Recent advancement in neuroanaesthesia

Afroza S

Introduction

Neuroanaesthesia has changed beyond all recognition since the advent of neurosurgery as a specialty. Neuro-anaesthesiologists today besides providing perioperative care to neurocritically ill patients are being asked to provide more and more assistance to patients for neuro-intensive care, neuro-radiology and neonatology. Whilst the changes that have occurred in the last decade, the period has seen a steady evolution of anaesthetic techniques in the operating theater, radiology suite and neurocritical care settings. These changes stem from our greater understanding of the cerebral physiology, pathophysiology and from the development of new anaesthetic agents.

History and development of neurosurgery

Asian countries, especially China and India, enjoy a long history of neurosurgery. Neurosurgery in each Asian country has developed differently.

The history of neurosurgery in Hong Kong dates back to 1956, with the arrival of the first neurosurgeon, Hsiang-Lai Wen\(^1\).

But in South Asia especially in our neighbouring country India, neurosurgery was started in 500BC, at that time Sushrutha used to perform his surgery with the help of concoctions of Indian hemp, opium and wine. The first cranial operation was made in 527AD by Raja Bhoj\(^2\).

The first neurosurgical independent department was started at CMC Vellore by Jacob Chandy in 1948\(^2\), though until 1965 all cases were anaesthetized breathing spontaneously, specially to have respiration as a guide to the extent of damage caused by surgery or raised intracranial pressure.

The first neurosurgical operation in Japan was performed by Susumu Sato, an army doctor, during the domestic South-Western War in 1877\(^3\).

The first neurosurgical operation in the history of Pakistan was performed by Jooma in October 1951, a thoracolumbar laminectomy for a spinal cord tumour\(^3\).

In Nepal, Dinesh Nath Gngol started neurosurgery by performing sub temporal decompression on a head injured male at Bir Hospital in 1961\(^3\).

Since the very onset it has been recognized that neurosurgical procedures needed specialized skill from both the surgeon and the anaesthesiologists.

Victor Horseley (1880-1886), father of neurosurgery in England described the effects of ether, chloroform, and morphine on ICP\(^4\). William Macewen (1878), a Scottish neurosurgeon, made strong recommendation that only a trained individual should administer anaesthesia\(^5\).

Harvey Cushing (1889), the pioneer American Neurosurgeon emphasized that quantative approach to neuroanaesthesia is essential for the development of safe neuroanaesthesia\(^6\).

Fedar Krause (1897), the father of German Neurosurgery advocated normothermia for neurosurgical procedure and he believed that brain tissue is pain insensitive\(^7\).

In Bangladesh neurosurgery as a speciality was started by Dr. Rashiduddin Ahmad in

---

Dr. Shahnaz Afroza, FCPS (Anaesthesia)
Senior Registrar, Department of Anaesthesia & ICU, Apollo Hospitals Dhaka.
Dhaka Medical College, although he himself as appointed in then IPGMR.

After that day by day number of neurosurgery is increasing both in govt. and private institutions.

Areas where the advancement is evident

Monitoring: Patient with neurologic disease undergoing surgical procedures have an increased risk of ischemic/hypoxic damage to the central nervous system. The risk may be related to hemodynamic/embolic events associated with a non neurosurgical operation. The risk may also be inherent in the neurosurgical procedure, e.g. temporary clipping of feeding artery during cerebral aneurysm surgery.

Current approach due to recent advances in monitoring system, a safer effective neurosurgery and neuroanaesthesia has evolved. Intra-operative neuro monitoring may improve patient outcome by (a) allowing early diagnosis of ischemia/hypoxia before irreversible damage occurs and (b) enabling surgeons to provide optimal operative treatment as indicated by the monitoring parameters.

Routine monitoring during neuroanaesthesia, in recent days includes, electrocardiography, direct arterial blood pressure monitoring, pulse oximetry, end tidal capnography, urine output, temperature, central venous pressure, TEE (trans esophageal echocardiography; to measure venous air embolism), bispectral index (to monitor depth of anaesthesia and also as a guide of dose adjustment of sedatives), EEG (monitored to assure cerebral well-being when a full neurologic examination can not be done and also to measure EEG suppression while using barbiturate therapy when the brain is at risk for ischemia and barbiturate as cerebral protection). In broad headline, the brain can be monitored in terms of (a) function, (b) blood flow, and (c) metabolism.

Cerebral protection: The preemptive use of therapeutic interventions to improve neurological outcome in patients who will be at risk for cerebral ischemia, is cerebral protection and the primary object of neuroanaesthesia is prevention of the deleterious effects of ischemia.

For clinical cerebral protection, there are non pharmacological and pharmacological therapies. Among the non pharmacological treatment are hypothermia, avoidance of hyperglycemia, avoidance of hypotension, hypoxia and hypercapnia, hemodilution, normalization of increased ICP, correction of acidosis and electrolyte imbalance.

The pharmacological treatments are use of barbiturate, other intravenous agents, opioids, benzodiazepines, calcium channel blockers, inhalational agents, anticonvulsants etc. There are also some experimental drugs like NMDA receptor antagonists e.g. Dizocilpine maleate, Magnesium, Glycinbinding site antagonism, Sodium channel blockers, Tirilazad, a lipid soluble 21 amino steroid etc.

Neuro vascular procedures: The neurovascular diseases like aneurysms and Arteriovenous malformation (AVMs) and several strokes can be managed by endovascular treatments. Therapeutic embolization of AVM done as a primary treatment or as a pre surgical adjunct to facilitate operative removal with less bleeding in patients with AV-fistulas, hypotension slows the low flow through the fistula and provides for a more controlled deposition of embolic materials and is used in these procedure. When glue is injected into a vessel there remains the risk of the glue causing inadvertent vascular occlusion or obstruction of the pulmonary circulation especially in small children with large AVMs. Therefore the anaestesiologists may need to intervene on an emergency basis. The target blood pressure in the post procedure period should be maintained 10-20% below the patient's normal blood pressure to prevent normal perfusion pressure break through.

Neuro radiology: The basic approach for Interventional neuro radiology therapy are occlusion of the proximal parent artery and obliteration of the aneurysmal sac. In this case
the anaesthetiologists should be prepared for aneurismal rupture and acute Sub Arachnoid Haemorrhage (SAH) at all times either because of spontaneous rupture or due to perforation of the wall during vascular manipulation.

**Strokes:** Several types of impending strokes are now amenable to endovascular treatment including vasospastic and atherosclerotic ischemic strokes. Vasospastic ischaemia and stroke may occur following SAH. Vasospasm refractory to medical treatment can easily be managed through endovascular approach.

**Stereo static procedures:** More recently stereo static procedures are applied for ablation of neural structures or placement of chronic stimulating electrode either by computerized tomography and microelectrode recording and stimulation guiding technique. All these procedures are very effective for the patients with movement disorder e.g. Parkinson diseases. Recently neurosurgery also advanced in the treatment of epilepsy in which several options are useful in decreasing the morbidity and mortality rates of seizures.

**Miscellaneous:** Another significant development towards Minimally Invasive Surgery (MIS) is endoscopic procedures in the treatment of hydrocephalus in which an endoscope is used to resect and cauterize the offending lesion. It is also used in clipping intracranial aneurysms.

Stereotaxy, to touch a point in space has long been used in neurosurgery. This procedure includes fixing a frame on the patients head and access a point in the depth of the brain through atlas and imaging. For some limitations in imaging quality, stereotaxy was used to biopsy only.

Radio surgery is yet another giant leap forward. Pin point irradiation of small tumour and AVMs in the brain can easily be managed with Gamma knife treatment which is nothing but a neuro radiological procedure where high dose of radiation delivered in a single stage to a small critical volume deep inside the brain, a tumour or an AVM to destroy it without opening the skull.

Gamma knife radio surgery used in Trigeminal neuralgia when medical therapy fails there is role of surgical treatment in the form of micro vascular decompression or percutaneous technique like thermal rhizotomy by radiofrequency lessoning, glycerol rhizotomy and balloon compression.

All these neurosurgical procedures may need the help of neuro-anaesthetiologist from the beginning or may at some stages of the treatment, but principle of neuroanaesthesia is being followed meticulously during anaesthesia and all these are possible with the modern advancement of pharmaceuticals and understanding of neuro physiology for cerebral protection and its proper implication.

The newer anaesthetic techniques e.g. Total Intravenous Anaesthesia (TIA) may replace the conventional O2:N2O inhalational anaesthesia in certain neuro surgical procedure where neuronal activity recording is necessary. Mild hypothermia (core temperature 32-340 c) is gradually gaining popularity for brain protection during neurosurgery.

**Conclusion**

As a third world country, Bangladesh being a member of South Asia country has also been in the race of development of neuroanaesthesia and now claiming its rightful share. From the year 1970 in Govt. Sector, later in Bangabandhu Sheikh Mujib Medical University (ex PG Hospital), Combined Military Hospital, other private hospitals and few clinics neurosurgery developed in uneven magnitude. From 2005 in private set up like Apollo Hospitals Dhaka (AHD), an appreciable number of neurosurgical procedures with an international standard have been performed. If we go through an unpublished data, the number of neurosurgery done in year 2006, about 2000 in govt. sector and about 800 in private hospitals. In 2005, this data is approximately about 1850 and 400 respectively. Among the private institutions,
about 30% neurosurgeries done in Apollo Hospitals Dhaka in 2005 and about 60% in 2006. Then one can see that private sectors are now undertaking greater load in terms of responding to the need of neurosurgical procedures.

Now a days, in addition to Neuro critical care unit, Intervention neuro radiology, newer surgical procedures like endoscopic surgery, aneurysm surgery, spinal surgery, pediatric neurosurgery etc have also been performed in Bangladesh. We hope that the way neurosciences are getting recognized in our country; a bright future awaits for the specialty. But this can be done with the help of trained neuro anaesthesiologists, some thing the country is seriously lacking at the moment.

If we look at some of our Asian neighbors, we will observe that there are societies of neuroanaesthesia, independent neuroscience institutions or centers that following different training programmes including super speciality doctoral courses (DM), Post Doctoral Certificate Course (PDCC), Post Doctoral Fellow (PDF) in neuroanaesthesia, but none is existing in our country. So in future if we want to join the race of the new era of the development of neurosurgery as well as neuroanaesthesia, a positive outlook would be necessary for required development in the specialty.

References