Seatbelt Injuries

Seatbelt use has increased from 58% in 1994 to a high of 85% in 2010. We know that seatbelt use saves lives, but trauma professionals are also aware that they can create their own injuries as well. This is a positive trade-off, because belt use prevents injuries that are difficult to treat (e.g. severe brain injury) and produces a higher number of intra-abdominal injuries that are easy to treat.

The spectrum of injuries attributed to seat belt use was finally appreciated in a journal article published 20 years ago. The authors wanted to catalog the various injuries seen in belted and unbelted motor vehicle occupants. They reviewed data from the North Carolina Trauma Registry, one of the most sophisticated state registries at the time. Although there were over 21,000 records in the database, only 3,901 involved motor vehicle crashes and had complete data on seatbelt use.

This study found the following:

- Mortality was higher in those not wearing their seat belts (7% vs 3.2%)
- Unbelted had a much higher incidence of severe head injury (50% vs 33%)
- Overall incidence of any abdominal injury was the same for both (14%)
- GI tract injuries were more common in the belted group (3.4% vs 1.8%)
- Solid organ injury was the same

**Bottom line:** This study sparked the recognition that seatbelts reduce severe head injury but increase the incidence of some hollow viscus injuries. About 514 severe head injuries were prevented in exchange for 21 additional abdominal injuries that were generally easily repaired. Good tradeoff!

The Seat Belt Sign

Officially, a seat belt sign consists of contusions and abrasions on the abdomen of a restrained occupant involved in a motor vehicle crash. The seat belt syndrome takes this one step further, with injury to the abdominal organs or spine.

Seat belts save lives by reducing the number of people dying from head injury after a car crash. However, they do so by diverting energy from the head to the chest and abdomen. Overall, people who don’t wear seat belts have a 10% chance of abdominal injury. With seat belts in place, this increases to 15%. And if the person is wearing seat belts and has a seat belt sign, the risk of injury increases to 65%!

This isn’t a bad thing, however. We can fix abdominal injuries, but we can’t fix the brain very easily; it has to heal on its own, and slowly at that.

Seat belts are associated with the Chance fracture, an uncommon fracture of the lumbar spine, usually at L1. These usually only occur with the use of lap belts without shoulder restraints, which is found less and less in cars today. These used to be located in the center of the rear seat, but most new cars offer shoulder restraints in this location now.

Chance fractures need to be assessed by a spine surgeon so that stability can be determined. If stable and there is minimal kyphosis, a brace may be appropriate for treatment. However, if the fracture is not stable or there is more than about 15 degrees of angulation, surgery will be necessary.

As seat belt use increases, seat belt signs are becoming more common. Any stable patient with a seat belt sign must have an abdominal CT. If any abnormal findings are noted, a surgeon must be consulted because it is very likely that operative intervention will be required.

Bucket Handle Injury

A bucket handle injury is a type of mesenteric injury of the intestine. The intestine itself separates from the mesentery, leaving a devascularized segment of bowel that looks like the handle on a bucket (get it?).

These injuries can occur after blunt trauma to the abdomen. The force required is rather extreme, so the usual mechanism is motor vehicle crash. In theory, it could occur after a fall from a significant height, and I have seen one case of this injury where a wood fragment was hurled at the abdomen by a malfunctioning lathe.

The mechanics of this injury are related to fixed vs mobile structures in the abdomen. Injuries tend to occur adjacent to areas of the intestine that are fixed, such as the cecum, ligament of Treitz, colonic flexures and rectum. During sudden deceleration, portions of the intestine adjacent to these areas continue to move, pulling on the nearby attachments. This causes the intestine itself to pull off of its mesentery.

The terminal ileum is the most common site for bucket handle tears. Proximal jejunum, transverse colon, and sigmoid colon are other possible areas. The picture above shows multiple bucket handle...
injuries in one patient. There are 3 injuries in the small bowel, and one involving the entire transverse colon. Note the obviously devascularized segment at the bottom center of the photo.

Always think about the possibility of this injury in patients with very high speed decelerations. Seat belt marks have a particularly high association with this injury. If your patient has an abnormal exam in the right lower quadrant, or if the CT shows unusual changes there (“dirty” mesenteric fat, thickened bowel wall, extravasation), I recommend a trip to the OR. In these cases, an injury will nearly always be present.

Practical Tips

An understanding of the mechanism of injury and a good physical exam are paramount. If the patient took a significant blow to the abdomen, especially in a motor vehicle crash (lap belt), be very suspicious. Any abdominal pain is of concern, particularly in the right lower quadrant (most common injury location). If a CT is indicated and there are focal changes in the mesentery or bowel wall, a trip to the OR is advised.

In some patients, the bowel is devascularized and takes 2-3 days to become necrotic. They experience slowly increasing focal pain, and once this develops it’s time to go to the operating room.

Intubated and/or comatose patients can be problematic for making this diagnosis. There is no physical exam, so the trauma professional has to rely on surrogates. The white blood cell (WBC) count is very helpful. The WBC count is typically elevated into the 15,000-20,000 range immediately after trauma, and declines to normal within about 12 hours. If the WBC begins to climb again after 24 hours, especially if it exceeds 20,000, an intestinal injury is likely.

CT scan and abdominal ultrasound are also helpful. A repeat CT scan may show a change in the volume of fluid, or a change in its character. If the amount of fluid increases significantly, or if a fluid bi-layer is seen, a bucket handle injury is very likely. These findings are pertinent in awake patients as well, but the physical exam usually makes use of these diagnostics unnecessary.

EAST Guideline Update: Initial Evaluation of Abdominal Trauma

A preliminary update to the EAST Practice Management Guideline for initial evaluation of abdominal trauma was presented and discussed at the 23rd Annual Scientific Assembly of the Eastern Association for the Surgery of Trauma.

The initial guideline was first published in 2001. It was updated by performing a new literature search spanning 1998 to 2009. A total of 33 new articles were reviewed to provide material for the revised guideline. As usual, the number of high quality references (3 Class I and 11 Class II) were outnumbered by lower quality Class III references (19).

For information on classes of data and levels of recommendations, please refer to the Primer on Evidenced Based Medicine on the EAST website.

Important: These guidelines are preliminary and may undergo further minor revision, so the final version may be slightly different than described here!

- The Level I recommendations remained basically the same, with one modification (bolded below):
  - FAST may be considered as the initial diagnostic modality to exclude hemoperitoneum.
- Exploratory laparotomy is indicated in hemodynamically unstable patients with a positive FAST. In hemodynamically stable patients with a positive FAST, follow-up CT scan permits nonoperative management of select injuries.
- Exploratory laparotomy is indicated for patients with a positive DPL and hemodynamic instability.

There was some interesting discussion about the continued utility of DPL. Some audience members felt that this was an outdated technique. Others pointed out that not all surgeons work in a Level I or II trauma center, and that FAST may not be available to them, so the technique remains relevant. Additionally, these guidelines may be used abroad where more advanced diagnostic testing is not as readily available, so it was recommended that the DPL language be retained.
The Level II recommendations are:

- When DPL is used, clinical decisions should be made on the basis of the presence of gross blood on initial aspiration (i.e. 10ml) or microscopic analysis of lavage effluent.
- Surveillance studies (i.e. DPL, CT scan, repeat FAST) should be considered in hemodynamically stable patients with indeterminate FAST results.
- CT scanning is recommended for the evaluation of hemodynamically stable patients with equivocal findings on physical examination, associated with neurologic injury, or multiple extra-abdominal injuries. Under these circumstances, patients with a negative CT should be admitted for observation.
- CT scanning is the diagnostic modality of choice for nonoperative management of solid visceral injuries.
- In hemodynamically stable patients, DPL and CT scanning are complementary diagnostic modalities.
- Contrast enhanced ultrasound (CEUS) is more sensitive than non-contrast ultrasound in the detection of solid organ injury. Many members of the audience were not familiar with this technique. I will comment on it in a later blog entry.
- In the patient at high risk for intra-abdominal injury (e.g. multiple orthopedic injuries, severe chest wall trauma, neurologic impairment) a CT scan should be considered in hemodynamically stable patients, even after a negative FAST.

Finally, the Level III recommendations are:

- Objective testing (i.e. FAST, DPL, CT scanning) is indicated for patients with abnormal mentation, equivocal findings on physical examination, multiple injuries, concomitant chest injury, or hematuria.
- Patients with seat belt sign should be admitted for observation and serial physical examination. The presence of intraperitoneal fluid on FAST or CT scan in a patient with seat belt sign suggests the presence of an intra-abdominal injury that may require surgery.
- CT scanning is indicated for suspected renal injuries.
- In hemodynamically stable patients with a positive DPL, a CT scan should be considered, especially in the presence of pelvic fracture or suspected injuries to the genitourinary tract, diaphragm or pancreas.
- Patients with free fluid and no solid organ injury on CT should be considered for laparotomy. Alternatively, laparoscopy or DPL may aid in diagnosis of bowel injury. Patients with no head injury and clear mentation may be followed by serial exams.

**Use Of CT Scan In Stabs To The Anterior Abdomen**

In general, stab wounds to the anterior abdomen (like any penetrating injury to the area) demand further evaluation to make sure there are no significant injuries. In the old days, a stab to the abdomen mandated a trip to the operating room. Fortunately, we recognized that more than half of these operations led to negative explorations.

Nowadays we can be much more selective. **Here is my recommended approach to evaluating these patients.**

First, are there any indications that the patient needs to go to the OR right now? **Check the vital signs.** If there is any hemodynamic instability, operate! **Check the abdomen.** If there is obvious peritonitis, or significant tenderness more distant from the actual stab site, off you go to the OR!

Next, after finishing all of the usual ATLS protocol it’s time to evaluate further. Several options exist:

- **Observation** – this is good for busy trauma centers that have lots of penetrating injury and busy ORs
- **DPL** – not used too much any more, but certainly is legitimate. I recommend that your RBC count threshold be reduced to 25,000 or 50,000
- **Local wound exploration** – this works in thinner people. Doing a LWE on an obese patient requires an incision that approaches the size of a small laparotomy. Might as well do it in the OR. Look for any violation of the anterior fascia.
- **CT scan** – the new kid on the block

**To use CT, the patient must be stable** (remember, they should be in the OR if otherwise) and have had a full ATLS evaluation. They should also not be terribly thin. Too little fat makes it difficult to gauge depth of the injury.

**The entry site(s) should be marked** with a small marker to minimize streak artifact. Resist the temptation to just scan the area around the stab itself. Do a full scan of the abdomen and pelvis with IV contrast only (no GI contrast needed).
Look closely for blood outlining the wound tract. If it reaches the anterior abdominal fascia, the exam is positive. You do not need to see specific injury to the muscle or abdominal viscera. Violation of the anterior fascia is an absolute indication to proceed to the OR. On occasion, the knife will not penetrate the posterior fascia, or penetrates but does not injury any organs. In these cases it is best to have operated and found nothing rather than delaying and increasing the risk of intra-abdominal complications or infections.

What Are These?
Scan using a QR Code App for your smartphone or tablet to connect to these websites.
Or, type the web address in your browser exactly, including upper and lower case.
You can also email the link to your desktop to access it.

EAST Practice Guideline
Evaluation of Blunt Abdominal Trauma

The Trauma Professional’s Blog