Indications for Operation in Abdominal Trauma

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IN general, traumatic wound therapy in civilians follows military practice. After World War II it was inevitable that the war time management of abdominal wounds should carry over into the peace time emergency rooms and operating theaters. The military practice of routinely performing early exploration was based on the almost uniformly fatal outcome of non-operative treatment of patients with intraperitoneal injuries [1]. The reduction of this rate was directly proportional to the reduction in the time interval between occurrence of the wound and repair [1,2]. Bowers [3] epitomized this policy of early surgery, "With penetrating abdominal wounds . . . the question is not if we should operate but when."

Routine early operation in abdominal trauma was carried out in our hospital in the early 1950's. In the period from 1952 to 1954, 133 patients with abdominal trauma were treated. In 75 per cent of these the injuries were of the penetrating type. (Table I.) Spreng [4], in an unpublished review of these cases, found that in seventeen of eighty-eight patients who underwent celiotomy there was no intra-abdominal injury. One patient died as a result of the exploration. Thirteen additional patients required no treatment at exploration; all these had liver injuries. Therefore, thirty patients or over one-third of those operated on did not require reparative surgery.

The patients were divided into three groups: *Group A* were patients who had evidence of intraperitoneal injury at operation or autopsy. *Group B* were patients who were treated without operation. *Group C* were patients who underwent celiotomy without findings of intra-abdominal injury.

The signs, symptoms and laboratory studies of these patients were correlated. (Tables II and III.) None of the patients in groups B or C had generalized, direct or rebound tenderness, abdominal muscular spasm or absent bowel

TABLE I
TYPE OF TRAUMA (133 PATIENTS, 1952–1954)*

Type of Trauma	No.	%	% Explored
Stab wound	88	66	53
Bullet wound	12	9	92
Auto accident	13	10	84
Falls	7	5	86
Other blunt	9	7	78
Total	137†	103	66

* After SPRENG, D. S., JR. [4].
† Four patients had combined trauma.

TABLE II
PERCENTAGE OF PATIENTS WITH ABDOMINAL SYMPTOMS (133 PATIENTS, 1952–1954)*

Symptoms	Group†		
	A	B	C
None	51	77	73
Local or regional pain	17	18	21
Generalized pain	27	6	6
Nausea, vomiting, hematemesis or proctorrhagia	20	0	0

* After SPRENG, D. S., JR. [4].
† A = Patients found to have visceral injury at operation or autopsy.
B = Patients treated but not operated upon.
C = Patients with no visceral injury found at operation.

TABLE III

PERCENTAGE OF PATIENTS WITH PHYSICAL FINDINGS (133 PATIENTS, 1952–1954)*

Findings	Group A	Group B	Group C
*Direct Tenderness**			
None	16	68	29
Local	14	18	50
Regional	30	14	21
Generalized	40	0	0
Rebound Tenderness†			
None	39	100	86
Local	6	0	0
Regional	20	0	14
Generalized	40	0	0
Spasm and/or Rigidity‡			
None	47	92	79
Local	2	0	7
Regional	20	8	14
Generalized	31	0	0
Bowel Sounds§			
Normal or hyperactive	36	100	90
Hypoactive	27	0	10
Absent	38	0	0

* Not recorded in 20 per cent.
† Not recorded in 45 per cent.
‡ Not recorded in 25 per cent.
§ Not recorded in 32 per cent.

sounds. In the main these patients had no abnormal abdominal physical findings. Therefore, if the ordinary criteria for an acute surgical condition of the abdomen had been used, exploration would have been avoided in all the patients in group C.

On the basis of Spreng's study the management of abdominal trauma was changed. Indications for operation became essentially the same as those used in general, non-traumatic, abdominal surgery. That is, peritoneal irritation evidenced by tenderness, rebound tenderness, spasm of the abdominal wall and/or reduced or absent peristalsis was considered of primary importance. Hematemesis, proctorrhagia or positive abdominal paracentesis became secondary substantiating signs.

TABLE IV

TYPE OF TRAUMA (180 PATIENTS, 1956–1958)

Type of Trauma	No.	%	% Explored
Stab wound	103	57	31
Bullet wound	9	5	55
Auto accident, pedestrian	18	10	28
Auto accident, driver or passenger	16	9	19
Falls	7	4	14
Other blunt	25	14	16
Miscellaneous	3	2	66
Total	182*	101	32

* Two patients had combined trauma.

METHODS AND MATERIAL

One hundred eighty consecutive patients with abdominal trauma admitted to the University Surgical Service and the Trauma Service of Kings County Hospital Center from January 1956 to December 1958, were studied. They ranged in age from two to ninety-one years; males predominated four to one. Two-thirds were Negro or Puerto Rican. Over 20 per cent of the patients were seriously intoxicated on admission. As a group they appeared to be of below average intelligence and were frequently belligerent, and often uncooperative both consciously and unconsciously. The operation, when indicated, was performed by the surgical house staff under supervision. Patients who were not operated upon were followed up closely by the house staff until there was no longer any question of intra-abdominal injury.

RESULTS

The type of trauma (Table IV) is unusual for a civilian institution [5]. Sixty-three per cent of the injuries were penetrating in type. Two patients had combined trauma having been stabbed and kicked in the abdomen. Neither underwent surgery. The patients were divided into groups as in the previous study and reviewed on the basis of history, abdominal examination, miscellaneous signs, laboratory findings, associated injuries, treatment and disposition.

TABLE V
PERCENTAGE OF PATIENTS WITH ABDOMINAL SYMPTOMS
(180 PATIENTS, 1956–1958)

Symptoms	Group A	Group B	Group C
None noted or not recorded	18	29	25
Local or regional pain	26	45	58
Generalized pain	34	9	0
Nausea or vomiting	29	6	16
Hematemesis or proctorrhagia (confirmed)	8	0	0

History. History (Table v) *per se* was of little value in determining the need for exploration. Little significance could be attributed to abdominal pain, mode of injury, reported length of knife, direction of blow or history of nausea and vomiting. Hematemesis and proctorrhagia, however, were good indications of visceral injury [6].

Generalized pain was found more often in the operative group but was frequently misleading as in the following case.

H. R., a twenty-one year old Negro man, was admitted to the hospital on July 20, 1958, with multiple non-bleeding knife wounds of the abdomen and chest. In addition he had been kicked in the abdomen several times. He complained of generalized abdominal pain and there were episodes of vomiting and retching. Regional and rebound tenderness with muscular spasm were present in the left upper quadrant. Bowel sounds were normal. The patient was kept under observation. He continued to complain of abdominal pain until he was discharged one week later. He entered the hospital again on July 29, 1958, still complaining of generalized abdominal pain. After a week of observation failed to reveal any pathologic condition of the abdomen, he was discharged. On August 7, 1958, he was admitted to another service with a stab wound of the epigastrium and the same complaints of generalized abdominal pain. Physical signs were equivocal. Exploration failed to reveal penetration or intra-abdominal injury.

Abdominal Examination. Physical signs (Table vi) as expected were of greatest prognostic value. The absence of bowel sounds was the most reliable sign of visceral injury and the presence of them prompted conservative management.

TABLE VI
PERCENTAGE OF PATIENTS WITH PHYSICAL FINDINGS
(180 PATIENTS, 1956–1958)

Findings	Group A	Group B	Group C
Direct Tenderness			
Not recorded	0	5	0
None	0	29	25
Local	18	40	58
Regional	29	21	0
Generalized	53	5	16
Rebound Tenderness			
Not recorded	18	20	8
None	18	62	58
Local	3	8	8
Regional	18	8	8
Generalized	42	1	16
Spasm and/or Rigidity			
Not recorded	10	11	8
None	13	64	67
Local	6	11	8
Regional	29	9	16
Generalized	42	1	0
Bowel Sounds			
Not recorded	0	6	0
Normal	12	69	58
Hyperactive	0	3	8
Hypoactive	42	8	25
Absent	47	0	8

G. A. was a nineteen year old Negro girl who had been severely kicked in the abdomen three hours before admission. When she entered the hospital she had diffuse abdominal pain which was accompanied by hematuria. There was diffuse abdominal tenderness with lower abdominal rebound tenderness and rigidity. Bowel sounds were normal. Tenderness was also present on rectal and pelvic examination. The patient was observed closely and was asymptomatic within twenty-four hours. She was subsequently discharged without further treatment.

J. A., a ten year old Negro boy, was struck by a car. At the time of admission he had diffuse abdominal pain. Direct and rebound tenderness with spasm was present in the lower part of the

TABLE VII
ASSOCIATED INJURIES

Injury	No.
Extremity fractures, closed	4
Extremity fractures, open	3
Pelvic fractures	5
Spine fractures	2
Thoracic cage injuries	15
Pleuropulmonary injuries	8
Cerebral injuries	9
Major soft tissue injuries	4
Minor soft tissue injuries	53

TABLE VIII
TREATMENT AND MORTALITY
(180 PATIENTS, 1956–1958)

Data	Patients		Mortality	
	No.	%	No.	%
Died before evaluation	2	1	2	100
Non-operative management	125	69	1	<1
Operated				
With visceral injury	40	22	8	20
Without visceral injury	13	7	0	...
Total	180		11	6

abdomen. Bowel sounds were normal. An abdominal roentgenogram showed a pattern of ileus. He was kept under observation and had an uneventful hospital course.

Miscellaneous Signs. The herniation of intraperitoneal contents was noted in seven cases. In one instance celiotomy was not performed. Intragastric blood or rectal bleeding was an accurate sign of visceral injury. However, in our series it only substantiated a diagnosis previously made on examination of the abdomen. Other rectal or pelvic findings were not of significance.

An elevation in the pulse rate and respiration, and a depression of blood pressure were noted more often in the operative group. Clinical shock was present in 28 per cent of the operative group and 3 per cent of those treated expectantly. In the latter cases the associated injuries easily accounted for the syndrome. The temperature on admission showed no statistical difference between groups.

Exploratory paracentesis was recorded in fewer than 10 per cent of the cases, but over 50 per cent of those recorded were of positive diagnostic value. However, no patient in whom the tap was positive would have been treated conservatively without this supplementary aid nor was the treatment hastened by the positive finding.

Laboratory Findings. Hemoglobin, white blood count and urinalysis were of little help in diagnosis. A leukocyte count over 10,000 per cu. mm. was noted in 34 per cent of those undergoing celiotomy and in 12 per cent of those who were not operated on. In no instance was it of help in deciding therapy. Gross or microscopic blood in the urine was noted with equal frequency in the operative and non-operative groups. Other urinary findings and the level of hemoglobin were not statistically significant.

The value of roentgenograms in the diagnosis of the need for exploration was disappointing. No patient with bowel perforation exhibited roentgenographic evidence of free intraperitoneal air or fluid. Evidence of ileus was divided equally between the two groups of patients. The main value of roentgenograms lay in the localization of bullets and in demonstration of bony and thoracic pathologic conditions.

Associated Injuries. These are summarized in Table VII. Multiple injury was frequent. Forty per cent of the patients in the operative group had associated injuries and 17 per cent had multiple injuries. Five of the deaths are attributable to the extra-abdominal injuries.

Treatment. Primary consideration was given to the management of shock and the restoration of normal respiratory function. Correction of blood volume deficits was always attempted prior to exploration, using both clinical findings and I^{131} blood volume determinations as guides. Splenic lacerations were treated by splenectomy. In liver injuries débridement, hemostatic sutures and drainage were employed in most instances. Lacerations of the stomach and small bowel were sutured after débridement. In multiple closely placed small bowel lacerations resection and closed aseptic anastomosis were performed. Wounds of the colon were treated by suture or by resection and closed aseptic anastomosis without colostomy.

Two patients died before complete assessment of the need for operative therapy could be made. (Table VIII.)

D. R. was a twenty-eight year old white man whose car struck a tree. He was admitted with

dyspnea and abdominal and chest pains. There was diffuse abdominal tenderness but peristaltic sounds were normal. There was a flail in the upper left side of the chest and fracture of the left femur. Despite tracheostomy and assisted ventilation the patient became comatose with bilateral Babinski signs; he died shortly thereafter. At autopsy there were contusions of the heart and aorta with multiple rib fractures and hemothorax secondary to pulmonary laceration. No intra-abdominal injury was found.

J. M., a sixty-three year old white man, was struck by a car. He was moribund on admission. At autopsy a ruptured spleen with hemoperitoneum was found.

One hundred twenty-five patients were not treated surgically for their abdominal injuries. Minor débridement of wounds was carried out as necessary. There was one death in this group.

R. N. was an eighteen year old Puerto Rican boy whose car struck a telephone pole at 90 M.P.H. He was thrown 75 feet from the car and was decerebrate on admission. There were abdominal and chest abrasions. The abdomen was soft and bowel sounds were normal. Operative repair of the partially amputated right arm with brachial artery and radial nerve repair and open reduction of the humerus were performed. The patient died twenty-two hours after admission. Autopsy revealed a subdural hematoma, cerebral contusion and pulmonary hematoma, but no intra-abdominal injury.

Twenty patients had minor febrile episodes and two had superficial infections of their stab wounds, but no morbidity could be attributed to lack of exploration.

Fifty-three patients underwent celiotomy. Of these, forty patients had intra-abdominal injuries which justified operation. (Table IX.) Hemoperitoneum was found in twenty-seven patients; eighteen had over 1,000 cc. of blood. Bile leakage was noted in two patients, gastric leakage in two patients and fecal spill in four patients. Eight patients in this group died.

G. A., a sixty-nine year old white man, was struck by an auto. He was admitted with signs of diffuse peritoneal irritation and moderate shock. In the operating room three hours later, massive hemoperitoneum from a liver laceration was found. The laceration was sutured over a Gelfoam® pack and drained. A fracture of the tibia was treated by closed reduction. The patient did well but died suddenly on the fifth postoperative day. An autopsy failed to reveal the cause of death.

TABLE IX
STRUCTURES INJURED*

Structure	No.
Abdominal wall, non-penetrating	20
Through peritoneum, no intra-abdominal injury	13
Stomach	8
Jejunum	4
Ileum	6
Colon	5
Spleen	16
Liver	9
Gallbladder	2
Pancreas	2
Kidney	2
Bladder	3
Portal vein	1
Gastrohepatic omentum	2
Gastrocolic omentum	5
Greater omentum	4
Diaphragm	3
Retroperitoneum	4

* As noted at operation or autopsy.

S. J., a thirty-two year old Negro man, was admitted with multiple stab wounds of the abdomen. He reached the operating room in thirty minutes. On celiotomy 1,500 cc. of blood mixed with gastric contents was noted. Lacerations of the stomach, gastrocolic and gastrohepatic omentum were sutured. Postoperatively urinary extravasation developed from a rupture of the urethra which occurred during a traumatic catheterization. He died while suprapubic cystostomy was being performed. An autopsy disclosed an unrecognized stab wound of the pancreas and a perirenal hematoma. The site of the urethral rupture was not identified.

J. B., a twenty-seven year old white man, was admitted with two thoracoabdominal bullet wounds. The patient had been held in another hospital for twenty hours without therapy. He arrived in profound shock with hemiplegia, and reached the operating room four hours later. A hole was found in the transverse colon, gastrocolic omentum and liver, with fecal leakage and purulent peritonitis. The lacerations were repaired and a closed thoracotomy drainage established for the left hemopneumothorax. The patient died twenty-two hours after admission. There were no other findings at autopsy.

A. C., a thirty year old Negro man, was admitted with multiple stab wounds. He had signs of diffuse peritoneal irritation; bowel sounds were absent. Blood was found on paracentesis. At celiotomy two hours later a 2,000 cc. hemoperitoneum with lacerations of the stomach, liver, spleen, diaphragm and transverse mesocolon were present. Splenec-

tomy and suture of the liver and gastric lacerations were carried out. A gastroenteric fistula and hemorrhagic pancreatitis developed on the fourth postoperative day. The patient died on the seventh postoperative day. At autopsy there were no additional findings.

R. B., a twenty-two year old Negro man, entered the hospital with two thoracoabdominal bullet wounds. On admission there were signs of diffuse peritoneal irritation. Marked respiratory difficulty from the left hemopneumothorax necessitated resuscitation before surgical therapy of the abdominal condition could be attempted. At exploration lacerations of the stomach, right kidney, diaphragm and spleen were found. The spleen was bleeding freely into the left hemithorax. The bullet had lodged in the lumbar spine with partial paraplegia. The stomach and diaphragm were sutured following splenectomy. Postoperatively, a subphrenic abscess and a leak at an unrecognized esophageal perforation developed. Two subsequent explorations failed to close this perforation adequately, and the patient died on the seventeenth postoperative day. At autopsy a large left subphrenic abscess and acute pancreatitis were found.

N. F., a sixty-five year old white man, was struck by an auto and sustained multiple open comminuted fractures of the right lower extremity and right pelvis. Moderate shock was present on admission, with lower abdominal tenderness and diminished bowel sounds. A cystogram showed rupture of the bladder. In the operating room four hours later, a rupture of the posterior urethra close to the neck of the bladder was found. A suprapubic cystostomy was performed. The peritoneum was not opened. Severe bronchopneumonia and hemorrhagic cystitis developed and the patient died on the twelfth postoperative day from sepsis. There were no additional findings at autopsy.

F. S., a seventy-one year old white man, had a history of a fall three days before admission. He had signs of diffuse peritoneal inflammation. Three hours later in the operating room a hemoperitoneum from a subcapsular rupture of the spleen was found. Following splenectomy, his convalescence was uneventful until the fourth postoperative day when he died from a cerebrovascular accident.

S. A., a twenty-seven year old white man, had been pinned under a stone wall for ten minutes. He was admitted to the Thoracic Service with marked respiratory distress and paradoxical motion of the chest wall. Bilateral clavicular and rib fractures were obvious. The abdomen was soft, with diffuse tenderness and subcutaneous emphysema. He was seen by the Trauma Service twelve hours after admission; at that time abdominal distention, diffuse tenderness and rigidity and lower abdominal rebound tenderness were present. Bowel sounds were absent. Paracentesis yielded free blood. Other emergency operations delayed exploration for four hours. At exploration a 2,000 cc. hemoperitoneum was found with a complete transected spleen. During splenectomy cardiac arrest occurred. Resuscitation was ineffective. There were no additional findings at autopsy.

In the remaining thirteen cases, exploration revealed no intraperitoneal injury. In two cases there were minimal signs of peritoneal irritation but the omentum protruded through abdominal knife wounds. At celiotomy there was no other intraperitoneal injury. In another recent case, not included in the present study, the patient was seriously intoxicated and semicomatose on admission. The wound was carefully débrided, the omentum ligated and excised and the remainder tucked into the abdominal cavity. He eventually awoke and had an uneventful recovery.

In one additional case herniation of intra-abdominal contents was the sole indication for exploration.

T. S., a forty-five year old Negro man, had a 1 inch stab wound in the right lower quadrant of the abdomen. Examination of the abdomen was within normal limits and the patient was kept under observation. Fifteen hours later a loop of bowel herniated into the abdominal wall and the patient exhibited signs of early intestinal obstruction. Laparotomy was performed and the prolapsed bowel was reduced. There was no other intra-abdominal injury and the patient had an uneventful recovery.

In some patients the abdominal findings do not make it possible to rule out visceral injury.

K. C., a forty-two year old white woman, was struck by an auto. When she was admitted to the hospital, there was abdominal distention with diffuse direct and rebound tenderness and regional spasm. Bowel sounds were absent. Roentgenograms showed a pattern of ileus and multiple pelvic fractures. At exploration there was massive retroperitoneal hematoma but no intraperitoneal injury. The patient had an uneventful recovery.

Since reasonable doubt of visceral injury existed celiotomy was indicated under the

criteria of this study. This represents an unavoidable exploration in which the findings were negative. In the remaining nine cases laparotomy would not have been performed if the indications for celiotomy had been observed more closely.

COMMENTS

Few reports in the literature have been devoted to the diagnostic considerations of abdominal trauma. While it is wiser to perform celiotomy needlessly than to miss the opportunity to repair a remediable defect [7], routine exploration carries a definite mortality and morbidity. The Second Auxiliary Surgical Group performed 333 (10.6 per cent) explorations on patients without visceral injury; there were twenty-four (7.2 per cent) deaths [8]. Rob [9] reports that in 560 laparotomies, sixty-six patients had no visceral injury; nineteen (29 per cent) of these died. Unnecessary operation was considered the major cause of death. Rob believed that careful preoperative examination and diagnostic evaluation were essential even on the battlefield. The operative policy of the Second Auxiliary Surgical Group in World War II as stated by Jarvis [10] was that celiotomy was indicated, with rare exception, for any wound involving the *contents* of the peritoneal cavity. Abdominal injury without intraperitoneal disease does not require exploration, and avoidance of such exploration is desirable. Our experience and that of others [9–13] suggest that such a diagnosis can be established with relative ease and with considerable certainty. With reasonable doubt of visceral injury, few would advise prolonged non-operative management.

Basic questions in the management of abdominal injuries therefore are: (1) What are the diagnostic criteria of visceral injury? (2) Are they reliable? (3) What may be considered reasonable doubt? (4) How long can we wait to resolve these doubts without detriment to the patient? In discussing the diagnosis of intraperitoneal injury Jarvis [10] observed that the usual signs of peritoneal irritation, in the main, were reliable in evaluating the need for exploration. In his review of 128 patients there were no cases of free peritoneal bowel perforation in which peristaltic sounds were audible. In Rob's study [9], peristaltic sounds were absent in eighty-three of eighty-nine patients with visceral injuries. The absence of peristaltic sounds is an absolute indication for exploration, and presence of them is a reliable guide towards conservative management [6,9–12,14,15]. I think this study has shown the reliability of abdominal signs in the diagnosis of abdominal injuries. In the patient in severe shock or with oversedation, signs may be mimimized. However, as these states are corrected, the abdominal signs return [7,10]. The equivocal cases are always difficult. The temptation is to "have a peek," but careful continual observation by the same surgical team in this study has revealed the subtle changes which demand or reject celiotomy [7,9,11,12]. Most of our quandaries were resolved within eighteen to twenty-four hours. In only two patients did splenic injuries become evident more than twenty-four hours after admission. In those operated on 70 per cent reached the operating room in less than four hours and an additional 20 per cent in from four to eight hours. Delay in these cases was not due to a failure of prompt diagnosis. Rarely did we need to worry about the patients in the non-operative group after the first twenty-four hours. In patients who have persistent evidence of peritoneal irritation and continued blood loss or shock [6], which are not attributable to other injuries, reasonable doubt of visceral damage exists, and celiotomy should be performed.

No mortality or morbidity could be attributed to our observant and expectant treatment. The application of trained surgical judgment rather than dogma is the more rational and intelligent approach to the managment of abdominal injury. I am in agreement with Jarvis [10], "With thorough diagnostic consideration negative exploration should become less frequently necessary as the experience of any given surgeon increases with this type of injury."

SUMMARY

One hundred eighty cases of abdominal trauma are presented with a statistical review of signs, symptoms, treatment and results.

The usual signs of peritoneal irritation, especially auscultation of peristaltic sounds, were valuable and reliable guides in determining the need for exploration.

Hematemesis, proctorrhagia or positive abdominal paracentesis were secondary confirming indications for celiotomy.

Vital signs and laboratory studies including roentgenograms were of little value in deciding the need for surgery.

No mortality or morbidity could be attributed to our observant and expectant treatment.

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