

the experience of the similar operation for ectopia vesicæ and the two are not quite comparable, it is difficult to make a prognosis. In this case the woman returned to her village and was told to report again in three months. This she is most unlikely to do if she is feeling well. Shortly afterwards I was transferred to another station, so I shall never hear of her again.

In conclusion I would say that in my opinion the excellent immediate result justified the operation, and I see no reason to be pessimistic about the remote results.

I wish to express my thanks to Lieutenant-Colonel R. F. D. MacGregor, M.C., I.M.S., late Residency Surgeon, Hyderabad, for his permission to send these notes for publication and for his kindness in giving me facilities to operate on this and other cases at the King Edward Memorial Hospital, Secunderabad.

Echoes of the Past.

TWENTY YEARS AFTER.

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(Continued from p. 380, No. 6, vol. lxxiii.)

II.—GUNSHOT WOUNDS OF THE CHEST.

CASE 10.—Hæmothorax from Wound of Subclavian Vein.

Clinical History.—Nature of wound: Gunshot wound, chest.

Signs and symptoms: Struck on chest. Wound leading to comminuted fracture of the right clavicle; no exit wound. Temperature 97° F. on admission, later in the day 101° F., pulse 110. Next day signs of left hæmothorax. Temperature 103° F., pulse 110, respirations 56 to 66; is very distressed. Next day spitting up blood-stained sputum; not offensive. Temperature 101° F., pulse 110, respirations 40. Thought to have a small hæmothorax and apical pneumonia. Next day temperature 100° F., pulse 106, respirations 42. Apex beat one and a half inches outside nipple line. Next day very dyspnoic; temperature sub-normal. Died.

Operation: Wound excised under local anæsthetic.

Survival: About ninety-six hours.

Post-mortem Result.—Chest: Comminuted fracture of the right clavicle with a wound of the right subclavian vein. The right pleura absolutely full of blood, thin, not clotted. Upper lobe of the right lung was solid, very dark red in colour (? red hepatization or concussion hæmorrhage); the rest of the lung collapsed. Left lung a little congested.

Pathological report: Section of portion of the upper lobe of the right lung shows extensive hæmorrhage in the lung tissue, the cause of which is

not apparent. No evidence of pneumonia. (No. 5 Canadian Mobile Laboratory.)

CASE 12.—Hæmothorax and Laceration of Spleen. Wound of Heart.

Clinical History.—Nature of wound: Gunshot wound, chest and abdomen.

Signs and symptoms: Admitted 3 a.m.; died immediately on admission.

Post-mortem Result.—Chest: Wound in the left chest is in the anterior axillary line, through the 6th rib into the pericardium and apex of the left ventricle; in the pericardium there was about two and a half ounces of blood. The left pleura was full of blood and the lung was collapsed; the margins of the lower lobe were filled with blood for about two inches; could see no actual wound; attribute it to concussion hæmorrhage. (We see it in every case of chest injury.) The diaphragm is depressed. The right side of the chest was normal.

Abdomen: There is a wound in the left flank. The spleen is much lacerated; much blood-clot tracking down the wall of the descending colon, which was not perforated. There was a handful of blood-clot around the spleen, and about a teacup full of blood free in the peritoneal cavity. Presumably during the collapse the hæmorrhage stopped somewhat. Did not trace the wound in the flank, but it was the exit wound of the chest missile; there was a track of blood-clot down from the wound in the diaphragm to the left of the liver and stomach into the left flank.

CASE 13.—Wound of the Lung and Liver. Shock.

Clinical History.—Nature of wound: Shell wound of chest and abdomen. Other multiple wounds.

Signs and symptoms: Extremities cold, pulse feeble, respirations rapid.

Operation: Operated on shortly after admission owing to multiple wounds which were excised (including one of the pericranium). The wound of the chest wall was excised and drainage tube inserted. Very shocked that night; never recovered properly.

Survival: About twenty-four hours.

Post-mortem Result.—Chest: A penetrating wound of the right pleural cavity in the posterior axillary line, through the 8th interspace and upper edge of the 9th rib, grazing the base of the lung and going through the diaphragm into the convex surface of the right lobe of the liver, penetrating a little distance. (Foreign body not found.) The liver substance had bulged into the wound of the diaphragm, shutting off the peritoneal cavity; around the point of entrance there were many small lacerations and hæmorrhages. A little blood in the right pleural cavity; right lung slightly collapsed; around the site of the pleural abrasion on the base was a wedge-shaped area of hæmorrhage into the base of the lung. Both lungs œdematous; the left slightly emphysematous. Some serous fluid in the left pleural cavity. A little dark blood free in the peritoneal cavity. Liver somewhat blanched. Spleen small and normal looking.

CASE 16.—Hæmothorax with Gas Infection. Wound of Liver.

Clinical History.—Nature of wound : Gunshot wound, chest.

Signs and symptoms : Wound lateral to the right nipple line ; oozing freely. Temperature on admission 98° F., respiration 36. Next day felt easier. Temperature 102° F., pulse 120, respiration 36. Abdomen appears to be normal, though he complains of pain over the epigastric region. Several days later he appeared to be improving. Examination of the chest showed impairment of resonance in the lower part of the right side ; breath sounds slightly diminished in this area. Heart : Apex beat about normal in position. Temperature 100° F., pulse 140, respiration 42. About eight ounces of dark foul-smelling blood taken from the right chest. Died next morning with a temperature of 98° F. and pulse 120.

Survival : Four days.

Post-mortem Result.—Chest : The wound through the chest wall was in the fourth right interspace in the anterior axillary line, chipping off the upper border of the 5th rib. The pleural cavity contained some foul gas, and was half full of dark liquid blood with an offensive odour. The lung was covered with a thick membrane which could be pulled off. (? fibrin from the blood or exudate.) This was also present on the diaphragmatic pleura. On the diaphragm was found a small piece of bone, and near this, a hole about the size of sixpence in the diaphragm ; this led into a wound of the upper surface of the right lobe of the liver ; this was continued as a track two inches long under the surface, coming out again. There was no sign of a foreign body, and no sign of hæmorrhage in the peritoneal cavity. (Presumably as usual the diaphragm contracted on the wound in the liver.) The lung was much collapsed and airless.

Comment : The temperature was again unreliable as a guide to the condition ; the pulse and respirations were more valuable. Thirty-six hours before death it struck me he was not doing too well ; his breathing was very rapid. The gas in the pleural cavity made the resonance more marked than it would otherwise have been, and was misleading as to the amount of hæmothorax.

Pathological report : Blood from chest. Aerobic culture : Staphylococcus. Anaerobic culture : Gram-positive capsulatus gas-forming bacillus, probably *Bacillus aerogenes capsulatus*.

CASE 30.—Hæmothorax and Secondary Hæmorrhage.

Clinical History.—Nature of wound : Gunshot wound, chest.

Signs and symptoms : Hit near the left axilla with shrapnel ; in the course of the first two days he got very pale. Temperature rose to 102° F., pulse 120 ; after that temperature dropped to normal, but the pulse remained about 120 ; colour very pale. He was aspirated, and forty ounces of dark offensive blood was withdrawn ; several ounces of Eusol were introduced ; after this he was more comfortable. Twenty-four hours later he was operated upon ; did well for that day, but died next morning from hæmorrhage.

Survival : About three and a half days.

Operation : Under local and light general anæsthesia the 7th rib was resected, foul smelling blood evacuated and Eusol washed through from the tube in the wound of entrance in the axillary region out through the lower tube.

Post-mortem Result.—Chest : A coating of fibrin over the parietal and visceral pleura ; lung collapsed to half its size ; in the lower lobe a large piece of shrapnel lay loosely embedded in the lung ; evidently from here the hæmorrhage had proceeded (? either from pressure erosion, or from septic ulceration of a vessel). Blood-clot in the pleural cavity.

Comment ; He had always been too ill to be removed for X-ray. (Rarely is it of much importance to locate the foreign body in chest cases ; here possibly removal might have saved his life.)

CASE 33.—Hæmopneumothorax and Lobar Pneumonia. Gas Infection of Wound.

Clinical History.—Nature of wound : Gunshot wound, chest. (Shrapnel.)

Signs and symptoms : Hit with shrapnel just below left axilla ; no wound of exit ; also gassed. On admission temperature 97° F., pulse 126. Dyspnœic. Colour, pale ; somewhat collapsed. Left side of the chest resonant, but was not examined much. Given oxygen for fifteen minutes every hour through a nose-piece with relief. Next day temperature 103° F., pulse 122. Colour much improved though is still very dyspnœic. Next day temperature 101° F., pulse 146. Heart displaced to the right of the sternum ; left side of chest resonant ; breath-sounds not heard. Over the right upper lobe breath-sounds puerile (probably pneumonic, Colonel Rigby thought). He also had gas infection of his wound ; coppery discoloration of the skin and emphysema spreading down the chest wall.

Slightly improved in the afternoon after the operation but still very ill ; dyspnœic and restless. Next morning temperature 98° F., pulse 132, colour bluish. Is very restless. Died the same evening. Unconscious for the last seven or eight hours ; colour livid. Tube was draining well ; discharge from it not offensive. Gas gangrene of the chest wall not extending, in fact was improving.

Operation : Under light open ether the chest wound was excised. The wound through the fractured rib was enlarged and almost two pints of dark blood (frothy and inodorous) were evacuated. A tube stitched in. Gas gangrene area of the chest wall freely incised, and a Eusol dressing applied.

Survival : About fifty-six hours.

Post-mortem Result.—Chest : Wound of the chest wall leading through the left 7th rib at the posterior axillary line ; a little blood in the pleural cavity. The lung was partly collapsed ; anterior surface covered with adherent lymph. Lower lobe pneumonic, most intense nearest the site of the perforating wound which went through the outer border of the lower lobe and came out at the base. The right lung extremely congested, otherwise normal.

Heart : Perhaps slightly to the right, but not much ; no evident lesion. Some ante-mortem clots in both ventricles, aorta, and pulmonary artery. No wound of the diaphragm seen. No foreign body found in the pleural cavity. Abdomen normal.

CASE 38.—Wound of Liver and Haemopneumothorax.

Clinical History.—Nature of wound : Gunshot wound, chest and arm. (Shrapnel.)

Signs and symptoms : Hit with shrapnel on the left costal margin, just to the left of the mid-line ; wound of exit is about two inches to the right of the right nipple ; there is also a lacerated wound through the right upper arm in the track of the same missile. He coughed up about two ounces of blood before admission. He is extremely pale and collapsed. Temperature subnormal. Chest : There is a churning noise in the right chest occasionally, as of air and blood mixed ; much oozing from the right chest wound. No definite surgical emphysema felt. Abdomen rigid. Decided to give him morphia, and rest in a semi-recumbent position. Next morning he felt better ; abdomen less rigid. He was thought to be a case of hæmopneumothorax, with a possible wound of the liver. Later on that day his abdomen became somewhat distended, especially in the suprapubic region ; flanks resonant ; liver dullness mostly gone. Temperature 96° F., pulse 148. Is unconscious and dying.

Survival : About thirty-six hours.

Post-mortem Result.—Neck, chest and abdomen : There is some surgical emphysema in the right side of the neck. The wound in the abdominal wall is at the tip of the 8th costal cartilage, about one and a half inches from the mid-line ; it leads along the anterior surface of the liver at its junction with the superior surface ; in situ it looked comparatively superficial, and the liver herniated through a hole in the diaphragm (size of half a crown) into the right pleural cavity ; when the liver was removed the wound was seen to be both extensive and deep. The wound of exit was through the 6th intercostal space in the anterior axillary line (about one and a half inches below the nipple line and two and a half inches external). The lung was partly collapsed, containing blood in its lower lobe, especially near the base, but it showed no trace of wound. The pleural cavity contained quite twelve to fifteen ounces of blood ; the dark semi-solid condition of the lung was either the result of the compression exerted by the hæmopneumothorax, or, as it was definitely hæmorrhagic in its lower part, perhaps due to concussion hæmorrhage. There was some surgical emphysema in the mediastinum. The abdomen contained about half a pint of blood in the flanks and in Douglas' pouch. There was no free gas in the peritoneal cavity. The loss of liver dullness was due to the colon being pushed up under the liver. The stomach contained a quantity of dark fluid (probably not blood, as there was no wound). The pericardium was normal.

Arms : The brachial artery and median nerve were uninjured.

CASE 46. — Hæmothorax and Hæmoperitoneum with Gas Infection.
Laceration of Lung.

Clinical History.—Nature of wound : Gunshot wound, chest.

Signs and symptoms : Hit in the back just to the left of mid-line about the 6th or 7th rib, fracturing it and penetrating the thorax. Dyspnœa on admission ; relieved in semi-recumbent position. Next day pale and very dyspnœic. Breath sounds audible over the front and lower part of the left chest, though not so loud as on the right side ; too bad to examine the back of the chest. An exploring needle was put in on both sides ; negative result. Died later in the day.

Survival : About thirty hours.

Post-mortem Result.—Chest : Left lung partly adherent, but pleural cavity absolutely full of dark blood, which was clotted in places. All except the apex of the left lung was disorganized ; the lung was much lacerated and practically absent in parts ; in what was left of it (with the exception of the apex) there was nothing but dark blood. There was a hole in the diaphragm just to the left of the left lobe of the liver, and in front of the spleen. The other lung was normal ; no sign of collapse.

Abdomen : Free dark blood in the peritoneal cavity, but could find no visceral lesion.

Bacteriological report : Films made from the hæmothorax were heavily infected with the *Bacillus aerogenes capsulatus*.

Comments : The state of the lung was worse than in two previous autopsies of gunshot wound of the chest, where the lung was totally adherent and there was no blood in the pleural cavity. The patient also lived longer, though not so long as those cases of hæmothorax pure and simple (without much hæmorrhage into the lung), which die of infection. Presumably the aspirating needle struck the blood clot, hence the negative result.

CASE 57.—Laceration and Hæmorrhage into Lung.

Clinical History.—Nature of wound : Gunshot wound, chest.

Signs and symptoms : Wounds on both sides of chest as the result of a raid. Cold, pulseless and pale.

Survival : About an hour.

Post-mortem Result.—Chest : The left chest was entered behind the posterior axillary line, furrowing the posterior wall of the chest on the inner side of the ribs and wounding the lower lobe of the left lung ; the lacerated lung contained several small pieces of bone, but no shrapnel. The whole lung was densely adherent all over (old) ; the lower lobe was solid with hæmorrhage ; the upper lobe a little congested. Right lung normal. Heart : Right auricle and ventricle much dilated.

Abdomen : Normal.

Comments : What the cause of death ? Was it due to the adherent pleura, in consequence of which he bled into the lung instead of into the pleural cavity ?

CASE 60.—Hæmopneumothorax.

Clinical History.—Nature of wound : Gunshot wound, chest.

Signs and symptoms : Hit in the upper part of the left chest ; a through-and-through wound coming out through the scapula. Developed a hæmopneumothorax. Was aspirated a day or two after admission, some blood and air drawn off ; this gave relief. Bacteriological report was negative. A day or two later aspirated again : this rather knocked him out ; air came straight through from the lung. Temperature became pretty high subsequent to this, and remained up until death. Aspirated again a day or two later ; died shortly after.

Survival : About five or six days.

Post-mortem Result.—Chest : Marked bronchitis on both sides. There was a track through the upper lobe of the left lung, surrounded by blood-clot, which in one part had become converted into an abscess. The wound in the lung still communicated with the pleura, and there was a good deal of hæmothorax. Some bronchopneumonia in the lung surrounding the wound track.

Bacteriological examination : (1) Mucopus from the bronchi contained small bacilli like influenza bacilli, also streptococci ; (2) pus from the lung abscess contained streptococci ; (3) film from the hæmothorax contained streptococci.

Comments : Possibly the suction of aspiration kept open the wound of the lung, and caused infection of the hæmothorax from the bronchi.

CASE 61.—Hæmothorax and Hæmorrhage into Lung.

Clinical History.—Nature of wound : Gunshot wound, chest.

Signs and symptoms : A through-and-through wound entering the upper part of the right chest anteriorly, and coming out through the scapula behind.

Survival : About forty-eight hours.

Post-mortem Result.—Chest : The right lung was adherent in places, but he had a good-sized hæmothorax ; also some hæmorrhage into a moderate area of lung substance.

Bacteriological examination : Film from the hæmothorax showed a Gram-positive coccus, chiefly in pairs.

CASE 62.—Bilateral Hæmothorax and Infective Pericarditis.

Clinical History.—Nature of wound : Gunshot wound, chest. (Shrapnel bullet.)

Signs and symptoms : Hit in the left shoulder, penetrating the 3rd intercostal space. Left pleural cavity aspirated, a tube put in through an intercostal space, and washed out with Eusol every six hours.

Survival : Several days.

Post-mortem Result : Chest : The track of the bullet was through the 3rd interspace, through the left lung, and then through the upper and posterior part of the pericardium, then across the upper surface of the right

dome of the diaphragm, contusing it. There were recent fibrinous adhesions of the left lung, shutting off clear brownish fluid in other parts of the pleura from the drainage tube. The left lung was somewhat collapsed, but otherwise healthy. There is some turbid fluid in the pericardial sac; some fibrin over the heart which was much dilated. In the right pleura there was a good-sized hæmothorax; the shrapnel bullet was lying at the bottom of the cavity.

Abdomen: Some blood on the under surface of the right side of the diaphragm; also extending from there into the pelvis. (This blood and the hæmothorax are apparently due to the contusion; could see no actual open wound.)

Bacteriological examination: Films from the left pleura during life showed an organism like *Bacillus aerogenes capsulatus*; culture showed streptococci. Films from the right pleura taken at the autopsy showed Gram-positive cocci, mostly in pairs; also some short chains. Pericardial fluid taken at the autopsy contained Gram-positive cocci, mostly in pairs; also short chains. Film from the left pleura taken at autopsy showed no organism; the previous positive finding from the left pleura was during life. It looks as if the Eusol had been quite effective.

COMMENTS MADE IN 1937 AFTER REVIEWING THE NOTES.

Hæmothorax.—In practically every case this was due to injury to the lung (or chest wall), but in one case, No. 10, it was due to a wound of the right subclavian vein. Case 10 illustrates that an exploring needle (in spite of its occasional failures) would have revealed the most disabling factor in this case, viz., hæmorrhage; although, of course, it would not have revealed its origin. A bacteriological examination would have revealed that, in spite of the fact that the temperature was 103° F., there was no infection.

I do not think even good portable X-rays will ever replace a decent-sized aspirating needle.

Recognition of the fact that No. 10 was bleeding from the subclavian vein would have saved him.

The signs and symptoms of hæmorrhage to this day are not always clearly recognizable. A high leucocyte count is not usually expected, yet I have seen a big abdominal hæmorrhage with a count of 30,000.

As to the treatment of hæmothorax (when uninfected) varied opinions were expressed at the meeting of the Second Army Medical Society in Ballieul in 1916. I expressed myself in favour of aspiration at the C.C.S. or shortly after arrival at the Base, so as to avoid long-standing compression of the lung. This view was also taken by most of those who had seen the cases at Base Hospitals in England, particularly those with post-mortem experience.

Infection of Hæmothorax.—This was a frequent cause of death; the infecting organism was usually *B. aerogenes capsulatus*, as in Cases 62, 46, 33, 30, and 16; occasionally a mixed infection. Those cases which escaped

infection, or where it was of a milder nature, were evacuated to the Base. The cases with gas infection were usually quickly fatal. (As it is more often a toxæmia rather than a septicæmia, it is possible that it would be amenable to frequent irrigation with Eusol, Dakin's, etc.) Sometimes the infection came from the man's own lung, e.g. where he was the victim of bronchitis (not an uncommon affection in that severe winter of 1916-17). In Case 60, where the lung of a man with bronchitis had been wounded, there was bronchopneumonia around the wound track and abscess formation at one part; the infecting organisms in the case were bacilli like influenza bacilli, and streptococci. Several cases have been recorded lately of streptococcal empyema treated by injection of 5 cubic centimetres of Prontosil into the pleural cavity. In these cases the improvement was immediate and the recovery complete.

Hæmopneumothorax.—This was met with occasionally; the air came either from the wounded lung or from without. It was later recognized that in gunshot wound of the chest it was essential as soon as possible to put a copious dressing over the wound to prevent this pneumothorax, which in the case of large wounds may cause collapse of the affected lung and a "flapping mediastinum"—fatal in its effect. Subsequent to the War, Graham worked out, on mathematical principles, that the largest opening compatible with life in a healthy adult is about two by four inches.

In hæmopneumothorax or in gas-infected hæmothorax, the resulting resonance is sometimes misleading; it conceals the extent of the hæmothorax. Case 16 is illustrative of this point.

Gas Infection.—The importance of either immunization against gas infection, or efficient treatment of it by serum, is emphasized in this series of cases where—apart from the appalling mortality of gas infection itself—cases of multiple flesh wounds were subjected to excision for fear of gas infection; in some of these, the presence of a chest complication such as an uninfected hæmothorax (which would otherwise have recovered) was sufficient to turn the scale against the patient.

Aspiration.—This (which is one of the most useful adjuncts of chest surgery) in Case 46 was misleading, due to the fact that it struck blood-clot; it withdrew nothing.

Surgical Empysema.—This was not common. Case 38 was unusual. It showed empysema on the right side of the neck at the autopsy, also in the mediastinum; presumably this had been entered by the missile. The air came either from the wound of exit in the chest wall, or from the lung (in which, however, no wound could be found).

Injury to Rib.—In some cases portions of the rib were driven into the lung.

Temperature and Pulse.—In chest cases, as in every other part of the body, the pulse was a much better guide than the temperature.

Thoraco-abdominal Injuries.—These were not uncommon; in most cases the missile went from the chest into the abdomen (from above downwards).

Hæmorrhage into the Lung.—Over and over again we find this associated in some cases with a wound of the lung, in others merely due to concussion from the adjacent passage of the missile. Case 62 is a case in which there was a contusion of the upper surface of the diaphragm from the grazing of a shrapnel bullet (found at the bottom of the pleural cavity). Yet there was some blood in the peritoneal cavity; some of it had gravitated down into the pelvis. Where the lung was adherent to the parietal pleura and the blood could not escape into the pleural cavity death seemed to come on more quickly. Case 57 seems a case in point. In Case 46, in which the lung was partly adherent, it was so disorganized that only the apex could be recognized as lung tissue.

Heart Wounds.—These were uncommon; most would die on the field. We had one case, No. 12, which had a wound on the left ventricle, together with hæmothorax and lacerated spleen; he died shortly after admission. There was one case in which the pericardium was in the track of the missile; this was not suspected during life; it showed streptococcal infection similar to the pleura. Whether it would have responded as well to the Eusol irrigation as the adjoining pleura did, is, of course, a matter for conjecture; or whether Prontosil (or allied drugs) injections in cases of streptococcal pericarditis of the future will help, I cannot say.

Current Literature.

WATER WORKS AND SEWERAGE. 1938, v. 85, 1130. **Galvanic Corrosion Stopped by Water Treatment.** [Summary taken from *Pub. Health Engineering Abstr.* Washington. 1939, May 13, v. 19. Signed R. E. Tarbett.]

“Experimental work under way by the Division of Sanitary Engineering of the Department of Public Health of Massachusetts is revealing that, in spite of corrective treatment of the water, galvanic action continues to occur in piping systems wherein dissimilar metals are brought together. Combinations of nine different kinds of service pipes (including those in common use to-day) have been immersed in raw surface and ground waters and in surface and ground waters treated to prevent corrosion. Results to date indicate that treatment with soda ash or lime has little or no effect on corrosion caused by galvanic action. Therefore, it is apparent that treatment of the water at the source is only effective in preventing corrosion at joints when a uniform kind of pipe is used in the distribution system and services. The conclusion is that anti-corrosion treatment does not prevent corrosion of services where pipes of dissimilar metals are used in contact with each other.”

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