St. Michael’s Hospital Trauma Program

Orientation for Residents

Leading with Innovation
Serving with Compassion

ST. MICHAEL’S HOSPITAL
A teaching hospital affiliated with the University of Toronto
Unlike the case for elective operations for cancer or heart disease, severely injured patients do not have an opportunity to choose their health care providers. To ensure a high level of quality and preparedness to deal with these complex patients, the Ministry of Health designates lead trauma hospitals in every region of the province. St. Michael's Hospital is one of only two adult Level 1 trauma centres in Toronto and attends to approximately 700 injured patients annually. We take this level of responsibility very seriously and seek to provide the highest quality of trauma care possible.

Severely injured patients do not have the physiologic reserve to allow for an ad hoc approach to care. To the greatest extent possible, everything must be prepared for or planned in advance. Where there are protocols, we expect these to be followed. The middle of the night at the bedside of trauma patient is NOT the time to deviate from protocols and standards that have been thought out at great length in the light of day.

Criteria for trauma team activation

The criteria for trauma team activation are used to identify patients who have a high likelihood of severe injury. By design, these criteria result in overtriage – assuming patients might be more severely injured than they might be after appropriate evaluation. We accept overtriage because of the dire consequences of undertriage. We revise these criteria from time to time as new evidence comes to light.

The trauma team should be activated with field information suggesting:

- Prehospital hypotension
- Hemodynamic instability in the ED with a trauma-related mechanism
- Facial injuries with need for airway management
- Intubated
- GCS < 15
- All injuries that comprise 2 or more systems
- Injuries associated with hypothermia
- Stab (any stabbing implement), or gunshot to the neck or torso
- Traumatic amputation of a limb proximal to the wrist or foot
- Penetrating extremity injury with significant blood loss at scene, pulse deficit or concern of compartment syndrome

Isolated head injuries have traditionally been managed by neurosurgery without trauma team activation. However, a head injury cannot be assumed to be isolated without the appropriate evaluation for truncal and extremity injuries. If the patient was not evaluated as they would have been at SMH, then trauma team activation with full evaluation is warranted.
The trauma team can be activated prior to the patient’s arrival in the ED when appropriate mechanistic or physiologic information is available from the prehospital personnel. Additionally, physicians (housestaff or attending) from services other than the ED may activate the trauma team if they feel this necessary, by calling the trauma team leader on call.

Composition of the trauma team
The composition of the trauma team is designed such that each contributes a particular expertise. These team members must work in parallel to rapidly evaluate and treat the patient. Where there is dispute about which issues take priority, the TTL is the final arbiter.

Working as a team
Resuscitation of a severely injured trauma patient has the potential to be very stressful. We have to act quickly on limited information in a very dynamic situation. There are a few key points that facilitate the team working together.

- Communicate your assessments and plan so that the trauma team can anticipate care, and so you and the TTL can determine priorities.
- Collegial and respectful behaviors enhance team function and the timeliness of care and movement to ICU/OR; disrespectful behaviour splits the team and slows care.
- There are normally 2 nurses in the Trauma Room; although they are highly knowledgeable and efficient, generally speaking it is not possible for 1 nurse to process the orders of 2 physicians simultaneously. This leads to confusion and affects medical safety. All orders should go through the TTL.
- Recognize that you in turn deserve respectful and collegial support, should that not occur, the CLM of the ED would be happy to follow-up.
- Should you feel uncertain about a course of action or procedure, ask for support immediately. Your learning is important but it should not take place at the expense of the patient. There is very little time or room for error in these patients.

The trauma team is comprised of the following:

- Trauma team leader (Anesthesia, ED, or surgical staff)
- Trauma fellow (if on call)
- General Surgery resident
- Anaesthesia resident
- Orthopedics resident
- Radiology resident
- ED Nurses - usually two
- Radiology technician
The following services do not routinely assess the patient but are available as required:

- Neurosurgery
- Plastics
- ENT
- Vascular surgery

In addition, the following services and/or individuals are alerted to the trauma code:

- Charge nurse in the operating room
- Charge nurse in the TNICU
- Blood Bank technician

**The Patient**

It is common to forget that at the center of all of this activity is a patient, who is typically terrified and uncertain of what is to happen. In our speaking with patients who have experienced a trauma resuscitation, much of their concern can be alleviated by a few simple interventions:

1. Introduce yourself to the patient and let them know your purpose
2. Let them know we appreciate they are afraid and re-assure them that we are here to care for them
3. Explain procedures before they are undertaken
4. Where possible trying to avoid 2 simultaneous painful procedures
5. Ensure adequate pain control. Fentanyl in small incremental doses is safe, has limited effects on blood pressure and is quite effective.
Trauma preparation and setup

You will find that trauma resuscitations are much more enjoyable and far less chaotic if you prepare in advance. This approach ensures that you will be able to do what you need to do relatively independently of others to accomplish your tasks while functioning as a critical member of the team. You want to minimize reliance on others to pass you equipment – each person has their role to do and to rely on others prevents them from doing what they need to do. You will often have several minutes notice before the patient arrives in the trauma room. Review the figure below and think what you need to do and where you need to be in those minutes leading to the patient’s arrival.

Layout of equipment and personnel after transfer of patient to stretcher. Arrows depict priorities: After GS SR and Nurse 2 assess and ensure intravenous access, the radiology resident may do the FAST exam. The GS JR assesses the patient and after placement of NG, rectal exam, Foley and femoral stab, the radiology technician begins with the lateral C-spine, chest and pelvis films. RR – radiology resident; RT – respiratory technician.
Make the best of the time available. As you walk into the room, get a gown on gloves on. Prepare a set of sterile gloves nearby as there is a high likelihood you might have a procedure to do. Put a lead apron on. While preparing, find out whatever you can about the patient before their arrival.

Preparation of the Trauma Room

The basic trauma setup includes:

- 4 soft restraints
- EKG monitor with leads, O2 sat probe, and automatic BP cuff
- Mayo stand with IV catheters and crystalloid solution (Mayo stand #1)
- Foley catheter, NG tube and equipment for a femoral stab (Mayo stand #2)

Equipment that can be set up right before a patient's arrival and for which the junior surgical resident is responsible for preparing include:

- Chest tube and central venous catheter (place on Mayo stand #3)
- If the patient is profoundly hypotensive or undergoing CPR, an open chest tray and rib spreaders should be prepared and placed on the left side of the patient

Greeting the Trauma Patient

1. Meet paramedics at the door
2. If the patient is awake and interactive, introduce yourself and let them know what is to happen
3. Five second evaluation:
   a. Adequate airway or intubated
   b. Moving air - listen to lungs
   c. Listen to heart, feed carotid pulse
5. During and immediately after the transfer, listen to the paramedics for a brief, initial vignette of the nature of the injury, the circumstances of the injury, the paramedic exam, and any changes that may have occurred during transport.
6. While a rapid primary survey is performed, the nurse, junior surgical resident and/or students completely expose patient, cutting clothes if necessary. The recording nurse takes first blood pressure and pulse, and places EKG leads.
7. Warming measures are used to maintain normothermia including placement of warm blankets, ensuring an acceptable room temperature and administration of warm IV fluids.
Each person then begins his or her pre-assigned duties:

**TTL**

- Determines priorities
- Assigns and delegates tasks
- Keeps an eye on the big picture
- Coordinates care across specialties
- All orders for meds and radiology studies go through the TTL

**Anesthesia**

- Focuses on airway and breathing

**Nurse 1 (charting)**

- Records report from EMS
- Applies 100% O2
- Assess first vital signs
- Attempts to obtain blood work – delegates to MD if femoral stab necessary
- Sends blood
- Documents

**Nurse 2 (circulating)**

- Assesses and secures peripheral intravenous access
- Begins crystalloid and/or blood infusion
- EKG
- Dips urine
- Ensures adequate pain control and sedation, tetanus administration
- Re-assesses response to interventions
- Assists with procedures when necessary
- Secures patient property (intact clothes and valuables)

**Orthopedic resident**

After primary survey is completed and while or after essential radiologic studies are performed:

- Assesses extremities
- Determines which imaging studies are required for musculoskeletal assessment and passes information on to TTL
- Evaluates spine during logroll
- Accomplishes temporizing skeletal traction/immobilization when necessary
Radiology resident

- After or coincident with secondary survey, completes FAST exam (if unstable) and then reviews plain films of C-spine, chest and pelvis.
- Communicates with the TTL regarding the need for additional imaging studies.
The general surgeon’s responsibilities in the trauma room:

Junior resident
The general surgery junior resident responds physically for every trauma code. You are present to learn about trauma resuscitation and to assist in the care of the patient.

Your responsibilities include:

1) The primary survey, which involves sequential assessment of AIRWAY, BREATHING, CIRCULATION, DISABILITY (Neurologic Status), and EXPOSURE/ENVIRONMENT

AIRWAY

Airway assessment is the first priority and is assessed in conjunction with the anesthesia resident. Assessment of the airway includes inspection for injuries leading to airway obstruction, most commonly due to loss of consciousness, mid-face fractures, mandible fractures, or tracheal injury. The airway may also be compromised by aspiration of foreign material, blood, or emesis. Finally, a particularly dangerous loss of airway is the progressive occlusion that can occur with swelling due to blunt trauma or inhalation injury. Simple maneuvers to protect the airway should be tried immediately: suctioning, chin lift/jaw thrust maneuvers, and insertion of an oral or nasal airway. When in doubt, however, definitive airway access – a cuffed tube in the trachea -- should be secured. The preferred route of a definitive airway is most commonly oral endotracheal intubation, but on occasion, surgical cricothyrotomy is required. All airway protection maneuvers are performed with efforts to maintain normal cervical spine alignment, as cervical spine injury is a real possibility. For patients who have had prehospital endotracheal intubation, accurate placement of the tube requires confirmation upon arrival to the hospital. Re-check the position of the field-placed endotracheal tube by direct visualization, end tidal CO2 monitoring, and chest x-ray.

BREATHING

Assessment of breathing immediately follows the establishment of a secure airway. You must ensure both adequate ventilation and oxygenation. This includes an evaluation for any mechanical impairment of respiratory function such a tension pneumothorax, flail chest, pulmonary contusion, massive hemothorax and open pneumothorax. Tension pneumothorax requires emergent decompression of the chest, accomplished most rapidly with an angiocatheter placed in the second intercostal space at the mid-clavicular line. This is followed by placement of a thoracostomy tube in an urgent fashion. Large diameter (34-36 French) chest tubes should be used as hemothorax is commonly present and blood can clot and obstruct small diameter tubes. Pulse oximetry monitoring is
helpful in assessing adequate oxygenation, but can be compromised by vasoconstriction, hypothermia, fingernail polish, methemoglobinemia, isosulfan blue dye, bright room lights, and movement. An early arterial blood gas (femoral stab if necessary) and chest x-ray should be obtained.

CIRCULATION

Assessment of circulation has three components: stop the bleeding, assess hemodynamics, and resuscitate. The initial focus is on the identification and control of all significant sites of hemorrhage. Simultaneous initiation of fluid resuscitation is undertaken, but the priority must be control of hemorrhage. The patient is assessed for signs and symptoms consistent with hypovolemic shock with careful attention paid to the vital signs. Persistent tachycardia or even brief and transient bouts of hypotension signifies major blood loss. Intravenous access with two large bore (14 gauge or larger) peripheral catheters is established and resuscitation is initiated with warmed crystalloid solutions. Obvious external hemorrhage is controlled with direct pressure, but if this is inadequate, place a tourniquet. DO NOT LET A PATIENT BLEED TO DEATH FROM AN EXTREMITY OR SCALP INJURY. In the case of the latter, a simple running suture or staples might suffice.

With no obvious external source of hemorrhage, attention is directed at looking for blood in the major body cavities: chest, abdomen, and pelvic retroperitoneum. It is not generally appreciated that a pelvic fracture can cause sufficient bleeding to result in death of the patient. For blunt trauma patients, internal hemorrhage is assessed with a chest x-ray to evaluate the thoracic cavity, a pelvis x-ray to evaluate for pelvic fracture and a potential source of retroperitoneal hemorrhage, and a diagnostic study to evaluate the peritoneal cavity. The peritoneal cavity can be evaluated with diagnostic peritoneal lavage (DPL), a focused abdominal sonogram for trauma (FAST), or computed abdominal tomography (CT). However, CT is not indicated in the hemodynamically abnormal or unstable patient.

One should not move beyond circulation in the primary survey until control of significant hemorrhage has been achieved with the patient responding to resuscitation by normalization of vital signs. This may require urgent operative intervention to accomplish. Patients with penetrating injuries and hemodynamic instability do not require much in the way of diagnostic studies but rather should proceed rapidly to the operating room for exploration.

DISABILITY

Assessment of disability refers to an initial evaluation of neurologic status. The key component of this part of the primary survey is to assess for the presence and severity of traumatic brain injury (TBI) or spinal cord injury. The primary tool in assessing brain injury disability is the Glasgow Coma Score (GCS) and
pupillary response to light. The GCS score provides a rapid assessment of ocular, verbal, and motor responses and allows for easy reassessment over time to track for the possibility of neurologic deterioration. A GCS < 8 suggests severe TBI and these patients will need airway protection with intubation and measures to avoid the development of secondary brain injury. Assessment for spinal cord injury requires sensory and motor exam, and deep tendon reflex and autonomic reflexes (bulbocavernous reflex; anal sphincter tone).

ENVIRONMENT / EXPOSURE

Refers to both fully exposing the patient and performing a logroll to avoid missing a critical injury such as the unexpected GSW to the back and to taking steps to address environmental exposure and prevent or correct hypothermia. Hypothermia should be addressed by first taking and recording body temperature. Prevent further heat loss with warmed intravenous fluids, warmed humidified ventilator gases, and warming blankets. For significant hypothermia (T < 35 C) active re-warming may be necessary.

Putting this all together, your specific responsibilities include:

- Setting up the equipment before the patient arrives (see figure)
- Rapid examination of the airway, head, face and neck
  - Are there scalp lacerations? Fractures? Is the trachea midline? Are there facial fractures? Loose teeth or bleeding in the oropharynx?
  - Is the trachea midline? Is the C-spine normal by palpation?
- Examine and auscultate the chest; assess need for chest tube
  - Is there sq air? deformity? or a flail segment?
- Palpate the abdomen; evaluate FAST with radiology resident
- Assess the pelvis for instability
- Perform a rectal exam to assess tone, the presence of blood, or a high riding prostate
- Assess neuro status (GCS, pupils, response to pain) and fully expose patient
- Assess extremities - crepitus, deformity, stability - pulse.
After rapid assessment:

- Place a nasogastric tube; this should be an orogastric tube in the case of suspected severe facial fractures
- Draw blood - a femoral arterial stab; this should be repeated just prior to departure from the trauma room
- Place the Foley catheter (if prostate is abnormal or blood at meatus, or large perineal hematoma please confer with TTL)
- As soon as you have moved beyond the head and chest with your evaluation, allow X-ray to move in to perform their designated tasks: cross table lateral C-spine, chest x-ray, pelvis x-ray. Cross table lateral should be done before NG tube is placed and should be done prior to intubation, unless patient has immediate, life-threatening airway problems
- Review CXR, lateral C-spine films and pelvic films and review with radiology resident
- When C-spine has been evaluated, log-roll patient to look at back
- Place central lines with assistance if necessary

Some of the above interventions might be omitted at the discretion of the trauma team leader, particularly if the patient appears to be minimally injured.

Once disposition has been decided:

- Assist in the transport of the patient
- Review CT neck, chest, abdomen and other radiographic studies
- Document and transmit to senior all other system injuries

The senior resident or fellow must be called in the following circumstances:

- Penetrating injury
- Any suggestion of hemodynamic instability, tension pneumothorax or cardiac tamponade
- Need for chest tube insertion
- There is a potential need for a resuscitative thoracotomy
- A trauma laparotomy, thoracotomy or sternotomy is required
- You are concerned or feel you need help

Senior general surgical resident responsibilities

- The senior resident should be present for all severely injured and unstable patients, preferably prior to their arrival
- They must respond to the needs of the TTL and the junior surgical resident and coordinate or perform procedures as required
- The senior surgical residents are to function as surgical consultants to the trauma team leader
• Through consultation with their staff and the TTL, they will assist in the prioritization of workup and hemorrhage control. As such, they must notify their staff of all patients with which they were involved. The timing of this notification is dependent on the severity and type of injuries. For example, notification of an isolated head injury after appropriate workup might be deferred. As non-operative management of a solid organ injury is a surgical decision, residents are obligated to notify their staff when they feel this approach is reasonable.
• The surgical staff should be notified early if the patient is at all unstable (transient or persistent hypotension)

In general patient should not spend more than 30 mins in the trauma room. It is imperative to maintain a sense of urgency. From the trauma room patients move directly to the OR, to the radiology suites (CT or angio) and then to the TNICU. Sometimes trauma patients are admitted to the ward or observed for a period in the emergency department and discharged home. If the patient is to be admitted, the trauma team leader will decide the admitting service.

TRAUMA PATIENT DISPOSITION

The admitting service will be decided by the trauma team leader. In general, the trauma service accepts the patient if there are active issues involving two or more services or there are complex issues in a patient with single system injuries. As a general surgery resident covering the trauma service, you will be caring for patients with complex surgical problems and needs that might be outside of the usual domain of the general surgery resident. Prioritizing patient needs and coordinating care across the different services is part of your responsibility. Nurse practitioners, case managers and allied health services play a significant role in assisting you in delivering care.
Trauma Protocols

Many of these protocols are in evolution, so please review with the trauma surgeon on call.

PENETRATING INJURIES

Hemodynamically stable patients with penetrating torso trauma, and no other immediate indication for thoracotomy, sternotomy or laparotomy, should undergo the following investigations. Otherwise the patient should be moved urgently to the OR

Chest
All need CXR at a minimum
If CXR negative then repeat after 6 hours
If hemo/pneumothorax – chest tube

Anterior cardiac box (clavicles to costal margin, nipple line to nipple line)
Surface 2D ECHO OR subxyphoid pericardial window in the OR
If positive, immediate sternotomy

Posterior cardiac box (between the scapulae)

CXR if abnormal then CTA, + aortogram AND/OR, esophogram, AND/OR OGD
AND/OR bronchoscopy, depending on trajectory defined by CTA

Transmediastinal GSW
CXR, CTA and other investigations as dictated by trajectory

Abdomen

Stab wounds
Anterior – costal margins to inguinal ligament and between the mid axillary lines
DPL (+ve 10,000 rbc/cc) or CT abdomen.

Posterior – posterior to the mid-axillary lines, below the scapulae, to the iliac crest (back or flank)
Triple contrast CT to evaluate retroperitoneal vascular, renal and enteric structures.

Thoracoabdominal - between the nipple/scapula and the costal margins
Need to clear pericardium, chest and abdomen
Pericardium - 2D surface ECHO or subxyphoid pericardial window in the OR
Chest – CXR + CT
Abdomen – CT vs DPL +ve = 10,000 rbc/cc or laparoscopy
GSW or SGW
In general, these patients will require laparotomy. If stable, then there might be time for AP and lateral plain films to localize the missile fragments but these are not imperative

Transpelvic GSW
DPL (+ve > 10,000 rbc/cc) then laparotomy
Rigid sigmoidoscopy, vaginal speculum exam
If all above negative then CTA with CT cystogram

Tangential GSW
CT to rule out peritoneal breech

Neck

Anterior - between the lateral borders of SCM and deep to platyma – explore or CTA, depending on zone involved
Posterior - lateral to the lateral borders of SCM, without other indication for exploration (hemodynamic instability evidence of viscus injury) – investigate with CTA

BLUNT TRAUMA

Abdomen
In general, assume there is an injury unless definitively excluded.
If unstable, FAST exam and if positive, laparotomy
If stable, CT
A FAST exam alone is not sufficient to exclude intra-abdominal injuries.

Spine clearance

Radiologic evaluation for screening for cervical, thoracic and lumbar spine fractures should be done with CT. There is very little role for plain films in this patient population. A dedicated CT of the cervical spine should be included in all patients at risk for a cervical fracture. The lumbar and thoracic spine can be screened from reconstruction of the torso (chest and abdominal CT). Any patient with a significant mechanism (fall from height > 15 ft, high speed MVC or ped/cyclist stuck at significant velocity) should undergo a torso CT. If lumbar and thoracic spine fractures are found, a dedicated spine CT of the involved levels should be done. This should be done in consultation with the spine surgeons and radiologists. Additional plain films of specific vertebral levels may be required as per the spine surgeon involved. Please ensure that all documentation including the spine clearing form is complete in a timely fashion.