
Jason Wolfe's ATLS Page

Aim: To give people a framework for thinking about the management of the traumatised patient and assist them to pass the ATLS trauma moulage. This webpage was produced as a culmination of the teaching and experiences I gained during a recent ATLS course.

Note: This is not meant as a short cut which negates the need to read the ATLS course manual. You are reminded that it is extremely unlikely that you will pass the course if you don't read the ATLS manual.

PS: Note that the term 'ATLS' is a registered trade mark of the 'American College of Surgeons'. This web-page is not affiliated to, or officially endorsed by them.

General Principles

1. There is a need for rapid evaluation of the trauma patient. Time wasted costs lives.
2. The absence of a definitive diagnosis should never impede the application of essential treatment.
3. The first 'Golden Hour' is crucial to both the short and long term survival of the patient. It also is also critical in determining the morbidity that the patient will endure.

4. There is a need to establish management priorities: The things which will kill the patient first are always the things which should be checked and treated first. Things which will kill the patient later are managed later. Thus, airway problems are managed and treated before breathing problems, which in turn are treated before circulatory problems.
5. All treatment modalities should be governed by the abiding principle of 'First do no harm'.

Overview of ATLS Protocol :-

1. **Preparation**
2. **Triage**
3. **Primary Survey (ABCDE) & Resuscitation**
4. **Adjuncts to Primary Survey & Resuscitation**
5. **Consider need for Patient Transfer**
6. **Secondary Survey (with AMPLE History)**
7. **Continued Post-Resuscitation Monitoring & Re-evaluation**
8. **Transfer to Definitive Care**

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1. Preparation - Equipment needed

You should familiarise yourself with all the following equipment. You should be able explain each item's use, not only just by physical demonstration but also by verbal description.

GENERAL

* **One Live Patient (usually an actor with copious but expert make-up to ensure realism)**
* **One Nurse Assistant (who usually is an inexperienced student)**
* **One Candidate (with large amounts of adrenaline in blood stream and suitably fast beating heart)**

* **One Examiner (to make life difficult and generally throw a spanner in the works)**
* **Universal Precautions**
* **Toilet +/- Cigarette for afterwards**

CERVICAL SPINE

* **Long Spinal Board**
* **Hard Collars of various sizes**
* **Sandbags**
* **Tape for securing head**

AIRWAY

* **Suction**
* **Oxygen**
* **Ventilator**
* **Laryngoscopes (various sizes & shapes)**
* **Bag and Mask with Reservoir**
* **Flexible Boogie**
* **Tongue Depressor**
* **Oropharyngeal / Nasopharyngeal Tubes**
* **Orotracheal / Nasotracheal / Endotracheal Tubes**
* **Needle Cricothyroidotomy Set**
* **Formal Cricothyroidotomy Set**
* **Tracheostomy set (for children under 12 yrs)**
* **Surgical Drapes**
* **10ml Syringes**
* **Scalpel**

BREATHING

* **Stethoscope**
* **Large Bore Cannula**
* **Chest Drain Set including :-**
* **Antiseptic swap**
* **Local Anaesthetic**
* **Scalpel**
* **Dissecting forceps**
* **Chest Drain**
* **Tubing**
* **Suitable container with underwater seal**
* **Stitch Material**
* **Occlusive dressing**

CIRCULATION

* **Pressure Dressings & Swabs**
* **Antiseptic swaps**
* **Hypodermic Needles**
* **Intra-venous Cannulas**
* **Long-venous Cannulas for use with Seldingers Technique**
* **Pericardiocentesis over-the-needle cannulas**
* **Venous Cut-down set**
* **Peritoneal Dialysis Catheter**
* **Adhesive Tape**
* **Giving sets**
* **Syringes**
* **Warmed Crystalloid / Colloid / Blood**
* **PASG : Pneumatic Anti-Shock Garment**

DRUGS

* **Set of Resuscitation Trolley Drugs**
* **Lignocaine (+/- Adrenaline) L/A Injection**
* **Lignocaine Gel for Catheterisation**
* **Xylocaine Spray for Oro / Nasopharyngeal L/A**
* **Heparin**

MISCELLANEOUS

* **Resuscitation trolley**
* **Defibrillator**
* **Pulse Oximeter**
* **Blood Pressure Monitor**
* **Cardiac Monitor**
* **Capnograph**
* **Normal & Low-Range Thermometers**
* **Nasogastric Tube**
* **Urinary Catheter**
* **Fast Intravenous Infuser / Warmer Device**
* **Ophthalmoscope & Otoscope**
* **Fracture Splints**
* **Glasgow Coma Scale Chart**
* **Broselow Paediatric Resuscitation Measuring Tape**
* **X-Ray Viewing Box**
* **Warming Blanket**
* **Polaroid Camera**
* **Hammer & Nails to prevent the paramedics who brought the patient in from leaving the department before they have given an ample history.**

2. Triage.

Triage is the prioritisation or ranking of patients according to both their clinical need and the available resources to provide treatment. The process is based on the same ABC principles as explained below.

3. Summary of Primary Survey & Resuscitation :-

(Explained in full detail later)

A - Airway & Cervical Spine Control
B - Breathing & Oxygenation
C - Circulation & Haemorrhage Control
D - Dysfunction & Disability of the CNS
E - Exposure & Environmental Control

4. Adjuncts to Primary Survey & Resuscitation :-

These are various useful monitoring or therapeutic modalities which supplement the information already obtained using clinical skills in the Primary Survey.

They include :-

1. Pulse Oximeter
2. Blood Pressure
3. Cardiac Monitor / Electrocardiogram
4. Arterial Blood Gases / End Tidal pCO_2
5. X-Rays - Chest X-Ray / Cervical Spine / Pelvis / Others
6. Nasogastric Tube & Urinary Catheter
7. Core Temperature

5. Consider the Need for Emergency Patient Transfer.

The particular accident unit or hospital where the patient has arrived is not always the most suitable place for the definitive care of that patient to be managed. Once the resuscitation is well under way and the patient is stable, consideration should be given to transferring the patient elsewhere. Transfer may be to another hospital which is more geared to treating the multiply injured patient (eg. a level 1 trauma centre) or to another facility which can adequately deal with the particular set of specialised injuries which are peculiar to your patient (eg. a neurosurgical unit). Transfer may also be to a different department of the same hospital (eg. theatres / radiology).
In any case, patient transfer is often the time of greatest peril for the patient because it is all too easy for the 'level of care' to decline. The challenge therefore is to ensure that this level of care does not deteriorate at any time. Transfer should always be as soon a possible after the patient is stabilised. The acquiring of specialised investigations should not hold up the transfer of the patient as these investigations are often more appropriately performed in the unit where the patient is to be transferred.

6. Secondary Survey.

A full AMPLE history is taken from anyone who knows the relevant details. This often includes both the family and the paramedics who brought the patient in. This is followed by complete head to toe & systems examination. All clinical, laboratory & radiological information is assimilated and a management plan is formulated for the patient.
During this time there is a process of continued post-resuscitation monitoring & re-evaluation. Any sudden deterioration in the patient should immediately prompt the

doctor to return to the primary survey for a re-assesment of the ABCDE's.

AMPLE History :-

A - Allergies
M - Medicines
P - Past Medical History / Pregnancy
L - Last Meal
E - Events / Environment leading to the current trauma

7. Transfer to Definitive Care

This is governed by the same principles as were mentioned above in the emergency transfer of patients. The level of care should not deteriorate.

The Primary Survey & Resuscitation.

(This is the main part which is tested in the practical moulages, so this the part will be covered in the greatest detail)

NOTE FIRST :-
9 Immediately Life Threatening Injuries or Conditions which should be picked up in ABCDE and treated immediately :-

1. Inadequate Airway Protection
2. Airway Obstruction
3. Tension Pneumothorax

4. Open pneumothorax
5. Flail Chest with Hypoxia
6. Massive Haemothorax
7. Cardiac Tamponade
8. Severe Hypothermia
9. Severe Shock from Haemorrhage Unresponsive to Fluid Resuscitation.

NOTE ALSO :-

13 Potentially Life Threatening "Non-Obvious" Injuries which should be considered in the traumatised patient, but whose management can often wait until after ABCDE until the time of definitive care :-

1. Simple Pneumothorax
2. Haemothorax
3. Pulmonary Contusion
4. Tracheo-Bronchial Injury
5. Blunt Cardiac Injury
6. Traumatic Aortic Disruption
7. Diaphragmatic Rupture
8. Mediastinal Traversing Wounds
9. Blunt Oesophageal Trauma
10. Sternal / Scapular / Rib Fractures
11. Ruptured Liver or Spleen
12. Rupture of an abdominal or pelvic viscus
13. Any other chest / abdominal / or pelvic injuries which have resulted in organ damage but not in immediate shock

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How to approach the Primary Survey and what to do :-

This next section assumes you are in a moulage scenario and goes through your possible actions and reactions in response to what you find with your patient.

A - AIRWAY & CERVICAL SPINE CONTROL

* **Say you are wearing universal precautions.**
* **Approach patient from head side and stabilise cervical spine using in-line immobilisation. Try to avoid placing your hands over the patient's ears.**
* **Introduce yourself and reassure patient.**
* **Assess preliminary ABC from patients response to this.**
* **IF THE AIRWAY IS NOT AT LEAST PARTIALLY SECURE, then definitive cervical spine control will have to wait. Ask the nurse to take over the function of in-line immobilisation of the cervical spine, and MOVE ONTO AIRWAY MANAGEMENT. Don't forget to come back to cervical spine management later.**
* **CERVICAL SPINE MANAGEMENT :-**
* **Ask for a hard neck collar. Measure the size of collar by measuring from the angle of mandible to the top of trapezius. The collar should be the same size from the black marker peg to the base of the hard part of the collar.**
* **Apply Sandbags and Tape.**
* **AIRWAY MANAGEMENT :-**
* **Suction out the airway or remove foreign bodies if necessary.**
* **IF - BREATHING IS SPONTANEOUS AND THE PATIENT IS CONSCIOUS, BUT AIRWAY IS COMPROMISED BY POOR PHARYNGEAL TONE / REDUCED LEVEL OF CONSCIOUSNESS (GCS 9-13) :-**
* **Try jaw thrust / chin lift and ask for response.**

*** If the response is good, insert an oropharyngeal (Guedel) or nasopharyngeal airway.**
*** Notes :-**
*** The oropharyngeal airway is measured from the edge of the mouth to the tragus.**
*** Don't attempt to insert a nasopharyngeal airway if the patient has a head injury with the possibility of a basal skull fracture.**
*** Assuming the patient responds to this, apply oxygen using a face mask with attached reservoir bag.**
*** If you haven't already done so, most patients should now have their neck immobilised with a hard neck collar, sandbags and tape.**

*** IF - THE SUPPORTIVE MEASURES ABOVE HAVE FAILED, OR IF PATIENT IS UNCONSCIOUS WITH A GCS OF 8 OR LESS, OR IF THE PATIENT IS APNOEIC :-**
*** The patient needs a definitive airway.**
*** Call for an anaesthetist.**
*** If the patient is COMPLETELY UNRESPONSIVE, it is necessary to proceed straight to endotracheal intubation.**
*** Method of ENDOTRACHEAL INTUBATION.**
*** Pre-oxygenate with bag and mask.**
*** The neck collar will need to be removed during intubation and during this time your assistant must provide in-line immobilisation of the neck.**
*** Standing above the head of the patient, insert a laryngoscope into the oropharynx, pushing the tongue to the left. Pull the scope upwards and away from yourself until the vocal chords become visible.**
*** Slip the endotracheal tube through the vocal chords, if necessary using a gum elastic boogie. Inflate the tube's balloon seal and connect the tube to a reservoired 'bag & mask' or ventilator. Some patients may be suffiently stable with the ET tube in situ to breathe spontaneously without the need for bag & mask or ventilator.**

*** Ensure positioning of tube in trachea by listening to the chest (listen to the lung apices, bases and over the stomach). Final confirmation can be made by connecting the tube to a capnograph.**
*** Once finished, re-establish cervical spine control using the hard neck collar, sand-bags and tape.**
*** If the patient is STILL PARTIALLY CONSCIOUS AND RESPONSIVE, then intubation will need to be carried out by 'RAPID SEQUENCE INDUCTION'. This procedure should only be carried out by practitioners who are quite familiar with its 'ins and outs' (which usually excludes everyone except experienced anaesthetists). If you aren't experienced enough to perform RSI, then 'bag & mask' until the anaesthetist arrives.**

*** IF - THE ACTIVE MEASURES ABOVE HAVE FAILED, OR THERE IS PARTIAL UPPER AIRWAY OBSTRUCTION WITH STRIDOR, OR THE PATIENT IS APNOEIC FROM COMPLETE AIRWAY OBSTRUCTION :-**
*** Perform NEEDLE CRICOTHYROIDOTOMY and describe this method.**
*** A large bore cannula is inserted through the crico-thyroid membrane and is then connected to high flow oxygen at 15 litres / minute. Inspiration / Expiration is achieved by intermittently holding ones thumb over the side of an open Y-connector attached to the cannula - 1 second inspiration, 4 seconds expiration. The patient can only be adequately oxygenated using this method for about 30 - 45 minutes.**
*** Call for an anaesthetist.**
*** Finally establish definitive airway by formal cricothyroidotomy and describe this method.**

*** OTHER INDICATIONS FOR A DEFINITIVE AIRWAY INCLUDE :-**

*** Severe maxillofacial / laryngeal / neck injuries with impending obstruction. The patient will almost certainly require a surgical airway.**
*** Severe Closed Head Injuries with a reduced level of consciousness, a risk of aspiration, and the need for hyperventilation.**

*** If you haven't already done so, apply 100% oxygen.**
*** Ask nurse to apply Pulse Oximeter, Blood Pressure Monitor and Cardiac Monitor. Ask her to take readings from all these monitors.**

B - BREATHING & OXYGENATION

*** If patient suddenly deteriorates at any point, move back and check airway again.**
*** Move down neck.**
*** Assess Carotid pulse for Rate, Character & Volume.**
*** Check Neck veins for distension.**
*** Check for Wounds, Laryngeal crepitus & Subcutaneous emphysema.**
*** Check if Trachea is central.**
*** Then move onto chest.**
*** Inspect for Bruising / Asymmetry of expansion.**
*** Palpate any areas of interest.**
*** Check for Subcutaneous emphysema and Flail chest.**
*** Percuss and Auscultate both anterior and lateral chest and ask for results.**
*** IF - PATIENT HAS A SIMPLE PHEUMOTHORAX :-**
*** Hyper-resonant chest, reduced / absent breath sounds, but neck veins down and trachea central.**
*** Ask the nurse to set up formal Chest Drain set.**

*** Don't insert the chest drain yet, but state that you intend to insert it later.**
*** CHEST DRAIN INSERTION :-**
*** Drape & surgically prepare the chest.**
*** If there is time, give an injection of lignocaine local anaesthetic.**
*** Make an incision in the 5th intercostal space just anterior to the mid-axillary line, and just above the upper border of the 6th rib.**
*** Blunt dissect down through the intercostal muscles, until the pleura is punctured. Clear away adhesions, clots or foreign bodies using a finger sweep.**
*** Clamp the proximal end of the chest drain and then advance it into the chest to the desired length.**
*** Connect the chest drain to an underwater-seal apparatus and then unclamp it.**
*** Check the drain is functioning correctly - the water column at the underwater-seal apparatus should move up on inspiration and bubble during expiration.**
*** Suture the tube in place using a purse-string suture and then apply an adhesive non-gas-permeable dressing to the site.**
*** Finally re-examine the chest and obtain an early chest x-ray.**

*** IF - NECK VEINS DILATED, TRACHEA DEVIATED, ABSENT OR REDUCED BREATH SOUNDS AND CHEST HYPER-RESONANT, THEN THINK 'TENSION PNEUMOTHORAX' :-**
*** Ask nurse to set up formal Chest Drain set.**
*** In the meantime, perform Needle Thoracostomy and check for hissing sound. Leave the needle thoracostomy open.**
*** Re-examine chest and ask for response.**
*** If patient stabilises, then leave formal chest drain until later.**

*** If they don't stabilise, perform another Needle Thoracostomy and proceed straight to formal Chest Drain insertion.**
*** Describe this method.**

*** IF - PATIENT HAS EVIDENCE OF CHEST TRAUMA, DILATED NECK VEINS, MUFFLED HEART SOUNDS, AND DECREASED ARTERIAL BLOOD PRESSURE (POSSIBLY EVEN PULSELESS ELECTRICAL ACTIVITY) (BECK's TRIAD), THEN THINK 'PERICARDIAL TAMPONADE' :-**
*** Proceed straight to Needle Pericardiocentesis.**
*** Describe this method and check for response.**
*** NEEDLE PERICARDIOCENTESIS :-**
*** Monitor the patient's vital signs and ECG before, during & after the procedure.**
*** Drape & surgically prepare the xiphoid area.**
*** Use a #16 gauge 15cm needle, 3 way tap, and a 20cm syringe.**
*** Puncture the skin 1 - 2cm below and lateral to the left xiphi-chondral junction, pointing the needle at an angle 45° to the skin and aiming for the tip of the left scapula.**
*** Advance the needle until there is a flush-back of blood, and at this point withdraw as much blood as possible.**
*** If the needle is advanced so that it penetrates the myocardium, the ECG pattern will change, producing wild ST-T segment variation and widened / enlarged QRS complexes. If this occurs, the needle should be withdrawn slightly until the ECG pattern returns to normal.**
*** It is sometimes necessary to leave a cannula in situ for repeat aspirations, and so here the needle may be changed to a plastic cannula using the Seldinger technique.**

*** IF - PATIENT IS HYPOXIC, SHOCKED, HAS A STONY DULL CHEST, ABSENT BREATH SOUNDS AND**

A TRACHEA DEVIATED AWAY FROM THIS SIDE, THEN THINK 'MASSIVE HAEMOTHORAX' :-

* **Establish intravenous access using two large bore cannulas.**
* **Proceed immediately to insertion of chest drain.**

* **IF - PATIENT HAS A FLAIL CHEST AND IS HYPOXIC :-**
* **Early intubation is essential.**
* **Perform Orotracheal intubation yourself preferably by 'Rapid Sequence Induction' or call for an anaesthetist to do it.**

* **IF - PATIENT HAS AN OPEN PNEUMOTHORAX :-**
* **Cover this opening with an occlusive dressing.**
* **Secure the dressing well so as to prevent air-leaks.**
* **Proceed straight to Chest Drain, placing the drain well away from the wound of the original open pneumothorax.**

C - CIRCULATION & HAEMORRHAGE CONTROL

* **Ask nurse to repeat measurements of Oxygen Saturation, Blood Pressure & Pulse.**
* **Palpate the patients head and hands looking for signs of 'shock'. This is defined as insufficient organ perfusion and oxygenation. It is suspected in a patient with cold, clammy, pale, peripherally shut down extremities.**
* **Move onto Abdomen & Pelvis.**
* **ABDOMEN :-**
* **Inspect abdomen for injuries or distension.**

*** Palpate abdomen for any masses or signs of peritonism.**
*** Consider abdominal percussion & auscultation.**
*** If there are signs of abdominal bleeding, ask the nurse to fast bleep the on-call surgeon and ask them to come to casualty.**
*** Ask the nurse to state that you have a clinically shocked patient in casualty who you suspect has abdominal bleeding, who you are in the process of resuscitating, but who may urgently need to be taken to theatre for laparotomy.**

*** PELVIS :-**
*** Palpate the Pelvis.**
*** Apply both lateral and antero-posterior springing forces onto the anterior superior iliac spines and feel for abnormal mobility or crepitus. Only perform this examination once.**
*** Ask examiner whether the pelvis is stable or unstable.**
*** If there are signs of a fractured pelvis, ask the nurse to fast bleep the orthopaedic surgeon on call and ask them to come to casualty.**
*** Ask the nurse to state that you have a clinically shocked patient in casualty who you suspect has an unstable fracture of the pelvis, who you are in the process of resuscitating, but who requires urgent stabilisation with a pelvic external fixator.**
*** Give consideration to the use of a PASG Pneumatic Anti-Shock Garment or internally rotate the hips (which may close an unstable open-book pelvic fracture and limit the bleeding).**
*** Try to get a pelvis x-ray before the orthopaedic surgeon arrives, provided this doesn't interfere with the rest of your resuscitation.**

*** LIMBS :-**

*** Quickly move onto the limbs, cutting off clothes as necessary, and examining for the presence of obvious deformity or soft tissue haematoma.**

*** Any sources of external haemorrhage should immediately be stemmed by applying direct pressure and wrapping in a bandage.**

*** If there are Open (Compound) Fractures, then these should be photographed, and then immediately packed with a Betadine soaked bandage and direct pressure applied. Ask the nurse to stand by with intravenous morphine, a tetanus injection and intravenous antibiotics (usually cefuroxime & metronidazole). The orthopaedic team should be informed and asked to attend the A&E department.**

*** FLUID RESUSCITATION :-**

*** Having examined the body for potential sources of haemorrhage as well as stemming any areas of overt haemorrhage, fluid resuscitation should begin in earnest.**

*** You need to place two large bore (#14 gauge) intravenous cannulas, one in each cubital fossa.**

*** Blood should be aspirated into a syringe for FBC, U&E, and Cross-Match. Ask the nurse to ensure that the sample is rushed to the lab. Ask for 2 - 4 units of O Negative Blood, 2 - 4 units of Type Specific Blood, and 2 - 4 units of Crossmatched Blood, depending on the individual circumstances.**

*** If cannulation is unsuccessful, then alternatives include the other cubital fossa, the femoral vein, the subclavian vein, the external jugular vein, the internal jugular vein, or a venous cut-down for the great saphenous vein.**

*** Immediately set up 1 litre of warmed Hartmanns for each of the two cannulas and run through using a fast infuser. This can take 1 - 2 minutes to run in.**

*** In children under 6 years, intra-osseous infusion is the preferred method of access after 2 unsuccessful attempts at cannulation. In infants, scalp veins may be tried, and in**

neonates the umbilical vein often provides excellent access. The volume of the infusion bolus in children is 20mls / kg and this can be repeated 2 or 3 times depending on response.

* **Ask the nurse to repeat Oxygen Saturation, Blood Pressure, Pulse & Respiratory Rate. Check also the Temperature.**
* **According to response, 500mls of colloid can then be infused through each cannula, or (more likely) in the absence of a clinical improvement, the 2 units of O Negative blood which have just arrived from the lab should be given using the fast infuser. If the patient can wait 10 minutes for type specific blood, then this is preferable.**

* **Check for Clinical Response.**

If the patient fails to respond, or initially responds but subsequently deteriorates, you should reflect on the various possible causes of this state of affairs :-

1. Go back and check Airway & Breathing.
2. The patient could be BLEEDING faster than you are replacing blood. These patients need to be taken to theatre immediately for surgical repair of the injured organ or vessel.
3. The patient could be HYPOTHERMIC and therefore may be responding more slowly than a normothermic patient.
4. The patient could be in CARDIOGENIC SHOCK: Here the heart pump is failing due to blunt trauma, or sometimes due to penetrating trauma. Consider again pericardial tamponade and act appropriately if required. Consider early CVP monitoring.
5. The patient may be PREGNANT. If moderately or heavily pregnant women are treated in the supine position, the

bulky uterus may impede the flow ofblood in the Inferior Vena Cava. Such patients should be bolstered so that they are lying slightly on their left side by placing sand-bags or pillows under the right side of the pelvis and chest. This manoeuvre should be carried out earlier rather than later in the resuscitation.

6. The patient may be in NEUROGENIC SHOCK: This occurs with spinal cord injuries in which the sympathetic outflow is damaged. This denervation of the heart and blood vessels results in a clinical picture of hypotension without tachycardia or peripheral vasoconstriction. Volume resuscitation is still the primary treatment, but consideration should be given to the judicious use of vasopressors. Early CVP monitoring & Swan-Ganz pulmonary artery catheterisation may also be useful.

7. SEPTIC SHOCK: This is uncommon in the early period following trauma but may occur in penetrating abdominal injuries with a perforated viscus or in other penetrating injuries where the wound has been contaminated with dirty exogenous debris, especially if arrival in A&E has been delayed for hours or days. It is identified by the presence of hypotension, tachycardia, pyrexia and cutaneous vasodilation.

All the above are treated by generous volume replacement along with definitive treatment of the cause of the shock.

Other Considerations in the Diagnosis & Treatment of Shock.

1. OLD AGE - Elderly patients have less 'physiological reserve': They are less able to increase heart rate and stroke volume in response to shock. Vital organs are more sensitive to the decreased blood flow and hypoxia associated with shock. The lungs are less efficient at the gaseous exchange of oxygen. The kidney is less able to respond to the volume

preserving stimulus of the stress hormones Aldosterone, Anti-Diuretic Hormone & Cortisol. All these facts contribute to its increased morbidity and mortality. It is thus even more crucial in the elderly patient to pay meticulous attention to volume resuscitation, and the placement of arterial and CVP invasive monitoring devices will greatly assist in its assessment. These devices should be placed earlier rather than later.

2. YOUNG AGE - Children and babies have an especially high physiological reserve. Homeostatic mechanisms maintain blood pressure and cardiac output despite the loss of large percentages of their blood volume. However when the percentage of blood loss gets to about 40% (Class IV haemorrhage), the blood pressure and cardiac output drop precipitously. The lesson here is that children may still have normal vital observations despite being in a high level of shock. Always take advice from a paediatrician early.

3. ATHLETES - Althletes may have an increased blood volume of up to 15 - 20%, stroke volume can increase by 50%, cardiac output can increase by 600% and resting pulse is generally lower than unfit individuals. These facts mean that the usual clinical signs of hypovolaemia may not be manifested in athletes, even though significant blood loss may have occurred.

4. PREGNANCY - Women have a higher plasma volume during pregnancy. Cardiac output increases by 1.0 - 1.5 litres / minute, and heart rate increases by 10 - 15 beats / minute. Minute ventilation increases also (primarily due to an increase in the respiratory tidal volume), and the Renal Glomerular Filtration Rate also increases. All these things increase the physiological reserve of the mother and mean that signs of hypovolaemia appear later. The physiological responses to shock will always favour the mother, and whereas even in moderate shock, the mother may be quite well, the foetus may actually be in severe shock, deprived of the majority of its perfusion. Invasive maternal monitoring and foetal cardiotocographic monitoring are often required at an early

stage to minimise complications to both mother and foetus. Always take advice from an obstetrician early.

5. DRUGS - Various drugs can affect the body's response to stress. Beta- blockers prevent the tachycardia and increased sympathetic responses to shock and may confuse the clinical picture. Diuretic use causes a relative hypovolaemia which may impair the body's reserve to respond to stress.

6. HEAD INJURIES - The brain has a very high demand for oxygen and so secondary brain damage will occur very quickly if the brain is deprived of its supply of oxygenated blood. The Cerebral Perfusion Pressure is equal to the Mean Arterial Blood Pressure minus the Intra-Cranial Pressure. Thus, brain perfusion is reduced either by a decrease in blood pressure, or by an increase in intra-cranial pressure. Head injuries may increase intra-cranial pressure by the presence of mass-lesions (haematoma) preventing the free circulation of cerebro-spinal fluid. Sub-arachnoid haemorrhage increases intra-cranial pressure because the blood in the cerebro-spinal fluid blocks the arachnoid granulations and thereby stops the CSF from being reabsorbed back into the venous system.

There are a number of conflicting processes in the head injured patient that make it essential to treat shock and hypovolaemia in a very precise manner. Over cautious volume resuscitation will result in hypotension wheras over enthusiastic volume resuscitation will result in volume overload which may exacerbate an already precarious intra-cranial pressure. The key aspects in the optimal management of the head injured patient include : early invasive monitoring to assist in accurate volume resuscitation, early endotracheal intubation to assist with hyperventilation, and early consultation with an experienced neurosurgeon.

D - DYSFUNCTION & DISABILITY OF THE CNS

* **An AVPU or GCS assessment is carried out.**

*** The patient's pupils are examined for size, symmetry & reaction to light.**
*** The consensual pupillary reflex can also be tested here.**

AVPU Assessment :-

A - Alert
V - Responding to Voice
P - Responding to Pain
U - Unresponsive

Glasgow Coma Scale (GCS) :-

*** Eye Opening**
4 - Spontaneous
3 - To Speech
2 - To Pain
1 - No Eye Opening
*** Best Verbal Response**
5 - Orientated
4 - Confused Conversation
3 - Inappropriate Words
2 - Incomprehensible Sounds
1 - No Response
*** Best Motor Response**
6 - Obeys commands
5 - Appropriate localising response to pain
4 - Withdrawal response
3 - Abnormal flexion response (Decorticate Rigidity)
2 - Extension response (Decerebrate rigidity)
1 - No Response

E - EXPOSURE & ENVIRONMENTAL CONTROL

*** Here, any clothes which haven't already gone are removed.**
*** Care is still taken to protect all areas of the spine from undue movement.**
*** Finally, the patient is covered with a blanket or other suitable warm covering to prevent hypothermia.**

Last Modified : 5th March 1999
