Worry About

- Periop exposure to high FiO_2s (>30%)
- Periop hypoxia
- Fluid overload, transfusion of red cells, and prolonged operative time
- Intrapleural administration of BLM, which has been associated with local pain and hypotension requiring symptomatic treatment

Overview

- Antibiotic with antitumor properties isolated from the fungus *Streptomyces verticillus* is used primarily to treat testicular cancers and lymphomas, as well as some head and neck tumors.
- BLM is also effective for treatment of malignant and recurrent pleural effusions.
- BLM is inactivated by the enzyme BLM hydrolase. Lungs and skin have the lowest levels of BLM hydrolase and thus are more susceptible to injury.
- Cleared by renal excretion. $T_{1/2}$ 4 h.

Etiology

- BLM binds both Fe^{2+} and DNA. The Fe^{2+} is oxidized to Fe^{3+}, resulting in free radicals, which damage DNA, leading to cell death.
- Oxidative damage to cell membranes and fatty acids likely initiates an inflammatory response resulting in myofibroblast proliferation and ultimately pulmonary fibrosis.
- Early reports demonstrated a link between administration of BLM/exposure to high FiO_2s and subsequent development of lung toxicity and fibrosis.

Assessment Points

System	Effect	Assessment by Hx	PE	Tests
RESP	Pulm fibrosis ARDS with O_2 exposure	Dyspnea, dry cough	Frequently normal Earliest sign is fine rales	CXR: Bilateral infiltrates progressing to consolidation and honeycombing High-resolution CT scan: Ground-glass opacities and fibrosis Decreased O_2 sat PFTs: Restrictive pattern/decreased DLCO
MUCOCUT	Inflammation, dermal fibrosis	Itching, burning, skin tenderness	Stomatitis, alopecia, scleroderma-like skin changes	
HEME	Minimal bone marrow toxicity			CBC

Key References: Reinert T, Baldotto C, Nunes F, et al.: Bleomycin-induced lung injury, *J Cancer Res*, 2013. <http://dx.doi.org/10.1155/2013/480608/>. (Accessed 24.02.16.); Aakre BM, Efem RI, Wilson GA, et al.: Postoperative acute respiratory distress syndrome in patients with previous exposure to bleomycin, *Mayo Clin Proc* 89(2):181–189, 2014.

Perioperative Implications

Preoperative Preparation

- In pts with Hx of testicular, squamous cell cancer, or lymphoma, inquire about exposure to BLM, as well as Hx of other risk factors.
- Any pt with abnormal PFTs, or who is clinically symptomatic, should be considered at high risk for development of ARDS.
- Pts receiving BLM within 8 mo of surgery are at higher risk, but BLM exposure most likely confers elevated lifetime risk of BLT.

Intraoperative Management

- Use of low FiO_2 has been mainstay of BLT prevention. Some studies call this practice into question. It is best to maintain FiO_2 below 30%, but perhaps not at expense of hypoxia.
- Utilize protective lung ventilation strategies.
- Maintain neutral fluid balance with preference toward colloids. Avoid transfusions if possible. Consider invasive monitoring to guide fluid therapy.
- In high-risk pts, pretreatment with corticosteroids (1 mg/kg prednisone) may be helpful in limiting postop ARDS.

Postoperative Period

- Provide adequate oxygenation with the lowest possible inspired FiO_2.
- Observe carefully for 3–5 d after surgery, for signs of dyspnea, hypoxia, cough, or rales.
- Use PEEP or CPAP to treat postop hypoxia.
- Add methylprednisolone up to 1 mg/kg/d if developing ARDS, and diuretics if clinically indicated.

Anticipated Problems/Concerns

- Pts who had previously received BLM and have received supplemental oxygen are susceptible to lung toxicity and ARDS.
- Maintaining adequate oxygenation with the lowest possible FiO_2 can be difficult.
- Neutral fluid balance and avoidance of transfusions if possible. Invasive monitoring may be useful for guidance.

Blindness

Stanley W. Stead

Risk

- Eye injuries represent 4% of claims analyzed in the ASA Closed Claims Project.
- Majority of entries in the ASA POVL Registry are associated with cardiac and spine cases, with a reported incidence as high as 4.5% and 0.2%, respectively. Other surgical procedures with POVL reported including head and neck, liver transplants, thoracoabdominal aneurysm resections, peripheral vascular procedures, and prostatectomies.
- In the Registry, POVL is most often associated with ION 89% of the time and CRAO 11% of the time.
- Blindness can result from injury to the eye, its surrounding structures (eyelid and conjunctiva), blood supply, and optic nerve.
- Blindness may be transient (glycine absorption), prolonged, or permanent (ION, CRAO, traumatic, and central ischemic events).

Perioperative Risks

- ION: Bilateral blindness in spine procedures in the prone position, cardiopulmonary bypass, head and neck dissections, complex instrumented spinal fusion surgery, where there is significant facial swelling and venous hemodynamics may be altered (highest incidence: Pts <18 y)
- CRAO: Periocular trauma and rarely bilateral blindness.
  - Procedure dependent factors: improper head positioning, use of a horseshoe headrest when placing the eye in contact with the headrest, anemia, blood loss greater than 1 L, systemic hypotension, and procedure duration greater than 6 h
- Intraocular procedures, procedures around the eye, prone position with padding around the face and eyes, exophthalmos, or ophthalmic nerve blocks
  - 1.5% glycine irrigation during TURP as well as transurethral bladder procedures and hysteroscopic procedures in women

Worry About

- Pressure on the globe or contact with eye by foreign objects or solutions
- Positioning of pt, especially prone
- Low blood-flow states: Systemic hypotension, anemia, and venous drainage impairment of the head and neck
- Operations in physical proximity to the eyes
- During ophthalmic surgery:
  - Movement of pt under either MAC or GA during intraocular surgery
  - Trauma to optic nerve, retinal artery, or vein during orbital or sinus surgery
  - Coughing or substantial Valsalva maneuvers by pt following intraocular surgery
- During ophthalmic nerve block:
  - Perforation of globe
  - Trauma to the optic nerve, retinal artery, and vein

Overview

- Unless associated with glycine irrigating solution, blindness is often an irreversible complication following anesthesia and surgery.
- Blindness is most often associated with injury to the eye, its surrounding structures (eyelid and conjunctive), blood supply, and optic nerve.

Etiology

- Conditions that can result in blindness following anesthesia include: Corneal abrasion, vitreous loss, hemorrhage, movement of pt while operating on or in the eye, chemical injury to the cornea or conjunctiva from cleaning materials on the anesthetic mask, spillage of prep solution into the eye, and direct trauma to the eye due to OR table padding, needle used in retrobulbar block, anesthetic mask pressure on the globe, or foreign body falling into the eye. Additionally, prone position, hypoxemia following cardiac arrest, prolonged hypotension, CRAO, increased intraocular pressure, and embolization, occlusion, thrombosis, or spasm of the retinal artery.
- Blindness may occur following absorption of glycine irrigating solution during TURP (glycine distribution similar to that of γ-aminobutyric acid, an inhibitory neurotransmitter; levels of glycine >143 mg/L associated with transient blindness).

Usual Treatment

- In the case of glycine, supportive treatment is indicated until plasma glycine levels <143 mg/L.
- ION: There is no effective treatment and most lost vision is not recovered.
- CRAO: Immediate lowering of intraocular pressure with acetazolamide and topical medications; hyperbaric O_2 therapy may be beneficial if begun within 2–12 h of symptom onset.
- Consider stated spine procedures on high-risk pts.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
GENERAL	Retinal artery occlusion	Migraines, coagulopathies, hemoglobinopathies, and oral contraceptives increase IOP	Pale ischemic retina with pathognomonic cherry-red spot and afferent papillary defect	
HEENT	Ischemic retinopathy	Hypotension Hypoxemia Shock	Funduscopic: Normal retina but optic nerve head is swollen and ischemic. Eventual optic nerve pallor	
	Orbital pressure		Funduscopic: Edematous retina with dilated arterioles and engorged veins	
GU	Transient blindness during or after TURP	TURP with glycine irrigating solution	Normal papillary response to light and accommodation; Fundus normal	Plasma glycine level (nml 13–17 mg/L)

Key References: Lee LA, Roth S, Posner KL, et al.: The American Society of Anesthesiologists Postoperative Visual Loss Registry: analysis of 93 spine surgery cases with postoperative visual loss. *Anesthesiology* 105:652–659, 2006; Shen Y, Drum M, Roth S: The prevalence of perioperative visual loss in the United States: a 10-year study from 1996 to 2005 of spinal, orthopedic, cardiac and general surgery. *Anesth Analg* 109:1534, 2009.

Perioperative Implications

Preinduction/Induction/Maintenance

- Proper positioning essential.
- If pt is prone, adequate padding so no pressure is transmitted to either globe or nasal bridge.
- When the face is completely draped, consider use of a metallic Fox shield to protect eye from inadvertent pressure.

Monitoring

- Eye checks frequently during the procedure to ensure no pressure on the globe
- Ensure adequate venous drainage without increased venous pressure or increased intracranial pressure, particularly when venous outflow may be compromised by position or procedure.

General Anesthesia

- Anesthetic masks may injure eye, either through inadequate drying and application of cleaning solution to eye or through direct pressure.
- Hypotension and hypoxemia implicated in cases of CRAO.
- Hypotension, anemia, and prolonged procedures are implicated in ION.

Regional Anesthesia

- In ophthalmic nerve blocks, needle does not enter globe or retinal artery, vein, or nerve. Avoid excessive volume of local anesthetic, which increases IOP and may compromise vascular supply of the globe.

Postoperative Period

- When pt is recovering in the prone position, ensure there is no pressure on orbit or globe.

Anticipated Problems/Concerns

- Absorption of glycine from 1.5% glycine irrigation fluid may be significant.
- ION usually occurs without any other evidence of vascular injury.
- Optic nerve may be very vulnerable to hemodynamic changes in the prone position.

Botulism

Debra E. Morrison

Risk

- Infant botulism.
- Wound botulism.
- Foodborne botulism.
- Adult intestinal toxemia.
- Injection botulism.
- Biological warfare/inhalational botulism (Category A biological threat).
- Incidence
  - In USA, approximately 145 cases are reported each year: infant botulism 65%, wound 20%, and foodborne 15%; adult intestinal colonization and iatrogenic botulism rare.
  - Foodborne outbreaks of two or more persons occur most years, and are usually caused by home-preserved foods with low-acid content (pH ≥4.6, although toxin will not be formed in acidic foods, low pH will not degrade any preformed toxin). Foods implicated differ between countries, reflecting local eating habits and food preservation procedures. Improper handling of commercially prepared foods has also been implicated (canned, fermented, salted, and smoked), including unrefrigerated infused cooking oils, baked potatoes wrapped in foil and left sitting out before eating, and ready-to-eat foods in low-oxygen packaging. Low temperature, high salt, and low pH prevent growth of bacteria and toxin formation. Food samples associated with suspect cases should be sealed, stored, and sent to labs.

Perioperative Risks

- Dx late, incorrect or missed
  - Differential Dx: For adults, myasthenia gravis, Eaton-Lambert, Guillain-Barre, virus attacking brain/spinal cord, CVA, organophosphate exposure, tick paralysis, other neurotoxin; may need brain scan, spinal fluid examination, and EMG, tensilon test to rule out other causes; for infants, sepsis, failure to thrive, dehydration, encephalitis, and metabolic disease
  - Nonspecific history and physical findings: classic adult symptoms include double vision, drooping eyelids, slurred speech, difficulty swallowing, dry mouth, muscle weakness; infants appear lethargic, feed poorly, are constipated, and have a weak cry and poor muscle tone—if untreated, symptoms may progress to cause paralysis of the respiratory muscles, arms, legs and trunk; fever and loss of consciousness are not associated symptoms
  - Onset of foodborne botulism: usually 12-18-36 h after eating contaminated food, but can be as early as 4 to 6 h or as late as 8 to 10 d
  - Laboratory result takes d to wk and should be used only as confirmation; treat before confirmation; tests are performed at some state health department labs and at CDC
  - Triad: Bulbar symptoms, resp compromise, and dilated pupils
- Prolonged weakness requiring prolonged support
- Enteral nutrition: Desired but problematic due to gastroparesis and bowel paralysis
- Aspiration risk
- Elevated potassium if immobile in ICU

Worry About

- Arrhythmias
- Hyperkalemia, arrhythmias, and then cardiac arrest
- Prolonged weakness necessitating prolonged intubation and leading to nosocomial infection
- Skin breakdown