ANESTHESIA FOR SUPRATENTORIAL TUMOR

Diana Christine Lalenoh, MD, PhD, Neuroanesthesiologist consultant, Obstetric Anesthesia consultant
Department of Anesthesiology & Intensive Care, Medical Faculty of Sam Ratulangi University; Department of Anesthesiology & Intensive Care, Prof. R.D. Kandou General Hospital; Department of Anesthesiology & Intensive Care, Permata Bunda General Hospital

Introduction

Approximately 51,410 new brain tumors are diagnosed each year in USA. Supratentorial tumor (>80%), and half of these are malignant. The most common primary tumors are gliomas (36%), meningiomas (32%), and pituitary adenomas (8%). The incidence brain metastases increase with age, source from breast, colorectal, kidney, lung, and melanoma.

Neuroanesthesia is a special chapter of anesthesia, referring to surgery that is performed right at the site of action of anesthetic drugs, namely the central nervous system (CNS). Changes induced by general anesthesia on the CNS are accompanied by changes in brain physiology, including cerebral blood flow (CBF), cerebral metabolic rate of oxygen (CMRO2), cerebral perfusion pressure (CPP) and electrophysiological functions. In neuroanesthesia, posterior fossa surgery faces difficult challenges due to the peculiarities observed from an anatomical and physiological point of view, which also requires the patient to be put in a specific position prior to surgery. Therefore, we have considered useful and detailed aspects of general anesthesia in this type of surgery, presenting data both from specialized literature and from personal experience of over 25 years.

Fundamentals of anatomy and physiology

The Posterior Fossa contains vital nerve structures such as the brainstem, the cerebellum and the fourth ventricle. The Brainstem is the most important area of the subtentorial space with a complex structure, representing the transitional area for the main ascending and descending nervous paths that cross each other belonging to the nervous system. The Gray Matter of the brainstem is represented by its own nuclei and origin nuclei of the cranial nerves.

The brainstem contains numerous vital centers such as: • The Respiratory center; • The Cardiovascular center; • The Swallowing center; • The Center of vomiting, coughing, and/or hiccups; • The Chewing center; • The Salivary centers. The Brainstem Reticular Substance plays an important role as it is involved in our sleep-wake state regulation, regulation of muscle tone, regulation of sensori-sensitive function and the regulation of our autonomic functions. Reticular formation is a vast neural mass stretched all along the brainstem as an unspecific, polysynaptic path also containing the majority of neural network points, somato-vegetative (respiratory, cardiovascular) and a series of extrapyramidal structures. T

he Cerebellum is another important part of the posterior fossa, as it plays a essential role in regulation, coordination, and controlling voluntary and involuntary motor activity like balance and locomotion. The IV Ventricle is a dilated region in the form of tent, located between the brain stem and cerebellum. It consists of the floor and ceiling. The fourth ventricle floor is the rhomboid fossa, posterior faces in correspondence to the bulbo-pontine area. This floor designs the bulbo-

protuberanţial locum for vital centers, and thus poses high risks during surgical practices.

General Consideration

Concern and problem: sign and symptoms from mass efect and generalized increased ICP, mainsurgical concern, main anesthetic concern, specific chllanges (intraoperative hemmorhage, seizure, air embolism).

Pathiphysiology of elevated ICP.

Cerebral perfusion and cerebral blood flow. Anesthesia and ICP, CPP, CMRO2. Reducing ICP, brain bulk and tension

Secondary Insult to Already Injured Brain

Intracranial

- Increased ICP
- Epilepsy
- Cerebral vasospasm
- Herniation: falx, tentorium, foramen magnum (vessel compression and ischemia), craniotomy (brain injury or skull edge).
- Midline shift: tearing of cerebral vessels

Systemic

- Hypercapnia/hypoxemia

- Ssystemic hypotension/hypertension
- Low cardiac output
- Hypo/hyperglycemia
- Osmolarity <280 or > 20 mOsm
- Shivering/hyperthermia

GENERAL ANESTHETIC MANAGEMENT

Preoperative Neurological Evaluation: History of Seizure, increase of ICP before: headache, nausea, vomiting, blurred vision, Focal neurologic deficit: motor or sensory deficit, Hydration: fluid intake, diuretics, Medications: steroids, antiepileptic drugs, and their advese effect, Associated medical conditions.

Preoperative Neurological Evaluation:

Physical Examination

Measure the Mental status, level of consciousness, is there any Papil edema, Cushing's response: hypertension, bradicardia, Pupil seize, Speech deficits, Glasgow Coma Scale score, Focal deficit

Preoperative Neurological Evaluation: Radiology (CT or MRI-scan)

- Size and locatin of the tumor (proximity to large vessels or eloquent brain area).
- Mass effect: midline shift, temporal or frontal herniation, absent basal CSF cisterns, hydrocephalus.

Preoperative preparation

- Premedication: patient who do not have sign of increase ICP may benefit from oral premedication with small dose of benzodiazepin.
- Vascular access: central venous access, arterial cannulation.
- Monitoring: cardiovascular, air embolism, neuromuscular blockade, metabolic, intracranial environment, cerbral function, ICP monitoring.

Suggested Anesthesia Induction Regimen

- Adequate preoperative anxiolysis
- ECG, capnograph, pulse oximeter, noninvasive blood pressure.
- Venous, arterial line (under local anesthesia).
- Preoxygenation, then fentanyl.
- Propofol 1,25-2,5 mg/kg or pentothal 3-6 mg/kg
- Nondepolarizing muscle relaxant.
- Hyperventilation (PaCO2 35 mmHg)

- Intubation.

Suggested Anesthesia Maintenance Regimen

- Sevoflurane 0.5-1.5%, desflurane 3-6%, propofol 50-150 mcg/kg/minute.
- Analgesia: fentanyl
- Pin holder placement: local anesthesia or fentanyl.
- Position: head up 10-20 degree, jugular venous free.
- Mannitol 0.5-0.75 g/kg or lumbar drainage
- Normovolemia: isotonic crystaloid or 6% HES to replace blood loss
- Brain dissection: decrease narcotic dosage .

Intracranial hypertension and Brain Bulging: prevention and Treatment

Prevention

- Preoperative adequate anxiolysis and analgesia
- Preinduction: hyperventilation on demand, head up position, head straight, no jugular vein compression.
- Avoid overhydration
- Osmotic diuretic (mannitol, hypertonic saline);steroid for tumor.
- Optimize hemodynamic: MAP, CVP; remifentanyl or beta blocker to prevent hypertension.

- Ventilation: PaO2 > 100 mmHg; PaCO2 35 mmHg, low inthrathoracic pressure (no PEEP).
- Intravenous anesthetic for induction and maintenance.

Treatment

- CSF drainage
- Osmotic diuretic
- Hyperventilation (PaCO2 25-28 mmHg).
- Increase depth of anesthesia using intravenous anesthetics (propofol, thiopental).
- Muscle relaxant
- Control head position and correct excessive rotation (avoid jugular compression).
- Mild control hypertension (MAP 100 mmHg) with phenylephrine if cerebral autoregulation intact.

Chemical Brain Retractor Concept

- Mild hyperosmolality (before bone flap removal give 20% mannitol 0.5-0.75 mg/kg or NaCl 7.5% 2-3 mL/kg.
- Mild hyperventilation.
- Adequate head-up positioning (10-20 degree)
- i.v anesthetic drugs (propofol)
- Normotension or mild hypertension (MAP 100 mmHg).
- Lumbal CSF drainage
- Venous drainage: jugular vein free
- Avoidance of brain retractors

Early versus Delayed Awakening: Pro and Cons

Early Awakening

Pros

- Earlier neurolgic examination and reintervention.
- Baseline assessment for susequent changes
- Less hypertension, catecholamine burst.
- Performed by anesthesilogist in charge of the patient.
- Decreased cost, less use of ICU resources.

Cons

- Increased risk of hypoxemia and hypercapnia
- Less time for stabilization

Delayed Awakening

Pros

- Less risk of hypoxemia and hypercapnia.
- Better respiratory and hemodynamic control
- Time for stabilization and potentially better hemostasis.

Cons

- Less neurologic monitoring
- Delay in the treatment of pain
- More hyertension, catecholamine release.

Check List before attempting Early Awakening: Precondition

- Adequate preoperative state of consciousness.
- Cardiovascular stability, normal body temperature, adequate oxygenation.
- No major brain laceration or complication during surgery.
- No injury to cranial nerves IX, X, XII.

- No removal of large AVM.

Conclusions

Preserving uninjured cerebral territories by global maintenance of metabolic, cardiovascular, and respiratory stability. Balancing CBF autoregulation and MAP and preserving cerebral vasoreactivity to PaCO2. Achieving and maintaining brain relaxation. Timely awakening to facilitate early and ongoing neurologic assssment and permit prompt diagnosis and treatment of complications.

The principles of the perioperative anesthetic management of patients with supratentorial tumors are reviewed. Emphasis is placed upon intracranial pressure (ICP) dynamics and the multiple causes of intracranial hypertension which may occur during the perioperative period. The author describes his experiences using routine ICP monitoring in these cases, arguing that this may help both the neurosurgeon and the neuroanesthetist to avoid many of the pitfalls currently associated with the perioperative care of these patients.

Refferences:

- Bedford RF. Anaesthetic management for supratentorial tumor surgery. Journal of Neurooncology,1 : 319-26. Netherlands

- Romanian Neurosurgery (2012) XIX 3: 183 - 192 183 Considerations on anesthesia for posterior fossa-surgery Eva Gheorghita, J. Ciurea, B. Balanescu Emergency Hospital Bagdasar Arseni, Bucharest
-