CASE WESTERN RESERVE UNIVERSITY
School of Medicine
Master of Science in Anesthesia

Anesthetic Management of Hypertrophic Obstructive Cardiomyopathy (HOCM)

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Background

- Hypertrophic Cardiomyopathy (HCM) is inherited by autosomal dominant genetics with variable penetrance. The prevalence of HCM is estimated to be 1 in 200-500 with systolic anterior motion (SAM) of the mitral valve present in 60-70% of individuals (Guigui, 2022).
- Hypertrophic Obstructive Cardiomyopathy (HOCM) is a variant that includes hallmark characteristics of:
    1. Left ventricular outflow tract obstruction (LVOTO)
    2. Myocardial ischemia
    3. Diastolic dysfunction
    4. Mitral regurgitation that can include systolic anterior motion of the anterior mitral valve leaflet (SAM)
- Recent data collected by echocardiography and cardiac magnetic resonance (CMR) have identified that drag forces caused by late diastolic mitral inflow create a posterior vortex pushing MV leaflets anteriorly before the onset of systole. Formerly it was believed than the presence of a "Venturi effect" caused by narrowing of the LVOT was responsible for SAM. The severity of SAM is highly correlated with the degree of LVOTO (Guigui, 2022).
- Myocardial ischemia is caused by abnormal coronary arteries, increased ventricular mass to coronary artery size, increased LVEDP, decreased diastolic filling time, increased oxygen consumption and metabolic derangement in oxygen use (Hines, 2022, pg 222-224).
- A surgical myectomy (Morrow procedure) is the gold standard for treatment of symptomatic HOCM. Alcohol septal ablation can be performed for patients that are too unstable for invasive surgical intervention. (Cui, et. al., 2020)
- Increased risk of arrhythmias resulting in cardiac death, preventative ICD placement can be indicated (Gropper, 2020, pg 1798-1799).

Resources

Cui, H., Schaff, H. V., Abel, M. D., Helder, M. R. K., Frye, R. L., Ommen, S. R., & Nishimura, R. A. (2020). Left ventricular ejection hemodynamics before and after relief of outflow tract obstruction in patients with hypertrophic obstructive cardiomyopathy and valvular aortic stenosis. *The Journal of Thoracic and Cardiovascular Surgery*

Gropper, M. A., & Miller, R. D. (2020). Anesthesia Management. In *Miller's Anesthesia* (pp. 942, 1798-1799). Elsevier.

Guigui, S. A., Torres, C., Escolar, E., & Mihos, C. G. (2022). Systolic anterior motion of the mitral valve in hypertrophic cardiomyopathy: A narrative review. *Journal of Thoracic Disease*, *14*(6)

Hines, R. L., Jones, S. B., & Stoelting, R. K. (2022). Heart failure and Cardiomyopathies. In *Stoelting's anesthesia and co-existing disease* (p. 222-224. Elsevier. *Hypertrophic cardiomyopathy (HCM)*

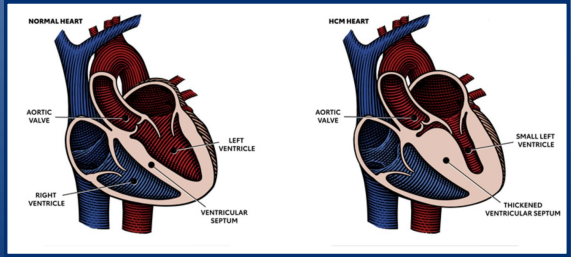
Moreno Garijo, J., Ibáñez, C., Perdomo, J. M., Abel, M. D., & Meineri, M. (2022). Pre Intervention imaging and intraoperative management care of the hypertrophic obstructive cardiomyopathy patient. *Asian cardiovascular & thoracic annals*

Shi, Y., Zuo, C., Zhang, Y., Zhou, C., Zhang, F., & Zhao, X. (2024). Remimazolam-based anesthesia in a patient with hypertrophic obstructive cardiomyopathy undergoing radical colorectal cancer surgery: A case report. *Medicine*, *103*(9), e37199

Case Report

- 73 year-old Female (59kg, NKDA) presented for a CABG x1. Past medical history was significant for HTN, mild AR, TR, paroxysmal atrial fibrillation with LBBB, GERD, T2DM, and hypertrophic cardiomyopathy. Prior to induction, a radial arterial line was placed. The patient was induced with 250 mcg of fentanyl, 80 mg of lidocaine, 20 mg of etomidate and 100 mg of rocuronium. The patient was intubated via direct laryngoscopy with a grade 1 view, 8.0 ETT. Following successful induction and intubation, the patient was noted to have significant hypotension which was treated with a 50 mcg phenylephrine bolus. The patient response to phenylephrine was exaggerated and noted by the anesthesia team. A central venous line with a PAC was placed with no complications. A TEE probe was placed for a perioperative TEE examination.

- On examination, there was septal hypertrophy and HOCM physiology with SAM and moderate to severe MR. Pressure gradients and severity of HOCM and SAM were highly dependent on preload, HR, and afterload. These findings were more severe than the outpatient preoperative TEE. The cardiac surgeon was notified and a cardiology consultation was requested. It was determined that adding a septal myectomy would be the most appropriate intervention following identification and further understanding of the severity of LVOTO and SAM. The CABG was performed as planned as well as the septal myectomy. The postoperative TEE showed significant improvement of SAM and MR with a mean LVOT gradient of 7 mmHg. The patient developed third degree heart block following the septal myectomy and had a BiV pacemaker placed a few days postoperatively. Her remaining postoperative course was uneventful.



Research and Best Practices

- According to Moreno et. al., induction of anesthesia and initiation of PPV can significantly change LVOT flow gradients. Intraoperative TEE is the standard of care for assessing fluid status and guiding fluid administration.

- Sinus rhythm should be maintained with a slow heart rate ideally between 60-65 bpm by use of β-blockers (Moreno, et al., 2022).

- Preload and afterload should be maintained to decrease outflow tract pressure gradients decreasing LVOTO. Preload is maintained through maintenance of intravascular volume through fluid administration and avoidance of prolonged fasting time. Maintenance of afterload achieved with Phenylephrine or Vasopressin (Moreno, et al., 2022).

- Contractility should be decreased with avoidance of inotropic agents as the hypertrophied ventricle has reduced compliance and increased contractility can worsen the LVOTO (Moreno, et al., 2022).

- Agents like Dexmedetomidine, Propofol, Ketamine, and Etomidate can be used in combination for a safe and effective induction. Remimazolam has also been shown to create a hemodynamically stable anesthetic in HOCM patients (Shi et. al., 2024).

Case Discussion

- When the extent of HOCM was identified and the degree of the obstruction was fully understood, we modified our anesthetic management following best practices:
    1. Switched from norepinephrine to phenylephrine to optimize afterload and decrease LVOTO.
    2. Arranged intraoperative consultation of TEE with cardiologist, cardiac surgeon and cardiac anesthesiologist to determine the most appropriate management and surgical intervention for the patient.
    3. Used intraoperative TEE to guide fluid management and fluid resuscitation to maintain preload.

- Management of this patient could have been improved by decreasing preoperative fasting time to reduce dehydration. Smaller tidal volumes with higher respiratory rate and minimal use of PEEP could have been used to minimize decrease in preload caused by positive pressure ventilation.