CHEST SURGERY IN WAR

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SOME ASPECTS OF CLOSED WOUNDS OF THE CHEST *

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Suggested Programme of Treatment

Prophylactic chemotherapy should be given as early as possible in every case, on lines similar to those recommended for other war wounds (Fuller and James, 1940). The possibility of prophylactic local application of sulphonamide drugs to the pleura by injection of suspensions of the drugs in a suitable vehicle seems as yet to be unexplored; local application to wounds elsewhere has been successfully used. Though local application to the pleura in cases of established infection with empyema has been disappointing, the method seems well worthy of trial as a prophylactic against the development of infection.

Immediate surgical treatment is necessary for cases showing the indications already described under "Surgical Intervention." Wherever possible, this and other forms of treatment should be planned after study of radiographic appearances.

In cases with "closed" wounds not showing indications for immediate surgical intervention, and those in which after necessary surgical treatment the chest has been closed (according to the indications outlined above), treatment should be planned to keep the pleura free from blood and exudate by aspiration, and to manage the pneumothorax most advantageously. These questions receive further consideration below.

Surgical intervention on the usual lines is required later for such conditions as empyema, pulmonary abscess, etc.

Management of the Closed Thorax after Penetrating Wounds

In most cases there will be varying amounts of blood and air in the pleura. The advantages of keeping the pleura free from blood and exudate seem overwhelming; the risk of infection, especially by anaerobic organisms, developing in spite of prophylactic chemotherapy is probably much less, and the occurrence of disabling pleural thickening and pulmonary fibrosis by partial organization of the slowly absorbing blood and exudate is avoided. The drawbacks are that unless efficiently performed early aspiration may be exhausting to a shocked patient; that aspiration may be difficult on account of fibrin clot which blocks the needle; and that simple aspiration may result in the recurrence or increase of bleeding by causing re-expansion of the partially collapsed lung. The latter danger may be avoided by air replacement at all early aspirations; this should certainly be done if there is evidence of pulmonary haemorrhage in the form of bright haemoptysis. With these points in mind the following list of indications may be suggested:

(i) *Aspiration and Air Replacement.*—These are indicated in all cases in which within a few days of wounding there is a considerable haemothorax. The indication for air replacement is not so strong if no haemoptysis occurs, but if there is haemoptysis early aspiration should be accompanied by air replacement.

Air replacement is contraindicated if there is evidence of a pleural infection.

(ii) *Simple Aspiration.*—This is required in cases seen later in which there are signs of considerable effusion into the pleura but without haemoptysis, and in cases in which a pneumothorax has been present for several days, haemoptysis has ceased, and there is a reaccumulation of fluid, especially if the temperature and pulse are rising, suggesting incipient infection. In the latter type of case the object of treatment should be to secure re-expansion of the lung to minimize the size of the empyema that may develop.

(iii) *Artificial Pneumothorax.*—The cases considered under heading No. i will be left with an artificial pneumothorax. In a few instances a wound of the lung may be causing haemoptysis without any considerable haemothorax or traumatic pneumothorax. In these, if haemoptysis continues, the formal induction of an artificial pneumothorax may be a very satisfactory line of treatment. In any case, when an artificial pneumothorax is induced by either of these methods it should be maintained for a few days only; possibly no refill, or at most only one, will be required. As soon as active pulmonary haemorrhage has ceased, as shown by the disappearance of bright blood from the sputum, no further refills should be given, and the lung must be allowed to re-expand slowly by spontaneous absorption of the air in the pleura. The value of artificial pneumothorax has been emphasized, on a basis of practical experience, by Kretzschmar (1940).

Technique of Aspiration

A few words about the technique of aspiration of the chest may be useful. Three points require attention: first, the patient must be supported comfortably in a convenient position, both so that he is not exhausted by the effort of

FIG. 2.—A useful position for aspiration of the chest, air replacement, etc.

maintaining it and so that the operator is not incommoded by difficulty of access to the chosen site; secondly, the common error of inserting the needle too low must be avoided; and, thirdly, a needle of adequate bore for the type of fluid present must be used.

Posture.—There may be factors, such as the site of external wounds, which influence decision about the most suitable posture. In most cases, however, that shown in Fig. 2 is possible and is very convenient. The patient sits propped up in a rather upright Fowler's position; with the arm of the sound side he clasps a blanket or blankets rolled into a cylinder about sixteen inches to eighteen inches

long, while the arm of the affected side is placed so that the hand rests on the opposite shoulder and the elbow rests on the top of the rolled-up blanket. This posture leaves the whole of the lateral wall of the chest accessible to the operator sitting by the bedside. It can be maintained without distress even by an ill patient.

Insertion of Needle.—In most cases of effusions into a free pleura the needle should be inserted in the fifth or sixth intercostal space in the mid-axillary line with the patient in the position described. The disadvantage of inserting the needle lower than this is that it is apt to get intermittently blocked by the diaphragm at the height of its excursion, that fibrinous particles are more numerous in the costo-phrenic "gutter," and that this "gutter" is in any case more narrow in its lower part, so that it may easily be almost obliterated by fibrinous deposit on the pleura. These troubles are minimized by inserting the needle higher up; if this has been done the last part of the fluid may be withdrawn by leaning the patient over towards the affected side.

Size of Needle.—The importance of using a needle of adequate bore seems too obvious to require emphasis. There is one difficulty, however—namely, that most large-bore needles are made much longer than necessary for pleural aspiration. Those supplied with most of Potain's aspirator sets are an example of this. Very few chest walls require a needle more than two inches in length; and unnecessary length partly defeats the purpose of a wide-bore needle by increasing the resistance to flow. Aspiration of a haemothorax may prove very difficult on account of repeated blockage of a needle of the usual sort, even of wide bore. In such cases it is tentatively suggested that larger trocars and cannulae, such as are used for the insertion of intercostal catheters or for thoracoscopy, might be tried. A trocar and cannula of this size can be inserted painlessly if the technique is sufficiently careful. The chosen site must be adequately anaesthetized, 20 c.cm. of local anaesthetic solution being required; the presence of fluid is confirmed; a small incision is then made with a fine scalpel or tenotomy knife, and through this the trocar and cannula are steadily thrust between the ribs into the pleural space. Aspiration through such a large cannula, if thoroughly performed, would rarely need to be repeated. It might be advisable to irrigate the pleura with normal saline at the end of such an aspiration to ensure that no fibrinous debris is left to interfere with subsequent aspiration through a more normal needle, should it prove necessary. During this procedure the interpleural pressure should be controlled by introducing or removing air through a second needle inserted higher up, as described below under "air replacement." After withdrawal of the trocar the small wound should be closed by a single stitch, and a dressing, firmly supported by elastic plaster, applied.

Technique of Air Replacement

Air replacement requires, in addition to aspirating apparatus, devices for measuring the intrapleural pressure and for admitting air, preferably in measured volume, into the pleura. These are, of course, both provided by any form of apparatus used for artificial pneumothorax work. Preparations having been made for aspiration as outlined above, a second needle is introduced, in the manner described for measuring the intrapleural pressure, higher up above the level of the fluid. Through this, as the fluid is withdrawn through the lower needle, air is admitted at such a rate that the intrapleural pressure is kept as constantly as possible at the desired level. The pressure required in the individual case can be judged from the degree of lung collapse initially present and the initial pressure before aspiration is begun. In general, in order to main-

tain constant pressure within the pleura rather less volume of air must be introduced than fluid withdrawn. The pressure required to produce a useful degree of lung collapse varies greatly: it will always be below atmospheric in men with previously healthy lungs—generally the mean pressure will lie between 0 and -4.

If a pneumothorax apparatus is not available the pressure may be measured with the manometer described on page 57, and the aspiration stopped occasionally to allow air to be injected through the lower (aspirating) needle with a large syringe, the amount being controlled by observation of the intrapleural pressure. This is a safe procedure, provided it is certain from the free flow of fluid on aspiration that the needle is in the fluid-containing space.

If there is a large haemothorax with no considerable air space above it, and an air replacement is indicated, the easiest procedure is to start as for simple aspiration. When about 100 c.cm. of fluid has been withdrawn inject 80 c.cm. of air through the aspirating needle, and continue thus until a useful air space is present above the fluid. Insert the upper needle into this, and proceed as in the cases with an initial air space.

Infection.—This complication should be watched for throughout. So long as fluid accumulates in the pleura specimens must at intervals be examined bacteriologically, by both aerobic and anaerobic culture, especially if the temperature rises or fails to fall. It is to be hoped that the incidence of infection will be reduced to a very low level by prophylactic chemotherapy and thorough early aspiration. When it occurs the case must be treated on the general principles of the treatment of pleural infections, which cannot be discussed here. It may be stressed that so long as there is a pyothorax—i.e., a collection of purulent fluid in a free pleura—aspiration or drainage by an efficiently closed method must be used; only when the condition has settled into a localized walled-off empyema may an open method of drainage be employed.

Tension Pneumothorax

This is a rare complication of chest wounds; it results from a pleuro-bronchial communication of valvular type, so that air can enter the pleura in inspiration and cannot leave it during expiration. The pleura thus becomes distended by air under pressure, causing gross mediastinal displacement and dangerous respiratory distress.

The presence of a tension pneumothorax may be suspected when there is extreme respiratory embarrassment with cyanosis, and on examination the affected side of the chest is immobile, possibly distended, hyperresonant on percussion and either silent or (rarely) with curious amphoric respiratory sounds on auscultation, and the heart and possibly the trachea are displaced on the opposite side. The diagnosis is made precise by measurement of the intrapleural pressure, which will be above atmospheric.

Such a case calls for immediate measures for its relief. In emergency, with no apparatus to hand, relief may be obtained by simply thrusting a needle into the pleura through one of the upper intercostal spaces. The outward hiss of air is easily audible if a tension pneumothorax is present, and confirms the diagnosis. This simple insertion of a needle brings the intrapleural pressure to atmospheric, and results in considerable relief of urgent symptoms. If the apparatus is available more information about the size of the valvular opening may be obtained by measuring the pressure, withdrawing a measured volume of the pleural gas to reduce the pressure a little below atmospheric, and watching for a time to see whether the pressure rises again. If it does not the needle may be withdrawn and the patient watched for recurrence of distress. If the pressure mounts rapidly or, after the needle has been withdrawn, distress

recurs rapidly, a suitable needle may be inserted and connected to a rubber tube attached to a simple under-water drainage bottle as used for closed drainage of empyemata (Fig. 3). This will afford great relief, but has the disadvan-

FIG. 3.—Simple under-water drainage bottle.

tage that, as air is expelled during cough, it may result in the development of a low intrapleural pressure, with too rapid re-expansion of the lung, giving the pleuro-bronchial fistula no chance to heal. It may be more satisfactory, in a patient who is not distressed by an intrapleural pressure equal to atmospheric, to leave a needle *in situ* open to the air, preferably through a loose cotton-wool filter. If, however, the patient is distressed with an atmospheric intrapleural pressure the arrangement shown in Fig. 4 may be

FIG. 4.—Apparatus for under-water drainage of tension pneumothorax, with safety-valve.

used. In this, bottle B is added to the simple under-water drainage bottle A to act as a safety-valve, letting air into the system whenever the pressure gets below a level equal to that number of centimetres of water below atmospheric by which the tube C projects below the surface of the water in bottle B. This is of course adjustable to whatever level is required for relief of the patient's discomfort. The rather more complicated apparatus described by Marriott and Foster-Carter (1940) may be used for the same purpose.

In general, in the treatment of valvular pneumothorax as little air as possible should be withdrawn or the pressure maintained as near atmospheric as it can be, in order to keep the lung as firmly collapsed as is consistent with the patient's comfort, since only thus has the pleuro-bronchial opening the best chance of healing. In valvular pneumothorax due to wounds surgical intervention will often be indicated; but the measures outlined above may be necessary life-saving preliminary steps.

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HEALTH INDICES FOR GREATER LONDON AND NEW YORK, 1931-40

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In a leading article (*Journal*, February 8, p. 201) dealing with the provisional notification and death rates from certain causes in the city of New York for the year 1940 regret was expressed that no recent death rates were available for London with which these could be compared. The February issue of the Quarterly Bulletin of the Health Department of New York City contained the death rates in each year from 1931 to 1940, at appropriate ages, from diphtheria, scarlet fever, measles, whooping-cough, tuberculosis, pneumonia, appendicitis, suicide, homicide, accidents, and some other causes. Greater London and New York are at present not far apart in their total populations, and it is of interest from a public health standpoint to compare the changes which have occurred in the death rates from these causes in the two cities since 1931. In such a comparison it must be remembered that while the New York figures do not include deaths of residents which occurred outside the city and do not exclude those of non-residents which occurred within the city, the Greater London rates have been corrected for inward and outward transfers and represent the total mortality suffered by residents. The effect of this can be illustrated from the following example. In 1940, 227 deaths from diphtheria, scarlet fever, measles, and whooping-cough were registered in Greater London, but of these only 104 were of residents; in addition 163 deaths of Greater London residents from these causes were registered in other administrative areas of England and Wales, making a total of 267 residents, compared with 227 registrations. If the same conditions hold for New York this would account for an apparent excess of 18% in the combined rate for these diseases in Greater London, but if a larger proportion of New York's infectious disease hospitals lie outside the city's boundaries a still greater apparent excess might result. The same considerations apply to tuberculosis, from which cause a large proportion of deaths of town dwellers occur in institutions situated in the country, and unless these are transferred to the towns of residence the death rates of the latter are fictitiously low. In New York it has been ascertained that the addition of deaths from tuberculosis of residents occurring outside the city would increase the rates by about 10%. Causes such as pneumonia and appendicitis are not likely to be affected to the same extent, but the general death rate of Greater London is raised appreciably by the process of allocation of all deaths to the place of residence of the deceased. In the December quarter of 1939, for example, 19,309 deaths from all causes were registered in the area, 6,360 of these being of non-residents, while 7,512 residents died elsewhere; the corrected death rate was consequently 6% in excess of the uncorrected rate.

Since it is uncertain to what extent the New York death rates are understated owing to this absence of correction, the best method of comparing the progress made in the two cities since 1931 is to study the changes in the *ratio* of the Greater London death rate to that of New York. Changes since 1931 in the distribution of hospital cases in and around New York are unlikely to have seriously affected the ratio, and if it has consistently increased the conclusion may be drawn that progress in reducing mortality from the disease in question in Greater London has not kept pace with that in New York, and vice versa.

For diphtheria the London/New York ratio in 1931-4 ranged from 2.0 to 6.5, but in 1937-40 it ranged from 6.0 to 8.6, for whilst New York has reduced the toll of this disease by more than 85% since 1932, Greater London's rate has fallen by little more than half. For scarlet fever, however, the ratio has not changed consistently, the average death rate in Greater London having fallen from 66 in 1931-4 to 15 in 1937-40 and in New York from 49 to 12—that is to say, by more than 75% in each city.