# Recent Trends in Anesthetic Management for Craniotomy of Supratentorial Tumors

Essay

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By

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Beshoy Zarief Nassar

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# *List of Abbreviations*

| Abb. | Full term |
|---|---|
| *ABG* | *Arterial blood gases* |
| *AC* | *Awake craniotomy* |
| *ADH* | *Antidiuretic hormone* |
| *AQP4* | *Aquaporin-4* |
| *ASA* | *American Society of Anesthesiologists* |
| *ASV* | *Avian sarcoma virus* |
| *ATM* | *Atomospheric* |
| *BUN* | *Blood urea nitrogen* |
| *CBF* | *Cerebral blood fusion* |
| *CBV* | *Cerebral blood viscosity* |
| *COPA* | *Cuffed oropharyngeal airway* |
| *CPP* | *Cerebral perfusion pressure* |
| *CVP* | *Central venous pressure* |
| *CVS* | *Cardiovascular system* |
| *ECG* | *Electrocardiography* |
| *ENU* | *Ethylnitrosourea* |
| *EtCO2* | *End Tidal capnography* |
| *FAP* | *Familial Adenomatous Polyposis* |
| *GA* | *General Anesthesia* |
| *GBM* | *Glioblastoma multiform* |
| *Gy* | *Gray* |

# List of Abbreviations (Cont...)

| Abb. | Full term |
|---|---|
| *HCT* | *Hematocrite* |
| *HTN* | *Hypertension* |
| *ICP* | *Intracranial pressure* |
| *JC virus* | *John Cunningham virus* |
| *LFS* | *Li–Fraumeni syndrome* |
| *LMA* | *Laryngeal Mask Airway* |
| *LOH* | *Loss of heterozygosity* |
| *MAP* | *Mean arterial pressure* |
| *MNU* | *Methylnitrosourea* |
| *MSV* | *Murine sarcoma virus* |
| *NF* | *Neurofibromatosis* |
| *NF1* | *Neurofibromatosis Type 1* |
| *NF2* | *Neurofibromatosis Type 2* |
| *PAH* | *Polycyclic Aromatic Hydrocarbons* |
| *PMBTs* | *Primary malignant brain tumors* |
| *RS* | *Respiratory system* |
| *RSV* | *Rous sarcoma virus* |
| *SI* | *The international system* |
| *SIADH* | *Syndrome of inappropriate secretion of antidiuretic hormone* |
| *SpO2* | *Pulse oximetry* |

# List of Abbreviations (Cont...)

| Abb. | Full term |
|---|---|
| *SSV* | *Simian sarcoma virus* |
| *SV40* | *Simian vacuolating virus 40* |
| *TCI* | *Target controlled infusion* |
| *TIVA* | *Total intravenous anaesthesia* |
| *V/Q* | *Ventilation perfusion mismatch* |
| *VT* | *Ventricular Tachycardia* |

# INTRODUCTION

Brain tumors are associated with significant morbidity and mortality. Supratentorial tumors accounts for approximately 80% of all brain tumors. A rapid recovery of neurologic function after craniotomy for supratentorial tumors allows for the prompt diagnosis of intracranial complications and early hospital discharge. The anesthetic care of patients undergoing craniotomy for supratentorial tumor resection requires understanding the impact of brain tumor on cerebral physiology and the effect of pharmacological agents on neurological function and oncological outcome. The perioperative goals for supratentorial tumor craniotomy are to optimize cerebral perfusion; oxygenation; and operating conditions facilitate rapid perioperative neurological testing and minimize postoperative pain and improve neurological outcome that matter most to patients ***(Gruenbaum and Bilotta, 2012).***

Anesthesiologists have long searched for the optimal anesthetic technique for patients undergoing craniotomy. Thiopental was considered to be beneficial for neurosurgical patients because it preserves autoregulation of cerebral blood flow and decrease transcranial pressure by reducing cerebral metabolic oxygen consumption and cerebral blood flow. Hypnotic agents like propofol have similar effects on cerebral blood flow, intracranial pressure, shorter half-life and have largely replaced the use of thiopental ***(Gruenbaum and Bilotta, 2013)***.

Neuroanesthesia for craniotomy should be aimed to ensure intraoperative loss of consciousness (unless awake craniotomy is the selected anesthesiological approach), pain control and an uneventful postoperative recovery, but should also be addressed to manipulate physiological variables including cerebral blood flow and to obtain optimal surgical exposure ***(Bilotta et al., 2012).***

Anesthesia for awake craniotomy is a unique clinical setting that requires the anesthesiologist to provide changing states of sedation and analgesia, to ensure optimal patient comfort without interfering with electro- physiologic monitoring and patient cooperation, but also to manipulate cerebral and systemic hemodynamic while guaranteeing adequate ventilation and airways safety ***(Bilotta et al., 2012)***.

Awake craniotomy is the preferred approach for functional neurosurgery including deep-brain stimulation for the treatment of Parkinson's disease. It is also indicated for epilepsy surgery, and for neurosurgical procedures requiring intra-operative monitoring of speech and motor functions to localize the area of surgical interest (including resection or biopsy of brain tumors in eloquent areas) since it allows wider tumor excision and lower perioperative morbidity ***(Bilotta and Rosa, 2009).***

# AIM OF THE STUDY

To present recent trends in anesthetic management for craniotomies and post operative challenges to decrease pain.

# Chapter 1

# ANATOMY OF CENTRAL NERVOUS SYSTEM

## Overview

The nervous system is organized into two parts: the central nervous system, which consists of the brain and the spinal cord, and the peripheral nervous system, which connects the central nervous system to the rest of the body. An image depicting the central nervous system can be seen below ***(Snell, 2009)***.

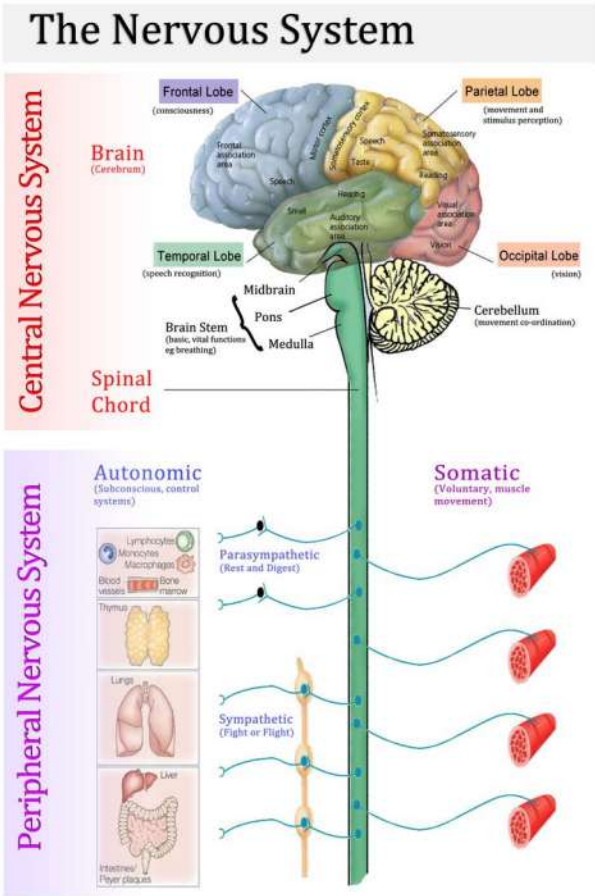


**Figure (1):** Nervous system, full body, anterior view ***(Snell, 2009)*.**

In the central nervous system, the brain and spinal cord are the main centers where correlation and integration of nervous information occur. Both the brain and spinal cord are covered with a system of membranes, called meninges, and are suspended in the cerebrospinal fluid; they are further protected by the bones of the skull and the vertebral column ***(Snell, 2009)***.

The central nervous system is composed of large numbers of excitable nerve cells and their processes, called neurons, which are supported by specialized tissue called neuroglia. The long processes of a nerve cell are called axons or nerve fibers. The interior of the central nervous system is organized into gray and white matter. Gray matter consists of nerve cells embedded in neuroglia; it has a gray color. White matter consists of nerve fibers embedded in neuroglia; it has a white color due to the presence of lipid material in the myelin sheaths of many of the nerve fibers. The billions of neurons in the brain are connected to neurons throughout the body by trillions of synapses ***(Snell, 2009)***.

## Gross Anatomy

### ***Brain***

The brain contains more than 90% of the body's neurons. The brain has been divided into 3 different areas: the hindbrain, the midbrain, and the forebrain ***(Brazis et al., 2011).***

The hindbrain is found in even the most primitive vertebrates. It is made up of the cerebellum, the pons, and the medulla. The medulla is a narrow structure nearest the spinal cord; it is the point at which many of the nerves from the left part of the body cross to the right side of the brain and vice versa. The medulla controls such functions as breathing, heart rate, and blood pressure. The Pons, located just above the medulla, connects the top of the brain to the cerebellum. Chemicals produced in the pons help maintain our sleep-wake cycle. The cerebellum is divided into 2 hemispheres and handles certain reflexes, especially those that have to do with balance. It also coordinates the body's actions ***(Snell, 2009)***.

The midbrain lies between the hindbrain and forebrain and is crucial for hearing and sight.

The forebrain is supported by the brain stem and buds out above it, drooping somewhat to fit inside the skull. It consists of the thalamus, the hypothalamus, and the cerebral cortex. The thalamus relays and translates incoming messages from the sense receptors except those for smell. The hypothalamus governs motivation and emotion and appears to play a role in coordinating the responses of the nervous system in times of stress ***(Turlough et al., 2011)***.

The cerebral hemispheres, located above the thalamus and hypothalamus, take up most of the room inside the skull. The outer covering of the cerebral hemispheres is known as the cerebral cortex. They are the most recently evolved portion of the brain, and they regulate the most complex behavior. Each cerebral hemisphere is divided into 4 lobes, delineated by deep fissures on the surface of the brain.

The occipital lobe of the cortex, located at the back of the head, receives and processes visual information. The temporal lobe, located roughly behind the temples, is important to the sense of smell; it also helps us perform complex visual tasks, such as recognizing faces ***(Blumenfeld, 2002)***.

The parietal lobe, which sits on top of the temporal and occipital lobes, receives sensory information, in the sensory projection areas, from all over the body and figures in spatial abilities. The ability to comprehend language is concentrated in 2 areas in the parietal and temporal lobes.

The frontal lobe is the part of the cerebral cortex responsible for voluntary movement and attention as well as goal-directed behavior. The brain starts response messages in the motor projection areas, from which they proceed to the muscles and glands. The frontal lobe may also be linked to emotional temperament ***(Blumenfeld, 2011)***.

These 4 lobes are both physically and functionally distinct. Each lobe contains areas for specific motor sensory function as well as association areas. The association areas are areas that are free to process all kinds of information and make up most of the cerebral cortex and enable the brain to produce