Extubation
- Ensure CNS status permits natural airway maintenance and protection.

Adjuvants
- Consider treatment for concomitant cyanide poisoning.

Postoperative Period
- Maintain 100% O_2.
- Consider hyperbaric O_2.

Anticipated Problems/Concerns
- Heart and brain affected most.
- Follow CNS function carefully.
- Seek concomitant smoke inhalation injury and cyanide toxicity.
- CO toxic in trace quantities (breathing 0.1% inspired CO for 1 h results in significant toxicity, with COHb ~30%); CO not detectable with conventional gas analysis instruments (e.g., capnographs, mass spectrometers).
- Standard pulse oximeters do not specifically measure COHb, and SpO_2 measurements are only minimally affected, even by severe CO poisoning.

Carcinoid Syndrome

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Risk
- Carcinoid is the most common GI endocrine tumor.
- 15 cases in 1 million population per y.
- Seen in fewer than 20% of pts with carcinoid.

Diagnosis
- Urinalysis for 5-HIAA and serotonin levels
- Platelet serotonin levels
- Serum chromogranin A
- CT scan and MRI
- Octreoscan and MIBG

Perioperative Risks
- Associated with pt's ability to tolerate abrupt hemodynamic change and/or bronchospasm

Worry About
- Abrupt Htn or hypotension with stress
- Right-sided valvular heart disease

Overview
- Endocrinologically active tumor from GI mucosa
- May release histamine-like substances, leading to hypotension and bronchospasm, or may release serotonin, leading to hypertensive reactions (and hypovolemia)
- Commonly found in ileum or rectum; less so in pancreas and lung
- Systemically active when metastatic to liver, or when released substances avoid metabolism by liver (carcinoid syndrome)
- Left-sided cardiac disease in 10% of pts if there is a pulmonary carcinoid

Etiology
- Acquired disease.
- Electrolyte disturbances (due to intestinal secretion of sodium, potassium, and water)
- Bronchospasm
- May be associated with other ectopic humoral tumors, such as MEN 1 syndrome.

Usual Treatment
- Surgery or arterial embolization to reduce tumor burden.
- Histaminic effects blocked only partially by H_1 and H_2 blockers, mainly H_2.
- Somatostatin analogues octreotide and lanreotide block humoral release.
- Interferon α (alpha) and cytotoxic agents may control symptoms.
- Surgical treatment can play a role in metastasis to the liver.
- No specific medical Rx for established valvular heart lesions.
- Catecholamines may increase humoral release and worsen symptoms.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Cutaneous flushing, lacrimation Pellagra-like skin lesions	Episodic flushing induced by stress, eating, alcohol consumption	Hyperkeratosis, hyperpigmentation	
CV	Histamine-induced hypotension Serotonin-induced Htn Endomyocardial fibrosis, especially in right heart	Sx of right-sided CHF	Murmurs of pulmonic stenosis, tricuspid regurgitation, ascites, edema	ECHO Cardiac cath
RESP	Bronchospasm Endobronchial tumor with obstruction	Episodic asthma poorly responsive to medication Focal wheeze at site of obstructing tumor	Wheezing associated with episodes of flushing	
GI	Diarrhea Obstructing tumor	Episodic watery diarrhea		Bowel films, hepatic CT, ultrasound, angiograms
ENDO	Serotonin secretion			Urinary 5-HIAA levels elevated in most pts Occasionally need to measure plasma histamine
RENAL	Dehydration from chronic vasospasm or diarrhea			BUN/Cr, lytes
CNS	Hemodynamic instability, vasodilation	Hypertensive headache Syncope with flushing		
MS	Cutaneous flushing, lacrimation Pellagra-like skin lesions	Episodic flushing, induced by stress, eating, alcohol consumption	Hyperkeratosis, hyperpigmentation	

Key References: Mancuso K, Kaye AD, Boudreaux JP, et al.: Carcinoid syndrome and perioperative anesthetic considerations, *J Clin Anesth* 23(4):329–341, 2011; Poell B, Al Mukhtar A, Mills GH: Carcinoid: the disease and its implications for anesthesia, *Contin Educ Anaesth Crit Pain* 11(1):9–13, 2011.

Perioperative Implications

Preoperative Preparation
- Assess adequacy of electrolyte and fluid balance.
- Assess right-sided valvular status.
- Somatostatin analogue (octreotide) available; its use has dramatically decreased hazards of anesthesia for pts with carcinoid syndrome.

Monitoring
- Expect rapid fluctuation of BP.
- Central venous pressures may not correlate well with fluid volumes.

Airway
- Risk of stress-induced wheezing (Rx: somatostatin analogue)

Induction
- Chronic vasoconstriction and diarrhea may cause hemodynamic instability.

Maintenance
- Volume assessments complicated by changing vascular tone
- Cardiac function limited by right-sided valvular lesions

Extubation
- Possible stress-induced hemodynamic instability (Rx: Somatostatin analogue)

Adjuvants
- Caution: Catecholamines may increase humoral release and worsen symptoms.
- Somatostatin analogue for hypotension or hypertension or bronchospasm has dramatically decreased anesthesia risk for pts with carcinoid syndrome.

Postoperative Period
- Humoral effects of hemodynamically active metastatic carcinoid usually not eliminated by surgery