

Induction

- A smooth induction with the use of anxiolytics should be implemented in pts who may hyperventilate secondary to stress. A deep plane of anesthesia must be balanced with the effects of agents such as propofol, which can cause hypotension and compensatory tachycardia.
- Aim to obtund the effects of laryngoscopy by using a supraglottic airway device such as a laryngeal mask airway where appropriate.
- Adequate preloading should be considered to avoid the use of sympathomimetics for BP, and sympathomimetics should be used cautiously.

Maintenance

- The volatile agent halothane can precipitate conduction via APs and should be avoided.
- Avoid agents that can precipitate tachycardia, such as ketamine and pancuronium.

Extubation

- Avoid neostigmine, which induces vagal tone, causing slowing of the AV node and preference for conduction down AP. Avoid atropine and glycopyrrolate, which can induce tachycardia.

Adjuvants

- For control of postop N/V, avoid metoclopramide and cyclizine, which can induce tachycardia.

Postoperative Period

- Adequate pain control is essential and use of regional anesthesia may be beneficial.

Anticipated Problems/Concerns

- SVT or VF in those known to have preexcitation with or without symptoms throughout the periop period.
- Vigilance is required in interpreting the ECG of a tachyarrhythmia to avoid incorrect drug selection.

Ventricular Septal Defect (Congenital)

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Risk

- Incidence: About 2–6:1000 live births.
- May be isolated or part of several complex malformations such as TOF.

Perioperative Risks

- Mortality higher in older children; elevated PVR (>7 Wood units); surgery may be complicated by complete heart block.

Worry About

- Worsening of L-to-R shunt with hyperventilation and increased FIO₂

- Paradoxical embolization
- Hypothermia
- Post-CPB pulm Htn and RV failure

Overview

- Small defects asymptomatic, present with murmur, and usually close spontaneously.
- Larger unobstructed defects result in CHF symptoms, poor weight gain, and URIs beginning at 3–12 wk of age, as decreases in PVR cause increase in L-to-R shunting.
- Untreated large L-to-R shunting may result in fixed pulm Htn (Eisenmenger syndrome) in some pts.

Indications/Usual Treatment

- Some 75% of small defects close spontaneously. Small, unrepaired defects do not require antibiotic prophylaxis.
- Medical therapy for symptoms of CHF includes digoxin, ACE inhibitors, and furosemide.
- Surgery is indicated when CHF not amenable to medical treatment or if there is FTT.
- Surgical repair contraindicated if PVR >10 Woods units unless reactive to selective pulm vasodilators.
- Transcatheter closure is often used for muscular defects, which can be difficult to access surgically.

Assessment Points

| System | Effect | Assessment by Hx | PE | Test |
|--------|--|--------------------------------|---|----------------------------------|
| CV | Low forward cardiac output due to L-to-R shunt Pulm Htn due to excessive flow | CHF symptoms, FTT Age of pt | Loud holosystolic murmur and thrill Cyanosis | Auscultation, ECHO, cardiac cath |
| RESP | Congestion/edema due to L-to-R shunt | Frequent URIs | Rhonchi | CXR |
| HEME | Anemia in massive L-to-R shunt; polycythemia in R-to-L shunt | Pallor or cyanosis | Paleness or plethora | Hct |
| MS | Chronic hypoxemia due to late reversal of shunt flow (Eisenmenger syndrome) | Cyanosis | Clubbing of digits | Pulse oximetry |

Key References: Penny DJ, Vick GW 3rd: Ventricular septal defect, *Lancet* 377(9771):1103–1112, 2011; Scully BB, Morales DL, Zafar F, et al.: Current expectations for surgical repair of isolated ventricular septal defects, *Ann Thorac Surg* 89:544–549, discussion 550–551, 2010.

Perioperative Implications**Preoperative Preparation**

- Digoxin and furosemide until day of surgery; ACE inhibitors controversial, but vasoplegic syndrome following CPB less common in pediatric pts.
- May not be possible to delay operation until pt is free of upper resp symptoms.

Anesthesia

- Limit FIO₂ to minimum necessary prior to CPB to restrict excessive pulm blood flow.
- Maintain normal to slightly high PaCO₂ to restrict excessive pulm blood flow.
- Pts typically receive inhalational anesthesia for induction; if peripheral IV in place, IV drugs can be administered alternatively.
- Avoid N₂O to prevent sequelae of paradoxical air embolization.

Monitoring

- Indwelling arterial catheter for invasive monitoring in all pts.
- Central venous access and pressure monitoring in most pts undergoing surgery with CPB.
- Standard ASA monitoring, including pulse oximetry, ECG, capnometry, multiple-site temp monitoring.
- TEE

Induction/Maintenance

- Mask induction with sevoflurane in most cases; IV drugs if peripheral IV in situ; IM induction possible for uncooperative pts.
- High-dose opioid anesthesia technique rarely used.

Surgical Stages

- Pre-CPB:
 - Low FIO₂, normal to high Paco₂.
 - Avoid hemodilution with large amounts of crystalloid and/or colloid prior to CPB.
- CPB:
 - After pt's Hct has been obtained in the OR, dilutional Hct including CPB prime is calculated. If calculated Hct is less than 25%, consider priming of CPB with whole blood or reconstituted whole blood (PRBC and FFP).
 - Inhalational anesthetic administration via CPB or continuous IV drug administration is recommended to allow for fast-tracking in most pts presenting for VSD repair.
- Post-CPB:
 - Rule out residual shunting by TEE.
 - Maintain Hct >25% to 30%.

Postoperative Period

- Most pts presenting for VSD repair can be extubated at end of surgery.
- Consider mechanical ventilation and sedation in the immediate postop period in pts prone to pulm hypertensive crises (e.g., Down syndrome).
- Infective endocarditis prophylaxis for 6 mo; if residual defect is present, should be continued indefinitely.

Anticipated Problems/Concerns

- Imbalance in pulm to systemic blood flow ratio:
 - Excessive pulm blood flow results in high arterial saturation but with diminished tissue perfusion and metabolic acidosis.
 - Diminished pulm blood flow results in good tissue perfusion but with cyanosis and potential injury due to hypoxia.
- Postop ventricular dysfunction more likely with ventriculotomy.
- Pulm Htn and/or right heart failure.
- Coagulopathy, particularly in very small children.