**REGIONAL ANAESTHESIA IN PATIENTS WITH HEAD INJURY**

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 Severe head injury remains common and patients who survive the initial insult are often left with a major neurological deficit. Apart from the head injury, often they have associated injuries of the musculoskeletal system which may necessitate immediate surgical attention. Those patients who, in addition suffer an extra cranial injury fall in to 2 broad categories:

 i. Those with an associated life threatening extra cranial injury ( e.g: ruptured spleen)

 ii. Those with less serious, non-life threatening extra cranial injury ( e.g: long bone or facio- maxillary injuries)

In the first group of patients, resuscitation and immediate surgical intervention under general anaesthesia is the priority management. The second group of patients are the one who may be benefitted by the regional anaesthesia. Even in the second group, if the head injury is serious with intracranial bleeding and mass lesion, it takes the priority and neuro surgical intervention under general anaesthesia becomes mandatory. The timing and type of anaesthesia ( whether it is G.A or Regional) will therefore depend on the severity and effect of that injury on the ability to maintain adequate brain oxygenation and cerebral perfusion.

**Traumatic Brain injury:**

 A basic knowledge about the traumatic brain injury is necessary to understand the role of regional anaesthesia in managing them. Traumatic brain injuries (TBI) are not like any other orthopedic injuries. Recovery should be complete with functional recovery. And no two brain injuries are alike and the consequences two similar injuries may be very different. Symptoms may appear right away or may not be present for days or weeks after the injury. The presence of lucid interval may give a false confidence for the attending physician and the patient. Selection of neuraxial blockade in these kind of patients may prove to be disastrous.

 TBI may be divided into primary and secondary injury. Primary injury is induced by mechanical force and occurs at the moment of injury. Secondary injury is not mechanically induced. It may be delayed from the moment of impact and it may super impose injury on a brain already affected by a mechanical injury.

**Primary injury:**

 The two main mechanisms that cause primary injury are contact and acceleration and deceleration. These forces can cause intracranial haematoma, diffuse vascular injury, contusions, diffuse axonal injury and injury to cranial nerves and pituitary stalk. If these problems are detected in a patient with head injury, then there is no role of any regional analgesia as a sole anaesthetic technique to tackle the associated non-neurological injury.

**Secondary Injury:**

 Secondary injury may occur hours or even days after the inciting traumatic event. Injury may result from impairment or local decline in cerebral blood flow after a TBI. Decreases in CBF are the result of local oedema, haemorrhage or increased intracranial pressure. As a result of inadequate perfusion, cellular ion pumps fail, causing a cascade involving intracellular calcium and sodium. Resultant calcium and sodium overload contribute to cellular destruction. Excessive release of excitatory amino acids such as glutamate and aspartate exacerbates failure of the ion pump. As the cascade continues, cells die causing free radical formation, proteolysis and lipid peroxidation. These factors ultimately cause neuronal death. Clinical conditions associated with the risk of a decreased CBF are arterial hypotension, hypoxaemia, intracranial haemorrhage, hyperthermia and malignant brain oedema.

 The background knowledge of secondary brain injury and the factors producing it is essential to decide about the further management. If a surgical management of a co-existing injury is mandatory, then it has to be decided whether the proposed surgery is essential to save the life of the patient. Because the proposed surgery and anaesthetic management may make the neurological condition worse by producing a second hit on the cerebral physiology.

**Damage Control Orthopaedics (DCO):**

 Damage control orthopaedics is an approach that contains and stabilises orthopedic injuries so that the patient's overall physiology can improve. Its purpose is to avoid worsening of the patient's condition by the "second hit" of a major surgical procedure and to delay definitive fracture repair until a time when the overall condition of the patient is optimized. Damage control focuses on control of haemorrhage, management of soft tissue injury and achievement of provisional fracture stability while avoiding additional insults to the patient

**Long bone fractures:**

 In a patient with head injury and an additional long bone fracture, the benefit of fixing the long bone immediately may be lost if the head injury worsens after the surgery. Generally early fixation of long bone fractures are advised since it avoids occurrence of many complications like fat embolism , ARDS etc. But in this situation, long duration of surgery with increased blood loss, hemodynamic instability and increased stress hormone level may produce a secondary damage of the injured brain. So the principle of DCO is followed here and only life or limb saving surgeries are permitted.

**Maxillo-facial surgery:**

 The majority of craniofacial trauma is associated with mild TBI. A conservative approach is reasonable in simple fractures whereas displaced fractures of facial bones can be dealt with open fixation after the facial, brain and airway oedema settles down. A prolonged surgery on the facial structures will definitely affect the cerebral haemodynamics adversely.

**Dilemma of type of anaesthetic management for non-neurological surgeries in a patient with head injury:**

 For deciding about the type of anaesthesia and the possible role of regional anaesthesia for non-neurological surgical emergencies in a patient with head injury, the severity of head injury is taken in to account. Patients with a Glasgow Coma Scale score below 12,mental state changes, Loss Of Consciousness more than 30 minutes come under the category of severe head injury patients. The decision of operating a non-neurological injury depends upon its severity and its impact on the well being of the patient. It generally follows the DCO concept. The primary aim is to correct or stabilize the fractures and injuries without further jeopardizing the cerebral physiology. General anaesthesia is ideal for these patients as most of them are already intubated and ventilated. Regional analgesia can be contemplated as an adjunct to general anaesthesia for providing peri-operative analgesia.

 In patients with mild head injury ( GCS more than 12, LOC less than 30 minutes with no neurological deficits), if non-neurological emergencies are planned, Regional anaesthesia can be selected for them without compromising the haemodynamics and cerebral perfusion. As the central neuraxial blockade like sub-arachnoid block often alters the haemodynamics and CSF pressure dynamics by producing a dural hole, it is contra-indicated. Peripheral nerves or plexus blockade can be given as they rarely affect the haemodynamics much.

**Role of Regional anaesthesia:**

 The role of regional anaesthesia is limited in these set up. Centrineural blockade is strictly contra-indicated in the group of patients where ICP is increased. But there is some scope for the peripheral nerve or plexus blockade in managing the emergency and critical care situations.

**Is there a role of Centrineural blockade in a patient with head injury?**

 Lumbar puncture is absolutely contra-indicated in the presence of unequal pressures between the supra-tentorial and infra-tentorial compartments. The presence of this pressure difference can be diagnosed from the following characteristic findings on CT scan of the brain

 Midline shift

 Loss of supra-chiasmatic and basilar cisterns

 Posterior fossa mass

 Loss of superior cerebellar cistern

 Loss of quadrigeminal plate cistern

Cranial CT scanning should be obtained before lumbar puncture in all patients with suspected Subarachnoid Haemorrhage (SAH) in order to diagnose obvious intracranial bleeding or any intracranial mass effect that might be present in awake and alert SAH patients with a normal neurologic examination.

 Lumbar puncture should not to be done in whom the disease process has progressed to the neurologic findings associated with impending cerebral herniation i.e deteriorating level of consciousness and brain stem signs that include pupillary changes, postural changes, irregular respiration and very recent seizure.

 CT scan is not 100% reliable in identifying who will herniate and who will not from lumbar puncture. Patients with normal CT's may still herniate. However ,CT findings that should always be excluded include loss of differentiation of grey and white matter, effacement of CSF spaces, sulci, fissures and ventricles and displacement of brain structures. In patients with papilloedema and focal neurologic signs, LP must be deferred. ***Patients with unequal pressures are still at risk for cerebral herniation following LP regardless of needle size.***

 Whichever neural/plexus blockade is selected either as a sole anaesthetic technique or as a part of combined G.A-Regional technique, the principles of anaesthesia are the same:

1. Avoidance of acute surges of Blood pressure which will produce increase in the cerebral perfusion leading to oedema.

2. Avoiding acute fall in the B.P which is detrimental to cerebral perfusion.

3. Avoiding overzealous administration of fluids which predisposes to oedema formation.

4. Avoiding hyperthermia.

5. Avoiding local anaesthetic toxicity especially when continuous nerve blocks are planned.

6. Maintenance of paCO2 around 35 -40 mm of Hg. Routine hyperventilation of brain trauma patients are no longer recommended.

7. Adoption of seizure prophylaxis measures.

8. Maintaining a strict glycemic status in diabetic patients.

9. Strict maintenance of electrolyte balance.

**Role of regional nerve blocks on arrival in the casualty:**

 The management of pain in the acutely injured patient can be challenging. Resuscitation, assessment and the treatment of life threatening injuries are the first priority in a trauma patient. Provision of adequate analgesia must be delayed until the patient is stable. However there is increasing evidence that the pain associated with injury is under treated, a condition termed " oligoanalgesia". Systemic opioids which are commonly used in this context are feared because of their properties like sedation, drowsiness, airway compromise, respiratory depression and interference with conscious level.

 Potential advantages of regional analgesia over systemic therapy are:

1. Decreased adverse effects like hypoxia, agitation, nausea and vomiting compared to sedative techniques.

2. No interference with neurological assessment

3. Improved comfort and safety in intra-hospital transport.

4. Reduction in stress response.

 As most of the injuries are pertaining to the limbs, peripheral plexus blocks can be given for the initial pain relief. USG and PNS increase the success rate and help us to reduce the dosage of local anaesthetics. Thoracic paravertebral block or intercostal nerve blocks can be tried for providing pain relief for multiple rib fractures. Fascia iliaca block or femoral nerve block have been used to provide pain relief for femoral neck and shaft fractures.

**Thoracic Para-vertebral block (PVB):**

 Paravertebral block either unilateral or bilateral can be tried as an alternate to neuraxial blockade as there is no risk of dural puncture occurring as in epidural block. PVB can be efficient in patients with multiple rib fractures as catheter can be put paravertebrally to produce long lasting pain relief. PVB catheters can be placed even in anaesthetised patients.

**Continuous Peripheral nerve blockade:**

 The pain intensity associated with trauma is often severe and long standing making Continuous Peripheral Nerve Blocks a useful tool. Catheters can be left in for days depending on the indication. Pumps can be programmed to deliver a background infusion of a low concentration of long acting local anaesthetic like 0.2% Ropivacaine. If needed, surgical analgesia can be provided by manual bolus of stronger anaesthetic.

**Conclusion:**

 The most important principle in managing head injury patients is to avoid all the causes that will result in secondary brain injury. Better understanding of pathophysiology of brain injury, improved resuscitation methods, diagnostic modalities, timely surgical intervention, rational use of regional anaesthesia will lead to an improvement in the outcome of these patients.

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