GUIDELINES FOR THE MANAGEMENT OF HAEMODYNAMICALLY STABLE PATIENTS WITH STAB WOUNDS TO THE ANTERIOR ABDOMEN

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Clinical practice guidelines have been shown to improve the delivery of care. Anterior abdominal stab wounds, although uncommon, pose a challenge in both rural and urban trauma care. A multidisciplinary working party was established to assist in the development of evidence-based guidelines to answer three key clinical questions: (i) What is the ideal prehospital management of anterior abdominal stab wounds? (ii) What is the ideal management of anterior abdominal stab wounds in a rural or urban hospital without an on-call surgeon? (iii) What is the ideal emergency management of stable patients with anterior abdominal stab wounds when surgical service is available? A systematic review, using Cochrane method, was undertaken. The data were graded by level of evidence as outlined by the Australian National Health and Medical Research Council. Stable patients with anterior abdominal stab wounds should be transported to the hospital without delay. Any interventions deemed necessary in prehospital care should be undertaken en route to hospital. In rural hospitals with no on-call surgeon, local wound exploration (LWE) may be undertaken by a general practitioner if confident in this procedure. Otherwise or in the presence of obvious fascial penetration, such as evisceration, the patient should be transferred to the nearest main trauma service for further management. In urban hospitals the patient with omental or bowel evisceration or generalized peritonitis should undergo urgent exploratory laparotomy. Stable patients may be screened using LWE. Abdominal computed tomography scan and plain radiographs are not indicated. Obese and/or uncooperative patients require a general anaesthetic for laparoscopy. If there is fascial penetration on LWE or peritoneal penetration on laparoscopy, then an urgent laparotomy should be undertaken. The developed evidence-based guidelines for stable patients with anterior abdominal stab wounds may help minimize unnecessary diagnostic tests and non-therapeutic laparotomy rates.

Key words: anterior abdominal stab wound, local wound exploration, penetrating trauma, practice guideline.

INTRODUCTION

Historically, there has been a low incidence of stab wound injuries in Australia and New Zealand.¹ The low incidence of stab wounds has led Australian and New Zealand surgeons to persist with a more operative approach to their management than in other countries, particularly in the case of anterior abdominal stab wounds.¹ Missed intra-abdominal injury is associated with significant morbidity and even mortality.²,³ However, there is also considerable morbidity associated with non-therapeutic laparotomy.¹ These guidelines examine evidence to make recommendations on how to best manage the stable patient with abdominal stab wounds and, in effect, reduce missed injury while minimizing negative laparotomy rates.

It is well recognized that intra-abdominal injuries from penetrating abdominal trauma are difficult to identify by physical examination alone. Initial physical examination may be unreliable because of the patient being under the influence of drugs and/or alcohol.⁴ In order not to miss injuries, the surgeon must have a high index of suspicion for their presence. This high index of suspicion may translate to liberal use of exploratory laparotomy.⁵ Both therapeutic and non-therapeutic laparotomies are potentially associated with complications and surgery should be carried out only when necessary to minimize these.⁶ In addition, non-therapeutic laparotomy may result in a hospital length of stay of up to 5–7 days (compared with 1 day for non-operative management).⁷

Determination of the most reliable, safe, efficient and cost-effective diagnostic and therapeutic modalities is a key focus of these clinical practice guidelines. The guidelines will make evidence-based recommendations for the management of patients with anterior abdominal stab wounds presenting to both rural and urban hospitals.
METHODS
The development of the guidelines followed the processes outlined by the Australian National Health and Medical Research Council.8–10 A multidisciplinary working party was established to assist in the development of key clinical questions and the construction of evidence-based guidelines. The following questions were prepared by the working party: (i) What is the ideal prehospital management of the patient with an anterior abdominal stab wound? (ii) What is the ideal management of the stable patient with anterior abdominal stab wound without an on-call surgeon? (iii) What is the ideal management of the stable patient with anterior abdominal stab wound when surgical service is available?

A systematic review, using Cochrane method, was undertaken. MEDLINE, Embase, and the Cochrane Database of Systematic Reviews and Controlled Clinical Trials were searched for all the available years. Articles were searched by title and abstracts of relevant articles retrieved for further evaluation. Full text of articles meeting predefined criteria was retrieved. The articles were then graded by their level of evidence described by the Australian National Health and Medical Research Council (Table 1).10–13 Recommendations were formulated from the most rigorous evidence of acceptable quality. The guidelines were reviewed by the working party and by key clinicians from Australia and internationally to ensure their appropriateness.

DEFINITIONS
The anterior abdomen is anatomically defined as anterior costal margins to inguinal creases, between the anterior axillary lines. Management of stab wounds to the thoracic abdomen is not covered by these guidelines. Patients with anterior abdominal stab wounds who are unstable are not included in these guidelines as they obviously require immediate surgery.

The haemodynamically stable patient is defined as a patient with a systolic blood pressure (SBP) >90 mmHg, a heart rate <120 b.p.m. and without clinical signs of shock.

| Table 1. National Health and Medical Research Council levels of evidence |
|---------------------------------|------------------------------------------------------------------|
| Level I                         | Evidence obtained from a systematic review of all relevant randomized control trials |
| Level II                        | Evidence obtained from at least one properly designed randomized control trial |
| Level III-1                     | Evidence obtained from well-designed pseudorandomized controlled trials (alternate allocation or some other method) |
| Level III-2                     | Evidence obtained from comparative studies (including systematic reviews of such studies) with concurrent controls and allocation not randomized, cohort studies, case–control studies or interrupted time series with a control group |
| Level III-3                     | Evidence obtained from comparative studies with historical control, two or more single-arm studies or interrupted time series without a parallel control group |
| Level IV                        | Evidence obtained from a case series, either posttest or pretest/posttest |

RESULTS
For possible inclusion, 698 articles were screened by title. Articles that did not meet the inclusion criteria were excluded resulting in 120 studies that were further evaluated in terms of level of evidence. Exclusion of articles that were superseded by a higher level of evidence resulted in 79 articles for inclusion. The practice guidelines are based on these 79 articles. An algorithm was drafted from these guidelines and is shown in Figure 1.

RECOMMENDATIONS
Clinical question
What is the ideal prehospital management of anterior abdominal stab wounds?

Guideline
Patients with anterior abdominal stab wounds should be rapidly transported to hospital with minimal scene time. Airway control using basic life support (BLS) manoeuvres and control of external haemorrhage is important.14 No other on-scene care should be provided and transfer should occur as rapidly as possible to hospital. I.v. access should be obtained en route.

Scientific foundation
A meta-analysis undertaken by Sethi concluded that there was insufficient evidence to determine the efficacy of advanced life support (ALS) in prehospital trauma care.15 In the absence of such evidence, Sethi suggests that strong argument could be made that prehospital (ALS) should not be promoted.

In the absence of a large prospective randomized trial and in acknowledgement of the difficulties of undertaking such, Liberman attempted to provide objective evidence on all aspects of prehospital trauma care through meta-analysis of non-randomized trials. The paper found that ALS increases mortality rate by 2.5 times compared with BLS (adjusted odds ratio 2.59).16 Although combining non-randomized trials has some limitations, this paper represents the best level of evidence available to date.

Several non-randomized studies have supported Liberman’s conclusion showing no benefit or worse outcomes in trauma patients who received ALS in the prehospital setting.17–20 In the 1970s and 1980s, Lewis advised that ALS should not be introduced.21 This was followed by arguments by Trunkey who suggested that there should be little investment in ALS.22

Intubation. The role of intubation in the prehospital setting has not been fully evaluated. Observational studies have shown mixed findings. Although Winchell and Hoyt found improved survival in head-injured patients who underwent prehospital intubation (64 vs 74% mortality), Winchell and colleagues found advanced airway management in the field to increase mortality (33 vs 24.2%, P < 0.05).23 The role of pre-hospital intubation is uncertain and requires further investigation.

Intravenous placement and fluid resuscitation. The landmark study of Bickell et al. has raised serious questions regarding the administration of i.v. fluid to bleeding trauma patients. In his prospective study, comparing immediate with delayed fluid resuscitation on 598 patients with penetrating torso injuries with a blood pressure of 90 or less, he found that patients with delayed fluid resuscitation had significantly higher survival (30 vs 38%);
Clinical question

What is the ideal management of anterior abdominal stab wounds in a rural or urban hospital without an on-call surgeon?

Guideline

In a thin patient, local wound exploration (LWE) by the general practitioner should be undertaken to determine the presence of anterior rectus sheath (fascial) penetration. If no fascial penetration is diagnosed, the patient should be observed for a period of 24 h and discharged if their condition improves. If, however, fascial penetration is identified, the patient should be transferred to the nearest main trauma service.

Scientific foundation

LWE has been used by many institutions for determining the need for laparotomy. Criticisms of LWE have stemmed from its inaccuracy in obese patients or patients with thick abdominal musculature which makes observation of the peritoneum difficult. If, however, LWE is used as a screening tool to identify patients with an intact fascia, then the sensitivity is 100% and specificity is 96%. Both Oreskovich and Carrico (2000) and Goldberger et al. have evaluated the safety and efficacy of LWE.

Military Anti-Shock Trousers suit. A randomized trial undertaken by Pepe et al. found that the Military Anti-Shock Trousers (MAST) suit offered no survival advantage in 175 patients with penetrating abdominal trauma. A MAST suit should not therefore be applied under any circumstances as it has been shown to increase mortality (31 vs 25%, P < 0.05).
Clinical question

What is the ideal emergency management of stable patients with anterior abdominal stab wounds when surgical service is available?

Guideline

Haemodynamically stable patients who have generalized peritonitis or evisceration should undergo early exploratory laparotomy.36–39 In a thin and cooperative patient, LWE should be undertaken to determine the presence of anterior rectus sheet fascial penetration.2,30,31 Determination of fascial penetration should result in the patients’ immediate transfer to the operating theatre. If LWE cannot be confidently undertaken because of obesity, uncooperative patients or poor or inadequate view of the abdominal rectus sheath, the patient may alternatively undergo laparoscopy or DPL. Given Australian and New Zealand surgeon’s experience with general laparoscopy, laparoscopy may be the preferred approach. In the event that either of these examinations is positive or indeterminate, the patient should be promptly transferred to the operating theatre.

Scientific foundation

Probabilities. Although the site of penetration may provide clues as to which organs could be injured, the site of entry alone does not accurately predict organs at risk.40

The greatest predictor of significant intra-abdominal injury is haemodynamic instability and abnormal physical examination. The positive predictive value of shock for predicting positive laparotomy is well over 80%.2,41 For patients presenting without signs of shock but with signs of generalized peritonitis the incidence of significant intra-abdominal injury approaches 85%,39,42 In the presence of omental or bowel evisceration serious abdominal injuries may be found in 75% of patients, with half of these having two or more organ injuries.36,37,42,43

Patients without signs of shock, peritonitis or evisceration are more difficult to assess. The incidence of intra-abdominal injury in asymptomatic patients is variably reported between 8 and 28%; this variation is because of institutional differences in the definition of stable patients.2,32,34,40 The risk of injury increases in the presence of peritoneal penetration. In all, 68–70% of patients with peritoneal penetration will have an organ injury,2,31 37% of these resulting in serious morbidity if left untreated.2

The incidence of occult diaphragmatic injury in asymptomatic patients with anterior abdominal stab wounds is approximately 7%, which if undetected is associated with high risk of subsequent hollow viscus herniation.2

The most commonly injured organs are the liver (22%), omentum (18%), mesentery (10%), stomach (8%), diaphragm and pleura (8%), small bowel (4%), large bowel (3%) and spleen (3%).44

Investigations. Clinical examination has a reported sensitivity of 88–100% and specificity of 79–94% for identifying intra-abdominal injury requiring surgical management.36,39,41–43,45 Clinical examination assessing for signs of shock, continuing haemorrhage, evisceration and generalized peritonitis will therefore identify most of the patients (90%) with intra-abdominal injury requiring laparotomy. However, 1–10% may have a significant injury that will go undetected despite thorough clinical examination. Physical examination should therefore be supplemented with a more accurate screening test.

LWE has been used by many institutions for determining the need for laparotomy.2,31–35 When LWE is used as a screening tool to assess the integrity of the fascia, it is highly accurate and will not miss any injury (sensitivity 100%, specificity 96%).2 The success of LWE is dependent on an adequate view of the peritoneum and individual clinician’s skills. If a fascial penetration cannot be excluded by LWE, DPL or laparoscopy may be undertaken in its place.

The accuracy of DPL has been variable across studies with a sensitivity of 91–100% and specificity of 86–99% for predicting a positive laparotomy.46–50 Its use in penetrating trauma has also been questioned.46,51 Reports on RBC counts used for positive DPL have varied from 1000 to 100 000/mm³. In an attempt to minimize false-negative results, both Sriussadaporn et al.46 and Nagy et al.49 have undertaken prospective studies examining the sensitivity and specificity of positive DPL, which they defined as the aspirate of 10 mL of frank blood or RBC count of 10 000/mm³. Application of these criteria in patients with anterior penetrating abdominal trauma has resulted in a sensitivity and specificity of 95–100% and 87–99%, respectively.56,49

Patients who have upper abdominal stab wounds are at higher risk of diaphragmatic injury that will not be detected by DPL.2,46 Therefore, these patients should undergo diagnostic laparoscopy without DPL to exclude the possibility of diaphragmatic injury.52 Laparoscopy has proven its accuracy in evaluating peritoneal penetration and diaphragmatic injury.52–55

Screening laparoscopy is highly accurate for excluding haemoperitoneum, upper abdominal organ injuries, diaphragmatic lacerations and retroperitoneal haematoma.53,54,56,57 However, laparoscopy as a diagnostic tool particularly in detecting injuries to the lower abdominal organs and hollow viscus is poor (sensitivity 18–50%). Therefore, laparoscopy should be used chiefly to rule out peritoneal penetration and diagnose diaphragmatic perforation. The sensitivity for the detection of injury to these structures is 98–100%.56,58 Laparoscopy should be carried out with a 30° telescope to help see the potential site of penetration of the abdominal wall.

A randomized study undertaken by Leppaniemi evaluated the use of diagnostic laparoscopy versus exploratory laparotomy in managing patients with abdominal stab wounds. Leppaniemi did not recommend use of laparoscopy. Hospital morbidity, length of hospital stay, cost and postdischarge disability were indifferent between the two groups. Postoperative pain and cosmetic results were not assessed in this study. Long-term outcomes such as incisional hernias and adhesive intestinal obstructions remain unknown.2

Plain radiographs of the abdomen are not useful in patients with stab wounds to the anterior abdomen unless there is suspicion of an imbedded foreign body.32,34,59 A study by Kester et al. examining patients with abdominal stab wounds found that an overwhelming majority of patients with injury requiring repair had a normal abdominal radiograph.59
Computed tomography scan of patients with abdominal stab wounds identifies solid organ injury with great accuracy (100% sensitivity, 96% specificity) and evaluates the retroperitoneum well. It does not, however, detect peritoneal penetration and is reported to be unreliable in detection of bowel and diaphragmatic injuries.\textsuperscript{32,60,61} It should not therefore be used for assessment of patients with anterior abdominal stab wounds.

**ASSESSMENT AND DECISION-MAKING**

Although most serious injuries will declare themselves on initial clinical assessment, there is a small but significant group of patients with normal vital signs and physical examination that may have an occult injury that if missed can cause serious morbidity. The proposed algorithm encourages the use of screening tools in line with the risk of injury, which should decrease the incidence of missed injury and inappropriate diagnostic testing. This aims to minimize morbidity associated with invasive tests.

Decision-making is based on the result of each screening tool and location of the stab wound. LWE is the initial procedure of choice as it does not miss any injuries and is not associated with morbidity. As the incidence of intra-abdominal injury in patients with peritoneal penetration exceeds 60%, exploratory laparotomy is warranted. However, the surgeon should be mindful of diaphragmatic injury in high abdominal stab wounds. Concomitant injury to the pleura should be evaluated using a chest radiograph to rule out pneumothorax.

In the past it has been the practice at many trauma centres to carry out a one-shot intravenous pyelogram (IVP) to evaluate the contralateral kidney in the event that a nephrectomy was required. The prevalence of a non-functioning kidney with a normal kidney on the contralateral side is less than 1%. Unilateral renal agenesis is even more uncommon with a prevalence of less than 0.1%. Nagy et al., in their evaluation of 175 patients with penetrating abdominal wounds, found that 1.1% of their patients had an uninjured kidney that could not be observed using a one-shot IVP.\textsuperscript{62} The sensitivity and specificity of one-shot IVP was found by Patel and Walker to be 25 and 76%, respectively.\textsuperscript{63} In light of the low incidence of kidney agenesis or non-functioning kidney, the inaccuracy of one-shot IVP and the delay it imposes to definitive management, there is no justification to undertake one-shot IVP. During laparotomy renal injury can be identified if present. In the unusual event that a nephrectomy was required, palpation of the other kidney should occur. To assess function of the kidney when a severe injury is present and bleeding is controlled, one can inject methylene blue and see if it is excreted. For this, one must have a non-functioning injured kidney or occlude the ureter on the injured side.

Morbidity and mortality from missed injury are greater than those associated with non-therapeutic laparotomy.\textsuperscript{59} Although this does not justify exploratory laparotomy for all patients, surgeons should have a low threshold for surgical exploration if diagnostic tests are equivocal. Focused assessment sonography in trauma (FAST) has little role to play in the stable patients. However, if free fluid is detected, then that would be an indication for surgery. A negative FAST, however, does not exclude intra-abdominal injury.\textsuperscript{64}

**CONCLUSION**

Patients should be transported to hospital without delay and procedures, such as i.v. cannulation, carried out en route to hospital. Selective management of anterior abdominal stab wounds, using clinical examination, LWE, and/or laparoscopy or DPL, has been evaluated in multiple institutions and is reported to be safe and efficacious.\textsuperscript{30,40,65–68} However, the success of this management protocol is dependent on individual practitioner skills. In a rural environment, if DPL or LWE cannot be carried out confidently, then it is recommended that the patient be transferred to the main trauma centre for further ancillary diagnostic work-up. Unnecessary investigations, especially abdominal radiographies and abdominal computed tomography scans, should be avoided. In the rural hospital determination of either fascial or peritoneal penetration will decrease unnecessary interhospital transfers and in urban centres minimize non-therapeutic laparotomies and morbidity from missed injury.

**REFERENCES**

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