RECOGNISING AND ASSESSING BLUNT ABDOMINAL TRAUMA

Anthony McGrath and Dean Whiting discuss the anatomy and physiology of the abdominal cavity, and the management of patients who have sustained major traumatic injuries.

Abstract

Blunt abdominal trauma is common following major traumatic injury but may not be recognised quickly enough and is therefore a cause of preventable death in trauma patients. Emergency department nurses have a major role to play in reducing the incidence of unrecognised abdominal trauma by enhancing their knowledge and skills. They can do this by attending trauma-related courses, taking on more expanded roles, carrying out full and comprehensive physical assessments, and ensuring that members of the multidisciplinary team use the wide range of diagnostic adjuncts available to them. This article reviews the anatomy and physiology of the abdominal cavity, explains abdominal trauma, gives an overview of advanced abdominal assessment techniques and diagnostic adjuncts, and reviews some management strategies for uncontrolled haemorrhage that have been adopted in the UK.

Keywords
Abdominal cavity, abdominal injuries, haemorrhage, injury, trauma

UNRECOGNISED ABDOMINAL trauma is one of the main causes of preventable death in severely injured patients throughout the world (American College of Surgeons Committee on Trauma (ACSCCT) 2012). About one fifth of all major trauma fatalities involve trauma to organs in the abdominal cavity (Brooks et al 2004) and blunt abdominal trauma is the third most common problem encountered in trauma patients. Yet it is often missed or its diagnosis delayed because patients’ clinical signs and symptoms are not immediately recognised.

Diagnosis can be complicated if the patients concerned have ingested alcohol or taken drugs, mortality and morbidity rates among trauma patients tend to be higher among those who have consumed alcohol (Small et al 2006). Diagnosis can also be complicated if patients have sustained distracting injuries, such as long bone or pelvic fractures (Michetti et al 2010, Diercks et al 2011). It is therefore essential that abdominal injuries are prioritised and managed in the context of concomitant injuries.

Abdominal trauma is classified as penetrating or blunt. Penetrating abdominal trauma is usually easy to diagnose due to the cause of the injury: gunshot or stabbing for example. Blunt abdominal trauma can be less obvious, however, even though it can produce life-threatening injuries (Blank-Reid 2004). Most preventable deaths following blunt abdominal trauma are due to failures in identifying the injuries involved (ACSCCT 2012), often because the signs and symptoms of abdominal injury take more than eight hours to appear or to be experienced, that is after patient arrival in hospital (Jones et al 2014).

Most abdominal injuries are secondary to high-speed road traffic accidents (Isenhour and Mark 2007, Fleming et al 2012) so emergency department (ED) nurses should always look for abdominal injuries in patients who have been in such accidents. Nurses must also understand fully the anatomy and physiology of the abdominal cavity, and the problems that can arise there due to trauma. The organ in the abdominal cavity that is most commonly injured is the spleen, followed by the
liver, and then the stomach, intestines and bladder (Isenhour and Marx 2011).

A small proportion of patients with abdominal injuries are haemodynamically unstable, on the cusp of physiological exhaustion due to continuing uncontrolled haemorrhage and therefore at risk of death (Spahn et al 2013). Immediate interventions in such patients are resuscitation and surgery (Ball 2014), with delays in these interventions often leading to worse outcomes and possibly death (Kirkpatrick et al 2008, Duchesne et al 2010).

The overall aims of assessing such patients are to determine the extent of abdominal trauma and indications for further treatment (Wiewióra et al 2011).

Anatomy and physiology

The abdominal cavity contains a number of organs and is partly enclosed by the lower thorax, where it extends into the ribcage during full expiration at the fourth intercostal space. The abdominal and pelvic cavities are lined by a serous membrane called the peritoneum, which also covers most of the abdominal viscera. The peritoneum consists of two layers: the parietal peritoneum, which lines the pelvic and abdominal cavities, and the visceral peritoneum, which covers the surface of most of abdominal organs (McGrath 2005).

The abdomen can be divided into three regions: the pelvic cavity, the peritoneal cavity and the retroperitoneal space. It is important to note, however, that the pelvic cavity also contains parts of the peritoneal cavity and the retroperitoneal space.

Because the abdominal cavity extends into the rib cage, the ribs protect some of the abdominal organs. The pelvis also protects the lower abdominal organs.

The peritoneal cavity can be divided into upper and lower cavities, both of which are lined by the parietal peritoneum (Martini et al 2011). The upper peritoneal cavity includes the diaphragm, liver, spleen, stomach and transverse colon, while the lower peritoneal cavity includes the small intestine, parts of the ascending and descending colon, the sigmoid colon and, in women, the reproductive organs (Tortora and Derrickson 2011).

The retroperitoneal space is situated behind the parietal peritoneum, and extends from the 12th thoracic vertebra and 12th rib superiorly to the sacrum and iliac crest inferiorly. The floor of the space is formed by the psoas muscle and the quadratus lumborum muscle, and is the origin of transversus abdominis muscle. Organs and vessels found in the retroperitoneal space include the aorta, vena cava, pancreas, suprarenal glands, kidneys, ureters, and the ascending and descending parts of the colon and duodenum (Tortora and Derrickson 2011).

The pelvic cavity is protected by the pelvic bones and contains the rectum, bladder, iliac vessels and in women the reproductive organs.

For descriptive purposes, many practitioners subdivide the abdomen into four quadrants. Lines cross at the umbilicus forming the four sections, known as the left upper, left lower, right upper and right lower quadrants. The abdominal organs in each quadrant are shown in Figure 1.

**Figure 1: Organs located in the four quadrants of the abdomen**

<table>
<thead>
<tr>
<th>Right upper</th>
<th>Left upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver.</td>
<td>Stomach.</td>
</tr>
<tr>
<td>Gallbladder.</td>
<td>Spleen.</td>
</tr>
<tr>
<td>Duodenum.</td>
<td>Left lobe of liver.</td>
</tr>
<tr>
<td>Head of pancreas.</td>
<td>Body of pancreas.</td>
</tr>
<tr>
<td>Hepatic flexure of colon.</td>
<td>Splenic flexure of colon.</td>
</tr>
<tr>
<td>Part of transverse and ascending colon.</td>
<td>Parts of transverse and descending colon.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Right lower</th>
<th>Left lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caecum.</td>
<td>Part of descending colon.</td>
</tr>
<tr>
<td>Appendix.</td>
<td>Sigmoid colon.</td>
</tr>
<tr>
<td>Right ovary and tube.</td>
<td>Left ovary and tube.</td>
</tr>
<tr>
<td>Right ureter.</td>
<td>Left ureter.</td>
</tr>
</tbody>
</table>
Mechanism of injury
Clear handovers from pre-hospital teams or eye witnesses help ED nurses and trauma team members to understand the mechanisms of patients' abdominal injuries and the risks involved. When obtaining patient histories pre-hospital teams, ED nurses and trauma teams can complete the ATMIST patient pre-alert and handover system, in which the acronym ATMIST describes the types of information teams require (Box 1).

The ATMIST handover format, which is used by the British military (Stannard et al 2008), was developed to enable paramedic and pre-hospital staff to provide essential information to receiving teams systematically (D’Amours 2004).

By determining the mechanism of injury, which can be classified as blunt, penetrating, thermal or blast (ACSCT 2012), ED nurses can begin to evaluate and assess the likely effects on patients, as well as the likelihood of abdominal problems.

When patients have sustained blunt trauma in road traffic collisions, nurses must ask specific questions to determine the risk of abdominal injury. These include:

- Was the patient in the vehicle at collision and, if so, where?
- Was the impact frontal, lateral, rear or side swiped? The answer to this can help clinicians visualise possible or likely areas of injury.
- Were there fatalities at the scene?
- What was the vehicle’s speed at the time of the incident?
- Did the vehicle decelerate rapidly?
- Was the patient wearing a seat belt?
- Was the vehicle’s air bag deployed?
- Was the patient ejected from the vehicle?
- Did the vehicle roll over or was there any intrusion into it?

If the patient was a pedestrian involved in road traffic collision, nurses should try to understand the phases of impact to gain a clear picture about potential injuries, for example to the lower leg, pelvis, abdominal and head (Gardiner and Kam 2011). There are usually three phases of impact involving pedestrians: with the vehicle’s bumper; with the vehicle’s bonnet, or windshield or both; and with the ground (Eid and Abu-Zidan 2007). Clinicians should then undertake the CABCDE trauma primary survey (Box 2) to ascertain the most likely life-threatening problems (Thim et al 2010) before a more detailed abdominal assessment is made.

Abdominal assessment
Physical assessments of the abdomen are usually undertaken by doctors but, as trauma team roles change, ED nurses may begin to take responsibility for this part of the trauma survey. It is therefore important that they understand and can carry out detailed physical examinations of the abdomen, identify early clinical concerns and ensure that appropriate interventions are undertaken (McGrath 2010).

In about 10% of abdominal examinations of trauma patients, significant injuries that later require surgery are missed (Michetti et al 2010). It is important then to ensure that such examinations are undertaken during immediate patient assessments and are supplemented by imaging to identify the presence of free fluid, which is associated with bleeding in the abdominal cavity and so a sign of trauma (Diercks et al 2011).

Special caution should be taken with patients who have ingested alcohol or drugs, those with spinal cord or brain injuries, and those with painful distracting injuries, which can mask, and consequently lead to misidentification of, abdominal trauma (ACSCT 2012).

Abdominal assessment begins with a full range of vital signs. Blood pressure and heart rate can help identify continuing internal bleeding and, because this is not always easily recognised, routine vital signs can be the first clue. Blood can fill the thoracic, abdominal, pelvic and retroperitoneal cavities without any early outward signs. Practitioners can alert themselves to this by recalling the saying ‘blood on the floor and four more’ or the acronym CRAMP, in which each letter stands for an area where blood can accumulate (Box 3, page 22).

Box 1  The ATMIST patient pre-alert and handover system

<table>
<thead>
<tr>
<th>A</th>
<th>Age and name of patient.</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Time of incident.</td>
</tr>
<tr>
<td>M</td>
<td>Mechanism of injury.</td>
</tr>
<tr>
<td>I</td>
<td>Injuries sustained or suspected, from top to toe.</td>
</tr>
<tr>
<td>S</td>
<td>Signs and symptoms, initially and subsequently.</td>
</tr>
<tr>
<td>T</td>
<td>Treatment given to the patient at scene and on the way to hospital.</td>
</tr>
</tbody>
</table>

(Adapted from South Western Ambulance Service NHS Trust 2013)

Box 2  The CABCDE trauma primary survey

| A | Airway. |
| B | Breathing. |
| C | Circulation. |
| D | Disability. |
| E | Environment and exposure. |

(Cadapted from Hodgetts et al 2006)
According to ACSCT (2012), a significant amount of blood can be present in the abdominal and pelvic cavities without any obvious signs and no change in the abdomen’s size or dimensions.

The abdomen should be inspected first for overt signs of abdominal injury, such as distension, entry and exit wounds, foreign objects, significant bruising or ecchymosis of the abdominal wall. Grey Turner's sign, a bruising of the flanks, is seen in severe abdominal injury and is associated with bleeding from the pancreas or kidney or with a pelvic fracture (Isenhour and Marx 2011). Next, the four abdominal quadrants should be given palpation and percussion to identify signs of tenderness. This practice may be difficult, however, in patients who are involuntarily guarding (ACSCT 2012).

The flanks, perianal and scrotal areas should all be inspected for bruising, swelling or lacerations. The urethral meatus should be checked for blood, and the vagina, rectum, peritoneum and buttocks for lacerations. Digital rectal examination (DRE) should be performed to check sphincter tone, position of the prostate and integrity of the rectal wall, and to assess for blood. A high-riding prostate suggests urethral disruption (ACSCT 2012) and the patient concerned must not be catheterised but sent for urethrography (Johnson et al 2013).

Although the Advanced Trauma Life Support manual recommends undertaking DRE in patients with penetrating trauma, pelvic fractures or spinal cord injuries, it appears to have little value in detecting blunt urethral injuries (Ball et al 2009). It should be noted that prostate evaluation in supine patients can be difficult and patient who are obese are less likely to have palpable prostates (Johnson et al 2013).

Adjuvants to aid diagnosis

Diagnostic imaging carried out by trauma team members, usually from the radiology department, has been an essential element of early trauma management since technological advances permitted its use in emergency care settings (Beck 2012). The widely accepted aim of imaging in trauma is to accumulate evidence of significant injury and facilitate subsequent treatment of life-threatening conditions (Kool and Blickman 2007). Diagnostic imaging in trauma is largely based on clinical protocols, or prediction rules, to ensure a standardised approach to patient care (Blackmore 2005). By following these rules, practitioners can identify which patients should undergo imaging and what imaging to use in any given situation.

Traditionally, a series of standardised radiological images, including X-rays of the chest, pelvis and abdomen, has been advocated for all injured patients (Diercks et al 2011); more recently, focused assessment with sonography for trauma (FAST) and computed tomography (CT) scans have been added to the list.

Although X-rays, and FAST and CT scans, have their place in injury surveillance, they are problematic in the management of unstable patients (Kam et al 2010). Blackmore (2005) suggests that routine use of imaging is often unnecessary and can delay treatment, while Clarke et al (2002) demonstrate that, in abdominal trauma patients who require laparotomy, the likelihood of dying increases by 1% for every three minutes’ delay. This delay can be attributed to diagnostic imaging being undertaken unnecessarily, especially where abdominal trauma is clinically evident.

Rossaint et al (2010) recommend that, in patients where the primary cause of instability is easily identified through physical assessment, surgical haemorrhage control should take place without further investigation. The clinical decision to operate should be based on knowledge of the mechanism of injury, and the patient’s haemodynamic stability and developing physiology. In such cases, there is no requirement to define anatomical injury before surgery because surgical procedures are systematic and involve assessment of injuries to all organs of the cavity (Rossaint et al 2010).

CT has become the ‘gold standard’ investigation for patients with blunt abdominal trauma because it is highly sensitive to solid organ injury in the abdomen. Because of its high degrees of specificity and sensitivity, it can be used to identify organ injuries and guide surgical management, which reduces the need for exploratory laparotomies. For these reasons, CT has major advantages over plain radiography, radionuclide imaging and angiography in the assessment of trauma-induced injuries (Cokkinos et al 2012).

Practitioners can also identify pelvic fractures, and injuries to the pelvic-wall soft tissue and pelvic cavity, from CT scans (Hassan and Aziz 2010), which are also useful adjuncts in haemodynamically stable patients who have sustained abdominal trauma. As a result, CT scans have almost replaced...
diagnostic peritoneal lavage (DPL) for the detection of abdominal injuries (Soto and Anderson 2012), even though they are time consuming and therefore contraindicated in haemodynamically unstable patients (Ruesseler et al 2009).

When carried out by trained and skilled practitioners, FAST offers between 98% and 100% specificity in blunt abdominal trauma (Natarajan et al 2010). It can also detect intraperitoneal free fluid, which is a clear indication of blunt abdominal trauma (Holmes et al 2012). This investigation can be carried out concurrently with other diagnostic or therapeutic procedures, and is especially useful for identifying or confirming pathology in patients who are pregnant or bleeding from multiple injuries, and for identifying pericardial fluid in patients with penetrating thoracic trauma (Kirkpatrick et al 2008).

FAST is a useful method of screening patients who require urgent surgical intervention because it allows for rapid triage to operative management when indicated (Holmes et al 2012). However, it is important to note that negative FAST scans do not exclude abdominal injuries (Fleming et al 2012), and Laselle et al (2012) found that they are not sensitive enough to detect all injuries in nearly half (49%) of patients with free fluid in the abdominal cavity following trauma, possibly because of the speed with which the investigation is undertaken as part of the primary survey. Therefore, although FAST is recommended as part of the primary survey to identify free fluid in trauma patients, a negative scan should not be relied on to rule out injuries and staff should use their clinical judgement when planning further management.

DPL, a surgical procedure involving insertion of a catheter and infusion of warm saline, is useful for identifying haemorrhage in the abdomen. It is also between 98% and 100% accurate for identifying intra-abdominal blood in haemodynamically unstable patients, and so is more sensitive than FAST (Cha et al 2009). As CT and FAST become more readily available, DPL is used less often, but it remains a useful adjunct for diagnosing internal abdominal haemorrhage and using it is an important skill for ED doctors. The three adjuncts are compared in Table 1.

Recent improvements in the management strategies for complex trauma, such as damage-control resuscitation, and in healthcare systems, such as the reduction in time between admission and bleeding control, have led to debate about the necessity of imaging in unstable trauma patients (Rossaint et al 2010). For example, if CT scans are needed, patients must be transported to an X-ray department and practitioners must evaluate the risk of further uncontrolled bleeding. If they decide to transport haemodynamically unstable patients, practitioners must ensure that all of their vital signs are monitored closely and resuscitation measures continued. However, Huber-Wagner et al (2009) show that the use of CT scanning can increase survival rates in patients with polytrauma and help practitioners identify multiple bleeding sources in patients with multiple injuries.

As a result of military campaigns in Afghanistan and Iraq over the past decade, the pathophysiological consequences of haemorrhagic shock (HS) and related management strategies have become better understood (Jansen et al 2009, Curry and Davis 2012). Cothren et al (2007) state that about 40% of trauma-related deaths are attributable to haemorrhage or related sequelae and, if imaging is used, are largely preventable (Holcomb et al 2008).

Blood and blood products that help improve oxygen delivery to tissues, and prevent and correct coagulation dysfunction, continue to play a major role in controlling haemorrhage (Yin et al 2014). Patients with suspected uncontrolled haemorrhage should be referred for surgical intervention as soon as possible because they could die from the haemorrhage or sepsis, and any surgical intervention that can mitigate these risks will help preserve life. Broad-spectrum antibiotics have been shown to help prevent sepsis and early use of tranexamic acid has proved useful in controlling haemorrhage (Shakur et al 2010).

<table>
<thead>
<tr>
<th>Purpose and characteristics</th>
<th>Type of scan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic peritoneal lavage</td>
<td>Focused assessment with sonography for trauma</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What is documented</th>
<th>Bleeding</th>
<th>Fluid</th>
<th>Organ injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure status</td>
<td>Low</td>
<td>Low</td>
<td>Normal</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>98%</td>
<td>86%-97%</td>
<td>92%-98%</td>
</tr>
<tr>
<td>Specificity</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Missed injuries</td>
<td>Diaphragm and retroperitoneum</td>
<td>Bowel, diaphragm and pancreas</td>
<td>Diaphragm, minor bowel and pancreas</td>
</tr>
<tr>
<td>Disadvantages</td>
<td>Invasive</td>
<td>Operator dependent</td>
<td>Expensive and time consuming</td>
</tr>
</tbody>
</table>

(Adapted from American College of Surgeons Committee on Trauma 2012)
Conclusion

Abdominal injury is a leading cause of morbidity and mortality among trauma patients of all ages but may go unnoticed. If ED nurses increase their knowledge of blunt abdominal trauma and mechanism of injury, they can assess patients more competently and effectively. Therefore it is essential that all ED nurses participate in ongoing training and education in major trauma management.

As emergency care provision evolves and traditional role boundaries disappear, nurses are increasingly taking on advanced roles, particularly in EDs (Considine et al 2012). ED nurses already have a great deal of knowledge, but to grasp these opportunities fully they need to develop and expand their skill base further. This will involve undertaking more in-depth patient histories and assessments, and developing clinical diagnostic skills.

There are many advanced practice courses designed to teach these skills to nurses throughout the UK. By embracing and taking on these changes, ED nurses can enhance the work of multidisciplinary teams and help reduce the number of preventable deaths due to particular trauma.

References

American College of Surgeons Committee on Trauma (2012) Advanced Trauma Life Support for Doctors: Student Course Manual. American College of Surgeons, Chicago IL.


