

Surgical Judgment in the Management of Penetrating Wounds of the Abdomen:

Experience with 2212 Patients

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The records of 2212 patients with penetrating wounds of the abdomen treated at three Charity Hospitals have been reviewed. A policy of selective observation for 393 stab wounds has: (a) reduced the percentage of negative explorations from 53% to 11% (b) reduced overall complication rate from 14% to 8% (c) reduced average hospital stay from 7.8 days to 5.5 days (d) reduced the percentage of patients subjected to exploration from 95% to 45%. Only 10 patients who were initially observed required subsequent delayed exploration. A mortality rate of 1.4% was recorded in stabbed patients since 1964. None of the patients who died had any delay of appropriate surgical intervention. The policy of selective observation has been safely and effectively applied to the management of stab wounds by a diverse group of surgical house officers. Among 1032 patients with gunshot wounds, 842 patients had one or more injured organs. Mortality rate was 12.5%. Analysis of records showed that 97% of injured patients could have been identified as such at the time of admission. Abdominal signs were the most common indicator, but the presence of shock was the most accurate and ominous sign of intra-abdominal injury. Of 138 patients who had negative laparotomy, 97 could have been identified preoperatively by a protocol allowing a period of observation. No complication occurred in 52 patients with gunshot wounds who were managed by observation. Negative exploration doubles hospitalization time and has a 10% complication rate in patients with gunshot wounds. Careful exercise of surgical judgment and selective observation should be considered in the management of penetrating wounds of the abdomen.

IN 1969 IT WAS REPORTED from our Department that adoption of a policy of selective observation in the management of patients with abdominal stab wounds reduced the incidence of negative laparotomy from 53%

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to 10% and reduced overall morbidity from 27% to 12%.¹² The policy of selective observation replaced one of mandatory exploration for *all* stab wounds of the abdomen which allowed no exercise of surgical judgment. In the previous study, all patients were seen by a member of the staff (FCN) under a strict prospective protocol. Since 1969 all patients with stab wounds admitted to the L.S.U. Service have been managed under a policy of selective observation by the house staff.

This paper will document the results of selective observation in the management of patients with abdominal stab wounds. In addition, we have reviewed the management of gunshot wounds of the abdomen with a view to establishing the feasibility of extending selective observation to the management of *all* penetrating wounds of the abdomen.

The records of 2212 patients with penetrating wounds of the abdomen were reviewed for this report (Table 1). There were 1180 patients with stab wounds. Management during three eras was analyzed. Four hundred-thirty-two patients with stab wounds were managed at Charity Hospital in New Orleans from January 1, 1964 to February 28, 1967 under the old policy of mandatory exploration. One hundred-twenty-six patients were treated on the L.S.U. Service at Charity Hospital in New Orleans from March 1, 1967 to February 28, 1969 under a strict prospective protocol of selective observation. Since the completion of the prospective study, 266 patients have been treated by the L.S.U. Service at three

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TABLE 1. *Penetrating Wounds of the Abdomen*
2212 Cases Reviewed

Stab Wounds (1180 Patients)	
1 Jan. '64 to 28 Feb. '67 (432 cases)	All stab wounds, CHNO
1 Mar. '67 to 28 Feb. '69 (126 cases)	All stab wounds, LSU Service, CHNO
1 Mar. '69 to 30 June '73 (266 cases)	All stab wounds, LSU Service, 3 Charity Hospitals
Gunshot Wounds (1032 Patients)	
1 Jan. '66 to 30 June '73	All gunshot wounds, CHNO and 2 other Charity Hospitals

Louisiana Charity Hospitals (Earl K. Long Hospital, Baton Rouge, Lafayette Charity Hospital, Lafayette and Charity Hospital, New Orleans) from March 1, 1969 to June 30, 1973.* These patients are included in the third group to be analyzed. This last group of patients was managed by the house staff under a general policy of selective observation (Table 2). The results of management in the three eras have been compared.

From January 1, 1966 to June 30, 1973, 1032 patients with gunshot wounds of the abdomen were treated at Charity Hospital in New Orleans and at the two hospitals in Baton Rouge and Lafayette. The data from these patients have been analyzed to assess the feasibility of extending the policy of selective observation to patients with gunshot wounds.

Sex, race and age statistics from the two groups of patients are summarized in Figs. 1 and 2. Ages ranged from 2 mos. to 77 years. Most of the injuries occurred in young patients between the ages of 18 and 30. Most patients were black and most were male. There was essentially no difference between the stab wound and gunshot wound populations with respect to age, sex and race.

Stab Wounds

In our previous communication, the case of B.T. was cited as an example of the inadvisability of rigid

TABLE 2. *Penetrating Wounds of the Abdomen: Indications for Surgery*

Signs of Peritoneal Injury
Unexplained Shock
Loss of Bowel Sounds
Evisceration of Viscus
Positive Diagnostic Study:
1. Blood in stomach, bladder or rectum
2. Needle paracentesis or peritoneal lavage
3. IVP, cystogram, cystoscopy
4. Plain x-ray (air, displacement, etc.)
5. Arteriogram
Observe All Others 24-48 Hrs.

* 356 stab wounds managed by Tulane Service CHNO since March, 1967 were reviewed but are not included in the statistical analysis.

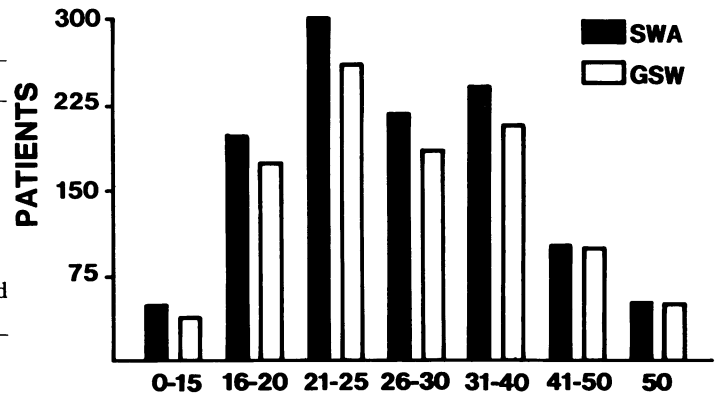


FIG. 1. Age distribution of 2212 penetrating wounds of the abdomen.

adherence to a mandatory policy of exploration for stab wounds of the abdomen. The patient had undergone six negative explorations for self-inflicted stab wounds. This patient has managed to have himself explored 3 additional times despite our new policy (Table 3). On two recent occasions the house staff explored the patient without indications because of the fear that intra-abdominal adhesions had made injury more likely. This patient's resourceful persistence has provided us with 1% of our total experience with stab wounds!

The management of patients in the three eras is summarized in Table 4. A marked reduction in the number of negative explorations ("No Injury") resulted from the institution of selective observation in 1967. The low incidence of negative laparotomy has continued as control of the protocol shifted to the house staff in 1969-73. During the latter era, the percentage of negative laparotomies has varied from a high of 18.2% in 1972 to a low of 5.6% in 1973. Despite the fact that these patients have

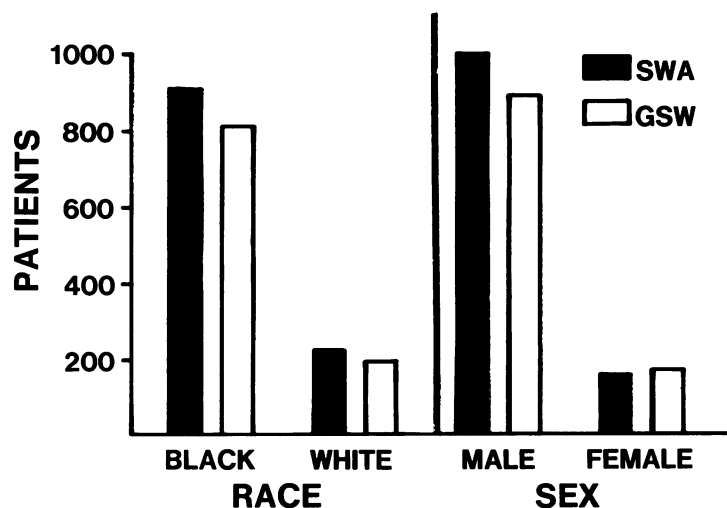


FIG. 2. Sex and race distribution 2212 penetrating wounds of the abdomen.

TABLE 3. *The Saga of BT*

Date	Weapon	Indication for Surgery	Injury
12 June 66	Ice pick	None	None
23 June 66	Ice pick	None	None
31 July 66	Ice pick	None	None
29 Sept. 66	Coat hanger	None	None
5 Oct. 66	Tooth brush	None	Small bowel*
21 Dec. 66	Ball point pen	None	Small bowel*
3 Feb. 67	Coat hanger	None	Not explored
10 Oct. 67	Wire	None	Not explored
30 Oct. 71	Wire	None	Small bowel*
17 Dec. 71	Coat hanger	None	None
6 June 73	Coat hanger	None†	Small bowel

* Iatrogenic injury.

† No signs or symptoms of injury. Explored because weapon appeared to be penetrating bowel on x-ray.

been managed by a changing group of young surgeons in training, the incidence of negative laparotomy has remained satisfactorily low. Less than half of all patients with stab wounds have required an operation. The continued success of the policy of selective observation in the hands of young and inexperienced surgeons has been reassuring.

Mortality for the entire series of 1180 patients was 1.4%. Only 17 patients died, three-fourths from hemorrhage and shock. Most of the deaths occurred shortly after admission. All deaths occurred in patients whose signs and symptoms mandated early laparotomy. None of the patients had their surgical exploration delayed as the result of our protocol (Table 5).

The policy of selective observation has *not* delayed the exploration of those patients who have intraperitoneal injuries. Patients with injuries required 4.9 hrs. to get to the operating room in 1964-67 and 4.5 hrs. in 1969-73. Evidence of an effective triage system is shown by the progressively decreasing time required by injured patients to get to the operating room (Table 6).

None of the patients managed by a period of observation suffered serious complications. Since 1967 only 10 patients initially observed have required subsequent exploration for injuries (there have been 4 negative explorations in initially observed patients). None of the

TABLE 4. *Stab Wounds: Management of Patients*

Disposition Group	1964-67 (432 Pts.)		1967-69 (126 Pts.)		1969-73 (266 Pts.)	
	No. Pts.	%	No. Pts.	%	No. Pts.	%
No exploration	21	4.9	74	58.3	136	51.1
No injury	229	53.0	13	10.2	31	11.6
Injury, no repair	42	9.7	4	3.2	14	5.3
Injury, repair required	140	32.4	35	27.6	85	32.0
% Operated	95.1		41.7		48.9	

TABLE 5. *Stab Wounds: Deaths (1964-73)*

Major Cause of Death	No. of Patients
Shock, hemorrhage	12
Sepsis	4
Negative laparotomy (sepsis)	1
Mortality Rate:	17/1180 1.4%

No patient had delayed laparotomy. All had symptoms or signs mandating early exploration.

patients whose operation was delayed by a period of initial observation suffered any serious sequelae although one patient with a jejunal laceration delayed for 12 hours had a wound infection. There has been a significant reduction in overall morbidity from 13.9% in 1964-67 to 8.3% in 1969-73 (Table 7).

Total hospitalization for all patients has also been substantially reduced by an average of two days (Table 8). The reduction in hospitalization has been most striking among the patients who had no intraperitoneal injury. Average hospitalization for this group of patients has been halved from 5.95 days to 2.97 days.

A change in the pattern of organ injury has been observed since the institution of the policy of selective observation (Table 9). In the earlier era, the liver was the most commonly injured organ. Since institution of selective observation liver injuries have dropped in frequency and small bowel laceration is now the most commonly encountered injury. This probably means that patients with trivial liver injuries are not being explored. In previous years, in our own institution, non-bleeding liver lacerations for which no treatment was required were very frequently encountered. These liver lesions produce few symptoms or signs and are undoubtedly being observed under our new protocol.

The institution of selective observation has allowed a far more flexible approach to the management of stab wounds. The protocol requires exercise of surgical judgment in each case (Table 2). Close observation of patients not operated upon immediately is mandatory. Despite faithful adherence to the protocol a small number of negative explorations continue to occur (10-12%). These may be the minimum consistent with safe practice. The major indications for surgery among injured patients have continued to be signs and symptoms of intraperitoneal injury (Table 10). In general, we have found that the differentiation of patients with injury

TABLE 6. *Stab Wounds: Preoperative Delay (Hours)*

Group	1964-67	1967-69	1969-73
No injury	6.0	4.6	6.1
Injury, no repair	5.1	4.3	5.6
Injury, repair required	4.9	5.1	4.5

TABLE 7. *Stab Wounds: Morbidity with Major Complications*

	No. Complications/No. Patients		
	(1964-67)	(1967-69)	(1969-73)
None	0/ 21	0/74	0/136
No injury	25/229	1/13	3/ 31
Injury, no repair	6/ 42	1/ 4	0/ 14
Injury, repair required	29/140	6/35	19/ 85
Totals	60/432	8/126	22/266
% Morbidity all Pts.	13.9	6.3	8.3

from those who have no intraperitoneal injury has been possible at the time of their first evaluation in the Accident Room. Only ten patients who were initially observed required subsequent exploration for injury. A most gratifying change since 1967 has been the marked reduction of explorations in patients who had *no* indication for surgery.

It is to be emphasized that no deaths have occurred among the 210 patients who have been observed since 1967.

Gunshot Wounds

Since 1966, 1032 patients with abdominal gunshot wounds have been treated at the three Charity Hospitals. The disposition and mortality rate of these patients is listed in Table 11. Six groups of patients have been defined: 1) patients with no exploration; 2) patients who had no injury (negative laparotomy); 3) patients with intra-abdominal injuries which did not require repair; 4) patients with one or two organs requiring repair; 5) patients with three or four organs requiring repair; and 6) patients with five or more organs requiring repair.

In general, the patients were managed under a protocol of mandatory exploration although a tendency to observe asymptomatic patients with gunshot wounds developed after institution of selective observation for stab wounds. Ninety-five per cent of all patients were explored. The incidence of abdominal injury is strikingly higher among gunshot wounds (81.6%) than among stab wounds where only one-third of patients sustain an injury.^{7,11,23} Nevertheless, there were 138 patients (13.4%) upon whom negative explorations were performed.

The mortality rate among gunshot wound patients was 12.5%. There were no deaths among the patients who

TABLE 8. *Stab Wounds: Average Hospitalization Time (Days)*

Group	1964-67	1967-69	1969-73
No exploration	2.7	2.2	2.0
No injury	6.2	7.9	7.2
Injury, no repair	8.9	7.3	8.4
Injury, repair required	10.9	9.6	11.7
Avg. all Patients	7.82	4.97	6.02
Avg. Among Patients with No Injury	5.95	3.05	2.97

TABLE 9. *Stab Wounds: Organs Injured*

Organ	(1964-67)	(1967-69)	(1969-73)
Liver	76	6	13
Sm. bowel	35	14	25
Colon	26	6	16
Stomach	27	4	16
Diaphragm	21	3	12
Spleen	11	2	14
Maj. vessel	9	0	6
Duodenum	4	3	3
Pancreas	3	0	5
Gallbladder	1	1	2
Kidney	5	0	2
Ureter	0	0	0
Other	14	5	13

were not explored or who underwent negative laparotomy. Mortality rate showed a good correlation with the number of organs injured. Among the patients with five or more structures injured, 41.7% died. All but one of the patients who died had unequivocal evidence of intraperitoneal injury at the time they were first evaluated. Half of the patients died within the first 24 hrs of admission in the accident room, operating room or recovery room (Table 12). The major cause of death was hemorrhage or shock. Two-thirds of the patients died of the consequences of hemorrhage, shock or renal failure. Sepsis in the form of pneumonia or peritonitis accounted for one quarter of the deaths.

Triage of patients with gunshot wounds was highly effective. Most patients were operated upon with a minimum of delay. Patients with lethal injuries or with 5 or more organs injured got to the operating room in the least time (less than 2 hours). Patients who had negative explorations took the longest to get to the operating room (Table 13).

Indications for exploration were evident in the vast majority of patients with injuries at the time of first evaluation in the accident room (Table 14). All of the patients with lethal injuries could have been identified by

TABLE 10. *Stab Wounds: Major Indication for Surgery*

Indication	Injury Found		
	(1964-67)	(1967-69)	(1969-73)
Shock	21	5	6
Abdominal signs	29	7	64
Absent bowel sounds	12	8	5
Evisceration	29	6	9
Diagnostic study	14	6	0
None	77	6	12
	No Injury Found		
Shock	5	1	0
Abdominal signs	9	4	9
Absent bowel sounds	5	0	3
Evisceration	8	3	0
Diagnostic study	1	2	0
None	197	3	15

TABLE 11. *Gunshot Wounds: Method of Management and Mortality* (Jan. 1, 1966—June 30, 1973)

Disposition Group	No. of Patients	% of Total	No. Dead	% of Group
No exploration	52	5.0	—	—
No injury	138	13.4	—	—
Injury, no repair	34	3.3	—	—
Injury, repair required (1-2)*	499	48.4	48	9.6
Injury, repair required (3-4)*	249	24.1	56	22.5
Injury, repair required (5+)*	60	5.8	25	41.7
Total	1032		129	12.5%

Per cent Explored: 95%

* Indicates number of organs injured

signs, symptoms or diagnostic tests. Only 3% of patients with intraperitoneal injury would have been subjected to any period of observation had the protocol of selective observation been in effect for gunshot wounds.

By contrast, among 138 patients who had a negative laparotomy, more than two-thirds had no signs or symptoms of intraperitoneal injury and probably could have been identified as patients without intraperitoneal injury had a protocol of selective observation been in effect. Thus, although their percentage of the total population of patients with gunshot wounds is small, it would appear that 90 or more patients without intraperitoneal injury might have been spared an unnecessary laparotomy. It should be noted that this ratio of identifiable patients with no injuries is the same as that observed among stabbed patients who had negative explorations during the era 1964-67.

Gunshot wounds inflict considerably greater morbidity than stab wounds. Average hospital time rises progressively with the seriousness of the injury as might be expected (Table 15). An overall major complication rate of 35.7% was noted in this series. This also rose progressively with the seriousness of the injury. Five-sixths of patients with five or more organs injured suffered a major complication. It is important to note that among the 190 patients with *No Injury*, negative laparotomy doubled hospitalization time and inflicted a 10% complication rate (Table 16).

The organs injured among 1032 patients with gunshot

TABLE 12. *Gunshot Wounds: Major Cause of Death*

Cause of Death	No. of Patients
Hemorrhage, shock	70
Peritonitis, sepsis	25
Renal failure	8
Pneumonia	6
Respiratory failure	4
Other	16
	129

66 patients died in Accident Room, Operating Room or Recovery Room.

TABLE 13. *Gunshot Wounds: Preoperative Delay*

Group	Average Hours to OR
No injury	3.4
Injury, no repair	3.4
Injury, repair required (1-2)*	2.7
Injury, repair required (3-4)*	2.1
Injury, repair required (5+)*	1.9
Deaths	1.5

* Indicates number of organs injured

wounds are listed in Table 17. Hollow viscus injuries comprise more than half the total. This fact is reflected in the incidence of deaths due to peritonitis and sepsis. It is important to note, however, that isolated hollow viscus injuries were seldom a cause of death.

Discussion

The substantial difference between the nature of civilian and military penetrating abdominal trauma was not really appreciated until Shaftan's¹⁸ classic paper in 1960. Shaftan demonstrated that patients with intraperitoneal injury could be identified with a high degree of accuracy and that the remainder of the patients could be managed safely by close observation. The adoption of his policy at our institution in 1967 produced a marked reduction in the morbidity, hospitalization time, and incidence of unnecessary operations, without altering mortality and without a serious complication in the 10 patients whose exploration was delayed by an initial period of observation. Since 1969 when the formal prospective protocol ended, all patients have been managed by the surgical house staff. The same low morbidity rate and low frequency of negative explorations has been maintained by this varied group of surgeons in training. This reassuring fact makes us feel confident that a policy of selective observation can be safely adopted by any competent surgeon adhering to the principles outlined in Table 2. Our residents were able to make the decision about exploration early in the patient's hospital course

TABLE 14. *Gunshot Wounds: Indications for Exploration*

Major Indication	Injury Found			Deaths
	No. of Organs Injured			
	1-2	3-4	5+	
Shock	74	74	36	88
Abdominal signs	322	130	16	21
Diagnostic study	33	23	5	9
None	90	12	0	0

Major Indication	No Injury Found	
	No Exploration	Negative Laparotomy
Shock	1	6
Abdominal signs	2	24
Diagnostic study	0	0
None	49	97

TABLE 15. *Gunshot Wounds: Hospital Stay*

Group	Hospitalization Time (Days)
None	3.8
No injury	8.5
Injury, no repair	6.1
Injury, repair required(1-2)	9.2
Injury, repair required (3-4)	18.7
Injury, repair required (5+)	22.5

because the vast majority of patients with intraperitoneal injury had indications mandating exploration *at the time of admission*. The large number of recent reports confirming satisfaction with the selective approach to management of penetrating wounds of the abdomen attests to its wide applicability.^{4,5,13-16,20,23} It is significant that there have been *no* institutions which have reported abandoning the selective approach once it had been adopted. By contrast, although a number of authors continue to express reluctance to adopt selective observation^{1,9,22} many institutions have abandoned mandatory exploration.

Several institutions^{2,19} have reported enthusiasm with the technique of radiologic demonstration of peritoneal penetration, first devised by Cornell *et al.*³ This technique can identify effectively peritoneal penetration with a high degree of accuracy. The technique was not used extensively in our series of patients since identification of patients with significant injuries has been relatively easy using conventional diagnostic methods. Moreover, the technique results in an excessive number of negative explorations since half of patients with peritoneal penetration have no injury to a viscus. Once the dye is injected into the wound tract, physical signs lose their validity and observation becomes more difficult.^{2,19}

Although Shaftan¹⁷ and others^{15,20} have applied the principles of selective observation to gunshot wounds, we have, in the past, limited our use of this approach to stab wounds. An aggressive operative approach to the management of gunshot wounds has been a long honored practice at our institution^{6,8,10,11,21} and we have been

TABLE 16. *Gunshot Wounds: Morbidity*

Group	No. of Patients	No. with Major Complications	% Complications
No exploration	52	0	0
No injury	138	14	10.1
Injury, no repair	34	6	17.6
Injury, repair required (1-2)	499	173	34.7
Injury, repair required (3-4)	249	125	50.2
Injury, repair required (5+)	60	50	83.3
Totals	1032	368	35.7

TABLE 17. *Gunshot Wounds: Organs Injured*

Organ	No. of Patients with Injury
Small bowel	348
Colon	296
Liver	296
Stomach	184
Kidney	123
Spleen	107
Pancreas	82
Great vessels	74
Duodenum	60
Gallbladder	32
Bladder	33
Other major vessels	99
Other organs (diaphragm, ureter, omentum, mesentery, etc.)	230

reluctant to change without adequate evidence that surgical judgment and observation could safely replace routine exploratory laparotomy. The need for reducing the high incidence of negative explorations and the relatively low incidence of intraperitoneal injury (40%) in stab wounds made this an ideal group of patients for evaluation. Our experience with this method of management in patients with stab wounds has convinced us that the principle of selective observation may be safely and effectively applied to gunshot wounds as well. The fact that the policy has been effective for stabbed patients even in the hands of inexperienced surgical house officers has been reassuring.

The most common indications for surgery in both stab wounds and gunshot wounds have been the signs of intraperitoneal injury familiar to all surgeons. These will identify the majority of patients. A *change* in bowel sounds has been particularly helpful as an indicator of intraperitoneal injury. Unexplained shock is highly accurate as an indicator of intra-abdominal injury. The presence of shock should be a mandatory indication for early exploration. Forty per cent of gunshot wound patients who were in shock at the time of admission died of their wounds. When diagnostic studies (Table 2) have been positive, they have proved highly accurate. When any of the diagnostic tests is clearly positive, early surgery is mandatory. Occasionally x-ray studies have proved misleading, such as in one of our patients with negative abdominal signs who underwent negative laparotomy because of a bullet in the midabdomen. (He had swallowed it!)

Analysis of the records of patients with intraperitoneal injury following gunshot wounds has indicated that only 2-3% of patients would have been subjected to observation. Similarly careful evaluation of the records of the 138 patients with *no injury* who were explored indicated that two-thirds could have been identified by a policy of selective observation. These conclusions, and the absence of complications in the 58 patients who were not operated

upon lead us to suggest that selective observation can be applied effectively and safely to the management of gunshot wounds of the abdomen. The percentage of patients who will be spared laparotomy will be smaller for gunshots than for stabs (60% vs 18%). Nevertheless, two-thirds of the 138 patients in this series who had a negative exploration would have been spared an unnecessary laparotomy had a policy of selective observation been in effect.

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DISCUSSION

DR. GERALD W. SHAFTAN (Brooklyn): My former Chief, Dr. Clarence Dennis has long insisted that operation was but a part of surgery; that the surgeon was a well-trained physician who also knew how to operate. It is not too chauvinistic, therefore, to suggest that the general, pediatric, cardiovascular, and thoracic surgeons each know at least as much about the disease processes they see as their internist colleagues. I feel it is reasonable, therefore, to make a plea for not treating civilian penetrating type injuries of the abdomen, even gunshot injuries, by dogma or dictum, as if we were mere surgical technicians.

The better shield, however, is hard facts. We agree entirely with Dr. Nance, and with other authors, that gunshot wounds are comparatively easy to evaluate clinically, and that the decision to operate can be made rapidly and accurately on these grounds alone.

In this earlier study we only operated upon two thirds of the patients with gunshot wounds. Our current reappraisal is not dissimilar in age and ethnic background from the author's series, and gunshot wounds have become a prominent part of our local battle casualties.

I read in *The New York Times* on Sunday that our outgoing Mayor has complained that the "Saturday night special" factories in Florida, Georgia, South Carolina and Virginia have put at least a quarter of a million illegal handguns into service in New York City; so that, while in 1960 out of 390 total homicides only 19% were due to bullet wounds, in 1972 handguns accounted for 49% of 1691 homicides.

Our injury rate follows suit. In 1960, one in twelve penetrating type wounds was gunshot. In 1973, five out of nine were due to bullets. Despite this increase, on average we are operating on a smaller percentage than in our previous series, and we still have no morbidity or mortality in those treated without operation.

The operated percentage varies, of course, from year to year, but on the whole New Yorkers, obviously, are just poor shots. Perhaps, however, our local gun club is getting better, because so far this year we have operated on 92% of the gunshot injuries that we have seen.

The point that Dr. Nance has modestly suggested, and which I exhort, is to examine each patient and think. I do not suggest that each of you jump into it with both feet, but that the first time that you find your clinical judgment correct, you will be