Practice Management Guidelines for
Nonoperative Management of Penetrating
Abdominal Trauma

Eastern Association for the Surgery of Trauma:
Practice Management Guideline Committee

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I. STATEMENT OF THE PROBLEM

Until the late 19th century, penetrating abdominal trauma was managed expectantly, with high mortality rates. In World War I, operative management replaced expectant management and became the accepted standard for penetrating wounds to the abdomen. It has since been realized that not all penetrating abdominal wounds require operation. As early as 1960, Shaftan advocated “observant and expectant treatment” rather than mandatory laparotomy in the management of penetrating abdominal injury. This was reinforced in 1969 by Nance and Cohn for the management of abdominal stab wounds. Since that time, selective nonoperative management of stab wounds to the anterior abdomen has become common. Gunshot wounds (GSWs) to the abdomen, however, are still commonly treated with mandatory exploration. The reason for this is there is thought to be a high incidence of intra-abdominal injuries and a low rate of complications if laparotomy is negative.

Reports on the incidence of unnecessary laparotomy range from 23 to 53% for patients with stab wounds and 5.3 to 27% for patients with GSWs. Complications develop in 2.5 to 41% of all trauma patients undergoing unnecessary laparotomy, and small bowel obstruction, pneumothorax, ileus, wound infection, myocardial infarction, visceral injury, and even death have been reported secondary to unnecessary laparotomy. Unnecessary laparotomy may also lead to greater lengths of stay and increased cost.
Mandatory celiotomy for penetrating abdominal trauma results in a high rate of unnecessary operations. There is associated morbidity and increased cost. There is a risk of transmission of blood-borne diseases to healthcare providers. Complication rates from unnecessary laparotomy must, however, be weighed against the mortality and morbidity of a missed injury. The goal of the trauma surgeon is to avoid unnecessary laparotomy while minimizing missed injuries. The surgeon deciding whether or not a laparotomy for trauma is indicated must know the risks and benefits associated with either course of action.
II. PROCESS

a. IDENTIFICATION OF REFERENCES

A computerized search of the National Library of Medicine and the National Institutes of Health MEDLINE database was undertaken using the Entrez PubMed (www.pubmed.gov) interface. The primary search strategy was developed to retrieve English language articles focusing on nonoperative management of penetrating abdominal trauma starting in 1990 and continuing through 2005; review articles, letters to the editor, editorials, other items of general commentary, and case reports were excluded from the search. These articles were then reviewed for relevance by the committee chair, and the final reference list of 51 citations was distributed to the remainder of the study group for review.

We would like to acknowledge Steven J. Grove, MA, MLS of the Brittingham Memorial Library at MetroHealth Medical Center for his assistance in this portion of the project.

b. QUALITY OF THE REFERENCES

Articles were classified as Class I, II or III according to the following definitions:

Class I: Prospective, randomized clinical trials (1 reference).
Class II: Clinical studies in which data was collected prospectively or retrospective analyses based on clearly reliable data (26 references).

Class III: Studies based on retrospectively collected data (24 references).

Recommendations were classified as Level 1, 2, or 3 according to the following definitions:

Level 1: The recommendation is convincingly justifiable based on the available scientific information alone. This recommendation is usually based on Class I data, however, strong Class II evidence may form the basis for a level 1 recommendation, especially if the issue does not lend itself to testing in a randomized format. Conversely, low quality or contradictory Class I data may not be able to support a level 1 recommendation.

Level 2: The recommendation is reasonably justifiable by available scientific evidence and strongly supported by expert opinion. This recommendation is usually supported by Class II data or a preponderance of Class III evidence.

Level 3: The recommendation is supported by available data but adequate scientific evidence is lacking. This recommendation is generally supported by Class III data. This type of recommendation is useful for educational purposes and in guiding future clinical research.

III. RECOMMENDATIONS:
a. Level 1

There is insufficient data to support a Level 1 recommendation on this topic

b. Level 2

i. Patients who are hemodynamically unstable or who have diffuse abdominal tenderness after penetrating abdominal trauma should be taken emergently for laparotomy.

ii. Patients with an unreliable clinical examination (i.e., severe head injury, spinal cord injury, severe intoxication, or need for sedation or intubation) should be explored or further investigation done to determine if there is intraperitoneal injury.

iii. Others may be selected for initial observation. In these patients:

1. Triple-contrast (oral, intravenous, and rectal contrast) abdominopelvic computed tomography (CT) should be strongly considered as a diagnostic tool to facilitate initial management decisions as this test can accurately predict the need for laparotomy.

2. Serial examinations should be performed, as physical examination is reliable in detecting significant injuries after penetrating trauma to the abdomen. Patients requiring delayed laparotomy will develop abdominal signs.
3. If signs of peritonitis develop, laparotomy should be performed.

4. If there is an unexplained drop in blood pressure or hematocrit, further investigation is warranted.

c. Level 3

i. The vast majority of patients with penetrating abdominal trauma managed nonoperatively may be discharged after twenty-four hours of observation in the presence of a reliable abdominal examination and minimal to no abdominal tenderness.

ii. Patients with penetrating injury to the right upper quadrant of the abdomen with injury to the right lung, right diaphragm, and liver may be safely observed in the presence of stable vital signs, reliable examination and minimal to no abdominal tenderness.

iii. Angiography and investigation for and treatment of diaphragm injury may be necessary as adjuncts to initial nonoperative management of penetrating abdominal trauma.

iv. Mandatory exploration for all penetrating renal trauma is not necessary.
Indications for laparotomy:

*Patients who are hemodynamically unstable or who have diffuse abdominal tenderness after penetrating abdominal trauma should be taken emergently for laparotomy. Patients with an unreliable clinical examination (i.e., severe head injury, spinal cord injury, severe intoxication, or need for sedation or intubation) should be explored or further investigation done to determine if there is intraperitoneal injury. If signs of peritonitis develop, laparotomy should be performed. If there is an unexplained drop in blood pressure or hematocrit, further investigation is warranted.* These recommendations are reasonably justifiable by available scientific evidence is strongly supported by expert opinion; therefore a Level 2 recommendation is appropriate. In general, patients fitting the above profile were excluded from nonoperative management and were not included in the studies evaluated by this committee.

Physical examination:

*In patients selected for nonoperative management, serial examinations should be performed, as physical examination is reliable in detecting significant injuries after penetrating trauma to the abdomen. Patients requiring delayed laparotomy will develop abdominal signs.* A number of Class II articles support this recommendation.

Demetriades and colleagues published a prospective series of 41 patients with minimal or equivocal abdominal signs after GSW to the abdomen managed nonoperatively.© Copyright 2007 – Eastern Association for the Surgery of Trauma
required delayed laparotomy within 4 hours to 4 days (3 colon injuries, 3 small bowel injuries, 1 liver injury); of these, two developed wound infection, one with abdominal dehiscence. There was no mortality or serious morbidity. The authors concluded that carefully selected patients with abdominal GSW can be safely managed nonoperatively.

A prospective study on GSW to the anterior abdomen using observation if the patient was stable, without peritonitis, and without severe head or spinal cord injury was published by Demetriades et al in 1997. One hundred six patients were in this group, with 14 undergoing delayed operation (13 for increasing tenderness and one for continued bleeding) of which 5 were therapeutic. Four of these patients had colon injuries managed by primary repair. Only one of these had a subsequent complication: a psoas abscess that required percutaneous drainage. One patient was observed for 48 hours in violation of the protocol and developed abdominal compartment syndrome and acute respiratory distress syndrome. The sensitivity of the initial negative physical examination was 97.1%. The mean hospital stay in the group with nontherapeutic operations was 6.4 days, and the complication rate was 27.6%. Of the total of 309 patients in the series, 92 (29.8%) were successfully managed nonoperatively.

Velmahos and coworkers, in 1997, published a prospective series of 230 consecutive patients with GSW to the back. Patients with hemodynamic instability or peritonitis underwent urgent operation. Of the remaining 188 patients, 58 (31%) underwent laparotomy (56 therapeutic, 2 negative) and 130 (69%) were initially observed due to negative clinical exam. 4/130 (3%) underwent delayed laparotomy after developing abdominal tenderness; all of these laparotomies were nontherapeutic. The authors also
note a diaphragm injury that presented with no clinical signs. The sensitivity and specificity of initial clinical exam in detecting significant intraabdominal injuries were 100% and 95% respectively.

In the same year, Velmahos et al reported 59 consecutive patients with GSW to the buttocks. Unstable patients underwent immediate laparotomy. Stable patients with peritoneal signs underwent surgery. Patients with gross hematuria or blood on rectal exam underwent cystography and/or rigid sigmoidoscopy. Patients without clinical signs of significant injury underwent "appropriate" diagnostic tests, including rigid sigmoidoscopy, and were admitted for serial clinical examinations. Nineteen (32.2%) underwent surgery based on clinical findings, with significant intraabdominal injuries in 17 (28.8%). The remaining 40 (67.8%) were successfully observed. There were no missed injuries or delays in diagnosis. Sensitivity and specificity of clinical exam for identifying significant intra-abdominal injury was 100% and 95.3% respectively.

A review of 37 patients with transpelvic GSW was published in 1998 by Velmahos and colleagues. Patients with peritoneal signs, hemodynamic instability, gross hematuria, or rectal bleeding underwent immediate operation. Eighteen were initially managed nonoperatively. Three of these subsequently underwent exploration for the development of abdominal tenderness. All 3 were nontherapeutic. The sensitivity of clinical examination was 100% in detecting the need for laparotomy.
A retrospective review of 792 patients with abdominal GSW treated with selective nonoperative management was published by Velmahos et al in 2001. During observation 80 (10%) patients developed symptoms and required a delayed laparotomy. Fifty-seven (72%) of laparotomies were therapeutic. Five (6.3%) suffered complications potentially related to the delay in laparotomy, which were managed successfully. Seven hundred twelve (90%) were successfully managed nonoperatively. If patients had been managed by routine laparotomy, the unnecessary laparotomy rate would have been 47% (39% for anterior and 74% for posterior abdominal GSW). Patients without surgery had significantly shorter hospital LOS and lower hospital charges.

**Use of computed tomography:**

*Triple-contrast (oral, intravenous, and rectal contrast) abdominopelvic computed tomography (CT) should be strongly considered as a diagnostic tool to facilitate initial management decisions as this test can accurately predict the need for laparotomy.* This recommendation is also supported by a number of Class II articles.

Himmelman et al found that a negative triple contrast CT has 100% sensitivity for retroperitoneal injury after penetrating trauma to the back and flank. Eighty-eight patients were enrolled prospectively. Five of nine high-risk scans had laparotomy, and two had injuries. Seventy-seven patients with non-high-risk scans were observed without complication.
Kirton and colleagues performed a registry review on back and flank stab wounds who were evaluated with CT with contrast enema. None of the 92 low-risk patients required surgery or had sequelae. Six of the 53 patients with high-risk scans had laparotomy (two due to CT findings and four due to evolving signs). CT predicted all surgical findings in all six.

A prospective study of 104 stable patients without peritonitis receiving triple-contrast CT after penetrating torso trauma was published by Shanmuganathan et al in 2001. A positive CT was defined as evidence of peritoneal penetration or injury to the retroperitoneal colon, major vessel, or urinary tract. Patients with a positive CT, except for patients with isolated liver injury or free fluid, underwent laparotomy. Nine patients with isolated hepatic injuries were successfully treated without laparotomy. Patients with a negative finding on CT were initially observed. Among patients with a negative CT, 67 (97%) of 69 were successfully observed. The negative predictive value of triple-contrast CT was 100% (69/69). The authors concluded that triple-contrast CT accurately predicts the need for laparotomy (97% accuracy) and excludes peritoneal violation in penetrating torso trauma.

A prospective study of 75 consecutive stable patients with penetrating injury to the torso (lower chest, abdomen or pelvis) without definite indication for laparotomy who underwent triple contrast CT interpreted by blinded radiologists was published by Chiu and coworkers in 2002. In patients with a positive CT, 18 (69%) had laparotomy, two nontherapeutic and one negative. The remainder was successfully managed.
Of the patients with negative CT, 47/49 (96%) were successfully managed nonoperatively and one received a negative laparotomy. The false-negative CT injury was a left diaphragm injury discovered at laparotomy. CT accurately predicted whether laparotomy was needed in 71/75 (95%) patients. The authors note that adjunctive angiography and investigation for diaphragm injury may be prudent.

Munera et al performed a prospective study of 47 patients with abdominal GSW who received a triple-contrast helical CT. Twenty patients had a negative CT scan. These patients were treated nonoperatively. One injury was missed at CT (a cecal wall contusion that was repaired). It was concluded that in stable patients with gunshot wounds to the abdomen in whom there is no indication for immediate surgery, triple-contrast helical CT can help reduce the number of cases of unnecessary or nontherapeutic laparotomy (accuracy of 96%).

Another prospective study of triple-contrast helical CT in 200 patients with penetrating torso trauma was published by Shanmuganathan et al in 2004. Two patients with negative CT findings failed to improve with observation and underwent therapeutic laparotomy. In one, an actively bleeding left upper quadrant mesenteric hematoma and a left diaphragm injury were found; in the other, a left diaphragm injury was found. Twenty-one of 23 patients with isolated liver injury had successful nonsurgical management. Angioembolization was performed on four of these patients. None of the six patients with renal injury required surgery. CT had 97% sensitivity (66 of 68 patients), 98% specificity (130 of 132 patients), and 98% accuracy (196 of 200 patients).
for peritoneal violation. The authors concluded that triple-contrast helical CT accurately demonstrates peritoneal violation and visceral injury in patients with penetrating torso wounds. The accuracy of CT for diagnosis of left diaphragm injuries requires further study.

**Morbidity of nontherapeutic laparotomy:**

Mandatory laparotomy for penetrating abdominal trauma detects some unexpected injuries earlier and more accurately, but results in a higher nontherapeutic laparotomy rate, longer hospital stays, and increased hospital costs. Nontherapeutic laparotomies for penetrating abdominal trauma carry morbidity. These statements are supported by Class I and Class II evidence.

A prospective series of 372 operations performed on 368 patients with penetrating injuries to the abdomen, chest, neck and extremities was reported by Demetriades and colleagues.\textsuperscript{17} There were 46 negative or non-therapeutic operations. Eleven percent of patients with nontherapeutic operations developed major complications due to anesthesia or operation (pancreatitis, aspiration pneumonia, wound infection, DVT, pneumonia). Hospital LOS was 4.1 days for those with uncomplicated nontherapeutic operations and 21.2 days for those with complications. The authors conclude that nontherapeutic operations for penetrating trauma carry a significant morbidity rate and they advocate a policy of selective conservatism.
Hasaniya and coworkers performed a retrospective study to look at complications of non-therapeutic laparotomies.\textsuperscript{18} Two hundred thirty of these were identified. The incidence of significant complications directly related to the anesthesia or operation was 8.2%. One patient with a major thoracic injury died secondary to complications of a nontherapeutic laparotomy. The average hospital stay for uncomplicated nontherapeutic operations was 5.1 days, and for patients with complications 11.9 days.

Renz and Feliciano, in 1995, reported a prospective case series of 254 patients with unnecessary laparotomies for trauma.\textsuperscript{4} Complications occurred in 41.3% of patients and included atelectasis (15.7%), postoperative hypertension that required medical treatment (11.0%), pleural effusion (9.8%), pneumothorax (5.1%), prolonged ileus (4.3%), pneumonia (3.9%), surgical wound infection (3.2%), small bowel obstruction (2.4%), urinary tract infection (1.9%), and others. The mortality rate for the entire series was 0.8% and was unrelated to unnecessary laparotomy.

In 1995, Leppaniemi et al reported a retrospective study of 172 patients undergoing mandatory explorative laparotomy for truncal stab wounds.\textsuperscript{19} It was concluded that mandatory laparotomy for truncal stab wounds leads to an unnecessary operation in about 40% of cases, with a 20% morbidity rate associated with the laparotomy itself.

In 1996, the same group published a prospective, randomized (not blinded) trial on the safety and cost-effectiveness of selective non-operative management compared to mandatory laparotomy in patients with abdominal stab wounds not requiring immediate
Fifty-one patients not requiring immediate laparotomy for hemodynamic instability, generalized peritonitis, or evisceration were randomly assigned to mandatory laparotomy or expectant, nonoperative management. The morbidity rate was 19% following mandatory laparotomy and 8% after observation. Four patients (17%) managed nonoperatively required delayed laparotomy. Suture repair of colon injuries was performed 6 and 18 hours after the injury in two patients; one patient underwent laparotomy for hemorrhage 44 hours after the injury, and was found to have a liver laceration that was not actively bleeding, but 1.4 L of blood in the abdomen; and a fourth patient was discharged home but represented 52 days later with empyema and was found to have a missed diaphragm injury through which the stomach had partially herniated and perforated. About $2800 was saved for every patient who underwent successful nonoperative management. Mandatory laparotomy detects some unexpected organ injuries earlier and more accurately but results in a high non-therapeutic laparotomy rate.

In the same year, Renz and Feliciano performed a prospective case series and found that unnecessary laparotomies for trauma resulted in a significant length of stay. Two hundred fifty-four patients had unnecessary laparotomy for trauma from 1988-1991. The mean length of stay for 81 patients with negative laparotomies and no associated injuries was 4.7 days. The presence of a complication or an associated injury significantly prolonged the length of stay.

**Duration of observation:**
Twenty-four hours of observation is adequate for the vast majority of patients with penetrating abdominal trauma managed nonoperatively. A number of observations and studies support this recommendation.

Alzamel and Cohn published a chart review of 650 asymptomatic patients with abdominal stab wounds who were admitted for serial examination.\textsuperscript{22} Fifteen of 650 left against medical advice within 6 hours of presentation. Sixty-eight of 635 underwent exploratory laparotomy. All patients who needed surgery were identified within 12 hours of presentation. Twenty-three (33\%) underwent surgery within 2 hours; 26 (38\%) between 2 to 4 hours; 9 (13\%) between 4 & 6 hours; 9 (13\%) between 6 & 10 hours; and 1 (1.4\%) at 12 hours. The authors conclude that asymptomatic patients with abdominal stab wounds may be discharged after 12 hours of observation with little likelihood of missed injury.

Velmahos and coworkers, in their article about gunshot wounds to the buttocks, found that observation of patients for more than 24 hours was unnecessary if they are stable, are able to tolerate a regular diet, and complain of no symptoms.\textsuperscript{8} In an article on the nonoperative management of 1856 patients with abdominal GSW, Velmahos et al observed that of 80 patients who required delayed laparotomy, only one required it after 24 hours of observation, and this patient was a policy guideline violation, in that a patient with a GSW to the liver and right kidney with a falling hematocrit was transfused instead of being taken to surgery.\textsuperscript{10} In a subsequent study, again by Velmahos and colleagues, now using CT in addition to physical examination, it was found that laparotomy guided
by CT findings was performed within an average of 4.5 hours and a maximum of 13 hours.  

Ginzburg and colleagues published a retrospective study of 83 patients using triple contract computed tomography (CT) to rule out injury after a gunshot wound to abdomen or flank. CT scans were classified as positive, equivocal or negative. The negative studies (53) were observed for 23 hours, with a 100% true negative rate. After this, patients were either discharged home or transferred to other services for treatment of associated injuries. No patient with a negative CT had a missed injury using this protocol.

**Visceral or omental evisceration:**

Visceral or omental evisceration through an abdominal stab wound in a patient with stable clinical signs and without evidence of peritonitis is a relative rather than absolute indication for exploratory laparotomy. This is supported by Class II and Class III evidence. We did not feel the data, however, was strong enough to support a recommendation on this topic.

McFarlane reported on a small series of patients (n=14) with anterior abdominal stab wounds and omental evisceration. The article does not state whether data was collected prospectively or retrospectively. There were no late complications or missed visceral injuries requiring laparotomy. The author concludes that omental evisceration through an
abdominal stab wound in a patient with stable clinical signs and without evidence of peritonitis is not an absolute indication for exploratory laparotomy.

Arikan et al published a prospective, nonrandomized series of 52 hemodynamically stable patients with abdominal stab wounds and either visceral or omental evisceration, who were treated either with exploratory laparotomy or wound exploration/closure under local anesthesia. Patients with obviously perforated hollow viscera or peritonitis were excluded. Seven of 31 patients treated selectively required delayed operation, of which 2 (6.5%) were negative. Of the 21 patients treated with a routine laparotomy, 7 (33%) were nontherapeutic. Of the routine laparotomy group, 19% (4/21) had complications, but only 1 patient with a nontherapeutic laparotomy had a complication (bleeding through the suture line controlled by simple suturing). The complication rate in the selective group was 3.2% (one case of small bowel obstruction managed nonoperatively). The mean length of stay was 137 hours in the routine exploration group vs. 81 hours in the selective group (p < 0.001). The authors concluded that selective observation is safe and superior to routine laparotomy for the treatment of penetrating abdominal stab wounds with omental evisceration.

**Right upper quadrant penetrating injury:**

*Patients with penetrating injury to the right upper quadrant of the abdomen with injury to the right lung, right diaphragm, and liver may be safely observed in the presence of stable vital signs, reliable examination and minimal to no abdominal tenderness.* This is supported by Class II and Class III evidence, but the numbers of patients are small.
Chmielewski and colleagues reported prospectively on 12 patients with a single GSW to the right upper quadrant, stable vital signs, reliable examination, and minimal or no abdominal tenderness. All were successfully observed. One nontherapeutic laparotomy was done secondary to abdominal tenderness.

Demetriades and coworkers performed a retrospective review of GSW to the liver. Sixteen stable patients were selected for nonoperative management. Five patients in the observed group underwent delayed laparotomy for peritonitis (four patients with liver injuries) and abdominal compartment syndrome (one patient who had received six units of blood in violation of the recommended policy). Except for a missed right diaphragm injury, there were no missed injuries in the 16 patients. One patient in the group with delayed laparotomy had multiple complications from abdominal compartment syndrome, and one patient in the nonoperative group developed a biloma, which was successfully drained percutaneously.

In 1994 Renz and Feliciano also reported on this subject. A prospective study on stable patients with GSW to the right thoracoabdomen was performed. Thirteen patients were identified. All patients had a right hemothorax treated with a chest tube. Complications included atelectasis (n=four), a small persistent pneumothorax (n=two), and pneumonia (n=one). It was concluded that stable patients without peritonitis after sustaining a GSW to the right thoracoabdomen can be managed nonsurgically with a low incidence of minor intrathoracic complications.
Investigation for diaphragm injury:

Investigation for diaphragm injury may be necessary as an adjunct to initial nonoperative management of penetrating abdominal trauma. A number of the aforementioned papers report missed diaphragm injuries. Other investigative modes, such as laparoscopy, may be necessary to rule out diaphragmatic injuries in appropriate patients. The discussion of operative procedures, such as laparoscopy, is beyond the scope of this manuscript.

Angiography:

Angiography may be necessary as an adjunct to initial nonoperative management of penetrating abdominal trauma. Only a few reports have described the use of angiography in this setting. Velmahos in 1999 described 40 patients undergoing angiography after penetrating abdominal trauma. Six of these patients had angiography performed during nonoperative management; the rest had this done as an adjunct to surgery. Three of the six patients managed nonoperatively had successful angioembolization: one liver injury and two renal injuries. Shanmuganathan reported four patients with liver injuries who were managed with angioembolization but not with operation. Further study is needed on the use of angiography and angioembolization in this patient population.

Penetrating renal trauma:
Mandatory exploration for all penetrating renal trauma is not necessary. Heyns and Vollenhoven performed a retrospective review of 95 patients with renal stab wounds.\textsuperscript{33} Patients with stab wounds and hematuria were selected for surgical exploration if they had signs of severe blood loss, an associated intra-abdominal laceration, or a major abnormality on an intravenous urogram. Sixty patients were in the nonoperative management group, and 35 were in the operative group. Only 4 patients underwent nontherapeutic laparotomy. Complications, however, developed in 12 of the 60 patients (20\%) in the nonoperative group and consisted mainly of secondary hemorrhage caused by an arteriovenous fistula or pseudoaneurysm. Management consisted of embolization in 6, nephrectomy in 2, heminephrectomy in 1, open ligation of a fistula in 1, and spontaneous resolution in 2. The authors concluded by stating that certain groups should be more aggressively selected for surgery, and that angioembolization may be a useful adjunct to nonoperative management.

Velmahos and colleagues reviewed the records of 52 consecutive patients with renal GSW.\textsuperscript{34} Renal injuries were explored only if they involved the hilum or were accompanied by signs of continued bleeding. Thirty-two patients underwent renal exploration and 17 of them required nephrectomy. In the remaining 20 patients, renal exploration was successfully avoided. No kidneys were lost unnecessarily as a result of this policy. One renal complication was identified in a patient managed nonoperatively. A patient developed hematuria one month after injury. CT revealed lack of upper pole perfusion on the injured side. The patient underwent a successful partial nephrectomy.
**Diagnostic peritoneal lavage:**

There are a number of articles that have investigated diagnostic peritoneal lavage (DPL) as a means to assess the need for surgery after penetrating abdominal trauma. There is large variability in the criteria for a positive study. Most of the studies regarding DPL are from the early to mid 1990s, with very few recent studies. DPL seems to have been supplanted by other diagnostic modalities, such as CT. Because of these factors, we did not feel we could make any recommendations regarding its use in this patient population.

**Ultrasound:**

There are few papers on the use of ultrasound (US) in the nonoperative management of patients with penetrating abdominal trauma. Only one addresses the use of Focused Abdominal Sonography for Trauma (FAST), and the conclusion is that additional diagnostic studies need to be performed in the face of a negative FAST to rule out occult injury. Of the two other studies investigating US, one described radiologist-interpreted US and the other described US to evaluate penetration of the abdominal wall. There is not enough data to make a recommendation about the use of US in this patient population.

**Local wound exploration:**

Although no studies address the issue of local wound exploration (LWE) in patients with abdominal stab wounds during the time period covered in this review, this technique was used in a number of series to rule out penetration of the anterior fascia. Patients with abdominal stab wounds may have intraabdominal injury ruled out by a LWE.
demonstrating that the anterior abdominal fascia has not been penetrated. If there is no other reason for hospital admission, these patients may then be sent home.

**Applicability:**
Prudent judgment should be exercised in deciding to apply nonoperative management of penetrating abdominal trauma in a particular institution, as the above recommendations are generally from large academic hospitals with in-house senior level clinicians with extensive experience in trauma, in which careful observation and close monitoring are possible. It may not be applicable to medical centers with fewer trauma resources. These patients need to be examined frequently, preferably by the same surgeon. Pain medications should be given with caution, if at all. If a patient should develop abdominal pain or hemodynamic instability, nonoperative management should be abandoned and the patient taken to surgery emergently.
V. FUTURE INVESTIGATIONS

Prospective, randomized trials would be useful in investigating this topic further, but are unlikely to be practical since many patients would be subjected to unnecessary laparotomies for the purposes of the research. The role of CT in identifying diaphragmatic injuries needs to be investigated further. Although there is no debate about the necessity of repairing injuries to the left diaphragm, further study is required in deciding the necessity of repairing right-sided tears due to penetrating trauma. The role of interventional radiology in the nonoperative management of penetrating abdominal trauma needs to be elucidated further.
VI. REFERENCES

1 Loria FL. Historical aspects of penetrating wounds of the abdomen. *Int Abstracts Surg* 1948;87:521-49.


22 Alzamel HA, Cohn SM. When is it safe to discharge asymptomatic patients with abdominal stab wounds? *J Trauma* 2005;58:523-5.


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<td>Stab wounds to the back/flank in hemodynamically stable patients: evaluation using triple-contrast computed tomography.</td>
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<td>2005</td>
<td>Arikan S</td>
<td>A prospective comparison of the selective observation and routine exploration methods for penetrating abdominal wounds with organ or omentum evisceration.</td>
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### Comments

- This is a prospective, nonrandomized series of 25 hemodynamically stable patients with abdominal stab wounds and either visceral or skin defects. The mean LOS was 81 hours. The authors concluded that selective observation was safe and superior to routine exploration.

- Seventy-five per cent of patients with a negative scan and no associated injuries were discharged within 12 hours of presentation. However, seven of 31 patients required emergency repeat laparotomy. Of these, seven of 11 patients were managed with a negative initial laparotomy. Two patients who were discharged after 12 hours of observation had a missed injury.

- The authors concluded that selective observation is safe and superior to routine exploration.
superior to routine laparotomy for the treatment of penetrating abdominal stab wounds with omental evisceration.


Bokhari F 2004

The ultrasound screen for penetrating truncal trauma.

This is a prospective blinded pilot study of 49 patients with truncal stab wounds (SW) and gunshot wounds (GSW) evaluated for stab wounds to the back and flank. Group I patients were admitted prior to 1999 and had mandatory celiotomy; Group II patients were evaluated after a negative DPL (i.e., the nontherapeutic antegrade IVP) or CT scan (i.e., a triple contrast computed tomographic scan). Group IIa included patients with hemodynamic instability, overt signs suggestive of internal injury and other signs of hypovolemia. Group IIb included patients with hemodynamic stability. Group IIc included patients with instability or atypical symptoms. Initial diagnostic studies were either an IVP followed by immediate laparotomy, triple contrast computed tomography scan alone, or an ultrasound (US) followed by a triple contrast computed tomography scan. Group IIe included patients with negative US and triple contrast computed tomography scan studied for stab wounds to the back and flank in whom the US replaced the IVP as the initial diagnostic study. Group IIe and IIc included patients with hemodynamic instability and overt signs suggestive of internal injury. The nontherapeutic laparotomy rate was 85% in Group I. None of the 34 patients in Group IId patients with hemodynamic instability and overt signs suggestive of internal injury underwent laparotomy, with no missed injuries. The sensitivity and negative predictive value of ultrasound in determining clinically significant truncal visceral injury was 100%; the specificity was 94%. The positive and negative predictive values were approximately 50%. The authors concluded that ultrasonic exam of the injured abdominal walls is an excellent screening tool.


Boyle EM Jr 1997

Diagnosis of injuries after stab wounds to the back and flank.

Diagnosis of injuries after stab wounds to the back and flank.

Diagnosis of injuries after stab wounds to the back and flank.

Diagnosis of injuries after stab wounds to the back and flank.

**J Trauma** 2000;58:526-32.

Boxham F 2004

The ultrasound screen for penetrating truncal trauma.
The therapeutic laparotomy rate increased from 15 to 80%.


Chihombori A 1991 Role of diagnostic techniques in the initial evaluation of stab wounds to the anterior abdomen, back, and flank.

This is a retrospective review of 162 patients with stab wounds, 103 with anterior abdominal wounds and 59 with back and flank wounds. Seventeen of 162 patients with shock, peritonitis, and evisceration were immediately explored. Most of the remainder underwent diagnostic peritoneal lavage (DPL). A total of 54 patients were explored with 6 negative laparotomies. Of 126 DPLs, none were false positive and 1 was false negative. Of 47 computed tomographic enema scans (CTEs), 3 were interpreted as an indication for angiography. The overall mortality was 4.3%. DPL was considered positive if red blood cells were > 2000/mm³, white blood cells were > 500/mm³ or lavage fluid exited the urinary catheter or chest tube. The authors concluded that their algorithm can be safely applied to patients with penetrating trauma, as 108 of 162 patients were spared laparotomy.


Chiu WC 2001 Determining the need for laparotomy in penetrating torso trauma: a prospective study using triple-contrast computed tomography.

This is a prospective study of 75 consecutive hemodynamically stable patients with penetrating injury to the torso (lower chest, abdomen, or pelvis) without definitive indication for exploration. A positive CT scan was defined as any evidence of peritoneal violation. A positive CT scan was defined as any evidence of peritoneal violation. Of 75 patients with positive CT, 25 (33%) had peritoneal violation. In patients with a positive CT, 18 (69%) had peritoneal violation. A positive CT scan was defined as any evidence of peritoneal violation. A positive CT scan was defined as any evidence of peritoneal violation. A positive CT scan was defined as any evidence of peritoneal violation. A total of 25 patients were explored, of which 6 patients were considered angiography. The overall mortality was 4.3%. DPL was considered positive if red blood cells were > 2000/mm³, white blood cells were > 500/mm³ or lavage fluid exited the urinary catheter or chest tube. The authors concluded that their algorithm can be safely applied to patients with penetrating trauma, as 108 of 162 patients were spared laparotomy.
Nonoperative management of gunshot wounds to the abdomen.

This is a prospective series of 172 operations performed on 12 patients with a single gunshot wound to the abdomen. Nine patients had a single gunshot wound to the abdomen and seven patients had multiple gunshot wounds. All patients were stable, with no signs of shock. The mean age of the patients was 35 years. The mean length of hospital stay was 4 days. No patient required a second operation. The authors conclude that nonoperative management of gunshot wounds to the abdomen is safe and effective.

Selective conservatism.

The authors conducted a prospective review of nonoperative management for penetrating abdominal injuries. They identified 12 patients who met the criteria for nonoperative management. All patients were stable and had no peritonitis. The mean length of hospital stay was 3.5 days. No patient required a second operation. The authors conclude that nonoperative management is safe and effective for selected patients with penetrating abdominal injuries.

Selective management of penetrating truncal injuries: is emergency department discharge a reasonable goal?

This is a retrospective review of 107 patients with penetrating truncal injuries who had a selective emergency department (ED) workup consisting of local wound exploration for stab wounds to the abdomen, a triple contrast computed tomography (CT) for penetrating injuries to the back/flank, or a triple contrast CT with sigmoidoscopy and/or cystography (depending on the trajectory) for penetrating wounds to the pelvis. Gunshot wounds to the anterior abdomen and left-sided thoracoabdominal injuries underwent operative intervention. Of the patients who did not receive operative intervention, 62/107 (58%) were discharged home after negative CT in the ED, 18 were managed operatively (for positive CT scan), and 27 were managed nonoperatively. Two missed injuries were later identified (one hepatic and one small bowel) and managed successfully. The authors conclude that certain patients having a negative ED workup can be safely discharged home.

Selective conservative management for gunshot wound of the abdomen.

This is a prospective series of 41 patients with minimal or equivocal abdominal signs after a gunshot wound (GSW) to the abdomen who were observed nonoperatively. Seven of the 41 required delayed laparotomy within 4 hours to 4 days (3 colon injuries, 3 small bowel perforations, 1 liver injury); of these, two developed wound infection, one with abdominal dehiscence. The authors conclude that carefully selected patients with abdominal GSWs can be safely managed nonoperatively.

Non-therapeutic operations for penetrating trauma: early morbidity and mortality.

This is a prospective series of 372 operations performed on 368 patients with penetrating injuries to the abdomen, chest, neck, and extremities. There were 46 negative or non-therapeutic operations. Eleven percent of patients with nontherapeutic operations developed major complications due to anesthesia or operation (pancreatitis, aspiration pneumonia, wound infection, DVT, pneumonia). Hospital length of stay was 4.1 days for those with negative nontherapeutic operations and 21.2 days for those with complications. The authors conclude that nonoperative management of penetrating abdominal injuries is safe and effective for certain patients.
This is a retrospective review of gunshot wounds to the liver. Sixteen stable patients were selected for nonoperative management. Five patients in the observed group underwent delayed laparotomy for peritonitis (four patients with liver injuries) and abdominal compartment syndrome (one patient who had received six units of blood in violation of the recommended policy). Except for a missed right diaphragm injury, there were no missed injuries in the 16 patients. One patient in the group with delayed laparotomy had multiple complications from abdominal compartment syndrome, and one patient in the nonoperative group developed a biloma, which was successfully drained percutaneously.

This is a prospective study on gunshot wounds to the anterior abdomen using observation if the patient was stable, without peritonitis, and without severe head or spinal cord injury. One hundred six patients were in this group, with 14 undergoing delayed operation (13 for increasing tenderness and one for continued bleeding). Four of these patients had colon injuries managed by primary repair, and all had a subsequent complication: a psoas abscess that required percutaneous drainage. One patient was observed for 48 hours in violation of the protocol. Except for a missed right diaphragm injury, there were no missed injuries in the 106 patients. The mean hospital stay in the group with nontherapeutic operations was 6.4 days, and the group with therapeutic operations was 4.8 days. The sensitivity of the initial negative rectosigmoidoscopic dissection syndrome test was 93%, and the sensitivity of the initial negative diagnostic imaging test was 92.8%. There was a significantly higher complication rate (13.6%) in the group with negative imaging tests compared to the group with positive imaging tests (0%). The mean hospital stay in the group with therapeutic operations was 6.4 days, and the complication rate was 27.6%. Of the total of 309 patients in the series, 92 (29.8%) were successfully managed nonoperatively. The mean hospital stay was 27.7% lower in the group that was successfully managed nonoperatively. The conclusion is that CT may be a good way to work up liver trauma.

This is a prospective, randomized comparison of computed tomography with conventional diagnostic methods in the evaluation of penetrating injuries to the anterior abdomen. Sixty-one patients with penetrating back and flank injuries were randomized into conventional testing or computed tomography (CT), if they did not need immediate operation. The sensitivity and specificity of the initial negative physical examination were 96% for CT and 99% for conventional testing. The false positive rate was 43%. The numbers in this study are small, and the conclusions may be limited. The conclusion is that CT may be a good way to work up back and flank trauma. Like the Demetriades studies, those who avoided surgery accrued lower costs.
Unnecessary laparotomy by using physical examination and different diagnostic modalities for penetrating abdominal stab wounds.

This is a retrospective review. Completed laparotomy in selected abdominal anatomic injury with complications or missed injuries.

Injury when using this protocol, which was regarded primarily.

The operation in the study group had a missed diagnosis.

Detection of diaphragmatic or pleural violation.

without surgical intervention. The rest were observed. There were no complications.

Two of 37 abdominal CTs were negative, although subsequent use of local anesthetic therapy through closure of abdomen or probe was performed.


Abdominal stab wounds: diagnostic peritoneal lavage criteria for emergency room discharge.

The study evaluated primary anterior stab wounds in a prospective fashion.

Diagnostic modalities for penetrating abdominal stab wounds.

Unnecessary laparotomy by using physical examination and different diagnostic modalities for penetrating abdominal stab wounds.
Hasaniya N 1994

Early morbidity and mortality of non-therapeutic operations for penetrating trauma.

This was a retrospective study to look at complications of non-therapeutic laparotomies (n=230; 21.7%) after penetrating trauma. The rate was significant at 8.2% and those with complications had longer stays than those without. One patient with a major thoracic injury died secondary to complications related to a nontherapeutic laparotomy. The conclusion is to attempt to avoid these surgeries by selective management.

Heyns CF 1992

Selective surgical management of renal stab wounds.

This is a retrospective review of 95 patients with renal stab wounds. Patients with stab wounds and hematuria were selected for surgical exploration if they had signs of severe blood loss, an associated injury, or a reflecting pelvic injury. Physical examination was 82% sensitive and DPL 91%. The latter missed 3 of 4 reflecting injuries. Only 4 patients underwent nontherapeutic laparotomy. Complications, however, developed in 12 of the 60 patients (20%) in the nonoperative group and consisted mainly of secondary hemorrhage caused by an arteriovenous fistula or pseudoaneurysm. Management consisted of embolization in 6, nephrectomy in 2, heminephrectomy in 1, and open ligation of a fistula in 1. The authors concluded that certain groups should be more aggressively selected for surgery, and that nonoperative management may be a useful alternative to nonoperative management in these selected groups.

Himmelman RG 1991

Triple-contrast CT scans in penetrating back and flank trauma.

A negative triple contrast computed tomography scan has 100% sensitivity for retroperitoneal injury. Eighty-eight patients were enrolled. Five of nine high-risk scans went to surgery; two had injuries. None of the 77 non-high risk scans had complications. The conclusion is that triple contrast CT scans in stable patients with penetrating back and flank trauma are safe and effective.

Kelemen JJ 3rd 1997

Evaluation of diagnostic peritoneal lavage in stable patients with gunshot wounds to the abdomen.

This was a prospective clinical trial to assess physical exam and diagnostic peritoneal lavage (DPL) in stable patients with gunshot wounds to the abdomen. Forty of 44 received laparotomy. Physical examination was 82% sensitive and DPL 91%; the latter missed 3 of 4 reflecting injuries. The conclusion is that DPL augments physical examination to help triage abdominal gunshot wound patients.

Kirton OC 1997

Stab wounds to the back and flank in the hemodynamically stable patient: a decision algorithm based on contrast-enhanced computed tomography.

Computed tomography (CT) was performed on back and flank injuries. None of 92 low-risk (without penetration of the subcutaneous fascia) patients had injuries or complications, and six of 53 high-risk (penetration beyond the deep muscle fascia) scans went to surgery (two due to scan and four due to evolving signs). CT predicted all injuries found at surgery in all six with no additional injuries. The conclusion is to perform all back and flank injuries on CT prior to surgery (low-risk) or for equivocal signs on CT (high-risk). The result was significantly better in the high-risk group, but the difference was not statistically significant.
<table>
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<th>Reference</th>
<th>Study Design</th>
<th>Outcome</th>
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<td>This is a retrospective study of 459 patients undergoing mandatory explorative laparotomy for truncal stab wounds.</td>
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<td>Of these, 172 (37%) were negative.</td>
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<td>McFarlane 1995</td>
<td>Management of penetrating abdominal injuries. This is a review of data retrieved from notes and operative records. Clinical criteria are used to determine the need for laparotomy in the management of patients with gunshot wounds (n=112), and mandatory laparotomy is recommended for all patients with gunshot wounds. Selective management is advocated for stab wounds who received a triple-contrast helical computed tomography scan and were elderly patients with no abdominal gunshot wounds.</td>
<td>27 West Indian Med J 1995;44:140-2.</td>
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<tr>
<td>McFarlane 1996</td>
<td>Non-operative management of stab wounds to the abdomen with omental evisceration. This is a report of 14 patients with omental evisceration without signs of peritonitis managed nonoperatively that had no complications. Thus omental evisceration is not a definitive indication for laparotomy. This study is limited by size, and the conclusion might not be supported at higher numbers of patients.</td>
<td>28 JR Coll Surg Edinb 1996;41:239-40.</td>
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<td>Morrison 1996</td>
<td>Complications after negative laparotomy for trauma: long-term follow-up in a health maintenance organization. The incidence of long-term complications after negative or nontherapeutic laparotomy is low. Negative or nontherapeutic laparotomies have a high 40% short-term complication rate (pneumonia, etc.) and no long-term complications. There was only a 63% follow-up. Seventy-nine percent were blunt patients, thus no visceral mobilization was needed.</td>
<td>29 J Trauma 1996;41:509-13.</td>
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<tr>
<td>Muckart 1990</td>
<td>Selective conservative management of abdominal gunshot wounds: a prospective study. This is a prospective study of 111 patients with low velocity gunshot wounds to the abdomen followed with repeated physical examination. Twenty-two (20%) underwent nonoperative management, and none required delayed laparotomy. The authors concluded that selective conservative management may be applied safely to a limited group of patients with low velocity gunshot wounds.</td>
<td>30 Br J Surg 1990;77:652-5.</td>
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<td>Munera 2004</td>
<td>Gunshot wounds of abdomen: evaluation of stable patients with triple-contrast helical CT. This is a prospective study of 47 patients with abdominal gunshot wounds who received a triple-contrast helical computed tomography scan and were elderly patients with no abdominal gunshot wounds.</td>
<td>31 Radiology 2004;231:399-405.</td>
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<td>Study Type</td>
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<td>Prospective</td>
<td>A method of determining peritoneal penetration in gunshot wounds to the abdomen</td>
<td>Nagy KK</td>
<td>1997</td>
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<td>Prospective</td>
<td>Gunshot wounds to the liver: A prospective study of selective nonoperative management</td>
<td>Renz BM</td>
<td>1995</td>
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<td>Prospective</td>
<td>Gunshot wounds to the right thoracoabdomen: A prospective study of nonoperative management</td>
<td>Renz BM</td>
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<td>Prospective</td>
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<td>Unnecessary laparotomies for trauma result in unexplained morbidity</td>
<td>Renz BM</td>
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**Study Type Definitions**
- **Prospective Study**: A study designed to determine the outcome of a treatment or intervention.
- **Retrospective Study**: A study that reviews and analyzes previously collected data.
- **Case Series**: A study that describes a series of cases with a common characteristic.
<table>
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<td>1995</td>
<td>J Trauma</td>
<td>Rosemurgy AS</td>
<td>ABdominal stab wound protocol: prospective study documents applicability for widespread use.</td>
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<td>2004</td>
<td>AJR Am J Roentgenol</td>
<td>Shanmuganathan K</td>
<td>Penetrating torso trauma: triple-contrast helical CT in peritoneal violation and organ injury and the need for laparotomy.</td>
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<td>AJR Am J Roentgenol</td>
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Note: The table above is a summary of the studies mentioned in the text. Each row represents a study, with columns detailing the year, journal, authors, and description of the study. The table is structured to provide a clear and concise overview of the research findings.
### Is exploratory celiotomy necessary for all patients with truncal stab wounds?

<table>
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<tr>
<th>Year</th>
<th>Journal</th>
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<tr>
<td>1990</td>
<td>Arch Surg</td>
<td>Penetrating stab wounds to the abdomen: use of serial US and contrast-enhanced CT in stable patients.</td>
<td>Soto JA</td>
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**For all patients with truncal stab wounds:**

- **Soto JA (1990)**: Penetrating stab wounds to the abdomen: use of serial US and contrast-enhanced CT in stable patients. This study is a review of mandatory celiotomy in patients with truncal stab wounds.
- **Taviloglu K (1998)**: Abdominal stab wounds: the role of selective management. This study is a review of mandatory celiotomy in patients with truncal stab wounds.
- **Soo JA (1998)**: Penetrating stab wounds in the abdomen: early US imaging. This is a prospective series of 23 patients with abdominal stab wounds who underwent exploratory laparotomy.
- **Sirinek KR (1990)**: This study is a review of mandatory celiotomy in patients with truncal stab wounds.
<table>
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<th>Selective clinical management of anterior abdominal stab wounds.</th>
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<td>This is a retrospective review of 77 patients with anterior abdominal stab wounds. Twenty-five were taken directly to the operating room for hypotension, evisceration or peritonitis. Seventeen underwent diagnostic peritoneal lavage (DPL) for thoracoabdominal wounds and 5 had local wound exploration. Three of five patients with grossly positive DPLs had therapeutic laparotomies. One of three with positive DPL by red blood cell count had a therapeutic laparotomy. Four of five patients had negative local wound explorations; one of these was performed on failed DPL. The remaining 30 patients were managed with serial clinical assessments and did not require operation. The authors concluded that patients sustaining anterior abdominal stab wounds who present without hypotension, evisceration, or peritonitis might be managed safely under a protocol of serial clinical evaluations.</td>
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<th>Role of ultrasonography in penetrating abdominal trauma.</th>
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<td>This is a prospective review of 370 patients with penetrating abdominal wounds (48 gunshot wounds and 322 stab wounds). Initially diagnostic peritoneal lavage and local wound exploration were used. All these methods were later abandoned. The exploration was revascularized with hemorrhage control. Delayed laparotomy did not increase morbidity or mortality. The overall rate of positive lavages for thoracic and abdominal wounds decreased while the rate of positive lavages for abdominal wounds decreased while the rate of positive laparotomies for thoracic wounds decreased while the rate of positive laparotomies for abdominal wounds decreased. The authors concluded that patients sustaining abdominal stab wounds who present without hypotension, evisceration, or peritonitis might be managed safely under a protocol of serial clinical evaluations.</td>
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This is a prospective case series of 37 patients with gunshot wounds to the back. Eleven patients were excluded from the study after receiving an emergency resuscitative thoracotomy. Four patients were operated on without abdominal findings due to spinal cord injuries in 2, inability to observe due to need for repair of another injury in 1, and participation in another protocol in 1. Of the remaining 188 patients, 58 (31%) underwent laparotomy (56 therapeutic, 2 negative) due to a positive physical examination (peritoneal signs, gross hematuria, rectal bleeding, or shock), and 130 (69%) were initially observed due to a negative clinical examination. Based on clinical findings, with significant intra-abdominal injuries in 77% (28/37), based on abdominal examination, 72% (27/37) were operated on. In the remaining 22% (8/37), diagnostic tests, including rigid sigmoidoscopy and peritoneal tap, were performed for diaphragmatic tears, including right subdiaphragmatic and were aimed for without clinical signs of significant injury underwent gastrointestinal, rectal, or right subdiaphragmatic peritoneal tap. Preoperative diagnosis was made after opening the abdomen in patients with positive intraperitoneal findings. The 60 patients with peritoneal signs and minimal hemodynamic instability underwent peritoneal lavage and management of peritoneal injuries if necessary.

This is a prospective study of 320 consecutive patients with gunshot wounds to the buttocks. Twenty (19.4%) were operated on immediately for gunshot wounds. Eleven (34.4%) underwent laparotomy or selectivity managing patients with peritoneal signs. The authors concluded that the sensitivity and specificity of clinical exam for identifying significant intra-abdominal injuries was 100% and 93%, respectively. The authors found that patients with peritoneal signs or shock underwent laparotomy. The remaining 42% (125/300) were successfully observed for diaphragmatic tears, including right subdiaphragmatic and were aimed for without clinical signs of significant injury underwent gastrointestinal, rectal, or right subdiaphragmatic peritoneal tap. Preoperative diagnosis was made after opening the abdomen in patients with positive intraperitoneal findings. The 60 patients with peritoneal signs and minimal hemodynamic instability underwent peritoneal lavage and management of peritoneal injuries if necessary.

This is a prospective study of 320 consecutive patients with transpelvic gunshot wounds. Nineteen (51.4%) were operated on immediately for indications of peritonitis (11/19), peritonitis with hypotension (1/19), peritonitis with hematuria (5/19), peritonitis with hypotension and hematuria (1/19), hypotension with a pulseless lower extremity (1/19). These were no missed injuries of delay in diagnosis. Sensitivity and specificity of clinical examination for identifying significant intra-abdominal injuries was 98% and 90.7%, respectively. The authors concluded that clinical examination is a reliable method of selecting patients with gunshot wounds to the buttocks.
Level I Trauma Center with an in-house trauma team. A policy of selective management is safe for managing patients with abdominal injuries. The authors conducted a retrospective nonrandomized study to evaluate the role of mandatory laparotomy in the management of patients with abdominal gunshot wounds (GSWs). The study included 1,856 patients with abdominal GSWs treated with selective nonoperative management. During observation, 80 (4.9%) patients developed symptoms and required a delayed laparotomy; 57/80 laparotomies were therapeutic. Five (0.3%) patients suffered complications related to the delay in laparotomy, which were successfully managed nonoperatively. The rate of unnecessary laparotomy was 1.4% among operated patients, compared to 5.0% in nonoperatively managed patients. The authors concluded that mandatory laparotomy is unnecessary; injuries that produce stable peripheral hematomas do not require exploration. A policy of selective management is safe and clinically effective, with a negative predictive value of 100%. The authors concluded that the clinical exam is the main indicator of injury. The use of abdominal CT angiography and other diagnostic procedures is not recommended. The authors performed a retrospective review of 792 patients with abdominal GSWs treated with selective nonoperative management. During observation, 80 (4.9%) patients developed symptoms and required a delayed laparotomy; 57/80 laparotomies were therapeutic. Five (0.3%) patients suffered complications related to the delay in laparotomy, which were successfully managed nonoperatively. The rate of unnecessary laparotomy was 1.4% among operated patients, compared to 5.0% in nonoperatively managed patients. The authors concluded that mandatory laparotomy is unnecessary; injuries that produce stable peripheral hematomas do not require exploration.


Selective nonoperative management in 1,856 patients with abdominal gunshot wounds: should mandatory laparotomy still be the standard of care? Velmahos GC 2001


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Selective nonoperative management in 1,856 patients with abdominal gunshot wounds: should mandatory laparotomy still be the standard of care? Velmahos GC 2001
This study is a prospective series of 100 stable patients with abdominal gunshot wounds to the abdomen selected for nonoperative management. The authors conducted that abdominal CT scanning is a safe method for selecting patients with abdominal gunshot wounds. The sensitivity of CT scanning was 90.5% and the specificity was 96% (Table 1). Two CT scans were false negative, missing hollow viscus injuries. The sensitivity of CT scanning on the basis of CT findings and two on the basis underwent operation on the basis of CT findings and two on the basis of clinical judgment. The authors concluded that abdominal CT scanning is a safe method for selecting patients with abdominal gunshot wounds to the abdomen selected for nonoperative management.