WAR WOUNDS AND AIR RAID CASUALTIES

The following is one of a series of lectures on the Treatment of War Wounds and Air Raid Casualties recently delivered at the British Postgraduate Medical School

THE ABDOMINAL INJURIES OF WARFARE—I

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Ever since "the dark backward and abysm of Time" the belly of an enemy has constituted an instinctive target, and the relative proximity of adversaries has in no small measure determined the incidence of abdominal wounds received in conflict. The vulnerability of the abdomen in the geological eras, when but a short space can have separated rival foemen, is attested in museums, where may be seen portions of the human lumbar spine with impaled flint arrow-heads; some of these relics embedded in the anterior portion of the vertebral bodies limn with unerring surety the transabdominal course of a missile shot long ages ago by some enemy hand of the Neolithic period, a dual monument to victor and to slain.

Incidence and Mortality

In the last great European conflagration, with the augmented frequency of wounds produced by artillery fire, injuries of the abdomen amounted to only 2 or 3 per cent. of all the wounded who reached an organized surgical formation; but, of course, large numbers of those injured in the abdomen died "on the field." It is of interest to learn that abdominal wounds accounted for no less than 9 per cent. of the casualties sustained in the recent air bombardments of Barcelona, and were mostly of a penetrating character. Many of those injured in the abdomen by enemy aircraft, especially by means of the so-called "liquid-air" bomb, had multiple wounds. The wound of entry may be small and easily overlooked, and yet most grievous damage may have been inflicted on the abdominal viscera. Careful scrutiny must be made of the whole body in the case of men and women injured by this form of enemy action.

Wounds of the abdomen which are inflicted by the modern missiles of warfare exert their lethal effect by producing haemorrhage or by engendering sepsis either through infection carried in with the fragment of high explosive or through damage to the hollow viscera of the belly, especially the gastro-intestinal tract. The bowel is that portion of the alimentary tube most liable to be wounded, and is damaged nine or ten times as often as is the stomach.

Personal experience and the published figures of other military surgeons testify that haemorrhage or the shock-haemorrhage syndrome is largely responsible for the deaths occurring in the early hours after wounding, and that those who die later mainly perish from sepsis. This does not absolve the surgeon from the necessity for rapidly deciding whether to operate or to abstain, even in those cases of penetrating wound of the belly where haemorrhage is not the prominent clinical feature.

The dangers attaching to wounds of the hollow abdominal viscera preponderantly outweigh those attending lesions of the solid organs, unless associated damage to

important and intimately related blood vessels threatens life: in all abdominal injuries early diagnosis and decision are the necessary prelude to success. It must, however, be admitted that hollow viscera have escaped injury when the intestinal area has been transfixed by missile or even by bayonet, and Gordon Bell's famous case furnished indisputable evidence that a natural cure might result when the bowel was actually penetrated. Spontaneous healing of gastric wounds has also been recorded. Such results are the freaks of fortune, and are to be disregarded in the formulation of rules for those called upon to deal with gunshot wounds of the belly. In the abdomen there are no insignificant wounds.

Diagnosis and Prognosis

The diagnosis of intestinal injury due to a penetrating wound in the abdomen is never beset with the same difficulty that obtains in deciding whether the bowel has been damaged by contusion or non-penetrating violence, and the indications for treatment are crystal-clear. Whatever the traumatic agency—a laceration by spike or stake, a stab with a knife, dirk, or dagger, a bayonet thrust, or the more frequent gunshot wound from bullet, shell, or bomb—the general principles of treatment are alike. A penetrating wound in the abdomen probably means a penetrating wound of bowel or other abdominal viscus, and demands the earliest surgical intervention, unless a wisdom and prescience born of great experience justifies self-restraint.

An escape of faecal material or flatus from a wound involving the abdominal parietes or even a portion of the body somewhat remote from the peritoneum is self-evident proof of an intestinal lesion; an abundant and persistent discharge of blood from wounds in the back, flank, or anterior belly-wall, an ebb which flows the faster and with greater force when the patient coughs or makes any effort, will likewise suggest some deep visceral lesion, and will call for surgical exploration. No comment is needed upon those cases where a portion of bowel or omentum projects from a wound in this region; and still more significant will be the diagnosis, and still more urgent the need for resuscitatory methods and preparation for laparotomy, if the wounded man is shocked, blanched, or passes blood from the rectum or if there is haematemesis. The situation of the wound may, however, not at first suggest an involvement of the coelomic cavity or its contents: it is perhaps hardly necessary to reiterate the frequency with which gunshot wounds of the buttock implicated the peritoneum or to emphasize the danger with which these injuries were fraught in the war of 1914-18.

The wound of entry may be in the thorax, and the missile, passing through the diaphragm, may implicate the gastro-intestinal tract. It has been pointed out by others, as well as by me, that the immediate prognosis of abdomino-thoracic wounds is in very many cases largely determined by the nature of the abdominal injury, and that those accompanied by a wound of a hollow viscus are very fatal: Sir Cuthbert Wallace found that only seven out of twenty-eight such cases in his collective series were evacuated to the base; Gask and Wilkinson saved only

three out of thirteen such cases. Others were more fortunate, for A. L. Lockwood of Toronto had eight successful cases out of twenty, and I have a record of eleven recoveries out of twenty-two abdomino-thoracic wounds associated with hollow viscus injury, of which several were complicated intestinal lesions. The wounds of entry may be even more remote from the abdomen; they have been encountered in the supraclavicular fossa or as far down the lower limb as the region of the patella. It may be pointed out here that these longitudinal wounds are very fatal in character.

The bowel may also be damaged by small bony spicules being driven through the peritoneum, although the projectile itself does not jeopardize life, the intestine being ruptured by indirect violence without any penetration of the coelomic cavity by the missile. This type of case was familiar to all such officers as had first-hand experience of gunshot wounds of the abdomen in the 1914-18 war; the small bowel in these "burst wounds" gives way either into the mesentery or along the anti-mesenteric border; the large bowel bursts more frequently between the taeniae coli, and often behind the peritoneum, occasioning a fatal retroperitoneal cellulitis or diffuse peritonitis, as was shown by the late Hamilton Drummond and by Sir John Fraser. It must be remembered that the mere fact of penetration apart from the presence of any intestinal or visceral lesion is in itself a serious menace to life, since infection of the abdominal cavity may occur from the wound of entry and a fatal peritonitis may ensue.

What symptoms and signs enable us to make a diagnosis of intestinal injury in the less obvious cases of gunshot wounds of the abdomen? Rigidity, pain and tenderness, vomiting, the facial expression, and a rising pulse are all suggestive. No one sign or symptom is diagnostic, but when they are present in combination the clinical picture becomes more clear. An x-ray examination will give valuable information as to the direction of a wound produced by gunshot injury and may furnish useful information as to the best mode of approach in the particular case.

Many of the foregoing paragraphs have only an academic value; the implications of a wound of the abdomen are obvious. *Every wound, whether penetrating or not, should be thoroughly explored, excised, and disinfected.* Even if an occasional operation should prove to have been unnecessary the patient will suffer little or no detriment from the exploration; nay, rather, with the excision of his parietal wound convalescence will be more safe, the wound should heal more kindly, and the surgeon will feel secure.

Shock

The treatment of shock has already been dealt with by the very surgeon who did so much to clarify our ideas of wound shock in the front-line areas during the great war (E. M. Cowell), and it must suffice to reiterate that every effort must be made to combat the development of secondary shock. As regards the intravenous administration of fluids in those with severe shock, I was never convinced of the utility of saline or bicarbonate of soda solutions in warfare, while the employment of gum-acacia solution must have cost many lives. Fortunately, the recent work of Stuttiford of New York has severely discredited this preparation, and it has now doubtless received its *coup de grâce*. The greater the share played by loss of blood in the shock-haemorrhage syndrome the more valuable is blood transfusion, and in all severe cases its use is demanded as a primary measure. In cases of pure

shock, where there is capillary atony with leakage of fluid, blood is of most temporary value, and is rapidly lost from the circulation. Possibly the employment of some vitamin infusion may prove of specific value in these cases.

Selection of Cases

In periods of rush and emergency a wise choice may have to be made of the abdominal cases awaiting the consideration of the surgeon. When the ideal of extending the benefits of surgery to all such as might legitimately be expected to profit by operation cannot be attained, it will be well to remember in this unenviable yet inevitable task of exclusion Owen Richards's slogan: "Too high, too late, and too bad." Furthermore, the experience of a quarter of a century ago taught the surgeon that a wound of the belly from a large fragment of missile was almost always fatal. Worthington, however, in the last war had a successful case where a fragment of shell weighing over half a pound was lying loose in the peritoneal cavity; there were two wounds of the ileum and one of the sigmoid. I saved another patient, who survived a double resection of bowel and bladder injury produced by a fragment of high explosive weighing just under a quarter of a pound. Such cures are exceptional, and cases of this kind should not be given preference over those that are more promising.

Those wounded who have extrusion of bowel from the abdominal cavity, especially if this be badly damaged, make poor recoveries. They are "bad surgical risks," although their general appearance and condition may deceive the observer; yet a number of marvellous recoveries of this nature, of course, resulted, and the first successful abdominal operation upon the British front concerned a Scotch Canadian who walked back from the German lines with his intestines extruded. A successful resection of six feet of small intestine was performed by Owen Richards, and the specimen is in the Museum of the Royal College of Surgeons of England.

Anaesthesia

Gas-and-oxygen produced the best results in the surgery of gunshot wounds of the abdomen: the finest statistics of all came from that excellent surgeon D. C. Taylor, who had the good fortune to be associated with Geoffrey Marshall. Not only was the latter a most able administrator of gas-and-oxygen, but he also taught its use to many of those charged with the duty of giving anaesthetics in the clearing stations. The badly injured abdominal case proves an easy subject for gas-and-oxygen administration. Only a lunatic would employ spinal anaesthesia, but I made much use of supplementary local or regional anaesthesia, unless the proximity of contaminated or septic wounds precluded it. Ether gave the best results in the hands of the majority of anaesthetists, and is perhaps the most useful of all anaesthetics. The employment of the barbiturates is to be deprecated in those with grave abdominal injury, and reliance should be placed upon morphine, omnopon, scopolamine, atropine, and such well-tried pre-operative injections.

Speed is the handmaid of success in the operative treatment of wounds of the abdomen, by whatever agency produced. There is no room for the surgical tortoise on the floor of any operating theatre in a casualty station or advanced base which is dealing with gunshot injuries of the belly. The captain of a surgical team who lacks the power to hurry wastes his own time and also that of nurses, anaesthetist, and henchmen; for not only will he fail to save those wounded men who might have

been rescued by one of a faster turn of speed, but he will also be debarred by the passage of time from extending help to others who are looking to surgery to save their life and limb.

Operation

In cases where there is more than one wound it is of paramount importance to deal with those situated on back, buttocks, or the posterior aspect of the lower limbs before the abdomen is opened. When a patient has had a laparotomy the act of turning in order to secure ready access to a wound on the back produces a great fall of blood pressure, which may prove fatal. This instruction cannot be too firmly insisted upon: the hindmost shall be first!

In most cases it will be wise to make a median or paramedian incision of generous dimensions. On opening the abdomen the first step will be to control such haemorrhage as is taking place; the bleeding most frequently comes from the mesentery, but may originate in a wound of omentum or the bowel itself. The intestine may bleed freely, as may the stomach, especially the vessels along its curvatures, and also on the walls of the viscus itself. The liver, spleen, and kidney must be investigated as possible sources of intraperitoneal bleeding; in the case of the spleen and kidney it is wise not to remove the injured organ unless haemorrhage is menacing life. A conservative attitude should be especially adopted in the first instance in respect of kidney injuries, and although in a certain number of cases where conservatism has at first been shown a secondary nephrectomy may prove necessary, a considerable proportion of kidneys are saved.

A retroperitoneal haematoma, if leaking into the peritoneal cavity, may demand attention, and severe haemorrhage from the inferior vena cava has been controlled successfully by suture (Sampson), or more easily by one or more pressure forceps applied to the rent in the vein, and left in position for some days with the handles projecting from the abdominal wound (D. C. Taylor, Gordon-Taylor).

Small Intestine

The small intestine, as that portion of the digestive tract most liable to injury, must be systematically inspected, coil by coil. It is well to start at the ileo-caecal junction and work upwards to the duodeno-jejunal flexure; on the other hand, the direction may be reversed. The surgeon must satisfy himself as to the condition of each loop on the first inspection: there must be no second look, after each coil has in its turn been replaced inside the abdomen. The patient is already shocked: evisceration and rough handling will augment the shock and jeopardize his life.

The surgeon must remember the possibility of wounds between the layers of the mesentery, and must examine any haematoma, especially if crepitant, in the vicinity of the duodenum, lest a retroperitoneal rupture of this fixed part of the small gut be overlooked. Perforation, or even rents of the small bowel, with the corolla-like eversion of the mucosa (Fig. 1), can well be dealt with by simple suture, and this method of repair should always be employed wherever it seems appropriate. A single Lembert stitch of silk or thread, on a round-bodied needle, suffices for the treatment of this type of perforation.

The pathological anatomy of gunshot wounds of the abdomen is hardly likely to differ, save in degree, from those encountered in the war of 1914-18; but if surgical technique does vary in the future the explanation will

be found in the greater shattering effect of high explosive, which is more likely to produce wounds of the intestinal tract necessitating resection rather than conservative repair.

FIG. 1.—Penetrating wound of small intestine of gunshot origin, showing the corolla-like eversion of the mucosa. (War Collection, R.C.S.)

Resection of small intestine should be employed in the following circumstances:

(a) The separation of the intestine from its mesentery for a distance of over three-quarters of an inch. (This understates the figure given by several writers on military abdominal surgery.) In the event of severe contusion or laceration of the implicated bowel any mesenteric detachment must be regarded still more seriously.

(b) Where the proximity of multiple wounds is likely to render the results of their individual suture a mosaic of threads or a misshapen patchwork, probably resulting in interference with the mechanical function of the bowel.

(c) In cases of intestinal infarction.

(d) When the weight of the missile has crushed the life out of the damaged intestinal coil.

(e) Where perforations are so numerous and extensive it may be less time-consuming to include all the lesions in one segment of bowel ablated.

The old boggy of the dangerous mesenteric angle was dispelled in the last war, and few operators entertain that surgical respect for the jejuno-ileum which is felt towards the large bowel.

(The article will be concluded in next week's issue)

We have received from Sir Henry Wood the statement of receipts and payments of the Henry Wood Jubilee Fund, which was organized to endow beds in London hospitals for British orchestral musicians. The amount received from all sources was £8,824, and of this sum £8,500 has been paid to five hospitals in the London area and one on its borders. The balance, less a small sum expended on postage, printing, and stationery, has been handed to the British Musicians' Pension Society, 21, Albert Embankment, S.E.11, which administers and acts as referee of the fund.