

THE INFLUENCE OF HÆMORRHAGE IN ABDOMINAL GUNSHOT INJURIES

BY FRANK L. LORIA, M.D.

OF NEW ORLEANS, LA.

FROM THE DEPARTMENT OF SURGERY OF THE TULANE UNIVERSITY SCHOOL OF MEDICINE
AND THE NEW ORLEANS CHARITY HOSPITAL

IN 1925, the New Orleans Charity Hospital Surgical Staff, at the suggestion of Dr. Rudolph Matas, appointed a committee to study all cases of abdominal gunshot injuries admitted to the hospital and to report on the subject at the end of the year. Professor Matas was named chairman of this committee and the writer secretary. It became the duty of the secretary to observe all cases admitted to the hospital for treatment, to follow, if possible to do so, their progress while in the hospital as well as after leaving the hospital in the event of recovery, and to observe and record all autopsies on the fatal cases. The latter became possible through the kindness and courtesy of the New Orleans Parish Coroner, Dr. George F. Roeling, who rendered invaluable coöperation during the period of study. The study extended over the years 1925 and 1926. After the cases admitted during the first five months of 1927 had been observed, it became necessary to discontinue the work. However, during the period named, 137 cases of abdominal gunshot injuries were treated at this institution, eleven died at the scene of the shooting, and the author has added five cases treated at Hotel Dieu (one case), Touro Infirmary (two cases), and the Presbyterian Hospital (two cases)—making a total of 153 cases in this series. The author has felt it a duty incumbent upon him to make reports of this study, aside from the reports made to the Charity Hospital Surgical Staff and which were never published. The present communication is concerned chiefly with the types of hæmorrhage observed and the causes of death, as well as the relationship of the one to the other.

In two rather recently published reports the author had occasion to analyze and evaluate the significance of injury to the various abdominal viscera and structures of importance, and later to discuss the factors of prognostic value in abdominal gunshot injuries. The discussion in each instance was based on the detailed study of 112 cases of this type comprising the entire group treated at the Charity Hospital during the years 1925 and 1926. In each of the presentations the very important rôle played by hæmorrhage in these cases was only casually mentioned, it being felt that a discussion involving this phase of the subject might be better given in a future report.

It was not until about July, 1925, that it was decided to classify hæmorrhage seen in these cases into slight, moderate, and massive. From then on the author classified each case as best possible in accordance with this classification. The cases which had already been observed were the most difficult

to classify from this point of view and the greatest number of the "undetermined type of hæmorrhage" group really come from them. Their histories were again reviewed and the records in the coroner's office again consulted for any remarks regarding the amount of blood lost in each case. In a large number of cases the writer observed the amount of blood lost while watching the laparotomy or at the autopsy in the event of a fatality. When it was impossible to observe the operation the operator of the particular case was consulted in regard to this as well as other features concerning the case at hand and the data recorded. The differentiation of the types of hæmorrhage in this series, therefore, is more or less approximate, there being no definite line of demarcation between them. Blood counts were not made because the indications for operation were usually based upon the clinical picture. No laboratory method of any kind was used which might have given a more accurate idea as to the severity of the hæmorrhage. In each case, therefore, the quantity of blood lost was a matter of estimation, the interpretation of which was left to the observation of one of several persons—particularly the operator of the case. The writer realizes and agrees that this was not altogether desirable. However, under the circumstances it was impossible to do otherwise. Again, the personal equation was a matter of great importance and various operators probably interpreted the amount of hæmorrhage in their cases somewhat differently.

No definite amount of blood lost was used as a basis from which to draw conclusions. However, although the amount of blood lost was not measured in any case, the loss of an amount up to 500 cubic centimetres was considered as slight; up to approximately 1,500 cubic centimetres as moderate; and above this the hæmorrhage was looked upon as massive. Each of the cases dying at the scene of the shooting disclosed an abdomen filled with blood at autopsy, with injury to some large blood-vessel. Several presented multiple gunshot wounds. Four of the five cases treated at the above-named private institutions presented massive types of hæmorrhage. In the fifth patient, who died of general peritonitis, the type of hæmorrhage could not be determined.

History of Abdominal Injuries.—One of the earliest references to a penetrating abdominal injury is given by Xenophon in his *Anabasis*. The case was that of a Greek captain who, after being wounded, made his way back to camp holding his bowels in his hands. Various ancient authors tell about the treatment of these injuries, most of which were of course caused by swords, knives, and other sharp or blunt instruments. In most cases the injury was chiefly an evisceration and surprisingly frequently the victim recovered. Gunshot injuries of the abdomen naturally were not seen until after the introduction of gunpowder and its use in firearms, some time during the fourteenth or fifteenth century. At first, the velocity of the bullet being relatively low, the injuries were less extensive. As the type of firearm improved and the velocity of the bullets increased, the wounds became more serious. Guthrie, in 1827, gives an excellent description of the management

ABDOMINAL GUNSHOT INJURIES

of this type of injury during the latter part of the eighteenth and early part of the nineteenth centuries. One of the most popular therapeutic measures during this time and up through the Crimean War in such injuries was bleeding or blood-letting. Since then, however, this practice very rightfully has been discontinued. It was during the Crimean War that Baudens suggested a small exploratory opening into the abdomen to determine the presence or absence of bleeding into the peritoneal cavity. If the sponge was returned without evidence pointing to active bleeding, the cavity was closed, otherwise the opening was enlarged and an attempt to arrest the hæmorrhage made. In a small monograph, published in 1891, Martin and Hare likewise stressed the importance of hæmorrhage in these cases. The early statistics during the World War showed a very high mortality until these cases were handled more thoroughly at the clearing stations nearer the front. Many who might otherwise have succumbed to hæmorrhage were saved by earlier explorations. The loss of blood and the adequate treatment of hæmorrhage have been recognized to be factors of great prognostic importance in the successful treatment of these cases.

In 1918, Fonio called attention to the importance of transfusions in gunshot wounds of the abdomen, the priority of which he ascribes to Agote. Rather recently Mason, in a study of 127 cases of gunshot and other injuries to the abdomen, reasoned that the greatest cause of death in these cases is hæmorrhage. He divided his cases into a "large hæmorrhage series" and a "small hæmorrhage series." The mortality in the former group was 87.2 per cent., and in the latter group 36.1 per cent. This author is convinced that more of these individuals could be saved if transfusions were used more frequently. A few months ago Billings and Walking, in reviewing the experiences of the Pennsylvania Hospital in Philadelphia, from 1909 to 1930, inclusive, outlined briefly the histories of 136 cases of abdominal gunshot wounds. Among them were found fifteen cases showing a slight hæmorrhage, nineteen showing a moderate hæmorrhage, eighty-six showing a severe hæmorrhage, and in sixteen cases the type of hæmorrhage was not given. In the group showing a severe hæmorrhage, fifty-nine, or 68.8 per cent., died, eighteen, or 30.5 per cent., of these being moribund on admission. The remainder—forty-one cases—were judged to be sufficiently good risks for exploration.

Charity Hospital Statistics.—The author believes that, aside from an actual seat of war, no hospital in the world sees and treats as many cases of abdominal gunshot wounds as the New Orleans Charity Hospital. This institution affords the most excellent opportunities for the observation and management of this very serious type of injury. We have here a veritable laboratory wherein a wealth of material not seen at any time except during wartime is almost constantly at hand. From 1900 to 1931, inclusive, there have been admitted for care into this institution 1,299 cases of abdominal gunshot wounds. This figure does not include the cases in whom a diagnosis of non-penetrating abdominal gunshot wound was made, nor does it include a

great number of cases dying during transportation to the hospital or dying in the admitting room as they arrived to be admitted. Among this number, 889 were colored and 410 white victims—a predominance of more than two-to-one in favor of the colored patients. The total number of deaths in this series of 1,299 cases was 807—giving a mortality rate of 62.3 per cent. During these thirty-two years there has been admitted to the institution one case almost every nine days, the average per annum being slightly more than forty cases.

A decennial study of the above figures shows that while the number admitted has increased slightly, each decennium the mortality has kept abreast of the admissions, there being very little variation in the proportion of cases dying.

DECENNIUM	ADMISSIONS	DEATHS	MORTALITY RATE PER CENT.
1900-1909.....	364	231	63.4
1910-1919.....	402	241	59.9
1920-1929.....	446	290	65.0
1930-1931.....	87	45	51.7
TOTALS 32 years.....	1299	807	62.3

CHART I.—Showing the decennial admission of cases to the New Orleans Charity Hospital since 1900 with the mortality rate for each decennium.

Prior to 1892, abdominal gunshot injuries admitted to this institution were treated conservatively. Practically none of the cases were operated upon. In 1902, Fenner reported 152 cases operated upon at this hospital from 1892 to 1901, inclusive. This author included stab wounds in the series and expressed himself in favor of exploring cases of penetrating wounds of the abdomen if they were seen sufficiently early. The mortality in this group of cases was 57.23 per cent. Apparently, the mortality increased later because a period followed during which relatively few operations were performed. It appears that only a small number of cases were operated upon up to 1914, following which explorations again seemed to be the preferable routine. Lately the loss of blood as a factor in the prognosis has come to be considered as very important. Until recently relatively few patients were given transfusions. However, during the past few years it appears that more have received this form of therapy.

Causes of Death.—Generally speaking, the two main causes of death in abdominal gunshot injuries are (1) extensive hæmorrhage associated with shock, and (2) general peritonitis. Other complications, such as subphrenic abscess, gangrene of a segment of intestines, pulmonary embolism, *etc.*, form a considerably smaller group—less than 8 per cent. of the sixty-eight fatalities among the 112 cases previously reported. In that group of deaths, 92.6 per cent. died of hæmorrhage and shock (54.4 per cent.) and general peritonitis (38.2 per cent.). Subcutaneous injuries to the various abdominal viscera cause death in more or less the same way. However, in the latter type of

ABDOMINAL GUNSHOT INJURIES

injury true shock from trauma appears to be a more conspicuous factor than in gunshot wounds. On the other hand, stab wounds and even cases of severe impalement appear to show less shock than gunshot wounds. This was very interestingly observed recently in an unusual case of abdominal injury by impalement reported by Sutherland. The existence of true shock, otherwise than from hæmorrhage in abdominal gunshot wounds, has probably been overemphasized. My observations on these cases impress me with the fact that the extent of shock varies with the amount of hæmorrhage and is proportional to it. This influence of hæmorrhage on shock has lately been carefully studied by a number of investigators. Phemister and Blalock were convinced, following severe trauma to an extremity of their experimental animals, that the reason for the shock was the loss of blood into the traumatized tissues. Blalock has also repeatedly produced shock by removing large amounts of blood from the experimental animal. The greater the hæmorrhage the more severe the shock, and those animals losing the largest amounts of blood responded proportionately less favorably to the various therapeutic measures no matter how soon the treatment was begun. In this series of 153 cases, also, the greater the quantity of blood lost by the victims the more severe the shock and the worse the prognosis.

Among the 153 cases there were 100 fatalities or a mortality of 65.3 per cent. This mortality of course included eleven cases dying at the scene of the shooting, and which might rightfully be eliminated for the time being. Without them the mortality rate on the 142 cases receiving hospital attention would be 62.6 per cent. Analyzing the causes of death in this group it will be seen that fifty-five cases, or 55 per cent., of the total died of hæmorrhage and shock, thirty-four cases died as the result of general peritonitis, while only eleven cases died from all the other causes combined. The first two factors, therefore, accounted for 89 per cent. of the fatalities. The other 11 per cent. died of subphrenic abscess (one case), gangrene of a segment of bowel associated with septicæmia (four cases), pulmonary embolism (one case), intestinal obstruction (two cases), and one case each of respiratory failure, acute gastric dilatation, and bronchopneumonia with peritonitis. Hæmorrhage in the majority of cases is, therefore, directly responsible for a fatal issue. However, it is the author's belief that this factor also influences greatly a fatal termination attributable to other causes, being more or less indirectly responsible for a great many of the other deaths, especially many of the cases dying of general peritonitis.

The loss of blood is undoubtedly the most influential factor concerned in the outcome of abdominal gunshot injuries. Mason has also arrived at the same conclusion. It is true also of the present series among which twenty-one cases showed a slight hæmorrhage, forty-two a moderate hæmorrhage, sixty a massive type of hæmorrhage, and in thirty the type was not determined. A further study of the statistics reveals that the mortality rate in this series of 153 cases increased with the quantity of blood lost. Accordingly, in the first group, *i.e.*, with slight hæmorrhage, there was a mortality rate of 28.57 per

FRANK L. LORIA

CAUSES OF DEATH	HÆMORRHAGE			
	Slight	Moderate	Massive	Undetermined
Abscess—subphrenic	0	0	0	1
Pneumonia and peritonitis	0	1	0	0
Gangrene and septicæmia	0	2	2	0
General peritonitis	5	21	2	6
Embolism—pulmonary	0	0	0	1
Hæmorrhage and shock	0	0	52	3
Acute gastric dilatation	0	1	0	0
Intestinal obstruction	1	0	1	0
Respiratory failure	0	1	0	0
TOTALS	6	26	57	11

CHART II.—Showing the causes of death in the 100 cases dying compared to the type of hæmorrhage in each group.

cent., in the second group, *i.e.*, those with moderate hæmorrhage, the mortality was 61.9 per cent., whereas the cases with a massive hæmorrhage had a 95.00 per cent. mortality. In the undetermined group in this series there was a mortality of 36.66 per cent., which is of course somewhat difficult to interpret.

In the present series 102 cases were found to have either a moderate or massive hæmorrhage. Among these, eighty-three, or 81.4 per cent., resulted in fatalities. Since the total number of deaths was 100, it results that 83 per cent. of the fatal cases fell in these two groups. A determination of the chief cause of death in these two groups shows that fifty-two of the fifty-seven cases, or 91.2 per cent., dying in the "massive hæmorrhage group," died as the result of hæmorrhage associated with shock. On the other hand, the predominant cause of death among the twenty-six fatalities occurring in the "moderate hæmorrhage group" was general peritonitis, which was responsible for the death of twenty-one, or 80.7 per cent., of the fatal cases in this group. Although the loss of blood, into the peritoneal cavity or elsewhere, lowers the resistance of these patients, the experiments of Sparks and David would appear to indicate that an infection in the peritoneal cavity is not otherwise influenced by the presence of blood. Is it not likely that among these twenty-six fatal cases several might have recovered had it not been for the loss of that quantity of blood which actually made the difference in their resistance to the peritoneal infection? Would all of them have died of general peritonitis if they had lost only a slight amount of blood? There can be but little doubt that the loss of blood is a most influential factor even among the cases dying of general peritonitis.

The greatest cause of death in the "slight hæmorrhage group" in the present series is also general peritonitis, being responsible for five of the six fatalities. However, it is this type of case which has the best chance for recovery as shown by a comparatively lower death rate. Although most of them received injuries to the gastro-intestinal tract, the majority overcame the peritoneal infection. The occurrence of only a slight hæmorrhage in these cases is undoubtedly a very influential factor in their recovery. Among the

ABDOMINAL GUNSHOT INJURIES

group in which the type of hæmorrhage was not determined there were eleven fatal cases—three dying as the result of hæmorrhage and shock and six from general peritonitis. The other two deaths were from pulmonary embolism and subphrenic abscess.

TYPE OF HÆMORRHAGE	TOTAL	LIVED	DIED	MORTALITY RATE PER CENT.
Slight.....	21	15	6	28.57
Moderate.....	42	16	26	61.90
Massive.....	60	3	57	95.00
Undetermined.....	30	19	11	36.66
TOTALS.....	153	53	100	65.36

CHART III.—Type of hæmorrhage and mortality in each group.

The Influence of Transfusion.—One of the most difficult problems faced by the operator in the treatment of abdominal gunshot injuries is securing a donor for transfusion. There can be no doubt but that the giving of blood in these cases ranks next in importance to an intelligently planned and rapidly but carefully performed operation that is actually twofold in its purpose—first and most important the securing of bleeding points and second the repair of injuries to the hollow viscera. Unfortunately, the securing of donors in these cases is usually hard. As in all emergencies these cases are rushed to the nearest hospital frequently by individuals who are perfect strangers to them and who usually have no more than a passive inquisitive interest in them. Such individuals as a rule depart very rapidly when asked to give blood to the victim. Frequently, also, by the time the patient's family or friends get to him the blood will do little or no good. These two factors seemed to be rather paramount in the management of the 153 cases making up this series, or rather the 142 receiving hospital care. On the other hand, a great many operators feel that their task is finished as soon as the operation is completed and very little thought and time are given to the post-operative treatment of the case at hand. A great many remain content with the administration of glucose or saline by infusion or hypodermoclysis and fail to take advantage of transfusing the patient—which in the light of our present knowledge is the method par excellence in the treatment of hæmorrhage and even shock. Very often transfusion is not resorted to except as a therapeutic measure of last resort—the period during which it could have done the most good being sacrificed—and the patient succumbs in spite of it. On the other hand, many patients, though conscious upon arrival at the hospital, have lost so much blood that no amount of blood will save them or give them a better chance for life.

In the present group of 142 cases receiving hospital care, only sixteen, or 11.26 per cent., were given transfusions. This is, of course, a very small number from which to draw any conclusions. The majority of these patients were Negroes and at the New Orleans Charity Hospital the greatest difficulty is encountered in securing donors for these individuals. Among the sixteen

cases receiving transfusions one was in the "slight hæmorrhage group," seven in the "moderate hæmorrhage group," five in the "massive hæmorrhage group," and three in the group having an "undetermined hæmorrhage." Further study shows that eight recovered and that four of the fatal cases occurred in the massive hæmorrhage group. If it were possible to make any deductions from such a small number, the giving of blood to these patients would seem to exert a beneficial influence. The author feels as Mason does that more and stronger efforts should be made to secure blood for these victims.

TYPE OF HEMORRHAGE

A	Slight		Moderate		Massive		Undetermined	
	Lived	Died	Lived	Died	Lived	Died	Lived	Died
	15	6	16	26	3	57 *	19	11

Transfusions given—type not being specified.

B	Yes		No		Yes		No		Yes		No		Yes		No	
	0	15	1	5	4	12	3	23	1	2	4	53 *	3	16	0	11

CHART IV. A—Mortality according to the type of hæmorrhage. B—Number of cases receiving transfusions under each type of hæmorrhage—whole or citrated blood.

* Includes cases dying at the scene of the shooting.

SUMMARY.—Abdominal gunshot wounds form one of the most formidable groups of surgical emergencies that the surgeon is called upon to confront. Until well beyond the middle of the nineteenth century bleeding was one of the chief therapeutic measures in the management of these cases, which probably explains, in great part, the mortality of 92.5 per cent. during the Crimean War, according to Lagarde. It appears that the simple matter of discontinuing blood-letting in these cases was sufficient to allow the mortality to drop to 69 per cent. during the Franco-German War even though few if any were explored, and 67.1 per cent. during the Spanish-American War. Today, instead of bleeding, we give blood, and the addition of this therapeutic measure alone seems to have helped reduce the mortality rather materially. This, too, in spite of operative care—although there is no denying the fact that operative interference is the therapeutic measure of first importance. The factor of prime importance, therefore, in these cases, is hæmorrhage. The amount of blood lost by the victim seems to influence, more than any other single factor, the prognosis, the mortality rising proportionately and rather definitely with the amount of blood lost. General peritonitis, which still continues to be a factor of serious consideration in abdominal gunshot injuries, is only second to hæmorrhage and shock among the causes of death. It seems that up to the present time too little attention has been paid to the importance of the loss of blood in these cases. There is no doubt that transfusions are as valuable in these cases as they are in cases of ruptured ectopic pregnancies or hæmorrhage from any other cause.

Conclusions.—(1) The New Orleans Charity Hospital statistics on penetrating abdominal gunshot injuries show 1,299 cases as having been treated

ABDOMINAL GUNSHOT INJURIES

at this institution in the thirty-two years from 1900 through 1931 with a gross mortality of 62.3 per cent.

(2) A series of 153 cases of penetrating abdominal gunshot wounds, 137 of which are from the Charity Hospital, have been carefully observed and studied.

(3) The causes of death in this series have been given and an attempt made to discuss them thoroughly. Hæmorrhage and shock headed the list, having accounted for 55 per cent. of the fatalities, while general peritonitis accounted for 34 per cent. of the deaths. Only 11 per cent. died of other causes in this series.

(4) Hæmorrhage as a rule accounts for most of the shock seen in these cases, the depth of shock being directly proportional to the quantity of blood lost by the victim.

(5) The mortality increases proportionately with the amount of hæmorrhage. Cases losing less blood have a considerably better chance for recovery. The author has divided the hæmorrhage observed, grouping the various cases according to the amount of blood lost.

(6) Transfusions are of indispensable value, second in importance only to operative interference as a therapeutic measure in these cases. Only sixteen of the 142 cases receiving hospital treatment in this series were given transfusions. The mortality among them was 50 per cent.

BIBLIOGRAPHY

- ¹ Xenophon: *The Anabasis*. Book II, Section V. Translation by C. L. Brownson. G. P. Putnam's Sons, New York, 1928.
- ² DeLint, J. G.: *The Treatment of Wounds of the Abdomen in Ancient Times*. *Annals of Medical History*, vol. ix, p. 403, 1927.
- ³ Guthrie, G. J.: *A Treatise on Gunshot Wounds*. Third Edition, printed for Burgess and Hill. Medical Booksellers, London, 1827.
- ⁴ Baudens, M. L.: *Clinique des Plaies D'Armes a Feu*, Paris, 1836.
- ⁵ Baudens, M. L.: *La Guerre de Crimée, etc.*, Paris, 1858.
- ⁶ MacLeod, G. H. B.: *Surgery of the Crimean War*, Richmond, Va., 1862.
- ⁷ Martin, E., and Hare, H. A.: *Wounds and Obstructions of the Intestines*. W. B. Saunders Co., Philadelphia, 1891.
- ⁸ Fenner, E. D.: Report of Six Cases of Penetrating Wounds of the Abdomen Submitted to Abdominal Section. *ANNALS OF SURGERY*, vol. xxxv, No. 1, p. 15, 1902.
- ⁹ Transactions of the Philadelphia Academy of Surgery, Meeting October 7, 1901. Gunshot Wounds of Abdomen. *ANNALS OF SURGERY*, vol. xxxv, No. 1, p. 111, 1902.
- ¹⁰ Fonio, A.: Transfusion of Blood after Gunshot Wounds of Abdomen. *Cor. Bl. D. schweiz. Aerzte.*, vol. xlviii, p. 1719, 1918; *Abst. Jour. Am. Med. Assn.*, vol. lxxii, p. 614.
- ¹¹ Lee, B. J.: Wounds of the Abdomen. *The Medical Department of the United States Army in the World War*. Surgeon General's Report, vol. xi, Part I, p. 443.
- ¹² Mason, J. M.: The Influence of Hæmorrhage on the Mortality in Gunshot and other Injuries of the Abdomen. *ANNALS OF SURGERY*, vol. lxxix, p. 382, 1924.
- ¹³ Bivings, C.: Treatment of Gunshot Wounds of the Abdomen. *Jour. Med. Assn. of Georgia*, vol. xvi, p. 166, May, 1927.
- ¹⁴ Loria, F. L.: Visceral Injuries in Gunshot Wounds of the Abdomen. *New Orleans Med. and Surg. Jour.*, vol. lxxx, p. 282, 1927.

FRANK L. LORIA

- ¹⁵ Dickinson, A. M.: Treatment of Non-penetrating Wounds of the Abdomen. *American Jour. Surgery*, vol. ii, p. 43, 1927.
- ¹⁶ Blalock, A., and Harrison, T. R.: The Regulation of Circulation, *etc.* *Am. Jour. Physiol.*, vol. lxxx, p. 157, 1927.
- ¹⁷ Blalock, A.: Mechanism and Treatment of Experimental Shock. *Arch. of Surg.*, vol. xv, p. 762, 1927.
- ¹⁸ Vance, B. M.: Subcutaneous Injuries of the Abdominal Viscera. *Arch. of Surg.*, vol. xvi, p. 631, March, 1928.
- ¹⁹ Phemister, D. B.: The Vascular Properties of Traumatized and Laked Bloods and of Blood from Traumatized Limbs. *ANNALS OF SURGERY*, vol. lxxxvii, p. 806, 1928.
- ²⁰ Sparks, J. P., and David, V. C.: Effect of Blood in the Peritoneal Cavity upon the Production of Peritonitis in Animals. *Surg., Gynec., and Obst.*, vol. xlviii, p. 780, June, 1929.
- ²¹ Blalock, A.: Experimental Shock. *Arch. of Surg.*, vol. xx, p. 959, June, 1930.
- ²² Loria, F. L.: Prognostic Factors in Abdominal Gunshot Injuries. *New Orleans Med. and Surg. Jour.*, vol. lxxxiii, p. 393, December, 1930.
- ²³ Sutherland, D. M.: An Unusual Abdominal Injury. *Brit. Med. Jour.*, vol. 1, p. 264, 1931.
- ²⁴ Billings, A. E., and Walking, A.: Penetrating Wounds of the Abdomen. *ANNALS OF SURGERY*, vol. xciv, p. 1018, December, 1931.
- ²⁵ Lagarde, L. A.: Gunshot Injuries, pp. 245-297. New York. Wood, 1916.