



MINIMALLY INVASIVE REPAIR OF PECTUS EXCAVATUM (MIRPE)

Surgical Specialty:	Thoracic Surgery
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Background:

- General Considerations
 - Pectus excavatum is the most common congenital chest wall deformity. It is characterized by the sunken appearance of the sternum, causing concavity of the chest.
 - Pectus excavatum has traditionally been corrected with an open procedure known as the Ravitch repair (There is a separate case guide on this topic).
 - Repair has now shifted to the minimally invasive approach known as the Nuss Procedure, or Minimally Invasive Repair of Pectus Excavatum.
 - It involves a thoroscopically assisted placement of transverse retrosternal bar(s) to support and lift the sternum.¹
- Patient Considerations
 - Most cases are idiopathic, although it can also be associated with connective tissue disorders, such as Marfan's Syndrome.¹
 - The clinical presentation depends on the severity of the defect.
 - If a minimal defect is present, children may be asymptomatic. Patients may request operation for cosmetic satisfaction.
 - Symptoms are mainly related to the compression of the thoracic cavity, with common symptoms including exercise intolerance, shortness of breath, palpitations, and chronic chest pain.^{2,3}
 - Potential cardiac comorbidities include mitral valve prolapse secondary to compression of the mitral valve annulus, right ventricular compression or outlet tract obstruction, and aortic root dilation.²
 - Patients may have restrictive lung disease due to external compression of the thorax.³

Anesthetic Planning:

- Pre-Anesthetic Evaluation
 - It is important to review any available imaging to assess the severity of the defect and its impact on the cardiac and pulmonary systems.
 - Patients often have an echocardiogram prior to surgical intervention to evaluate for other common sequelae of pectus excavatum (see above).
 - Patients may also have PFTs performed prior to intervention.
 - This may demonstrate a restrictive pattern with a reduced total lung capacity (TLC) and forced vital capacity (FVC) but increased forced expiratory volume (FEV₁).³
- Specific or Unique Room Set-Up Requirements
 - Airway
 - Lung isolation may be required to allow for optimal visibility if cryoablation is being performed.
 - Single lung ventilation can be achieved using either a double-lumen tube (DLT) or a bronchial blocker (such as an EZ-Blocker™).
 - Placement of DLT can be difficult in younger and smaller patients, so a bronchial blocker may be favorable in these cases. Placement should be confirmed with a fiberoptic scope.⁴
 - Drugs/Infusions
 - Premedication may be considered to reduce preoperative anxiety and initiate early multimodal analgesia (e.g., oral midazolam, gabapentinoids, and/or acetaminophen).⁵
 - Monitors
 - Standard American Society of Anesthesiologists monitors are utilized for cases.
 - If the patient has significant cardiopulmonary compromise, invasive blood pressure monitoring with an arterial line should be considered.
 - Transesophageal echocardiography may be a useful tool intraoperatively if the patient is known to have significant cardiac compression to allow for close volume assessment and cardiac function during the procedure.³
 - Blood Availability (if indicated)
 - Blood loss is generally minimal in these cases.
 - PICU Bed Availability (if indicated)
 - ICU admission is not routinely required.

Intraoperative Considerations:

- Induction
 - Standard induction can be performed using either inhalational or intravenous agents.
- Positioning
 - The patient is supine with arms abducted at 70° and externally rotated at the shoulder.
 - All pressure points should be padded, and wrists and elbows should be maintained in a neutral position.
- Maintenance
 - Cases are performed under general anesthesia with an inhalational agent or total intravenous anesthesia.
 - Nitrous oxide is contraindicated due to the risk of expanding pneumothoraces that could be created as a result of the surgical technique.³

- Muscle relaxation is indicated to provide optimal operating conditions and prevent the patient from moving or coughing during bar placement and manipulation.
- Hemodynamic/Physiologic goals
 - Large bore IV access should be established, given the proximity of surgery to vital structures and theoretical risk of hemorrhage.
- Surgical Considerations
 - Two small incisions are created on either side of the chest through which the camera, surgical tools, and bars pass.
 - Minimal blood loss is expected.
- Emergence/Disposition
 - Consider deep extubation to limit coughing during emergence.³
 - Patients will be admitted to the hospital for further management post-op with a focus on postoperative pain control.
- Post-op Care
 - Imaging
 - Postoperative chest radiograph may be obtained to evaluate pneumothorax and confirm bar position.
 - In most cases, routine imaging may be reserved for patients with new concerning symptoms.⁶
 - PONV
 - PONV should be treated early using common antiemetics, such as ondansetron, dexamethasone, and a scopolamine patch.³
 - Pain
 - Cryoablation is a popular choice for pain control following surgery.
 - It has led to shorter hospital stays, decreased opioid requirements, and faster ambulation postoperatively.^{1,3}
 - It is performed at the start of the surgery prior to bar placement, and full relief may take 24 hours.³
 - Patients may be on an opioid infusion such as a PCA while awaiting the full analgesic effect of ablation.⁵
 - Different regional techniques have been considered to cover pain following repair, especially in cases where cryoablation may not be available.
 - Previously, thoracic epidurals were the standard for pain control and may still be favored at some centers.^{1,3}
 - The most common nerve blocks include the erector spinae plane block, the paravertebral block, and the serratus anterior block.²
 - Multimodal analgesia strategies are used as well.
 - Medication classes include non-steroidal anti-inflammatory drugs, opioids, gabapentinoids, steroids, N-methyl D-aspartate antagonists, and alpha-2 agonists.⁵

Case-Specific Complications/Pitfalls

- Bars typically stay in place for 2-4 years before removal. Removal too soon can lead to the recurrence of pectus deformity, while delaying removal may lead to challenging bar extraction due to bar ossification.
- Given that the bars remain in place for an extended period of time, it is important to consider metal allergy, bar displacement, and infection as potential complications.
- Since the procedure is performed in the thoracic cavity, damage to the pleura, pericardium, and other intrathoracic structures is possible.²

References

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