

GUNSHOT WOUNDS OF THE ABDOMEN

A SURVEY OF 238 CASES

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PRIOR TO WORLD WAR I conservative treatment was generally advised for gunshot wounds of the abdomen received during battle. In the American Civil War there were 3,690 such cases, with a mortality of 90 per cent.¹ In the Spanish-American War there were 44 cases reported. Four were operated upon, and all four died. Of the remaining 40 that were treated conservatively, 25 died, a mortality of 62.5 per cent.¹ During the Boer War (1900) and the Russo-Japanese War (1904-1905) these patients were treated by starvation and large doses of morphine.² Because of such war reports, the military surgeons in the early days of World War I were of the opinion that practically all cases recovered were not operated upon. The reports from civil life pointed to a more favorable result with early operation. Grant,³ in 1899, collected 253 civilian operated cases of gunshot wounds of the abdomen, with a mortality of 52 per cent.

Early in World War I, Leriche⁴ reported that the mortality with conservative treatment was over 80 per cent, and advised early operation. In 1916, Wallace⁵ reported a study of 1,200 cases of gunshot wounds of the abdomen among the British Expeditionary Forces. In this large group the mortality of the operative cases was 53.9 per cent, which was not strikingly less than the total mortality of 60.2 per cent, including the nonoperative cases. In 1917, Lockwood and Kennedy⁶ reported 500 cases seen in an advanced casualty station. There were 356 operative cases, with a mortality of 51.7 per cent.

In 1924, Condict⁷ reported nine deaths in 20 cases of gunshot wounds of the abdomen seen at the Gouverneur Hospital, New York. In 1931, Billings and Walking⁸ reported 114 cases from Philadelphia, with an operative mortality of 48.2 per cent. Prey and Foster⁹ reported a 68 per cent in 22 cases. McGowan¹⁰ analysed 164 cases of penetrating wounds of the abdomen, of which 64 were gunshot wounds, with a mortality of 59.3 per cent. Oberhelman and Le Count¹¹ reviewed 343 cases from the Cook County Hospital, with a mortality of 61.4 per cent in the operative cases. In 1938, Taylor¹² reported 101 cases of gunshot wounds of the abdomen which included 11 that had been shot with shotguns. There was a mortality of 53.4 per cent for the operative cases of the entire group. In an analysis of 35 personal cases Storck¹³ was able to show a mortality of 40 per cent. In 1941, Rippey¹⁴ reviewed 369 cases that were seen in a 17-year period. Three hundred and thirty-seven of the patients were operated upon, with a mortality

of 60.5 per cent. The mortality of 29 of these cases treated in 1940 was 41.3 per cent. He also presented 36 cases of shotgun wounds of the abdomen, with a mortality of 80.5 per cent. More recently, Hamilton and Duncan¹⁵ reviewed 336 cases of penetrating wounds of the abdomen. The total mortality for 190 gunshot wounds was 51 per cent; the operative mortality for 182 cases was 48.9 per cent.

This study is based on 238 patients who were admitted from January 1, 1937, to January 1, 1943, to the Surgical Service of the Emory University division of Grady Hospital, with the provisional diagnosis of gunshot wound of the abdomen. All of the patients were Negroes. Those who died in the emergency clinic before admission to the wards are not included. With this exception, the cases were consecutive. Of the 238 patients included in this series, 29 were shotgun wounds and 209 were produced by rifle or pistol.

Shotgun Wounds.—Of the 29 patients wounded with shotguns, two died before any operative procedure could be carried out. Nine patients were not operated upon because it was thought that very few, if any, of the pellets had entered the abdominal cavity and that the small perforations, should there be any, would seal spontaneously. In this group there was one death from pelvic abscess and peritonitis. This death occurred three weeks after admission. One of the unoperated patients required a transfusion after passing fresh blood in the stools. Six of the operative cases required resection of involved intestine; one of these survived, and in this instance an exteriorization and delayed anastomosis was done. Those requiring resection were shot at close range with resulting extensive destruction of the abdominal wall, and often there was serious damage to the liver, kidney, pancreas and large blood vessels. The mortality for the operated group was 55.5 per cent, and the total mortality for the entire group, including the unoperated cases and those that died immediately after admission, was 44.8 per cent (Table I).

TABLE I
SUMMATION OF 29 CASES OF SHOTGUN WOUNDS

	Died Immediately	Operated		Not Operated	
		Died	Improved	Died	Improved
1937.....			1		1
1938.....		2			2
1939.....	1	1			
1940.....		2	2		5
1941.....	1	4	2		
1942.....		1	3	1	
	—	—	—	—	—
	2	10	8	1	8

Pistol and Rifle Wounds.—In the group of 209 patients who were shot with pistols or rifles, 15 died before any operative procedure could be carried out. These patients were admitted in severe shock and did not respond to intravenous fluids or transfusions. One patient refused operation and left the hospital against advice; it was thought that his only injury was to the liver. His death was not subsequently recorded. Thirteen patients

were not operated upon because it was thought that the bullet did not enter the peritoneal cavity; one of these died, and autopsy revealed a large abscess in the right paracolic space. One patient was admitted to the hospital with an abscess extending above the umbilicus and pointing in the pelvis, three weeks after having received a bullet wound in the right lower quadrant. She improved after drainage of the abscess. Of the 181 patients in this group who were operated upon, 84 died and 97 were discharged improved, making a mortality rate in the operative group of 46.4 per cent. The total mortality, including those that died soon after admission, was 47.8 per cent (Table II).

TABLE II
SUMMATION OF 209 CASES OF PISTOL AND RIFLE WOUNDS

	Died Immediately	Operated		Not Operated	
		Died	Improved	Died	Improved
1937.....	4	21	18		3
1938.....	5	15	17		3
1939.....	1	11	9		
1940.....	2	15	18		3
1941.....	1	16	18	1	1
1942.....	2	6	17		2
	15	84	97	1	12

Injuries Found at Operation.—In the group of 181 patients wounded with pistols and rifles who had exploratory celiotomies, a combination of large and small intestinal wounds was found most frequently. Injury to the small intestine alone was next frequent and injury to the large intestine alone was third in order of frequency. The injuries and results are recorded in Table III.

Cause of Death.—Seventeen of the 238 patients died immediately after admission, and four died on the operating table. Shock and hemorrhage were striking findings. Forty-seven of the 94 postoperative deaths (50 per cent) occurred within 48 hours. These deaths are arbitrarily classified as due to shock and hemorrhage, pneumonia and peritonitis, or combinations of these. Mason,¹⁷ and Loria¹⁸ have emphasized the influence of hemorrhage on the mortality. Severe blood loss seems to predispose to the development of pneumonia and peritonitis, hence there is much confusion of these factors as the actual cause of death in the early postoperative period. Twenty deaths occurred between the second and seventh postoperative days and, with one exception, all were due to pneumonia or peritonitis. The exception was a case with evisceration on the fifth and death on the sixth postoperative day. The late complications and their results are shown in Table IV.

Chemotherapy.—Thirty-three of the entire operative group of 199 patients were given sulfanilamide. Fourteen received the drug subcutaneously and 19 received it both subcutaneously and intraperitoneally; the number of deaths was six and five, respectively, making a mortality of 33 per cent. The drug seemed to be of considerable value in controlling the peritonitis. The average amount used intra-abdominally was 5 Gm.

TABLE III
TABULATION OF LOCALIZATION AND RESULTS ON PISTOL AND RIFLE WOUNDS OPERATED UPON

	No. of Cases	Died	Lived
Stomach	8	4	4
Stomach and small intestine	3	2	1
Stomach and liver	1	1	0
Stomach and kidney	1	1	0
Stomach and pancreas	2	1	1
Stomach and colon	4	3	1
Stomach, pancreas and kidney	1	1	0
Stomach, kidney and spleen	1	1	0
Stomach, colon and small intestine	1	1	0
Stomach and chest	2	2	0
Liver	16	3	13
Liver and kidney	6	4	2
Liver and chest	1	1	0
Liver and colon	1	0	1
Liver, stomach, pancreas and kidney	1	1	0
Small intestine	37	14	23
Small intestine and colon	32	15	17
Small intestine and bladder	2	1	1
Small intestine, bladder and rectum	3	1	2
Small intestine and head	1	1	0
Duodenum and colon	1	1	0
Duodenum and liver	2	2	0
Large intestine	17	8	9
Colon and appendix	1	1	0
Colon and chest	1	1	0
Bladder	3	0	3
Gallbladder, liver and stomach	2	0	2
Kidney	3	0	3
Kidney and spleen	2	1	1
Kidney, colon and small intestine	4	3	1
Kidney and chest	1	1	0
Spleen, large and small intestine	3	2	1
Blood vessels:			
Aorta and vena cava	1	1	0
Aorta and small intestine	1	1	0
Vena cava and small intestine and colon	1	1	0
Portal vein	1	1	0
Common iliac	1	1	0
No perforations found	7	1	6
No peritoneal perforation	5	0	5
	181	84	97

Diagnosis.—In most instances, the diagnosis offers little difficulty. It is desirable to ascertain the time interval between the injury and hospitalization and, if possible, the direction of line of fire. As emphasized by Meyer and Shapiro,¹⁹ the back and sides, as well as the front of the abdomen, should be inspected and palpated carefully. When there is no wound of exit, frequently the bullet may be felt immediately beneath the skin at some distance from the point of entrance. Eisberg²⁰ has called attention to the need for careful study of the point of entrance in order to determine the direction of the bullet. When the bullet enters the skin obliquely, an area of abrasion appears on the proximal side of the wound and an area of undermining in the subcutaneous tissue. Muscle rigidity may be absent or as pronounced as that found with ruptured viscus. Palpation of the umbilicus or palpation of the pelvic peritoneum by rectum

TABLE IV
LATE POSTOPERATIVE COMPLICATIONS OTHER THAN PNEUMONIA AND PERITONITIS

	No. of Cases	Deaths
Postoperative obstruction requiring operative relief	5	2
Pelvic abscess	8	5
Empyema	3	3
Liver abscess	2	1
Subdiaphragmatic abscess	1	0
Pylephlebitis	1	1
Postoperative evisceration	5	1
Granuloma of lung	1	1
Arteriovenous fistula (femoral), postoperative gangrene of leg	1	1
	27	15

will reveal cases with minimum peritoneal irritations. Occasionally, when the internal injury is confined to the chest and associated with a hemothorax, there may be rigidity and tenderness of the upper abdomen. The presence or absence of peristalsis cannot be relied upon; it may be present when there is either blood or small amounts of solid feces present in the abdominal cavity. Many of the cases seen early have peristalsis.

Immediately upon admission to the hospital a urine specimen should be collected and examined for blood. If no urine or only a few drops of blood are found on catheterization, it is probable that there has been a perforation of the bladder. Roentgenologic examinations are helpful in many instances. They may indicate the position and probable course of the bullet or may reveal the presence of free air in the peritoneal cavity, and thus influence the location of the incision. Some patients have practically no abdominal findings except the wound of entrance; therefore, it is best to explore the wound of entrance to determine the depth and direction of penetration or to explore the abdominal cavity if it is at all possible that the bullet had entered it. To await signs of peritoneal irritation is not justifiable. Peritoneoscopic examination has been advocated by Hamilton²¹ in questionable cases of penetration of the peritoneum.

PREOPERATIVE OPERATION

Patients in shock are immediately placed in Trendelenburg position. Fluids are administered intravenously in all cases. Many of the patients will require blood or plasma. When urgency demands, Group "o" blood may be given without cross-matching. Morphine sulphate is administered immediately unless the patient is in an alcoholic stupor. Warm blankets and hot water bottles are placed about the patient. A tube is inserted into the stomach through the nose, the gastric contents are aspirated, and the tube is left in place. If sufficient time elapses in the preoperative period, 500 cc. of 0.8 per cent (4 Gm.) sulfanilamide, is given subcutaneously as the initial dose. Mixed antianaerobic serum and 1500 units of antitetanic serum is administered prophylactically to all patients. Attempts are made to move the patients to the operating room quickly and in the best possible condition. Supportive measures can be continued during the operation.

Anesthesia.—Although spinal anesthesia has been advocated for selected

cases, its safety cannot always be predicted. Nitrous oxide-oxygen induction followed by ether is safest. Some method for aspirating the pharynx and trachea should be available.

OPERATIVE PROCEDURE

Wounds of entrance and exit are first excised, treated with sulfanilamide crystals, and packed.

Muscle-splitting rectus incisions have been used for all explorations. In most instances this is placed on the right side and gives ample exposure to explore the entire contents of the abdominal cavity. Occasionally, the left rectus incision, or a transverse incision in the flank, will offer better exposure of the area of greatest damage.

Immediately upon opening the abdomen the contents of the peritoneal cavity are aspirated. Vigorous bleeding, if present, is controlled. Usually, bleeding from the liver can be temporarily controlled with moist, hot packs, and bleeding from large mesenteric vessels with digital compression of the root of the mesentery, until clamps can be placed on the open vessels. Hemorrhage from wounds of the larger vessels is controlled with digital pressure until the site of bleeding is exposed and sutured. Autotransfusions, as suggested by Hamilton and Duncan,¹⁵ may be employed under desperate circumstances.

Usually, the cecum is examined first; the small intestine is then inspected from the ileocecal junction to the ligament of Treitz, using warm, moist packs to handle the intestine. Any perforations are repaired as they are found. Should a resection be necessary, clamps are placed on the open ends as a landmark, while the remainder of the small intestine is examined; thus avoiding the possibility of performing two anastomoses that could readily be converted into a single one without the loss of too large a segment.

The large intestine is explored next. Solid feces is removed with dry gauze sponges. The stomach and retroperitoneal structures are then carefully examined. Moderately-sized retroperitoneal hematomata are left undisturbed unless they involve the kidneys, pancreas or duodenum. Longer incisions and evisceration, as advocated by McGowan,¹⁰ and Connors,²² should be used if areas of injury cannot be exposed adequately. Minor lacerations of the kidney or spleen can usually be sutured; otherwise these organs should be removed. Most wounds of the liver are not bleeding at the time of exploration, but if active bleeding is present sutures on a large, half-round, blunt needle can be used. In some instances it is necessary to use a gauze pack which is brought out through the incision or a stab wound. Perforations of the diaphragm (on the left) should always be closed to avoid the possibility of herniation.

All perforations in the intestines are freed of protruding mucosa and closed transversely with a running suture of fine chromic catgut, which includes all layers. This, in turn, is inverted with interrupted sutures of fine silk. Silk has been used on many occasions for the initial line of sutures and no

apparent difficulty has been encountered. However, silk should never be used in bladder mucosa since it may initiate calculus formation.

After completing the exploration and repair of injuries, the peritoneal cavity is again aspirated. No attempt should be made to irrigate the peritoneal cavity. Peritoneal drains are not indicated. Four to 6 Gm. of sulfanilamide crystals are dusted into the abdomen. At the present time this seems to be the drug of choice for these cases.^{23, 24} The peritoneum is closed with catgut. The remainder of the wound, including all layers except the peritoneum, is closed with through-and-through sutures of silver wire or silkworm gut. About 1 Gm. of sulfanilamide is placed in the incision.

POSTOPERATIVE TREATMENT

The patients are placed in Fowler's position after reaction, unless shock is evident. Constant suction with an indwelling tube is applied to the stomach and 4,000 to 5,000 cc. of fluids is administered daily. Sulfanilamide is given subcutaneously, using 150 cc. of 0.8 per cent solution (1.2 Gm.) every six hours. Frequent blood sulfanilamide determinations should be made. The appearance of jaundice and anemia are indications for discontinuation of the drug. In the absence of toxic effects, administration is continued subcutaneously until sulfadiazine can be taken by mouth. This usually takes four to five days in uncomplicated cases. When peristalsis is normal, the abdomen soft, and flatus is being passed by rectum, gastric suction can be discontinued and water given by mouth. During the immediate postoperative period oxygen with 5 per cent carbon dioxide is administered every 4 hours to prevent pulmonary atelectasis. Obstruction and paralytic ileus occurring in the early postoperative period respond well to the use of the Miller-Abbott tube. Feeding is begun on the sixth or seventh day. Wound infection, pelvic abscess and subphrenic suppuration should be carefully watched for.

DISCUSSION.—The mortality rate in gunshot wounds of the abdomen has remained high (and will probably continue to remain high) because there is always a large percentage of deaths by virtue of extensive damage to the abdominal viscera and large blood vessels. The factors that determine mortality fall into two groups: (1) Those that cannot be influenced by the surgeon's skill and management; and (2) those that can be minimized by greater efficiency in treatment. The severity of the wound, the time required to reach the hospital where adequate therapy can be instituted, and the physical status of the patient prior to receiving the injury are obviously uncontrollable factors. The type of anesthesia, the prompt but complete exploration, with repair of damage, the proper use of chemotherapy, and the postoperative management are all factors which are definitely controllable.

Many of the patients considered here were intoxicated and some were in an alcoholic stupor. Their state of nutrition was frequently poor; syphilis and cardiovascular diseases were common. The severity of hemorrhage and shock was controllable to some extent by the prompt administration of

plasma or whole blood, thus allowing the patients to be brought to operation more quickly, and increasing the chances of survival.

SUMMARY

1. A statistical review of 238 cases of gunshot wounds of the abdomen is presented.

2. The general plan of treatment is discussed.

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