SAJS
General Surgery

# Laparotomy for blunt abdominal trauma in a civilian trauma service

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## Summary

This report looks at the group of patients who required a laparotomy for blunt torso trauma at a busy metropolitan trauma service in South Africa.

*Methods.* A prospective trauma registry is maintained by the surgical services of the Pietermaritzburg metropolitan complex. This registry is interrogated retrospectively. All patients who required admission for blunt torso trauma over the period September 2006 - September 2007 were included for review. Proformas documenting mechanism of injury, age, vital signs, blood gas, delay in presentation, length of hospital stay, intensive care unit stay and operative details were completed.

*Results.* A total of 926 patients were treated for blunt trauma by the Pietermaritzburg metropolitan services during the period under consideration. A cohort of 65 (8%) required a laparotomy for blunt trauma during this period. There were 17 females in this group. The mechanisms of injury were motor vehicle accident (MVA) (27), pedestrian vehicle accident (PVA) (21), assault (5), fall from a height (3), bicycle accident (6), quad bike accident (1) and tractor-related accident (2). The following isolated injuries were discovered at laparotomy: liver (9), spleen (5), diaphragm (1), duodenum (2), small bowel (8), mesentery (8), bladder (10), gallbladder (1), stomach (2), colon/rectum (2) and retrohepatic vena cava (1). The following combined injuries were discovered: liver and diaphragm (2), spleen and pancreas (1), spleen and liver (2), spleen, aorta and diaphragm (1), spleen and bladder (1) and small bowel and bladder (2). Eighteen patients in the series (26%) required relaparotomy. In 10 patients temporary abdominal containment was needed. The mortality rate was 26% (18 patients). There were 6 deaths from massive bleeding, all within 6 hours of operation, and 3 deaths from renal failure; the remaining 9 patients died of multiple organ failure. There were 8 negative laparotomies (7%). In the negative laparotomy group false-positive computed tomography (CT) scan findings were a problem in 3 cases, in 1 case hypotension and a fractured pelvis on admission prompted laparotomy, and in the other cases clinical findings prompted laparotomy. All patients who underwent negative laparotomy survived. There were 10 pelvic fractures, 5 lower limb fractures, 2 spinal injuries, 4 femur fractures and 2 upper limb fractures. CT scans were done in 25 patients. In 20 patients the systolic blood pressure on presentation was <90 mmHg and in 41 the pulse rate was >110 beats/min. In 16 patients there was a base excess of <-4 on presentation.

*Conclusion.* Laparotomy is needed in less than 10% of patients who sustain blunt abdominal trauma. Solid visceral injury requiring laparotomy presents with haemodynamic instability. Hollow visceral injury has a more insidious presentation and is associated with a delay in diagnosis. CT scan is the most widely used investigation in blunt abdominal trauma. It is both sensitive and specific for solid visceral injury, but its accuracy for the diagnosis of hollow visceral injury is less well defined. Clinical suspicion must be high, and hollow visceral injury needs to be actively excluded.

*S Afr J Surg* 2012;50(2):30-32.

Blunt abdominal trauma is difficult to manage, as injuries are not obvious and indications for operation not as clear as in penetrating abdominal trauma. Many solid visceral injuries are suitable for conservative management, whereas almost all hollow visceral injuries require operation.[1,2] Deciding on treatment may be difficult, and the fear of missing a surgical lesion is always present. This study reviews our experience with high-velocity blunt torso trauma and attempts to refine our management algorithms.

## Patients and methods

All patients with blunt abdominal trauma in Pietermaritzburg are assessed by the surgical staff in our receiving departments. Standard resuscitation protocols are followed. Cervical spine, chest and pelvic radiographs are routinely requested. If a total-body computed tomography (CT) scan is to be performed we omit cervical spine views. Unstable patients who do not respond to resuscitation are taken to the operating room. Surgeon-performed ultrasound is not available to us. Stable patients who meet our indications are subjected to a total-body or abdominal CT scan.

We use the following indications to request a total-body CT scan: mechanism of injury, hypotension on presentation, unexplained acute anaemia, impaired consciousness from any cause, and a widened mediastinum on plain chest radiograph.

A prospective trauma registry is maintained by the surgical services of the Pietermaritzburg metropolitan complex. This registry is interrogated retrospectively. All patients who required laparotomy for blunt abdominal trauma over the period September 2006 - September 2007 were included for review. Basic demographic data,

mechanism of injury, vital signs and blood gas results on admission, time to presentation, length of hospital stay and intensive care unit (ICU) stay, and operative details were recorded.

## Results

A total of 926 patients were treated for blunt trauma by the Pietermaritzburg metropolitan services during the period under consideration. Of this total 65 (8%) required a laparotomy. There were 17 females in this group. The mechanism of injury was motor vehicle accident (MVA) (27), pedestrian vehicle accident (PVA) (21), assault (5), fall from a height (3), bicycle accident (6), quad bike accident (1) and tractor-related accident (2). The following isolated injuries were discovered at laparotomy: liver (9), spleen (5), diaphragm (1), duodenum (2), small bowel (8), mesentery (8), bladder (10), gallbladder (1), stomach (2), colon/rectum (2) and retrohepatic vena cava (1). The following combined injuries were discovered: liver and diaphragm (2), spleen and pancreas (1), spleen and liver (2), spleen, aorta and diaphragm (1), spleen and bladder (1) and small bowel and bladder (2). On presentation 25% of patients had a systolic blood pressure of <90 mmHg, 50% had tachycardia (pulse rate >100 beats/min), 22% had a Glasgow Coma Score (GCS) of <14/15, and 20% were acidotic. A CT scan was done in 27 cases (41%). In the remainder the decision to perform a laparotomy was made on clinical grounds.

The mortality rate was 18 (26%). There were 6 deaths from massive bleeding, all within 6 hours of operation; of these patients 5 had liver injuries and 1 a combined splenic and aortic avulsion. There were 3 deaths from renal failure, and the remaining 9 patients died of multiple organ failure secondary to sepsis.

There were 8 (7%) negative laparotomies in the series. In the negative laparotomy group, the CT scan demonstrated small amounts of free fluid in 2 cases. In 1 case hypotension and a fractured pelvis on admission, and in 2 cases abdominal distension during orthopaedic surgery, prompted laparotomy. The reason for laparotomy in the remaining 3 patients with a negative laparotomy was clinical uncertainty. Seven patients who underwent negative laparotomy survived, but 1 patient developed acute renal failure and died from this complication. Liver packing was performed in 6 patients. There were 18 patients (26%) who required relaparotomy in this series. In 10 patients temporary abdominal closure was needed.

There were 76 chest injuries, 97 orthopaedic injuries, 11 head injuries and 4 vascular injuries in this series. These associated injuries are documented in Tables 1 - 3. There were therapeutic delays of over 12 hours in 15 patients, and in 10 of these cases the delay was 24 hours or more. In the delayed group there were 4 bladder injuries, 6 jejunal perforations, 1 duodenal injury, 2 infarctions of the ascending colon and 2 small-bowel mesenteric avulsions. All 5 of the assault victims were in the delayed treatment group.

**Table 1. Associated orthopaedic injuries**

| | |
|---|---|
| Clavicle | 11 |
| Scapula | 8 |
| Humerus | 6 |
| Radius and ulna | 2 |
| Pelvic | 30 |
| Femur | 13 |
| Tibia and fibula | 10 |
| Hip dislocation | 1 |
| Cervical spine | 4 |
| Thoracic spine | 8 |
| Lumbar spine | 3 |

**Table 2. Associated thoracic injuries**

| | |
|---|---|
| Haemothorax | 13 |
| Pneumothorax | 16 |
| Rib fractures | 41 |
| Pulmonary contusion | 6 |

**Table 3. Associated traumatic brain injuries**

| | |
|---|---|
| DAI | 1 |
| Contusion | 5 |
| BOS | 1 |
| Subdural | 1 |
| Subarachnoid | 3 |

DAI = diffuse axonal injury; BOS = base of skull fracture.

## Discussion

Blunt abdominal trauma secondary to an MVA or a fall does not occur in isolation, and these patients often present with hypovolaemic shock. In our series a quarter of all the patients presented with class III and IV shock and a further 25% had compensated or class I - II shock. Extra-abdominal injuries determine overall survival and length of stay in the ICU and may distract from serious abdominal pathology.

Laparotomy for blunt abdominal trauma is necessary in less than 10% of cases (7% in our series). Accurately identifying patients who require laparotomy following blunt abdominal trauma may be difficult. Blunt trauma is diffuse and may inflict neurological injury and other distracting extra-abdominal injuries. Delay translates into morbidity and mortality.

A number of algorithms have been developed to guide the management of patients with blunt abdominal trauma.[1-7] Diagnostic peritoneal lavage (DPL) is sensitive but nonspecific. It is also invasive, and once performed cannot be repeated and precludes ongoing clinical or radiological assessment of the abdomen. It cannot diagnose retroperitoneal injuries. Multidetector CT scan with contrast is the mainstay of algorithms for the investigation of the haemodynamically stable patient with blunt abdominal trauma and accurately delineates solid visceral injury.[3-7] The diagnosis of hollow visceral injury, however, remains controversial. CT features that suggest hollow visceral injury include free air and extravasation of intraluminal contrast. Features such as mesenteric haematomas or beading of the mesenteric vessels and acute cut-off of mesenteric vessels are suggestive of mesenteric injury. Bowel-wall thickening is suggestive of injury to the bowel wall.[5-11] The presence of isolated free fluid in the abdomen was initially regarded as an indication for

laparotomy. However, dramatic improvements in CT technology have resulted in very small quantities of free fluid being detected. Small amounts of isolated free fluid are not regarded as an indication for laparotomy.[5-11] We can support this with the results in our own series, in which 2 patients underwent unnecessary laparotomy because the CT scan demonstrated small amounts of free fluid.

Specialised investigations take time and remove the patient from the resuscitation area. For an adjunctive investigation to be of benefit it must be readily available at the time of need, non-invasive, mobile, repeatable, and both sensitive and specific. Surgeon-performed ultrasonography meets these criteria and has been used extensively for assessment of the unstable patient with blunt abdominal trauma. Laparoscopy has not been widely applied in the investigation of blunt abdominal trauma.[12,13]

The most commonly injured solid viscus is the liver, followed by the spleen. Renal and pancreatic injuries are less common. This is reflected by our results. Provided the patient remains haemodynamically stable, even relatively severe grades of liver or splenic injury may be successfully treated non-operatively.[14] Most of the patients operated on for solid visceral injury underwent emergency operation for ongoing haemorrhage. Damage control for major trauma has become a well-established concept. Bleeding liver injuries are packed and actively bleeding spleens are removed.[15,16] Despite this, high-grade liver injury and retro-hepatic caval injuries are still associated with a high mortality. In our series, out of 6 early deaths there were 5 high-grade liver injuries; 2 of these were associated with a right diaphragmatic injury and 1 with a retro-hepatic caval injury. Liver packing was utilised in two-thirds of the liver injuries in this series.

Delay in recognising the need for laparotomy is a problem.[17-23] Hollow visceral injury has an indolent and occult presentation and in our series was associated with long delays in diagnosis. The retroperitoneal position of the duodenum tends to mask peritonitis following duodenal injury, and both the patients with duodenal injury in our series experienced a prolonged delay in diagnosis. Both died secondary to breakdown of the repair and retroperitoneal sepsis. Intraperitoneal bladder rupture may not present with overt clinical signs and must be actively excluded by radiological imaging.

There were significant delays associated with the cases of intraperitoneal bladder rupture in our series. Small-bowel mesenteric avulsion may not present with early signs as the avulsed segment only becomes ischaemic after several hours. Initially the segment may remain viable and patent. As full-thickness ischaemia of the bowel wall develops, the small bowel may perforate. Only once this has occurred will clinical signs develop. There were five victims of interpersonal violence in this series. All these patients experienced long delays in diagnosis. A forceful direct blow to the abdomen such as a kick, a tackle or a blow with a stick can result in a blow-out-type perforation of small bowel or the duodenum. It is important for managing staff to get a detailed history of the assault. If the history suggests a great deal of force, it is essential that advanced imaging be obtained. Delay in diagnosis of a small-bowel perforation results in increased morbidity and mortality. The long delays in recognising the need for laparotomy reflect poor understanding of the mechanism of injury and unfamiliarity with the pathology. Development and propagation of algorithims for the assessment and management of blunt torso trauma are necessary if we hope to reduce the incidence of delay.[17-23]

## Conclusion

Blunt abdominal trauma does not occur in isolation and is associated with significant extra-abdominal injuries, many of which will determine the overall outcome. These patients frequently present with signs of shock and require resuscitation. Their care is complex and requires multidisciplinary input. Laparotomy is needed in less than 10% of patients. Identifying who requires a laparotomy may be difficult. Good clinical judgement is important. Solid visceral injury that requires a laparotomy presents with massive bleeding and haemodynamic instability. The presentation of hollow visceral injury, however, is more insidious and clinical examination is unreliable. CT scanning is currently the most widely used investigation in blunt abdominal trauma. While it is both sensitive and specific for solid visceral injury, its accuracy for the diagnosis of hollow visceral injury is less well defined. Clinical suspicion must be high and hollow visceral injury needs to be actively excluded. In our environment there are long delays prior to establishing the need for laparotomy. Hollow visceral injury following assault is particularly associated with long delays in diagnosis. This deficit needs to be addressed.

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