

CHEST SURGERY IN WAR

This is one of a short series of articles based on lectures given at the British Postgraduate Medical School, Hammersmith

ABDOMINO-THORACIC INJURIES

BY

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Popular opinion is accustomed to associate penetrating injuries of the trunk with grievous mortality, and statistical inquiry only too truly confirms the fatality of wounds implicating the thoracic or abdominal cavity under conditions of modern warfare. The ancients knew the lethal character of wounds of this portion of the human frame; it suffices to mention here the wound of Eurymachus from the arrow from Odysseus's powerful bow, and the injuries inflicted upon Polydorus and Tros by the great Achilles or on Sarpedon by the spear of Patroklos—all these abdomino-thoracic wounds recounted in the Homeric epics proved fatal. The English stage and Scottish history also testify to the gravity of the abdomino-thoracic injury: in Shakespeare's drama, Macbeth unseamed Macdonald from "nave to chap" in the manner of one accustomed to wield the claymore. The backhand of the claymore could easily split a man from clavicle to thigh: many of General Mackay's soldiers perished in this way, endeavouring with their muskets to protect their heads and trunks in that fierce overwhelming rush of Graham of Claverhouse's men at Killiecrankie.

The surgery of those regions which adjoin the midriff is not entirely modern. The behaviour of wounds of the diaphragm received in warfare has been known to surgeons since the days of Ambroise Paré, and was accurately noted and discussed by Guthrie when writing of the war surgery of the Napoleonic era. The surgical treatment of thoracic wounds by Guthrie and by Baron Larrey, Napoleon's Surgeon General, has proved no inaccurate presage of the modern treatment of gunshot injuries of the chest. In respect of the repair of visceral injuries on the abdominal aspect of the diaphragm, over six centuries have rolled past since Henri de Mondéville counselled suture of the colon and affirmed the recovery of some of those who had received wounds of the large intestine.

Injuries which involve thorax, diaphragm, and abdomen may be of penetrating or of non-penetrating character. In the war of 1914-18 the first-named group completely overshadowed and outnumbered those which were sub-pleural lesions.

ON PENETRATING ABDOMINO-THORACIC INJURIES

In one series of cases from the war of 1914-18 (Sir Cuthbert Wallace, 1922) abdomino-thoracic cases constituted 12% of the abdominal cases which reached the casualty hospitals of an army; the operations performed on this group of patients also accounted for 12% of all the abdominal operations in that army. In the Spanish Civil War the proportion of abdomino-thoracic wounds in all wounds

of the belly admitted to a hospital of first urgency was not dissimilar to that which obtained in 1914-18—i.e., 11% (Jolly, 1940). Abdomino-thoracic injuries formed 9% of a certain series of thoracic cases admitted to a "clearing station" (Gordon-Taylor) during 1918.

Statistics of abdomino-thoracic wounds culled from the Official History of the War of 1914-18 demonstrate that in a vast majority the abdominal lesion determines the gravity of the prognosis, and, further, that wounding of the hollow abdominal viscera greatly augments the fatality of the injury. The most fleeting glance at any anatomical atlas will demonstrate those organs most likely to suffer in abdomino-thoracic injury (Figs. 1 and 2). It will at once be apparent that the anxieties occasioned by a wound of the left dome of the diaphragm must greatly exceed those which are aroused by right-sided penetration of the midriff.

In a series of addresses on various aspects of the surgery of the chest by different lecturers it is obviously desirable

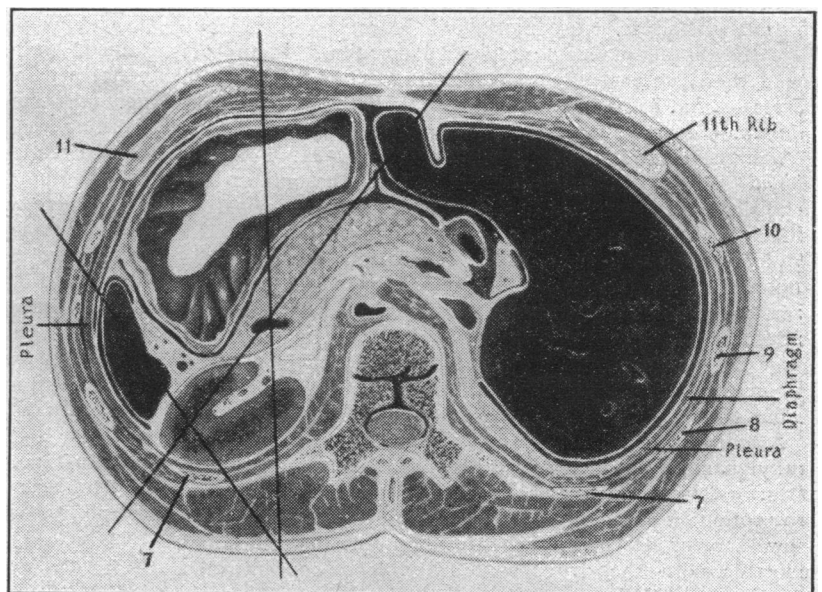


FIG. 1.—Horizontal section through abdomino-thoracic zone to demonstrate the organs liable to injury in penetrating wounds of this area.

to aim at some uniformity of nomenclature, classification of wounds, etc. I therefore make no apology for utilizing the excellent classification of penetrating abdomino-thoracic wounds given by my friend Tudor Edwards:

1. The chest and abdomen may be penetrated by separate missiles, the wounded man sometimes becoming a veritable St. Sebastian, his abdomen and chest riddled with fragments of high explosive or machine-gun bullets.

2. Missiles may penetrate the chest, and may emerge through the abdominal wall or be retained within the belly; on the other hand, the track of the missile may be in the reverse direction—the wound of entry in the abdomen and the fragment retained within the thorax.

3. Traversing wounds of the lower chest, especially if inflicted during expiration, may pass through the diaphragm and occasion damage to the abdominal organs lying immediately subjacent to the midriff.

4. Tangential wounds of the lower thorax in which considerable damage, including diaphragmatic injury and perfora-

tion, is produced by the missile and in-driven fractured ribs ("stove-in chest").

The Diaphragmatic Lesion

The injuries of the diaphragm in abdomino-thoracic lesions are mostly in the sloping muscular portion, and are specially frequent where this lies in contact with the thoracic wall. In cases that come to operation the rent is usually small; in one series the linear tear was half an inch long or less in 50% of the cases. Many openings are mere punctures; larger irregular apertures in those suitable for surgery are seldom found to be more than one and a half to two inches in diameter.

Lockwood and Nixon (1918) compared the cardiac and respiratory embarrassment due to a rent in the diaphragm to that produced by an open pneumothorax; on the other hand, Sauerbruch writes that the importance of the diaphragm in relation to respiration and the circulation has been exaggerated. The great improvement in the recovery rate of abdomino-thoracic cases after the diaphragm began to be sutured by British surgeons in the last war may have been partly due to the repair of that muscle, but also to the improved treatment of the thoracic condition and increasing familiarity with the many problems of war surgery. Small wounds undoubtedly heal sponta-

due to the thoracic, to the abdominal, or to other concomitant injury. Nixon (1919), who had great experience of these cases, writes that if there is a fair air-entry into the lungs thoracic injury is not to be held accountable.

The anatomical site of the aperture of entry and of exit of a traversing wound of the trunk limns the track of the missile with fair accuracy. The position of the patient at the time of injury also demands consideration; the structures probably damaged can then be readily adumbrated. In cases in which a fragment of metal, spicules of broken rib, etc., are retained, *radiological investigation* is indispensable; its necessity in estimating diaphragmatic movements and thoracic pathology cannot be overestimated. There are also clinical signs and symptoms which arrest attention and which may clarify, or may, on the other hand, obscure, the diagnosis.

1. *Abdominal rigidity* does not of necessity betoken involvement of the subphrenic viscera. It is well known that injuries of the pleura or lung, especially if situated in proximity to the diaphragm, may occasion abdominal rigidity and may arouse suspicion of an abdominal lesion: (a) The abdominal rigidity associated with an injury below the diaphragm is more likely to be bilateral; in the case of a thoracic wound rigidity of the belly wall is usually confined to one side. (b) The abdominal rigidity accompanying a chest injury tends to be intermittent, some relaxation of the rectus abdominis occurring during inspiration.

2. Sickness and vomiting have been known to occur in cases of lower thoracic injury, but are more frequent in abdominal lesions, as is eructation of gas.

Diaphragmatic injury is suggested by an almost entirely thoracic type of respiration, with a catch at the end of inspiration, sometimes a definite spasm or hiccup; yet the actual respiratory rate may be little altered. In the late stages of injury to the diaphragm there is fixed pain, exaggerated on exertion and referred to clavicle or scapula according to the position of the injury or location of the retained missile. Pain is induced especially by lifting, coughing, or even deep respiration. The diaphragm is kept motionless on the affected side.

The diagnosis of a wound of the diaphragm is not easy in subparietal injuries. The syndrome of tension pneumothorax may be simulated by the sudden irruption of stomach or colon into the chest. *Radiology* and the determination of the intrapleural pressure enable a correct diagnosis to be attained.

In the case of penetrating injuries the decision as to the time of operation, the type of surgical procedure, and the chronological sequence of the stages of the undertaking will depend upon: (a) the degree of shock and collapse of the patient; (b) collapse of the opposite lung, as suggested by intense dyspnoea, cyanosis, and respiratory retraction of the chest wall on the contralateral side (in such a case the administration of an anaesthetic and a thoracotomy in the last war usually proved fatal); (c) the experience and judgment of the surgeon.

The existence of blast-contusion of the lung is now well established on clinical and x-ray evidence and by post-mortem findings, yet it may be only the index of perhaps graver changes in the organs below the diaphragm. Other serious cases may have been in very close proximity to detonating bombs, and may be suffering from a dangerous and grave degree of saturation of the blood by explosive gases, such as carbon monoxide or nitric oxide. The

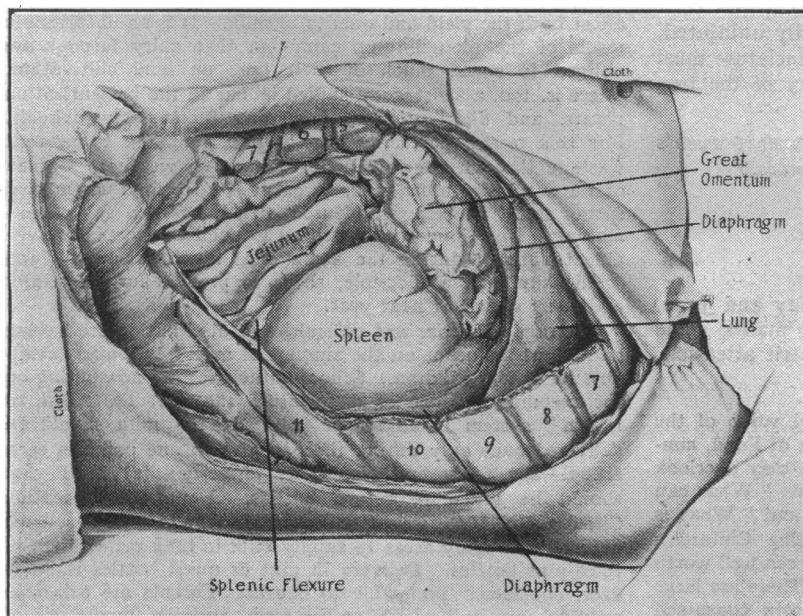


FIG. 2.—Dissection of the left-sided abdomino-thoracic region, showing viscera liable to injury in penetrating wounds. (Prepared by Prof. John Kirk, Middlesex Hospital.)

neously, and others are at least temporarily plugged by omentum, spleen, liver, stomach, etc.

Wounds of the central tendinous part are obviously more serious than those at the periphery, but some survive. A century ago Guthrie published notes of a man with a wound of pericardium, left ventricle, lung, liver, and the tendon of the diaphragm. The man survived for four or five months; he suffered from palpitation and uneasy sensations in the chest, and died of bronchitis. Fuchsig (Sauerbruch and O'Shaughnessy, 1937) successfully operated upon a stab wound of the right ventricle which also perforated the central portion of the diaphragm. The track passed obliquely inwards from the fifth sternochondral articulation, and was thought before operation to implicate the stomach.

Diagnosis of Penetrating Abdomino-thoracic Wounds

Doubt may be felt at first whether the gravity of the condition of a man with an abdomino-thoracic wound is

severity of the clinical state may even be due to such lesions as myocardial trauma. Such possibilities should not be overlooked amid the circumstances of this "total" war; their presence and the existence of other grave multiple injuries heavily load the scales against recovery.

Penetrating Injuries by Large Missiles

The injuries produced inside the abdomen by large fragments of metal or other foreign body are *almost always irrecoverable*; the result is scarcely likely to be different in those wounds if more than one cavity of the body is implicated. I have, however, figured elsewhere a piece of brass tubing, 4½ inches long, removed from a Greek soldier, who recovered after the simple extraction of the missile, which had passed from the middle of the right scapula and projected in the epigastrium (Gordon-Taylor, 1939).

Saint (quoted by Gordon-Taylor) had a successful right-sided abdomino-thoracic case, in which a fragment of shell weighing two ounces had traversed chest, diaphragm, and liver and produced two perforations of the duodenum and one in the hepatic flexure of the colon.

In one of my patients, the successful result of whose case is recorded elsewhere, a missile weighing nearly four ounces produced the most grievous damage inside the belly, and fractured the bony wall of the thorax (Gordon-Taylor, 1919). The diaphragm was apparently uninjured, and a strict observance of the approved nomenclature must therefore exclude this case from the category of the true "abdomino-thoracic."

(The second part of this paper will appear in next week's issue, and will contain a list of references.)

FEEDING IN WARTIME

No. 9 of the Wartime Nutrition Bulletin (May and June, 1941) summarizes the latest food facts and makes some observations and recommendations which merit attention.

Sugar and Jam

It believes, for instance, in the psychological value of the jam spread for the average child. The Ministry of Food, concerned to provide a scientifically balanced diet, may overlook these minor yet pressing questions of home life: "What can we have with our bread at tea-time to-day?" and "What is there to give the children for a treat?" The Children's Nutrition Council considers that it would have been well worth while to hold more stores of sugar in reserve. There are large West Indian surpluses available. Great Britain consumed before the war about 2½ million tons of sugar a year. Rationing has reduced this to less than 1½ million tons, of which half a million will probably come from home-grown sugar beet, leaving 1 million only to be supplied from abroad. When it is realized that 350,000 tons are available from Java and India alone, and that the Empire countries are capable of producing 1½ million tons, it will be seen that the world surplus of this commodity will be enormous.

Bread and Wheat

Wheat production is in a similar position. Most of the Australian wheat crop of 1939-40, which totalled 195 million bushels, was purchased for either export or home consumption; in fact, however, it has been possible to ship only 45 million bushels, and in December, 1940, there were 110 million bushels in hand for storage. In the last war Canada's wheat acreage was expanded from 10 to 17 million acres; in this war the position will probably be reversed. By August there is likely to be a surplus of 570 million bushels, and the total storage capacity of the country is only 470 million bushels. Storage on farms or in improvised elevators is not practicable owing to the numbers of mice and beetles that congregate in these places. Meanwhile in England we are assured that there is sufficient grain in the country and that

bread is not likely to be rationed. It is not anticipated that barley or potato flour will be used, but if this should be necessary the new types of brown flour will have prepared the population for change.

The brown versus white bread controversy is still being influenced by milling and baking interests, and although the new standard loaf has become a familiar object there are areas where it is slow in making an appearance. The conflict between commercial and scientific interests is complicated by the movement away from the big mills, which are often situated in vulnerable areas, to the smaller inland mills, which are now being reconditioned. These small mills are often well fitted to produce good quality wheatmeal flour, but are at a disadvantage in manufacturing the highly processed modern white variety.

Milk

The most important factor influencing milk yield is the quantity of protein concentrates in the fodder. This is, unfortunately, higher in food coming from abroad than in home produce, so that the total milk yield is practically certain to diminish with the coming winter. It will, however, be a help if farmers can make good silage and hay from the reduced grassland now left to them. "Unprofitable" cows are being removed from the dairy herds in order to conserve food for the higher-yielding animals, but the lack of skilled farm labour may begin to have an effect upon the quality of the stock. Experience is needed in detecting abnormalities at an early stage, and if mastitis is allowed to flourish it will affect both the yield and quality of milk. It is an unfortunate result of the ploughing-up campaign that dairy farmers are obliged to spend much of their time on land cultivation. There is, too, a shortage of skilled labour in the pasteurization plants, and distribution is becoming increasingly difficult. For this reason particular care should be taken to prevent wastage through souring during the warm weather. Much of the surplus summer milk, an extra 10% beyond the normal spring flush, is being condensed, dried, or used for cheese-making. The Children's Nutrition Council considers it advisable to import during the summer as much dried milk and dried skim milk as possible, so as to provide for the winter and early spring of next year.

Shortage of labour and difficulties of distribution are having an adverse influence on the amount of milk being made available for school children. School authorities are now acting on the recommendations of distributors that (a) the "sale or return" system is no longer justified; (b) milk should be delivered once only during the day and to one point in each school—not to several classes as formerly; (c) more care should be taken to return bottles. Board of Education Circular No. 1548, issued on April 17, admits that it will be necessary in many areas to supply milk in bulk rather than in third-pint bottles. Delivery in pint or quart bottles is, however, considered preferable to churns. Parents are asked to provide cups or beakers for the term, and the importance of cleansing these is stressed.

Vitamin C

The importance of vitamin C for children is being continually stressed. One South Midlands town is now ordering in bulk 10,000 synthetic tablets for each of ten welfare centres. If tablets are purchased in quantities of 50,000 the price is 23s. 6d. per 1,000. They are sold to mothers at a farthing per two daily doses of 12½ mg. each. It is pointed out that advertisements for products containing vitamin C are often misleading. Vitamin C may in fact be present, but in insufficient quantities.

Communal Feeding

A picture of communal feeding—the example being an East Anglian industrial town—is given by the Nutrition Bulletin. The town is an evacuation area but few people have left it. The Town Council has borne the primary cost of the five or six feeding centres which have been established, and the Ministries have now approved the scheme. The first established centre provided meals between 12 and 2 o'clock for shifts of 60 people. Numbers rose from 127 on the first day to a regular attendance of between 250 and 320. These figures were not affected by the opening of a second centre