

Gunshot Wounds of the Abdomen

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THIS IS A CONTINUING serial study of civilian gunshot wounds of the abdomen as seen in a large metropolitan hospital over a 40-year period. It began in 1930–1938 and indicated a startling 52.8 per cent mortality for all perforations of the abdominal cavity.⁴ When an abdominal viscus had been injured, 60 per cent died. To present day standards this is unbelievable and yet these were average figures of the period.

From that time to the present, similar studies were made in the Marion County General Hospital covering the periods 1938–1946,⁵ and 1955–1962.² The present report presents the experience for 1962–1970. It is noted that no analysis was made during the years 1946–1955. Including this undocumented period there were some 700 patients operated upon at our hospital for gunshot wounds of the abdomen, 1930–1970.

A word might be said about our “gunshot” clientele. Nearly two-thirds were Negro in a city in which blacks constitute one quarter of the population. As might be expected two-thirds of all patients were in their young active years, 18 to 35. In the early years of the study practically all were charity patients. Presently, many are subscribers to health insurance.

The Marion County General Hospital is a large city hospital into which which many patients are channeled who are injured in auto accidents and practically all who sustain gunshot wounds. It is a teaching hospital associated with Indiana University School of Medicine. It is staffed by interns, residents and a voluntary staff which in recent years is partly replaced by a full time staff. Throughout this 40-year period, although the staff has changed, those in charge have been well trained, qualified and dedicated in the field of trauma and violence.

There are few examples which illustrate recent surgical progress so dramatically as that seen in the treatment of

gunshot wounds of the abdomen. The decrease in the expected mortality to one fifth during four decades is startling and gives cause for reflection and analysis of this progress. The over-all picture is briefly indicated in Table 1. A 60 per cent rate of mortality through a relatively short period of 40 years has been reduced to 12.7 per cent.

Also shown are the percentage of negative explorations for abdominal gunshot wounds which have remained relatively constant. No excuses are offered for these incorrect diagnoses. We expect them in the future and feel that this level of “mistakes” should be maintained. If allowed to drop to a lower level it is our belief that the death rate would rise above the present enviable figures. During the four periods reported there were 92 negative exploratory operations. In these periods there was but one operative death. Autopsy findings failed to indicate a cause.

The hospital's policy is to perform immediate laparotomy unless it can be definitely shown that the bullet did not enter the abdominal cavity. Watchful waiting suggested by some is not advocated.⁶ Beneath the innocent cutaneous puncture mark may lie damage requiring the utmost skill to attempt a repair. We have not used opaque media and x-ray to determine penetration of the abdomen but have resorted to judgment as to course of the bullet, clinical findings and occasionally local exploration of the tract. A period of observation in stab wounds has been useful but rarely in gunshot wounds.

During the last 8-year study there were 39 negative explorations in 246 laparotomies. The injuries of six patients which were observed without operation proved to be tangential wounds and two shotgun wounds with a diffuse pellet pattern which were also successfully observed. To complete this most recent group of un-

operated patients there were three who had central nervous damage precluding and overshadowing all thought of abdominal exploration. These patients were omitted from analysis since the abdominal wound was not the deciding factor. Patients who died before admittance to the hospital were excluded from study.

Also indicated (Table 1 and Fig. 1) is a distressing feature of modern American life. After a brief decline during the World War II years, gun-play on our streets has spiraled and is increasing at a very rapid rate. It is not known what part of all civilian gunshot wounds occur in the abdomen but it is assumed that this percentage by chance remains constant and is representative. The escalation of violence has been noted by others^{3,6,7} with no indication of control. Only the care and treatment affects the medical profession but certainly this violence is cause for worry and serious concern.

Table 2 analyzes the mortality rate resulting from various organ injuries through the four periods. In our earlier reports and as noted by others, multiple viscus injuries are prone to carry an increased mortality rate. This feature is unexplainably absent in the most recent group.

It was interesting to find that in the years 1962 to 1970, deaths from injuries of the stomach and/or small intestine dropped to less than 3%. This represented one death in 42 patients caused by a shotgun blast at close range with death occurring in the operating room.

We are beginning to save a few patients with injury to the great vessels. During the first two series these patients never reached the operating room. As noted less than half of ten patients survived following injuries of the aorta, renal artery or portal vein. In 21 injuries to the iliacs or vena cava since 1955 there were six deaths. This indicates progress but it is not expected to improve much more nor to be as dramatic as the improvement after injuries of other viscera. Vascular injuries require a tremendous amount of transfused blood at operation. The average was 7.2 units per case and the maximum given was 25 units.

There has been considerable discussion among members of the department as to whether or not all colon injuries and repairs should have a diverting colostomy

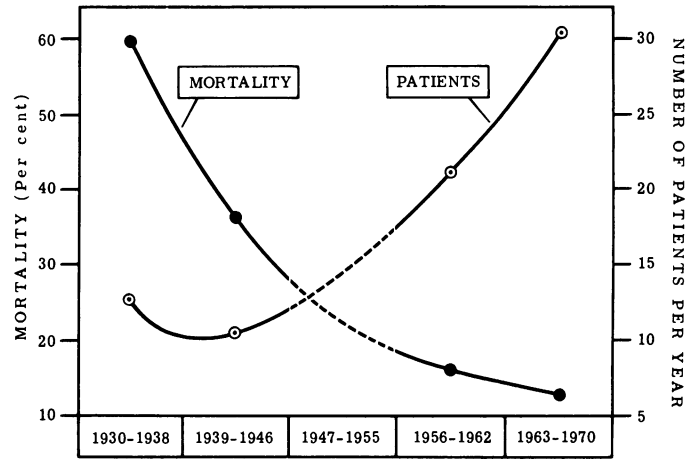


FIG. 1. Graphic representation mortality and incidence of gunshot wounds of the abdomen.

TABLE 2. Mortality Per Cent Resulting from Various Injured Organ

	1930-1938	1938-1946	1946-1955	1955-1962	1962-1970
Stomach-Small	45.	0	—	15	2.38
Colon-Rectum	33.	33.	—	0	11.8
Gut + Solid Visus	84.	70.	—	36	11.9
Solid Visus	70.	5.3	—	13.	11.1
Great Vessel—					
Aorta, Renal A.					
Portal V.	—	—	—	75	62.
Iliacs, Vena Cava	—	—	—	45.	20

at the time of exploration. The procedures used and results obtained are listed for the most recent study (Table 3). Although the numbers are small it would seem that uncomplicated wounds to the colon can safely be closed primarily and that many complicated colon injuries may safely receive the same treatment. Also indicated is the fact that extremely severe injuries definitely should have primary colostomies with or without exteriorization of the injured segment but that there will be a sizeable mortality in such cases despite this procedure. On the basis of such cases we are in agreement with the Houston series,¹ believing that each situation must be individualized.

Shotgun injuries have not been compared with other

TABLE 1. Overall Results—574 Surgically treated Patients

	1930-1938	1938-1946	1946-1955	1955-1962	1962-1970
Mortality with					
Visceral Injury	59.8%	36.2%	—	16%	12.7%
Neg. Explorations	14. %	21.4%	—	17.5%	15%
Pts. Explored	101.	84.	—	148	241

TABLE 3. Colon Injury 1962-1970

	Primary Closure	Colostomy or Exteriorization
Colon Injury Only	3 cases All lived	4 cases All lived
Colon Injury + Other Viscera	13 cases 1 died	43 cases 6 died

bullet wounds of the abdomen as they are a thing apart. If inflicted at a distance where they produce a diffuse spattered pattern they are often benign and the patient may be observed. However, at close range they are as lethal as a cannon, removing all tissue in their path. During the most recent study there were 13 shotgun wounds with ten operations and three deaths. Three were safely observed.

It is surprising that approximately 20% of the patients in the last series had self inflicted wounds. Of these instances it is impossible to determine those patients with suicidal intent since the history often changed after admission.

A word might be said about high velocity gunfire in comparison with the usual low velocity bullet in our civilian injuries. The occasional wound inflicted by a high velocity missile left its unmistakable telltale mark of great tissue damage. Our statistics would be far less favorable had these weapons predominated.

During the last 246 explorations there were at least two overlooked perforations which eventually lead to death. This is a tragedy but perhaps can not be entirely prevented since an overly long and tedious search at operation may also add to the risk.

Annalysis of Improved Mortality

No single feature stands out above all others as being responsible for this gratifying salvage of patients with abdominal gunshot wounds. We find instead a number of improvements along the 40-year span which when taken singly are only moderate innovations, but added together they have provided significant advances.

First of all the manner of managing patients has changed completely. In the early days the staff doctor was alerted at all hours to help with or actually perform the operation. This routine was used before the 4-year residency period. At the present time the fourth year resident who has had more experience with cases of abdominal trauma than the average staff doctor, handles it well and competently. He merely notifies his staff and proceeds with the necessary treatment. Often when the great vessels are involved there is no time for even this procedure. Chests and abdomens have been opened in the emergency room in an attempt to control hemorrhage. These heroics will continue to yield only a small salvage rate although none of these patients were saved before.

Next in importance is the introduction and continued use of the naso-gastric suction tube. Strange as it now seems, this procedure was not used at all during the first reported period. The remarkable improvement indicated in the second period (1938-46) must in great part be due to a flat abdomen and deflated gut which provided

a better physiological situation to effect wound healing and sustain life by postoperative naso-gastric suction.

Third in importance must be knowledge of electrolyte balance and gas exchange. The latter has come into clinical use only during the most recent study and the former received little consideration during the first periods of study. The assessment of both values are now considered vital to the management of any gunshot wound. In this connection the amount of blood given preoperatively during consecutive periods is interesting. This amounted to an average of 20 ml. per patient during the first period; had increased to 580 ml. for the next 8 years; 1250 ml. for the third period and decreased to 875 ml. for the most recent years. The decline is not due to lack of appreciation of this colloid but the realization that in the early stages, dextran or Ringer's lactate can be safely substituted for blood. The above figures exclude the amount of blood that was given to patients with great vessel injuries.

Antibiotic agents are considered by many to be the most important factor in the survival of these patients. This is an argued point. Antibiotic agents were not available during the first two periods of the continuing study and yet one of the most remarkable improvements in the mortality rate occurred between the first and second periods. Unfortunately every patient in the most recent study received antibiotic agents in huge amounts. There were no controls who received none. During the third period study (1955-1962) antibiotic agents which were used in most patients but not all. This provided no important differential.

It is our personal opinion that the administration of antibiotic agents are of little use in controlling general peritonitis or abdominal abscess. They can be of inestimable value in combatting the complications of pneumonia, pylephlebitis and pylelitis, which may be deciding factors of life or death. They should be administered but indiscriminate use may not affect the primary abdominal contamination. Reliance on drugs must never be substituted for good surgical treatment.

Lastly, much credit for recent improvements in mortality rates must be given to the anesthesia department. Our patients are in competent hands throughout the operative care and later in the intensive care units. There has been considerable advancement from the old methods of open drop ether given by an available intern or medical student.

It has not been the purpose of this paper to report the details of operative procedure or gut repair which have been adequately described many times. Technical details vary moderately at other institutions and while arguments may arise from such disagreements, they are of little consequence in the overall picture. Technical

changes of operation in our own institution have varied little in the past 40 years but there has been a vast change in the modern overall care of patients. It is to this factor that we direct attention.

Addendum

Recently there have been several spurious reports advocating lavage of the contaminated general peritoneal cavity with saline alone or mixed with antibiotic agents. May it be stated that the remarkable improvement indicated in the present review was achieved without this practice.

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