CRITICAC CARE

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St. George's Hospital Elective: Intensive Care Medicine
Learning Objectives

- **To learn more about the recognition and management of sepsis and secondary brain injuries in the critically ill patient.**

Sepsis:

Sepsis can be defined as the presence of actively dividing bacteriaor it's toxins in the blood, resulting in a systemic response that leads to organ dysfunction. The surviving sepsis campaign (SSC) was set up 10 years ago to raise awareness of severe sepsis and to improve it's management. The SSC describes sepsis as disease continuum with 3 groups:

- SIRS: systemic inflammatory response syndrome, a clinical response to a nonspecific insult e.g. infection, burns, inflammation, and includes 2 or more of the following:
    - Temp <36 or >38
    - Heart rate >90bpm
    - Respiratory rate >20 per minute or PCO_2 <32 mm Hg
    - WCC >12 or < 4 x 10_9 cells/L
- Sepsis: SIRS with a confirmed source of infection
- Severe sepsis: Sepsis with signs of organ dysfunction, hypoperfusion, or hypotension (septic shock)

Sepsis is a serious illness and is often fatal. There are a number of derangements in sepsis, including:

- Endothelial injury
- Abnormal coagulation
- Excess production of TNF
- Poor glycaemic control
- Lack of steroid hormones
- Hyperactive neutrophils
- Cell apoptosis

Early Warning Scores are used by ward staff to detect when a patient may become seriously ill. This consists of:

- Respiratory rate
- Heart rate
- Systolic blood pressure
- Temperature
- Oxygen saturations with appropriate oxygen therapy
- Urine output
- Level of consciousness (using AVPU)

A score is given for each parameter, according to the range it falls into. E.g. If all of the parameters were within a normal range, the patient would have a score of zero.

In ITU, there are a number of measures undertaken for monitoring/ avoiding sepsis:

- An aseptic technique is used when inserting any sort of line into the patient (e.g. cannulas, venepuncture, arterial and central lines, catheters, tracheostomies and ET tubes)
- It is documented in the notes and on the charts how many days each line has been in for.
- Lines are checked for signs of sepsis e.g. redness and discharge coming from a cannula site. If a line appears to be infected, it is removed ASAP.
- Secretions are checked e.g. urine cloudy, sputum colour? If the patient is suspected to have an infection, secretion samples are sent off for MC+S
- The ITU team work closely with the microbiology team in identifying and treating infection. The Micro team advise on what antibiotics to use for a particular patient and for how long. Drug charts

with antibiotics prescribed will often say ask that the drug be reviewed within a few days, when the team decide whether the patient has responded to treatment, if it can be stopped or if they need a different drug if they have not improved.

On ITU, septic patients are resuscitated using an ABC approach. If their GCS is <8, they are deemed unable to maintain their own airway and will be intubated. They will be sedated and ventilated. Not all septic patients require intubation; some can maintain their own airway and just require oxygen therapy to help increase their oxygen saturations. Simultaneously, the circulation is monitored (i.e. BP, HR and peripheries). A shocked patient will require aggressive fluid resuscitation. This will increase the intravascular compartment, but in sepsis, this may be temporary as fluid leaks out through the 'leaky' blood vessels into the extravascular compartment. Refractory hypotension may be due to adrenal dysfunction and iv hydrocortisone may be given. Fluid status is closely monitored with a central line for central venous pressure and a urinary catheter for urine output, but monitoring flow is more effective, using a pulmonary catheter. Intravenous insulin may be required until the sepsis resolves. Secretions are sent for MC+S, then iv broad-spectrum antibiotics are given. Once an organism has been isolated, the appropriate antibiotic can then be given. Other investigations to find the source of infection can be done e.g. MC+S of urine, sputum and stools (depending which ones are indicated), blood cultures, CXR looking for consolidation. Routine bloods e.g. FBC and clotting for coagulation derangement, LFTs and U&Es should also be carried out to monitor progress.

Secondary brain injuries:

Brain injuries can be divided into primary and secondary injuries.

- Primary: damage occurs at the time of the initial insult, includes contusions, bleeding from damaged blood vessels e.g. epidural haemorrhage, subdural haemorrhage, subarachnoid haemorrhage, intracerebral haemorrhage; and axonal shearing
- Secondary: damage occurs minutes to days after the initial injury, where there are anatomical or neurophysiological changes e.g. haematoma, cerebral oedema, raised intracranial pressure

Cerebral oedema is not uncommon after head injuries. There are 3 major types:

- Cytotoxic – neuronal degeneration
- Vasogenic – damaged blood brain barrier, capillaries leaking plasma into the brain
- Ischaemic – a combination of cytotoxic and vasogenic

Initial management of any head injury starts with ABC. The patient will repeatedly be assessed for their level of consciousness (GCS) and signs of raised ICP, e.g. oculomotor palsy. Papilloedema and Cushing's reflex (bradycardia and hypertension) are late signs. In the case of raised intracranial pressure (ICP), it is important to keep the Mean Arterial Pressure (MAP) up in order to maintain Cerebral Perfusion Pressure (CPP), because:

$$CPP = MAP - ICP$$

Normally: $CPP\ (80\ mmHg) = MAP\ (90mmHg) - ICP\ (10mmHg)$

ICP can be measured with a bolt. CT head scans can show a source of raised ICP e.g. haematoma, oedema. There may be small/absent sulci, low attenuation within the white matter, compression of the ventricles, or poor grey-white differentiation. If raised ICP were combined with cerebral oedema and an expanding lesion such as a haematoma, it could lead to brain herniation (coning).

In head-injured patients, CPP shouldn't be <70mmHg, if it were, CPP would be inadequate and the outcome poor. Simple measures can help reduce ICP e.g. ensuring venous drainage is not obstructed by endotracheal tube tapes, head elevation to around 20-30 degrees, avoiding hypoxia and prolonging expiratory cylces and maintaining normothermia. Keeping the patient sedated helps reduce the brains activity and therefore it's demand for oxygen, while you try to reduce ICP. The MAP can be increased by administering Noradrenaline (inotropic support). This would help deliver oxygen and glucose to the brain and prevent cytotoxic oedema developing. If the BBB is intact, osmotic diuretic Mannitol can be given to make the blood hypertonic and draw water out of the neurons.

- **To look at the various phases of the patient's journey through treatment and how management changes throughout.**

ITU accepts seriously ill patients from casualty, theatres, the wards, or other hospitals. An example of a patient's journey through ITU would a trauma patient:

- Admitted via hospital via A&E,
- Primary survey and be resuscitated using ABC approach.
- Sometimes emergency surgery
- ITU for organ support e.g. respiratory, renal etc.

Management changes according to the level of care the patient needs. On general wards, patients are self ventilating and receive basic nursing care. On HDU, patients tend to be self-ventilated or at risk of one organ failing. ITU cares for ventilated patients or those with at least 2 organs failing. While on ITU, daily plans for the patient are made and reviewed. The patient is cared for by a multidisciplinary team (nurses, physios, dieticians, pharmacists, doctors and surgeons from multiple specialties). From ITU, they are stepped down to HDU and from there to a general medical or surgical ward.

- **To learn more about iatrogenic complications affecting critically ill patients and how this affects the long-term outcome of these patients.**

One particular complication relating to ITU is Ventilatory-Associated Pneumonia (VAP) defined as pneumonia occurring within 48 hours of intubation with an endotracheal or tracheostomy tube and was not present before. Endotracheal and tracheostomy tubes are foreign objects that introduce infection to the lungs. They also bypass the body's natural defences against pathogens (i.e. rhonchi, cilia). Sedation and intubation inhibits the ability to cough, making it difficult to clear secretions and increasing the risk of developing VAP. Some risk factors are associated with VAP e.g. presence of chronic lung disease, sepsis, acute respiratory distress syndrome, neurological disease, trauma and previous antibiotic use. VAP increases the ITU stay by 28% and each case costs the NHS £6000-22000. VAP has a large impact on morbidity and mortality.

- **To become more proficient in assessing a critically patient, to formulate management plans and present to the rest of the ITU team. To gain feed back from the team on my performance and team work and request constructive criticism.**

Discuss with consultant, see feedback on assessment sheet.