Intracranial Pressure Monitor

AKA - "bolt", "ICP bolt"

What is it?

A small 3-4mm diameter transducer device inserted into the brain by the neurosurgical team to enable close monitoring of intracranial pressure.

An ICP bolt can be inserted by a neurosurgeon inside a critical care unit at the bedside, or in theatre, under sterile surgical technique.

How does it work?

A small transducer, with the tip placed into the brain parenchyma, is secured at the skull surface with a plastic mount. The transducer monitors the intracranial pressure.

What does it look like?

The image opposite shows the winged introducer which is hollow. This is fixed to the skull and the transducer is passed into the intracranial space.

The transducer is then clamped by the introducer to hold the wire (transducer) in place and maintain sterility of the tip.



What does it do?

Provides very close real-time monitoring of intracranial pressure.

This is useful in sedated patients who display fewer clinical signs of raised ICP and helps to guide patient management (e.g. whether to perform a decompressive

craniotomy/craniectomy or institute medical treatment to lower the ICP).

What can go wrong?

The most **common** complications and how to deal with them:

- Sudden change in ICP
 - Ensure neurocritical care parameters are being met using an ABCDE approach (see the neurocritical care parameter sticker on the patient's chart) and optimise ventilation/ BP/ electrolytes accordingly
 - Ensure the patient's position is 30° head up (in the absence of any spinal injuries which would preclude this)

- Contact the critical care registrar ± neurosurgical team urgently
- Monitor for clinical signs of raised ICP including 'coning'
- Inaccurate measurement of ICP
 - Re-zero the ICP bolt
 - Assess waveform is the waveform flat or does it have changed morphology?
 - Ensure the patient's position is 30° head up (in the absence of any spinal injuries which would preclude this)
 - If persistently raised, follow guidance for *sudden change in ICP* and escalate to a senior
- Infection
 - As with any surgical procedure/ invasive monitoring device, the risk of infection is present and the ICP bolt should be considered as a potential source of infection in patients who have raised inflammatory markers/ erythema around the bolt/ pyrexia as part of a 'septic screen'.
- Dislodged bolt
 - This can sometimes happen during patient positioning. In the event this happens, apply a sterile dressing and inform the neurosurgical team for a review as the exit site will need to be sutured.
- Leaking
 - Escalate to the neurosurgeons for review

Other note

EVDs may be used as a method of ICP monitoring but are more invasive (requiring theatre and general anaesthesia) and carry a considerably larger risk of infection.

Unlike an arterial line/ central line/ EVD, the transducer is an intrinsic part of the monitor (on the end), is inside the patient's head and is electronic. It needs to be calibrated ('zeroed') on the monitor however isn't attached to an external transducer which needs to be at a specific level/ position.

If an ICP catheter has been inserted as part of a surgical procedure, the may not always have the plastic introducer.

Further reading

Physiology and waveforms of ICP/ monitoring - (<u>https://www.researchgate.net/figure/The-correlation-between-ICP-waveform-and-autoregula</u> tion-A-P1P2-reflects-a-good fig1 311525129)

Traumatic brain injury (TBI): <u>https://litfl.com/traumatic-brain-injury-tbi-overview/</u>

Raised ICP in TBI: <u>https://litfl.com/increased-intracranial-pressure-in-tbi/</u>

Oxford Handbook of Critical Care (see notes on the management of raised intracranial pressure).