

Cerebral Palsy

Risk

- Leading cause of childhood motor disability: 2–2.5 per 1000 live births in developed countries.
- Incidence has not decreased despite improved perinatal care due to increased survival in premature neonates.
- Cerebral palsy pts undergo surgery at higher rates due to frequent comorbidities.

Perioperative Risks

- Dehydration
- Electrolyte imbalance
- Hypothermia
- Delayed recovery
- Hypotension
- Seizure

Worry About

- Difficult intubation
- GE reflux and aspiration

- Associated respiratory impairment and hypoxemia
- Drug interactions or hypersensitivity
- Latex allergy

Overview

- Any nonprogressive central motor deficit dating to events in the prenatal, perinatal, or postnatal periods
- Wide spectrum of symptoms
 - Cognitive impairment
 - Seizures
 - Sensory loss (visual and hearing)
 - Communication and behavioral disturbances
 - Respiratory, GI and orthopedic problems
- Normal intellect (especially dyskinetic group) often
- Classified as spastic (87%), dyskinetic (7%), ataxic (4%), and mixed (2%)

Etiology

- Mostly unknown and multifactorial
- Antenatal cerebral events causing complications at time of delivery (e.g., periventricular hemorrhage, genetic disorder, infection)
- Postnatal events such as trauma and infection
- All causes: Result in damage to the CNS during early brain growth

Usual Treatment

- Anticonvulsants, antispasmodics (benzodiazepines, baclofen, and dantrolene), antidepressants, antireflux agents, laxatives, and anticholinergics
- Often intramuscular botulinum toxin injections and orthopedic procedures (tendon releases and osteotomies), fundoplication for reflux, gastrostomy tube placement, tracheostomy, major spine surgery, and dental rehabilitation

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Tongue thrusting Poor dentition Salivary drooling	Difficulty swallowing	Dental malocclusion Dental caries	Formal airway assessment usually difficult
RESP	Restrictive defect Aspiration pneumonia Recurrent chest infections	Cough Dyspnea (difficult to detect if mobilization limited)	Often normal Reduced air entry Bronchial breathing Wheeze	Pulm function tests, ABG CXR
CV	Right-sided heart failure from restrictive lung disease	Often normal Dyspnea	Tachycardia S ₃ or S ₄ Distended JVP Hepatomegaly	ECG ECHO
GI	GE reflux Esophageal dysmotility	Poor swallowing Night waking	Dehydration Pallor Malnutrition	CBC Lytes ± Endoscopy
MS	Spasticity Dyskinesia Ataxia	Muscle pain and spasms	Increased muscle tone Contractures Tremor	Gait analysis performed before major orthopedic surgery
CNS	Epilepsy (30%) Visual and hearing defects	Tonic-clonic and complex-partial seizures	Myopia Visual field defects Strabismus	Not usually relevant
HEME	Iron-deficiency anemia	Fatigue	Pallor	CBC, differential
METAB	Electrolyte imbalance Hypovolemia	Laxative use Fatigue Never thirsty	Dehydration Malnutrition	UA Albumin

Key References: Wongprasartsuk P, Stevens J: Cerebral palsy and anaesthesia. *Paediatr Anaesth* 12:296–303, 2002; Wass CT, Warner ME, Worrell GA, et al: Effect of general anesthesia in patients with cerebral palsy at the turn of the new millennium: a population-based study evaluating perioperative outcome and brief overview of anesthetic implications of this coexisting disease. *J Child Neurol* 27(7):859–866, 2012.

Perioperative Implications

Preoperative Preparation

- Pts can have normal intellect. (One-third have mental retardation.)
- Involve parents in management because parents have good insight into periop care.
- Avoid unfamiliar faces if possible.
- Optimize respiratory status (bronchodilators, antibiotics, and physical therapy).
- Optimize nutrition and fix electrolyte imbalance and hypovolemia.
- Continue medical Rx, especially anticonvulsants.
- Pts may need antireflux, antisialagogue, or sedative premedication (cautious doses of sedatives).
- Topical local anesthetic for venipuncture.
- Discuss periop analgesia (often a regional technique for lower-limb surgery).

Monitoring

- Core temp (susceptible to hypothermia)
- Neuromuscular blockade
- Airway pressures

Airway

- ETT is better sized to age, not weight.
- Salivary secretions may make ventilation difficult.
- Overbite may make intubation difficult.

Induction

- Rapid sequence may be required but is often impractical.
- IV access often difficult.
- Inhalation sometimes favored (in semisitting position if concerns of reflux exist).

Maintenance

- Position pt carefully and check frequently.
- Consider antiemetics, especially when opioids are administered.
- IV fluids.
- MAC may be lower in cerebral palsy as much as 20% and up to 30% if pt is on anticonvulsants.
- Use warming devices.
- Consider regional (epidural) techniques for lower-limb surgery.

Other Intraoperative Challenges

- Bleeding:
 - Anecdotal evidence that pts with neuromuscular scoliosis bleed more than pts with idiopathic scoliosis.
 - Poor nutritional/nonambulatory status.
 - Borderline low platelet count and function due to anticonvulsants.
 - Subnormal clotting factor level.

Temp:

- Pediatric pts with severe CP may be unable to regulate temp.
- Pts may have little subcutaneous fat.
- Some arrive to OR with temp <35° C.
- Warm room until pt is draped, and use warming blanket/gases/fluids.

Extubation

- Awake if prone to reflux

Drug Considerations

- Baclofen should not be stopped abruptly; however, it may cause postop bradycardia and hypotension.
- Resistance to nondepolarizing NMB may occur (but is probably not clinically significant).
- Ketamine and methohexital may be avoided in epileptic pts.
- N₂O and opiates may worsen nausea.

Postoperative Period

- Ensure aggressive respiratory care and frequent aspirations.
- Maintain normothermia.
- Pts susceptible to N/V.
- Avoid/treat muscle spasms (IV diazepam and epidural clonidine).
- Facilitate early mobilization.

Anticipated Problems/Concerns

- Latex allergy
- Hypothermia
- Prolonged recovery time
- Postop N/V (worse with opiates)
- Postop muscle spasms
- Retention of secretions and postop chest infection

Cerebrovascular Transient Ischemic Attack

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Risk

- Overall incidence in USA: Approximately 1.1 per 1000.
- Risk related to demographic factors: Age, gender, and race.
- Estimated prevalence of TIA in men is 2.7% versus 1.6% in women ages 65–69 y, and 3.6% in men versus 4.1% in women ages 75–79 y. The overall prevalence is estimated to be 0.4% among adults 45–64 y.
- African Americans and Hispanics at higher risk than Caucasians.

Perioperative Risk

- Pts with Hx of TIAs at increased risk of postop stroke.
- Risk of periop stroke increased in pts with medical Hx of cerebral vascular disease, peripheral vascular disease, hypertension, diabetes, chronic renal insufficiency, COPD, and atrial fibrillation.
- Pts with CAD for CABG have a high incidence of carotid stenosis (50% with some; 20% with stenosis >50%).
- Likewise, pts with carotid stenosis have high incidence of CAD (over 50%).
- Risk of periop stroke increased in pts with planned surgery: CABG (3–6%), vascular (1%).
- Pts with Hx of stroke 9 mo or less ago at increased risk of major adverse cardiac events and mortality

after elective, noncardiac surgery (even low- and intermediate-risk surgeries).

Worry About

- Crescendo TIAs
- Duration of symptoms >1 h
- Symptomatic or critical internal carotid artery stenosis
- Known cardiac source of embolus, such as atrial fibrillation
- Known hypercoagulable state

Overview

- TIA: Transient episode of neuro dysfunction caused by focal brain, spinal cord, or retinal ischemia, without acute infarction. The end is biologic (tissue injury) rather than arbitrary (24 h).
- Risk of hospitalization for major cardiac event after TIA is 2.6% for first 90 days.
- ABCDD score for assessing risk of stroke after TIA.
 - A = Age (> 60 y = 1 point)
 - B = Blood pressure elevation when first assessed after TIA (systolic ≥ 140 mm Hg or diastolic ≥ 90 mm Hg = 1 point)
 - C = Clinical features (unilateral weakness = 2 points; isolated speech disturbance = 1 point; other = 0 points)
 - D = Duration of TIA symptoms (≥ 60 min = 2 points; 10 to 59 min = 1 point; <10 min = 0 points)

- Diabetes (present = 1 point)
- Score interpretation:
 - Score 6 to 7: High 2-day stroke risk (8.1%)
 - Score 4 to 5: Moderate 2-day stroke risk (4.1%)
 - Score 0 to 3: Low 2-day stroke risk (1%)

Etiology

- Cerebral vessel disease: atherosclerosis, lipohyalinosis, inflammation, amyloid deposition, arterial dissection, developmental malformation, aneurysmal dilation, or venous thrombosis
- Remote disease: embolus formed from the heart or other circulation, which lodges in a cerebral vessel
- Blood flow–related: related: Inadequate cerebral blood flow due to decreased perfusion pressure or increased blood viscosity (hypotension, trauma, surgical compression, steal, and coagulopathy)

Usual Treatment

- Determine causing factor.
- For cerebral vessel disease: Antiplatelet therapy, anticoagulation, and revascularization (carotid endarterectomy, carotid stent, vertebral artery stent).
- In remote disease, investigate and treat causing factor (e.g., atrial fibrillation, valvular disease), and use antiplatelet therapy and anticoagulation.
- If blood flow–related, treat underlying cause and use antiplatelet therapy and anticoagulation.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Neck trauma Compression			
CNS	Cerebrovascular disease Transient focal neuro deficit	Vision changes, language changes, weakness, sensory changes, ataxia Previous stroke	Carotid bruit Retinal exam (for ischemia)	Carotid Doppler Angiography: Carotid and vertebral artery CT/MRI
CV	CAD disease Atrial fibrillation Possible valvular disease	MI Angina Decreased exercise tolerance Risk factors for atherosclerosis	Irregular heart rate/rhythm Murmur	ECG Stress test Holter, TEE/ TTE
GI		N/V		

Key References: Easton JD, Saver JL, Albers GW, et al: Definition and evaluation of transient ischemic attack: a scientific statement for healthcare professionals from the American Heart Association/American Stroke Association Stroke Council; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular Radiology and Intervention; Council on Cardiovascular Nursing; and the Interdisciplinary Council on Peripheral Vascular Disease. The American Academy of Neurology affirms the value of this statement as an educational tool for neurologists, *Stroke* 40(6):2276–2293, 2009; Anastasian ZH: Anesthetic management for acute ischaemic stroke, *Br J Anaesth* 113 (Suppl 2):ii9–ii16, 2014.

Perioperative Implications**Perioperative Preparation**

- Determine blood pressure range that the pt normally experiences.
- Manage blood pressure with both cerebral perfusion and CAD in mind.
- Perform preop cardiac workup and medical stabilization and consider postponing surgery if nonemergency surgery.
- Conduct preop neuro exam to identify any baseline deficits.
- Avoid excessive premedication (pt can be more sensitive).
- Avoid long-acting intraop agents that can obscure postop neuro exam.

Monitoring

- Use ECG monitoring for ischemia and arrhythmia.
- Consider arterial line and central line/PA catheter if extensive CV disease is present.

Airway

- Avoid extreme neck manipulation and pressure on the carotid artery during ventilation and intubation.

Preinduction/Induction

- Maintain pressure to allow for sufficient cerebral perfusion (rightward shift in cerebral autoregulation in Htn).
- Titrate medication because patient requirements can decrease.

Maintenance

- Pts can be more sensitive to medications.

- Avoid long-acting agents if neuro exam is to be performed postop.
- Isoflurane theoretically neuroprotective allows lowest cerebral blood flow before EEG symptoms of ischemia.

Extubation

- Ensure pt is awake, following commands, and able to protect the airway.
- Ensure pt does not have a large neuro deficit that would lead to swelling and respiratory insufficiency postop.

Postoperative Period

- Period of greatest risk for stroke is after general surgery.
- Resume antiplatelet therapy and anticoagulation as soon as possible.