BLOOD TESTING GUIDELINES FOR TRAUMA PATIENTS

These guidelines apply to all trauma patients who are managed by the trauma team. They are evidence-based, and are designed to reduce unnecessary testing without compromising the quality of patient care.

The Trauma Team Leader is responsible for determining which tests should be ordered, and should generally follow the guidelines. However, they may deviate from the guidelines if sound clinical reasons exist.

Patients should be considered under one of three categories, depending on injury severity. Some modifications occur for co-morbidities.

1. **Mild To Moderate Injury**
   Airway, breathing and circulation are stable and not predicted to deteriorate.

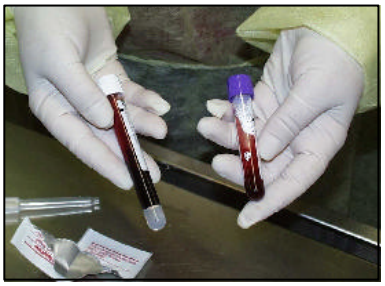
   No blood tests required unless there are specific medical indications.

2. **Serious Injury**
   Airway or breathing may be compromised. Circulation is stable, with less than 2 litres fluid requirements.

   - **Full Blood Count (FBC)**
   - **Group and Hold**
   - Urea, Electrolytes, Creatinine (UEC) **only** if >60 years or known pre-existing co-morbidity.

3. Serious Injury Obviously Requiring Transfusion.
Patient has poor perfusion or ongoing haemodynamic instability.

- FBC
- UEC
- Cross Match - **O Negative or O Positive blood awaiting cross-match.**



BLOOD ALCOHOL

The NSW Motor Traffic Act 1990 (white certificate) legislates mandatory blood alcohol testing for all drivers, motor cyclists, pedestrians, pedal cyclists, skateboarders, rollerbladers, horseriders etc. who present to hospital following an incident on a public property and are aged 15 years or greater. The Rail Safety Act 1993 and Marine Act 1991 cover boat drivers and train drivers requiring care following an accident (mustard certificate). Medical or nursing staff may complete the certificate and requirements. The packs are self explanatory and the serial number should be recorded in the nursing flow chart and trauma sheet.

OTHER GENERAL GUIDELINES

1. Amylase – rarely indicated.
2. Coagulation studies – not indicated acutely unless the patient is taking warfarin (then INR should be done).
3. CPK – only indicated to confirm rhabdomyolysis – so please do not order routinely, it is useless!
4. Cardiac enzymes – only if myocardial ischaemia suspected (CPK has no role in managing “myocardial contusion”. Troponins are more useful).
5. Liver enzymes – only if hepatic injury suspected.

6. Arterial Blood gases – indications:
   a. Seriously injured patient with abnormal breathing or poor perfusion.
   b. 15 minutes after instituting mechanical ventilation.
   c. Elderly patient.
   d. Blood gases are under utilised – they are very useful indicators of:
      - Oxygenation status,
      - CO_2 (ventilation status), and especially
      - perfusion.

      They may be the only indicator of underperfusion and hypovolaemia.

Please do a blood gas routinely on trauma patients > 65 years. Look at their base deficit, if abnormal, think "this patient is potentially worse than I recognise".

7. Serum lactate - like ABG's, serum lactate may provide a useful monitor of perfusion – if abnormal, repeat every 2 hours and assess the trend.

In resuscitation, think of the cells – blood gases and lactate are the best monitor of cellular function at present.

FAST See Page 155.

DPL See Page 161.

RADIOLOGY

The use of radiology within the resuscitation room should conform with guidelines published by the Department of Health with regard to Radiation Safety.

"…mobile x-ray equipment be used only for examinations where it is impractical or not medically acceptable to transfer patients to a stationary radiological installation and only after proper attention has been given to the radiation protection measures required in its use" International Atomic Energy Agency-SS115, II.16.c, 1996.

"There are some patients who cannot or should not be moved from their beds, although some seriously ill patients can often be transported to the Radiology Department without detriment to their condition for a much improved radiographic result. Every effort must be made to ensure that patients are not radiographed unnecessarily or more frequently than necessary and that radiation to staff and other patients in adjacent areas is minimised." NHMRC, Radiation Health Series No14, paragraph 54, 1985.

Staff essential to patient care during an x-ray examination must wear a radiation protective lead apron. Pregnant women must never be called on for this purpose.

The trauma team should actively consider whether it is safe for a patient to be transferred from the resuscitation room for further investigation (see page 243).

All patients transferred for further investigation require an appropriately skilled nursing escort. Appropriate cardiorespiratory monitoring should be in place prior to transfer. Suction, oxygen supply and an appropriate oxygen delivery device must accompany the patient. If appropriate, the drug and treatment pack should accompany the patient. Where there has been documented hypotension or where there is the potential haemodynamic instability, a medical member of the trauma team skilled in resuscitation must accompany the patient.

Ventilated patients must be accompanied by a medical member of the trauma team who has specific airway skills. The medical officer must remain with the patient during transfer and while the patient is undergoing further investigation. The use of continuous pulse oximetry and $ETCO_2$ monitoring is mandatory in the ventilated patient.

Investigation with CT scan, angiography, duplex or cardiac echo may be appropriate for an individual patient (see Management Algorithms page 105)

REFERENCES:

1. *Emergency Department Orientation Handbooks for RMO / Interns and Registrars*, Liverpool Hospital, 2002.
2. *Blood Testing Guidelines for Trauma Patients*, in Liverpool Hospital Policy and Procedure Manual, 2000.

SECTION 3

The trauma victim requires a multidisciplinary approach to care. Coordination between ED, surgery, ICU, anaesthetics, orthopaedics and other subspecialties is a complex task requiring knowledge, confidence, speed and diplomacy. This is the role of the Trauma Team Leader.

A good Trauma Team Leader inspires confidence in the team by anticipating problems and giving clear direction. This process begins from the initial notification of impending patient arrival. Anticipation of the patient's likely requirements allows a smoother, faster, safer movement through the system. For example, if a patient is coming from an MVC in 10 minutes with hypotension and a GCS of 6, a number of things can be put in place:

1. Arrange the trauma team and make sure roles are well defined.
2. Team to put on splash gowns, gloves, goggles and lead gowns.
3. Contact Trauma Surgeon on call.
4. Follow an A,B,C approach to organisation, **therefore**:
   A---Get airway drugs drawn up, check tubes, laryngoscopes, O_2 saturation monitor, chest tube trolley standing by
   B---CXR plate in place before the patient arrives.
   C---Prime Level 1™ infuser, organise IV lines, warmed fluids
   D---Contact CT to tell of patient and notify theatre / neurosurgeon.

Then make sure there is quiet for the MIST hand-over and minimise any unnecessary external noise.

The Trauma Team Leader must have the knowledge base to anticipate which algorithm each patient will require. Each subspecialty team will have different priorities so the team leader must negotiate the appropriate investigations and treatment. This is a dynamic situation and will require vigilance and regular updating as well as discussion with the Trauma Fellow, Trauma Surgeon and involved subspecialists.

SECTION3

TYPES OF FLUID AVAILABLE

Debate remains on which fluid or fluids are the most appropriate to restore volume and tissue oxygenation, and whether the specific choice of fluid has any impact on morbidity or mortality. The only two indisputable facts are that in comparison with colloid, larger volumes of crystalloid are required to restore intravascular volume, and colloids, but not crystalloids, can cause anaphylaxis.

CRYSTALLOIDS

Solutions containing approximately isotonic concentrations of sodium (e.g. 0.9% saline, Hartmann's solution) will distribute rapidly across most of the extracellular space. It is estimated that 1500 ml to 2000 ml of crystalloid is needed to replace an acute blood loss of 450 ml over 1 hour, depending on how fast normal blood volumes are reached. Thus, when replacing blood loss with crystalloid, a volume 3-4 times greater than the blood lost is required. EMST (ATLS©) recommends lactated Ringer's (Hartmann's) rather than saline as the initial fluid for trauma patient resuscitation. The rationale for this is that large volumes of saline will induce a hyperchloraemic metabolic acidosis. Whether this acidosis is potentially harmful is uncertain. In comparison with plasma, Hartmann's has a lower osmolality and large volumes of Hartmann's will reduce serum osmolality and may contribute to cerebral oedema. This effect is enough to encourage the use of 0.9% saline rather than Hartmann's in head-injured patients.

COLLOIDS

Colloids contain particles that are large enough to exert an oncotic pressure. In comparison with crystalloids, they have greater intravascular persistence.

Gelatin solutions (Haemaccel®, Gelofusine®)

Gelatin polypeptides are derived from bovine collagen. They are modified chemically to increase molecular size and intravascular retention. Gelatins may induce an anaphylactoid reaction but these appear to be rare in the trauma patient population. Gelatin solutions remain a very popular fluid for resuscitation in Europe and Australia.

Dextrans

Dextran reduces blood viscosity, reduces platelet adhesiveness, and enhances fibrinolysis. These properties make dextran useful for prophylaxis against thromboembolism but unpopular in the trauma setting. They may cause anaphylaxis and are not used in trauma patient resuscitation.

Hydroxyethyl starch

Hydroxyethyl starch (HES) solutions are modified natural polymers of amylopectin. Some HES is extravasated into the interstitial space where a proportion is taken up by the reticuloendothelial system. HES may cause coagulopathy by the reduction of Factor VIII and von Willebrand factor. There is preliminary evidence suggesting HES reduces the capillary leak associated with the systemic inflammatory response syndrome. HES is not available in Australia at this time.

Albumin

Human albumin is a single polypeptide. The use of albumin in critically ill patients has not been shown to improve outcome and is expensive. It is provided in glass bottles and is not used during acute resuscitation of trauma patients.

HYPERTONIC FLUIDS

Hypertonic 7.5% sodium chloride produces a transient increase in intravascular volume of many times the volume infused. This may be an advantage in the pre-hospital setting where storage and the ability to carry weight are limited. Hypertonic saline causes an increase in heart rate and contractility, and a reduction in peripheral vascular resistance and the addition of colloid extends its intravascular persistence. Several pre-hospital trials of hypertonic fluids are ongoing.

Haemoglobin-based oxygen carriers

A number of haemoglobin-based oxygen carriers (HBOC) are now at advanced stages of development. The main sources of HBOCs are bovine blood, out of date human blood, and recombinant biotechnology. For the immediate future, human donor blood will remain the only method with which to provide an increase in oxygen carrying capacity.

Blood

A full blood cross match will take at least 45 minutes (not including transport times). Type specific blood is available in about 20 minutes.

Un-crossmatched blood (2 units of O-ve and 4 units of O+ve) is available in the blood fridge in ED resuscitation area. Blood should be administered after 2 litres (adults) or 40 ml/kg (children) of crystalloid or colloid have failed to stabilise the patient, or where there is obvious exsanguinating haemorrhage.

GIVE BLOOD EARLY IN ELDERLY PATIENTS.

TEMPERATURE

Hypothermia, defined as a core temperature of less than 35°C, results from exposure, hypoperfusion, and infusion of cold fluids. In trauma patients, hypothermia is a significant predictor of mortality. Hypothermia causes a reduced heart rate and cardiac output and increases arrhythmias. Hypothermia shifts the oxyhaemoglobin dissociation curve to the left, impairing peripheral oxygen delivery in the hypovolaemic patient at a time when it is most needed. Shivering increases the lactic acidosis. Hypothermia contributes to coagulopathy by retarding the function of enzymes in the clotting cascade, enhancing plasma fibrinolytic activity, and reducing platelet aggregation. Even mild hypothermia increases peri-operative blood loss and appears to be associated with an increased incidence of infectious complications.

All IV fluids should be warmed. Use of high capacity fluid warmers, such as the Level 1™, in seriously injured patients will minimise the hypothermia associated with fluid resuscitation. Forced air warming blankets are very useful in patients with mild or moderate hypothermia and all other measures must be taken to prevent hypothermia.

RAPID INFUSION DEVICES

The Level 1™ fluid warmer is capable of warming fluids and blood from cold to warm at rates of 500ml/min. It needs to be primed and should be thought of early during the resuscitation process. Be aware that there is a possible risk of air embolism when using this device.

REMEMBER: RAPID INFUSION DOES NOT STOP THE BLEEDING.

RATES OF INFUSION

Hypovolaemia causes cardiovascular decompensation, reduced oxygen delivery and the development of lactic acidosis. If oxygen delivery is not restored quickly, irreversible cell damage results in organ failure or death. Acute anaemia is better tolerated than hypovolaemia, therefore, intravascular volume should be increased first. This must be balanced against the risk that fluid resuscitation may worsen outcome by disruption of thrombus, coagulopathy, haemodilution and rebleeding.

Rule number one in fluid management for trauma patients is: STOP THE BLEEDING.

ASSESSING HYPOVOLAEMIA

The ATLS® / EMST classification of haemorrhage is well established. However, the physiological responses to injury and haemorrhage are not as consistent as is commonly believed. Heart rate and blood pressure may be poor measures of hypovolaemia and haemodynamic stability, particularly in young and fit patients. The effects of numerous cardiovascular drugs used by trauma patients with pre-existing disorders adds to these difficulties of assessment.

RATE OF FLUID ADMINISTRATION

The concept of ***permissive hypotension*** was derived from studies demonstrating that aggressive fluid resuscitation **in penetrating trauma patients** increased blood pressure, but also reversed vasoconstriction, dislodged early thrombus and increased blood loss. Survival was improved by allowing blood pressure to remain low until haemorrhage was controlled. Care should be taken in extrapolating this concept to all trauma patients, particularly those with severe brain injury. When there is profound initial blood loss or when there is likely to be a delay until the patient can get to an operating theatre, significant hypovolaemia and hypoperfusion will develop. The risk of organ ischaemia may outweigh the risk of provoking more bleeding with fluid resuscitation and the best approach may be judicious fluid

infusion while expediting surgical haemostasis (i.e. ***controlled resuscitation*** for uncontrolled haemorrhagic shock). The challenge lies in tolerating hypotension before haemorrhage is controlled, whilst watching closely for indicators of severe ischaemia. **Attempts at fluid replacement should not delay surgical control of bleeding**.

FLUID BOLUS (WHEN AND HOW MUCH)

When faced with continued hypovolaemia in the trauma patient the following general approach is suggested:

- **Expedite surgical haemostasis.**
- Initial crystalloid bolus (0.9% sodium chloride solution) of 1000ml for adults (20 ml/kg for children).
- Re-evaluate.
- Second bolus of 1000ml crystalloid or colloid - gelatin solution (20 ml/kg for children).
- Re-evaluate.
- Give blood Group O Rh-ve or O Rh +ve.
- Clear evidence of exsanguination is an indication to administer blood earlier.

Once haemorrhage is controlled, normovolaemia should be restored and fluid resuscitation targeted against conventional endpoints. In practice, fluid resuscitation for major trauma will include a mixture of blood, colloid and crystalloid solutions.

REMEMBER: To stop bleeding, surgery or embolisation is required. This decision-making must involve the Trauma Surgeon.