from a fracture, ought not to be confused with a rachitic enlargement of the ribs—the so-called rosary—even if no history can be elicited; for the rosary is bilateral, and is accompanied by flattening of the thorax, in addition to signs of rickets elsewhere in the body.)

Fracture of the ribs has been caused by muscular action. Severe sneezing, due to taking snuff, occasioned it in one instance. Fracture of the sternum due to muscular action occurs, as, for instance, during the pains of labour. This fact is generally known, as it is mentioned in all anatomical lectures. If the force was noticeably weak, it is well to remember that fragilitas ossium may be present. In old people, it is advisable to give a guarded prognosis if the case is not seen be-

fore the callus has begun to form, because a carcinoma of the ribs might cause the fracture, and then continue to increase.

Large extravasations may be found on the wall of the thorax as the result of some injury to the shoulder. Pitha reports a very interesting case of this nature. An extravasation the "size of a loaf of bread" was situated on the thoracic wall after an injury to the shoulder. Autopsy showed, omitting other details, that the subscapular artery had been torn away from the axillary trunk.

We now turn to the discussion of OPEN WOUNDS OF THE THORAX.

The wound is unmistakably penetrating:

1. If part of the lung protrudes (prolapsus pulmonis). In recent cases such lung tissue is readily recognised because it contains air, and therefore crepitates; later, the lung is incarcerated and becomes gangrenous. If in the projecting tissue a sharp margin or incisure can still be recognised, it will aid in making the diagnosis.
2. If air streams in and out of the wound.
3. If pneumothorax or hæmo-pneumothorax exist.
4. If a penetrating body, which by its position and length shows that the wall of the thorax must have been perforated, is removed from the wound.

The case may be doubtful if emphysema, *and that alone*, is seen; for, as has been shown, emphysema may occur in non-penetrating wounds as a result of the movements of the chest wall aspirating air into the

wound. In such cases the wound should be promptly closed, and probing avoided.

As a rule, emphysema indicates a penetrating wound, as aspiration of air into the wound is a rare complication; if present, the resulting emphysema is very limited in extent.

The case may also be doubtful if no pneumothorax exists, only coughing of blood. The pneumothorax may have disappeared. A penetrating wound, in such cases, is only probable; and the probabilities must be carefully weighed and all circumstances considered before an opinion can be formed.

If the lung is adherent at the point of injury, hæmoptysis may occur, and yet pneumothorax be absent. As a rule, however, emphysema will then be found.

If a wound proves to be penetrating and there is considerable hemorrhage, we may suspect that an intercostal artery or the internal mammary, if the wound is at the sternum, has been damaged. Suspicion is strengthened if the hæmothorax increases and symptoms of internal hemorrhage develop; but the diagnosis must remain in doubt unless we see the spurting vessel in the wound or feel the warm stream of blood when the finger is introduced at the proper site.

George Fisher has collected and critically compiled all the cases of *wounds of the heart and pericardium* which appear in the literature. His work shows that there is not a single pathognomonic symptom which permits the diagnosis of a wound of the heart with any certainty. Dupuytren describes a case where a patient came to the hospital with five inches of steel sticking in his heart. He evinced neither pain nor dyspnœa; his pulse was quiet, his walk firm, and his facial ex-

pression unchanged. The patient died after twenty-two hours. The right auricle and the lung were wounded.

The pericardium or the heart are injured beyond a doubt if the wounds of these organs can be felt or seen. Bamberger, in a wound of the pericardium, was able to palpate with his finger the shape and change of position of the heart due to its contractions. Ollenroth was able to do the same, and in addition saw a flat wound about six lines in length, at the apex. The diagnosis of complete avulsion of the heart—it has happened that the detached heart has popped out of the wound—is an anatomical and no longer a surgical task. Formerly, surgeons claimed that probing of the wound, to determine whether the pericardium or heart had been injured, was contraindicated. The location of the wound, the primary symptoms—such as extreme terror, unconsciousness, and the forebodings of impending death—and the later ones—such as fainting, subnormal temperature, trembling, cold sweat, combined with the information obtained by auscultation, percussion, and observation of the pulse—sufficed in many instances to make a probable diagnosis. In more modern times wounds of the heart and pericardium have been actively treated. The wounded pericardium or heart has been successfully sutured. In order to employ such therapeutic measures, diagnosis of the conditions must necessarily follow certain rules. It is no longer contraindicated to enlarge the wound sufficiently to introduce the finger, or, in a given case, to expose the heart by resection of the ribs, in order to ascertain the true state of affairs.

Wounding of the *pericardium* can be positively diagnosed without the use of probe or finger, if pneumo-

pericardium is found and a wound of the pleura can be excluded. The air enters with the instrument which causes the injury. By very exact deductions, wounds of the heart can be distinguished from wounds of the great vessels.

Rupprecht reports the case of a painter, who stabbed himself up to the hilt with a dagger, in the region of the heart. The dagger was withdrawn and dark blood flowed from the wound. As the blood was not frothy and no air came out of the wound, injury to the lung was excluded. None of the venous trunks situated in this neighbourhood could have been injured without the lung suffering at the same time. Therefore the diagnosis of injury to the right ventricle was made.

Injury to the *esophagus*—as the result of bayonet or knife thrusts—are positively recognised as such when the ingested food flows from the chest wound. If this sign is wanting, such an injury may be suspected with considerable certainty if an area of dulness, which at first might be due to blood or exudate, regularly and markedly increases after the patient eats or drinks. The same holds true if the patient feels a peculiar sensation on swallowing, accompanied at first by *vomiting* of blood, and later of pus.

Wounds of the *diaphragm* can be suspected from the pain, caused by the stronger contractions of that muscle, due to coughing or vomiting, and from the severe hiccough which follows; but it is evident that the appearance of these phenomena in a penetrating wound of the thorax can admit of other interpretation. A large tear in the diaphragm can alone account for the presence of abdominal viscera in the thorax—in other words, a diaphragmatic hernia. But reflection will show that the proof is very difficult. If any of the hollow viscera enter the thorax, the resulting tympa-

nitic note and displacement of the heart admits of more than one explanation, as pneumothorax already exists. If the stomach is forced into the thorax and displaces the liver, the consequent displacement of liver dulness toward the region of the stomach would favour the diagnosis. Symptoms of incarceration, which will be spoken of under hernia, would lead to careful analysis and weighing of the facts.

The diaphragm may be penetrated in thoracic injuries, the wound extending directly into the abdominal cavity. In such cases omentum may prolapse through the diaphragmatic wound into the thorax, and appear externally through the thoracic wound. The presence of a combined thoracic and abdominal wound is then apparent at a glance.

The primary symptoms which follow *gunshot wounds* of the thorax may be exceedingly mild, even if the projectile has passed through the lung. The course of the bullet can not be accurately determined, and therefore prevents an early diagnosis. As pneumothorax and emphysema fail to appear, hæmoptysis is the guiding symptom. In many instances insignificant primary symptoms are followed by widespread and frightful gangrene if septic material has been introduced by the projectile. The situation of the bullet can not always be determined. As an instance of a lucky diagnosis, I will mention a case of Strohmeier's. Here, in addition to a pleuritic effusion, pain was felt in the neighbourhood of the spinal column, and spasm of the diaphragm followed. He declared that the bullet was at the floor of the thorax, and autopsy confirmed his view.