Flight

Fitness to fly

The cabin is pressurized, by legislation, to avoid any passenger discomfort in an airplane and to maintain physiological environment at a high altitude ¹⁾.

If so, we can argue that it is reasonably safe for passengers to fly after surgery. We need more evidence to refute this $^{2)}$.

The cranial cavity is a closed compartment and any breach to this confined space secondary to neurosurgery or trauma cause an imbalance between atmospheric pressure and intracranial pressure. As the altitude increases, the atmospheric pressure decreases and hypoxia with hypercarbia is a well-known fact. In children, there is an argument to suggest that hypoxia can contribute to mild increase in intracranial pressure during commercial flights ³⁾.

There seems to be paucity of evidence on when one can fly following neurosurgery. With a paper based on surgeon's preference, only 5 out of 66 surgeons were not against flying after neurosurgery $^{4)}$.

Airline regulations that currently exist are framed based on several factors aimed on a safety net recommended by the medical team, particularly the neurosurgeons.

The aim of Balasubramanian and Kaliaperumal, is to explore this topic leading to a reasonable solution. It is not unusual to get referrals to the local tertiary neurosurgical care center from a holiday destination that they would like to air transfer someone who underwent an emergency neurosurgical procedure. So, what are the concerns behind the air transfer for these cohorts of patients?

They look at 3 different common neurosurgical scenarios that one may encounter under this context.

• Trauma: Unoperated with or without breech in the skull base (cerebrospinal fluid otorrhea, rhinorrhea, or leak from fractured site in the cranium)

• Intracranial surgery:

Craniotomy/craniostomy

• Endoscopic intracranial surgery (retraction injury is less to the adjacent normal brain, but apart from that all the risks of open surgery are present in endoscopic surgery as well, although relatively less)

• Intracranial shunts (programmable and nonprogrammable) TRAUMA Negative pressure can cause pneumocephalus in postop patients and, rarely, tension pneumocephalus. This could potentially increase the intracranial pressure warranting urgent intervention. An emergency craniotomy aimed to treat an intracranial pathology creates an environment that will preclude a state of potentially causing cerebral edema and hypoxia with higher altitude ⁵⁾.

Does this really happen when one has a tight head bandage in a pressurized cabin? This is something one needs to ponder.

Ventriculoperitoneal shunt revision surgery is something commonly performed in a neurosurgical

setting. Does the increase in altitude affect the shunt in a functional VP shunt patient?

What is the difference, if this is a case after an emergency shunt revision? A questionnaire-based survey by a local hydrocephalus association via 4 social media outlets resulted in 5.6% response (18 out of 323) that suggested that 72% of these 18 patients reported occurrence of transient symptoms. This resolved in 24 h to 2 weeks after travel in commercial airplane travel.

Are programmable or nonprogrammable valves at increased risk of malfunction in a low-pressure setting? In the same group, 3 parents reported changes in the valve settings. On the other hand, one-third of the parents who responded did not report any shuntrelated symptoms during air travel ⁶.

DURAL CLOSURE AFTER SURGERY

An interesting surgical technical point is that pertaining to water-tight closure of the dura mater at the end of surgery to avoid the atmospheric/intracranial pressure discrepancy and then applying this to changing altitude.

In theory, postcraniotomy or neuroendoscopy and if the dura is closed water tight then arguably the intracranial pressure is potentially normalized to near physiological state, albeit not exactly the same, as before surgery. We do recommend a water-tight closure of the dura if the surgeon anticipates that if the patient will possibly need to fly soon after surgery ⁷⁾.

POSTSURGERY COMPLICATIONS AND THEIR IMPACT

If the surgery is uneventful without any complications, Balasubramanian and Kaliaperumal argue that the risk with flying would be less. Modern neurosurgery has less retraction injury to the adjacent brain but any neurosurgery is prone to cause seizure, ischemia, and inflammation. In case of stroke or cerebral artery insufficiency, hypoxia may be problematic and supplemental oxygen may be advisable⁸⁾.

Airlines expect a formal medical clearance for those patients if they were to travel within 10 days of the event. Interestingly, passengers are allowed by the airlines to travel after 3 days if they are stable or recovering from stroke. The same would be arguably applicable to patients who had postoperative cerebrovascular compromise/stroke. Passengers with epilepsy should preferably delay air travel for 24 h after a grand mal seizure. Hypoxia due to altitudinal increase and hyperventilation can precipitate seizures in patients ⁹. and, arguably, we can extrapolate this to the postop cohort.

PROTOCOL MANDATES? Should we need to take the onus of formulating a clear mandatory protocol? If so would this be applicable to all postneurosurgery?

Options/questions to consider and these are subject to further debate:

- 1. Are patients safe to fly within the first 24 to 48 h after surgery?
- 2. Postop neuroimaging (CT/MRI) before air travel?

3. Clear guidelines as above similar to brain ischemia, ie, no travel for the first 3 to 10 days.

4. Or flying after 6-wk postoperative follow-up?

There is no obvious contraindication to flying sooner after neurosurgery and discretion should be individualized based on the overall health of the patient. Further studies in this regard would be beneficial. The treating physician should provide necessary information outlining all the potential problems that these patients may encounter such as ear pain, hypoxia, and intracranial pressure rise, which are known to occur physiologically and not proven to cause major pathology, and let the patient or the relatives make a decision. Higherlevel patient comfort seems to be the issue rather than a real problem in common less invasive cranial surgery with a good postop assessment ¹⁰.

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