Trauma and Anaesthesia

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Introduction :

History: Since the first recorded death from injury when Cain murdered his brother, Abel (Genesis 4:8, 4004 BC), trauma has remained the most common cause of premature death and disability.
The first recorded use of anaesthesia for military wounds was in 1847 under the direction of Edward H. Barton, when ether was administered to a soldier during a lower extremity amputation.
Alexandrian physicians around 300 BC used ligation to control bleeding. Celsus in the first century AD described wounds, extraction of foreign bodies, and surgical instruments. Galen (130-201) used sutures for wound closure.
Wound surgery always has been war surgery and war advanced the management of trauma.

Definition :

Trauma has been defined as physical harm or damage to the body as a result of the acute exchange of mechanical, thermal or other environmental energy that exceeds the body's tolerance, whether blunt or penetrating, it frequently affects more than one body region and may involve several organ systems.
The treatment plan must be individualized according to the particular set of injuries sustained. Each member of the team must understand the over all aims of trauma management in order to interact effectively with other team members and deliver integrated care.
Trauma center organizations recognize trauma as a specific surgical disease, which requires highly trained anaesthesia care for optimal outcomes.
Trauma alert is a notification system for activation of trauma team members.
Potential role of the anaesthesiologiest in the case of trauma patients.

1. Trauma team member
2. Trauma team leader
3. Anaesthesiologist
4. Critical care physician
5. Pain relief physician
6. Pre-hospital care physician
7. Critical care transport physician or director.
8. Disaster planning consultant

Scoring System :

The development of trauma centers has been accelerated by the indices of trauma severity. The injury severity score (ISS), an anatomical scale composed of the sum of squares of the Abbreviated Injury Scale (AIS) from the three most severely injured body regions, is used retrospectively to compare outcomes in trauma centers. Prospective physiologic scoring systems such as the Trauma Score (TS) and the Pediatric Trauma Score (PTS) are used to predict outcome and direct patients to appropriate facilities. The Glasgow

Coma Scale (GCS) is a useful prognostic tool for paticnts with acutc head injuries. The American Society of Anaesthesiologist Physical Status (ASAPS) score has been demonstrated to predict mortality from blunt trauma but is not very useful for discriminating small differences in severely injured patients.

Careful analysis shows that trauma death has a trimodal distribution (Turnkey, 1983) :

1. The first peak or immediate death occurs within seconds or minutes in 50% of cases. This is due to brain and cardiovascular damage.
2. The second peak or early death occurs in 30% of cases within one hour (Golden hour) due to uncompensated blood loss (Hemorrhage) or potentially treatable conditions such as hypoventilation hemopneumothorax, cardiac tamponade, or an expanding intracranial mass.
   Thus early group is a preventable death. The fashionable killer, trauma, causes death due to hypoxaemia, hypotension, head injury, hypothermia and hours of delay in definitive treatment (Four Hs.) Time elapsed between injury and definitive surgery is critical to the survival and this period is know as the Golden Hour.
3. The 20% of deaths (late) occur during the next few weeks due to late complications of trauma like sepsis and multiple organ failure. So, the late group is also a preventable death.
   The help that can be rendered by the anaesthesiologist are of a wide range.
   - Emergency team leader
   - Airway management
   - Resuscitation to establish tissue perfusion.
   - Respiratory care
   - Manipulation of intracranial pressure.
   - Anaesthesia & Analgesia
   - Trainer for Emergency Medical Technicians (EMTs)

   The key point in trauma care is to improve chances of survival by giving priorities of treatment for various injuries in terms of time (Based on survival threats).
   The Control Systems Approach to Trauma Care

a) Anatomic Structure Control requires appropriate Assessment and Intervention.
b) Physiological System Control is a prime function of anaesthesiologist. Applied to trauma care, it can be summarised in 5 Systems :
   - Respiration
   - Circulation
   - Nervous System
   - Metabolism & excretion.
   - Host defence

Physiological problems in the traumatized patient.

1. **Respiration**
   Airway compromise (from direct or adjacent injury, or from central nervous system depression)
   Pulmonary contusion
   Haemopneumothorax
   Flail segment
   Ruptured diaphragm
   Tracheobronchial rupture.
   Pulmonary Aspiration
   Pulmonary collapse
   ARDS and fat Embolism

2. **Circulation**
   Hypovolaemia
   Dilutional anaemia
   Thrombocytopenia and coagulopathy
   Myocardial contusion.
   Pericardial tamponade.

3. **Nervous System**
   Coma
   Intracranial hypertension
   Seizures
   Cerebral irritation and poor cooperation from the patient.
   Spinal cord injury
   Pain
   Anxiety.

4. **Metabolism Excretion.**
   Metabolic acidosis
   Fluid shifts and electrolyte abnormalities..
   Myoglobinuria
   Oliguria and acute renal failure
   Acute gastric dilatation and ileus
   Stress-induced diabetes mellitus

5. **Host defence**
   Infection
   - Contaminated wounds
   - Nosocomial infection
   - Risk of transmitted disease from body.
   - Fluids

   Immunity
   - Immunosuppression.
   - Allergy to drugs.

   Inflammation
   - Upper gastrointestinal stress ulceration.
   - Traumatic pancreatitis
   - Acalculous cholecystitis.

   Intoxication
   - Alcohol intoxication
   - Drug and substance abuse.

   Injury
   - Presenting anatomical injuries.
   - Prolonged surgical positioning and
   - pressure area injury
   - Hypothermia.

Respiratory Control

Control of the airway

- Cervical spine limmmobilization
- Oral intubation : rapid-sequence induction using a bougie and careful cricoid pressure
- Oral intubation : alternative equipment, e.g. Bullard laryngoscope.
- Awake intubation : blind nasal and fibreoptic intubation.
- Cricothyroidotomy
- Lung isolation techniques : double – lumen tubes and emergency techniques to isolate a bleeding o disrupted lung
- Sputum and aspirate clearance.

Control of breathing

- Control of oxygenation and humidification
- Control of Pco2 (eg. mild hypocapnia in the head-injured patient and permissive hypercapnia i servere pulmonary contusion and ARDS)
- Control of airway pressure (including the use of PEEP and jet ventilation).
- Chest decompression.
- Lung isolation for lung and mediastinal injuries.

Circulatory Control

Control of Circulating blood volume and haemoglobin level

- Large-bore peripheral and central venous access.
- Venous cutdown
- Intravenous access
- Crystalloid, colloid and blood administration
- Rapid infusion systems, massive transfusion and blood salvage
- Invasive monitoring.

Control of perfusion pressure

- Maintenance of perfusion pressure to brain, kidneys and spinal cord
- Curbing blood pressure if there is a risk of aortic rupture or bleeding from other 'sealed' majo blood vessel.
- Permissive hypotension (befor achieving haemostasis).

Control of cardiac output and oxygen delivery

- Inotropic support during resuscitation (including calcium after massive transfusion)
- Pulmonary artery catheterization and the maintenance of above normal haemodynamic indices (aft achieving haemostasis).

Correction of arrhythmias

- Management of electromechanical dissociation (including mechanical causes).
- Suppression of extrasystoles.
- Control of asystole and bradycardias
- Control of atrial fibrillation and other tachyarrhythmias.

Control of coagulation status

- Monitoring coagulation status and the use of fresh frozen plasma, cryoprecipitate and platelet transfusio
- precautions for deep venous thrombosis.

Nervous System Control

Analgesia

- Opioid increments during resusctiatin and perioperatively
- Postoperative opioid infusions and patient-controlled analgesia
- Epidural analgesia.
- Nerve blocks, e.g. femoral

Sedation

- During and after intubation in the resusctitation room
- Postoperatively on the ITU and during transfer.

Induction of anaesthesia

- Induction in injury to tha airway or adjacent structures
- Induction in the face of continuing hypovolaemia.
- Induction in cardiac tamponade
- Induction in head, eye and sealed major vessel injury

Maintenance of anaethesia

- Intraoperative control of conscious level and prevention of awareness
- Prolonged anaesthesia.

Control of cerebral blood flow and intracranial pressure

- Ventilatory control.
- Blood pressure control
- Patient positioning
- Measurement of intracranial and cerebral perfusion pressures.
- Mannitiol and other diuretics.
- Crystalloid restriction.

Control of cerebral metabolism

- Reduction of cerebral metabolic rate in head injury
- Glucose control.

Control of Metabolism and Excretion

Control of pH

Control of blood glucose

Control of electrolyte concentrations in the extracellular fluid, Sodium, potassium and calcium.

Maintenance of urine output.

At least normal hourly output in all trauma patients.

Twice normal in patient at risk (e.g. myoglobinuria from crush injury or electrical burns).

Renal-dose dopamine.

Mannitol and bicarbonate in myoglobinuria.

Host Defence

Prophylaxis against infection

Antibiotic prophylaxix in open fractures, penetrating bowel injuries and contaminated wounds.

Antitetanus prophylaxis.

Prophylaxis Against Stress Ulceration

Sucralfate, ranitidine and early enteral feeding.

Control of Body Temperature

Warm environment

Body- warming devices.

Intravenous fluid and blood warming.

Cardiopulmonary bypass.

Patient Positioning and Care of the skin, spine and wounds.

Spinal Precautions
Applying an appropriately sized semirigid collar.
Considering the use of a spinal board.
Using head blocks or sandbags and tape
Log-rolling to examine the back (which requires at least four people to perform)
Resuming manual in-line immobilization for any air intervention. (i.e. for intubation)

Mechanisms of Injury determine the pattern of injury and helps in focussing the treatment priorities.

1. *Blunt versus Penetrating Injury*
   Blunt Trauma occurs mostly from motor vehicle accidents or falls resulting in widespread energy transfer to the body.
   Penetrating Trauma causes injury as the energy behind the penetrating instrument causes stretching or crushing of tissues. e.g. bullet injury.
2. *Neck and Airway Trauma*
   It is potentially life threatening and requires anaesthesiologist's intervention.
3. *Thoracic Trauma*
   It is usually a blunt chest trauma due to automobile accident and can injure the cardiopulmonary system directly. Shock and air embolism can affect the CNS.
4. *Closed Head Injury with an open Femur Fracture*
   It occurs commonly in automobile accident. Prevention of secondary brain injury requires strict avoidence of hypotension and hypoxia. Associated cervical spine fractures needs evaluation. Hypoxic respiratory failure may occur due to fat Embolism.
   Another way of categorising trauma is to divide into intentional (deliberate) versus unintentional (accidental). Third one comprises urban versus rural trauma.

Sequence of Management of Trauma Patients

i ***Overview***

A. Perform visual scan of patient for obvious injuries
B. Obtain history from prehospital personnel and patient (if able)

AMPLE History

A Allergies
M Medications (current)
P Past medical and surgical history.
L Last meal, last tetanus booster, last menses.
E Events and environment related to the injury

ii ***Primary survey (ascertain "ABCDEs")***
(Primary Assessment and Intervention)

A. Airway maintenance (with cervical spine Control)
   1. Look for chest wall movements, retraction, and nasal flaring
   2. Listen for breath sounds, stridor, and obstructed ventilation
   3. Feel for air movement.

B. Breathing (give supplemental oxygen).
   1. Determinc whether ventilation is adequatc.
   2. Inspect chest to exclude open pneumothorax, sucking chest wound, or flail segment.
   3. Auscultate for bilateral breath sounds.
   4. Provide assisted ventilation for ventilatory failure.

C. *Circulation (establish venous access)*
   1. Check peripheral pulses, capillary refill, and blood pressure
   2. Obtain electrocardiogram
   3. Grade shock according to vital signs.
   4. Correct hypovolemia and obtain blood samples.

D. *Disablility (determine neurologic status)*
   1. Evaluate central function.
      A : alert
      V : responds to vocal stimulus
      P : responds to painful stimulus.
      U : unresponsive
   2. Evaluate pupil response to light

E. *Expose patient for complete examination.*

iii. Resuscitation phase

iv. Secondary survey (Secondary Survey & Intervention)

v. Definitive care phase.

Conditions not to be missed during the primary assessment

Airway obstruction
Tension pneumothorax
Open pneumothorax
Massive haemothorax
Major flail chest
Pericardial tamponade.

Conditions not to be missed in the secondary assessment.

In the chest
Pulmonary contusion
Aortic disruption
Myocardial contusion
Oesophageal disruption
Diaphragmatic disruption
Tracheobronchial disruption
In the abdomen or pelvis
Intrapcritoncal bleeding or organ disruption
Retroperitoneal bleeding from pelvic fracture or renal injury
Pelvic bleeding and rectal or genitorinary organ disruption

Conclusion

Thus 1) Injury Severity, 2) Time to definitive care 3) Quality of that care and 4) Host factors (i.e. co-morbidities) influence the outcome after trauma. Besides emphasis on improving trauma care, attention has also focused on the influence of age and pre-existing comorbidities on trauma and trauma related morbidity and mortality. Early aggressive monitoring helps improve outcome and early advice and help of intensivist is invaluable along with multi disciplinary management of the trauma.

Trauma is on the increase world over. As the medical centres are manned by increasing number of sub (super) specialist, the unique skills of the anaesthesiologists are being found to be the critical factors that

can be useful to prevent deaths of trauma victims, particularly the immediate and early deaths after th injury. Thus it is a challenge for the anaethesiologist.

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