Indian Journal of Clinical Anaesthesia 2022;9(4):518–522

Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Clinical Anaesthesia

Journal homepage: www.ijca.in

Case Report

Anaesthethetic management of craniotomy for recurrent astrocytoma in case of large atrial septal defect with severe pulmonary hypertension: A case report

Deepak Chandrakant Koli[1,*], **Poonam Gupta**[1], **Sandip Katkade**[1], **Ankit Gupta**[1], **Hemant H Mehta**[1]

[1] *Dept. of Anaesthesia and Pain Management, Sir H. N. Reliance Foundation Hospital and Research Centre, Mumbai, Maharashtra, India*

ARTICLE INFO

Article history:
Received 15-06-2022
Accepted 17-08-2022
Available online 15-11-2022

Keywords:
Atrial septal defect
Severe pulmonary artery hypertension
Craniotomy
recurrent astrocytoma
Echocardiography

ABSTRACT

Introduction: In adult population after bicuspid aortic valve, atrial septal defect (ASD) is the most common congenital acyanotic heart disease, with high prevalence in females. Large ASD with pulmonary hypertension (PAH) posted for non-cardiac surgery poses a challenge to anaesthesiologists because intraoperative hypercarbia, hypoxemia, and hyperthermia can result in increased pulmonary vascular resistance (PVR), which can result in shunt reversal, congestive heart failure, and fatal arrhythmias.

Case Presentation: We report successful anaesthetic management of 48yrs female case of recurrent astrocytoma posted for craniotomy. Patient was having large ostium secundum ASD (35 mm in diameter), with severe PAH having PASP 75mmhg by TR jet, with dilated RA/RV, moderate TR and LVEF 55% under GA, with titrated induction, avoiding rise in PVR and maintaining systemic vascular resistance (SVR) with vasopressors intraoperatively to avoid shunt reversal.

Conclusion: To conclude patients with severe PHT due to large ASD, require meticulous intraoperative management to prevent any rise in PAH, and maintenance of systemic vascular resistance with optimal oxygen delivery and excellent postoperative analgesia for excellent outcome.

1. Introduction

The most common acyanotic congenital heart disease is atrial septal defect (ASD) which accounts for 10% of congenital heart disease in adults with more occurrence in females compared to males. Most of the patients are asymptomatic as late as middle age. ASDs are mainly classified in to three types which are ostium primum, secundum and sinus venosus of these three the most common type seen is ostium secundum having high prevalence of 70% with more commonly seen in females (male: female ratio 1:2).[1]

In case of large ASD with left to right shunt, there is more flow of blood from left side to right side of heart through the shunt, which leads to volume overload in right ventricle. This volume overload can then gradually progresses to right ventricular hypertrophy and development of pulmonary hypertension (PAH), dilation of right atrium and ventricle, atrial fibrillation and finally can lead to shunt reversal that is known as Eisenmenger's syndrome. The main goal for anaesthesia management in ASD patients posted for non-cardiac surgery is to avoid rise in PVR and maintain the SVR to avoid shunt reversal.

Individualised pre-assessment is the current standard of care before elective surgery, and there are specific guidelines for the peri-operative assessment and management of patients with acquired heart disease.[2–5] These guidelines are

* *Corresponding author*.
E-mail address: deepak.c.koli@rfhospital.org (D. C. Koli).

https://doi.org/10.18231/j.ijca.2022.104

insufficient for effective risk assessment and management of patients with pulmonary arterial hypertension and congenital heart disease.

Exercise capacity objective measures are well-established risk stratification tools in patients with acquired heart disease. A lower exercise capacity of less than four metabolic equivalents (METS), equivalent to being unable to climb two flights of stairs, is associated with a higher incidence of post-operative cardiac events.[6] Subjective measures of exercise tolerance, such as the New York Heart Association (NYHA) functional classification, can be misleading and difficult to interpret in PAH-CHD patients who tend to downplay their symptoms, making the NYHA functional class a poor surrogate of exercise capacity in this population.[7]

Individuals with PAH-CHD face additional disease-specific risks that require careful, targeted management, depending on the cause of the pulmonary hypertension, the extent of cyanosis, and the presence of systemic ventricular dysfunction or severe obstructive valvular lesions. As a result, while it is widely acknowledged that general anaesthesia and sedation pose significant risks in all PAH –CHD patients, stratifying patients within this group into higher- and lower-risk subjects is difficult. As a result, accurate pre-operative risk assessment in PAH —CHD should take into account the procedure's inherent risk, traditional cardiac risk factors, as well as CHD-specific risks.[8]

We report successful anaesthetic management of patient having large ASD with severe PAH posted for craniotomy for recurrent astrocytoma.

2. Case Report

A 48 yrs. female (height 156cm/weight 67kg) operated case of left fronto- temporal astrocytoma presented with slow slurred speech and personality changes on recent MRI brain, recurrent tumour seen in left fronto-temporal region posted now for craniotomy and excision of tumour. The patients' medical history was significant with large congenital atrial septal defect (ASD) and severe pulmonary hypertension. K/C/O ASD since 1999, but asymptomatic and not on any treatment.

Patient has detailed preoperative assessment done, and a cardiology referral, suggested that the patient was moderate to high risk from a cardiac standpoint. As a result, the cardiologist advised postoperative ICU care, the patient and relatives informed about same, and a high-risk consent taken.

Physical examination was normal. On room air, saturation was 98%, Blood investigations revealed haemoglobin 11.4 gm/dl and platelets count 154,000, while the rest of the blood tests were normal. Chest radiography revealed marked cardiomegaly, pulmonary vascular engorgement and homogenous opacity in left hilar region. ECG shown right axis deviation and right bundle branch block. Transthoracic echocardiography (2D-ECHO) showed a large osteum secundum ASD (35 mm in diameter) with a left to right shunt, dilated main pulmonary artery, severe pulmonary hypertension (PAH) with an estimated pulmonary artery systolic pressure (PASP) by TR jet 75mmhg, with dilated right atrium and right ventricle, mild mitral regurgitation (MR) and moderate tricuspid regurgitation (TR), good left ventricle systolic function with of LVEF 55%.

We had a 48-year-old female with a large ASD, primarily L to R shunt, RVH, severe PAH, cardiomegaly, pulmonary plethora, and a room air Spo2 of 98 percent, indicating that the patient had not progressed to the stage of Eisenmengers disease. For such individuals, the goals are to 1) Maintain PVR rather avoid decrease in PVR (which can lead to increase L to R shunt). 2) Avoid further rise in PVR (by maintaining PCO2 around 40, using minimum FIO2 35 to 45 percent, avoiding hypothermia, acidosis and provide good analgesia and maintain depth of anaesthesia), 3) Reducing SVR will lower L to R shunt but at the same time with RVH and severe PAH (PASP 75mmhg); we wanted to maintain RV perfusion pressure and avoid leftward shift of interventricular septum, so our plan was to maintain low normal SVR and MAP around 70 to 80mmhg with use of small dose of vasopressors.

Ideally, such patients should have cardiac catheterization to determine exact hemodynamic variables, but with improved understanding of 2D ECHO and Doppler technology, cardiac catheterization is nowadays only used in select cases. We had already sought cardiology advice for this case, and cardiac catheterization was not recommended for our patient.

On the day of surgery, the patient transferred to the operating room (OT), and all ASA monitors attached. In the OT, on room air, the patients' blood pressure was 130/84mmHg (MAP 99mmHg), heart rate was 90-100 beats per minute, and SpO2 was 98 percent. Patient sedated with inj midazolam 1mg and inj fentanyl 25mcg. Under local anaesthesia right radial artery was canulated. patient was then preoxygenated for 5 minutes and induced with titrated doses of inj propofol total 100mg given slowly, inj fentanyl 25mcg given, after confirming bag and mask ventilation 50mg atracurium given, inj phenylephrine (Frenin) 50mcg/ml 4 boluses were given to keep the MAP between 70 and 80mmHg, and the patient was intubated with a no. 7 ETT fixed at the 20cm mark at the angle of the lip, The pressure controlled ventilation with volume guaranteed (PCV-VG) mode of ventilation was used following intubation. Central line catheterization of the right internal jugular vein under USG guidance with 7FR triple lumen done to monitor the patient's intravascular volume status and ventricular function.

Hypotension was treated intraoperatively with phenylephrine (50mcg/ml boluses), ephedrine (3mg/ml boluses), and titrated norepinephrine (0.02-0.3mcg/kg/min) infusion. Intraoperatively, patients' body temperature recorded with an oesophageal temperature probe and ranged from 36-37.2 degrees Celsius, maintained using forced air warmers and warm IV fluids. The peak inspiratory pressure was 15–18 mmHg during the intraoperative period. Hypoxia, hypercarbia, and hypothermia avoided during surgery by using proper perioperative planning and vigilant monitoring.

The surgery lasted 180 minutes. The total intraoperative fluid administered to the patient was 2000 ml, the measured blood loss was 700 ml, and the urine output was 800 ml. ABG was performed on FIO2-55 percent after surgical closure (PH-7.36,PCO2-39.7,PO2-190,HCO3-22.6,SO2-100%, NA/K-138/4.2,Hb-10.5,HGT-122). At the end of surgery, the norepinephrine infusion gradually tapered and stopped when the patient's vital signs stabilised. After adequate neuromuscular reversal, the patient was extubated on the table and transferred to the intensive care unit for post-operative observation. Transient right-side weakness and aphasia observed in the immediate post-operative period, but it improved with physiotherapy and speech therapy. On day 3, the patient transferred to the wards, and discharged on day 7 with a neurologically stable condition.

3. Discussion

In India, the incidence of central nervous system (CNS) tumours is from 5 to 10 per 100,000 people and is on the rise. CNS tumours make about 2% of all malignancies.[9,10]

One of the most prevalent juvenile gliomas is pilocytic astrocytoma. Adults, on the other hand, experience them far less frequently, with an incidence of 3.4/1 million.[10] In adults, they are equally likely to be supratentorial, whereas in youngsters, they typically occur in the cerebellum.[11]

In comparison to other cancers, the associated morbidity and mortality have a significant impact on the death-adjusted life years' despite being relatively uncommon.

According to several studies, pilocytic astrocytoma patients who are older had poorer overall survival rates, with 5-year survival rates falling from 96.5% in paediatric patients to roughly 53% in adults over 60.[11,12] Additionally, adult pilocytic astrocytomas seem to have higher rates of recurrence and a higher propensity for developing into malignancy. When possible, the aim should be to resect as much tissue as is safe, as studies have shown that the size of resection directly correlates with improved survival.[13,14]

Here we will discuss previously operated case of astrocytoma now posted for craniotomy for recurrence of tumour in left fronto temporal region with congenital large ASD with left to right shunt.

A defect in the interatrial septum in ASD patients causes pulmonary venous return from the left atrium to flow directly to the right atrium. ASD classified based on the location of the defect in relation to the fossa ovalis, the size of the defect, and the volume of the shunt. It can be associated with anomalies that result in a variety of clinical manifestations ranging from asymptomatic cardiac sequelae to right heart failure, pulmonary arterial hypertension, and, in rare cases, atrial arrhythmias.[15] The most common type of ASD is Osteum Secundum, which accounts for 70% of cases with a male-to-female ratio of 1:2. It is located in the mid-septal region and involves the fossa ovalis.[16]

Large ASD, greater than 20 mm, causes significant shunting and can have significant haemodynamic effects in the form of increased pulmonary perfusion and resulting increase in pulmonary vascular resistance, which, if chronic, leads to the development of PAH.[17,18] The choice of investigation is echocardiography to confirm the size and type of ASD, the volume of shunt, and the presence and grade of PAH. PAH is classified into three levels: mild (36-49 mmHg), moderate (50-59 mmHg), and severe (>60 mmHg).[19–21] Long-term PAH has been associated with ventricular hypertrophy, myocardial ischaemia, arrhythmias, and even heart blocks, expected during general anaesthesia, along with air embolism in cases of ASD.[22] Pulmonary Vascular Resistance (PVR) is very high in Eisenmenger syndrome, which is characterised by irreversible pulmonary vascular disease with reversed or bidirectional shunt flow.[18]

In our case, a 48-year-old female with a large Osteum Secondum defect and Severe PAH undergoing craniotomy for recurrent astrocytoma, general anaesthesia is the preferred anaesthetic technique because it leads to better ventilation and maintenance of systemic vascular resistance.[17] Furthermore, mechanical ventilation of the lungs stimulates the release of nitric oxide and prostaglandins, both of which are pulmonary vasodilators.[23] One of the most important precautions to take is to avoid systemic air embolization[18] so the IV lines deaired with caution. The patient induced by giving Inj. Propofol in small increments of 20 mg until she lost consciousness. Lovell AT believes that the rate and dose of the IV-induction agent are more important than the drug itself.[18] Phenylephrine 50mcg boluses used to prevent a drop in SBP during induction, but N2O avoided for anaesthesia maintenance to reduce the risk of paradoxical air embolism. Post-induction Noradrenalin infusions through the central line used in titrated doses to keep the MAP between 70 and 80mmHg.

The primary goal of anaesthetic management in patients with pulmonary hypertension is to keep pulmonary vascular resistance as low as possible while maintaining systemic vascular resistance. Acute right ventricular failure and decreased cardiac output in patients without intracardiac shunting or oxygen desaturation followed by decreased

cardiac output in patients with intracardiac shunting may result from abrupt increases in pulmonary vascular resistance. In both cases, severe bradycardia may occur, followed by cardiac arrest. Pulmonary hypertensive crisis treated by hyperventilation, correcting the acidosis, avoiding further sympathetic nervous system stimulation, maintaining normothermia, minimizing intrathoracic pressure, and by using inotropes and vasopressors drugs. Inhaled nitric oxide may be useful in treating acute increases in pulmonary vascular resistance, and it should most likely be available in the operating room for use in high-risk patients.

As a result, the goal was to maintain normotension, euthermia, adequate pain relief, and anaesthesia depth. To avoid hypercapnia and desaturation, the patient was optimally oxygenated and ventilated. Due to the presence of PAH, intravenous fluid administered with caution. To reduce the sympathetic response associated with these procedures, 2% Lignocaine preservative free (Xylocard) was administered 1mg/kg intravenously prior to intubation and extubation. Following surgery, the patient monitored in the intensive care unit (ICU) and adequate pain relief provided. The rest of the course in ICU was uneventful and patient discharged with stable hemodynamics and without any fresh neurological deficit.

4. Conclusion

Finally, in patients with severe PHT caused by ASD, posted for non-cardiac surgery successful management possible with efficient preoperative preparation, meticulous intraoperative management to prevent any rise in PAH, and maintenance of systemic vascular resistance with optimal oxygen delivery and excellent postoperative analgesia.

5. Conflict of Interest

Nil declared by the authors.

6. Source of Funding

No funding received for this paper.

References

1. Feldt RH, Avasthey P, Yoshimasu F, Kurland LT, Titus JL. Incidence of congenital heart disease in children born to residents of Olmsted County, Minnesota, 1950-1969. *Mayo Clin Proc*. 1971;46(12):794–9.
2. Kristensen SD, Knuuti J, Saraste A, Anker S, Bøtker HE, DeHert S, et al. ESC/ESAGuidelines on non-cardiac Surgery: cardiovascular assessment and management. *Eur Heart J*. 2014;35(35):2383–431.
3. Fleisher LA, Fleischmann KE, Auerbach AD, Barnason SA, Beckman JA, Bozkurt B, et al. ACC / AHA clinical practice guideline 2014 ACC / AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery. *Circulation*. 2014;130:278–333.
4. National Institute for Health and Care Excellence (NICE), Preoperative Tests (update). Routine preoperative tests for elective surgery. Clinical Guideline NG45; 2016. Available from: https://www.nice.org.uk/guidance/ng45.
5. Pre-operative Assessment and Patient Preparation The Role of the Anaesthetist. London: The Association of Anaesthetists of Great Britain and Ireland; 2010. doi:10.21466/g.PAAPP-T.2010.
6. Biccard BM. Relationship between the inability to climb two flights of stairs and outcome after major non-cardiac surgery: implications for the preoperative assessment of functional capacity. *Anaesthesia*. 2005;60(6):588–93.
7. Bredy C, Ministeri M, Kempny A, Alonso-Gonzalez R, Swan L, Uebing A, et al. New York Heart Association (NYHA) classification in adults with congenital heart disease: relation to objective Measures of exercise and outcome. *Eur Heart J Qual Care Clin Outcomes*. 2018;4(1):51–8.
8. Lui G, Saidi A, Burchill L, Deen J, Earing M, Gewitz M, et al. Diagnosis and management of noncardiac complications in adults with congenital heart disease: a scientific statement from the American Heart Association. *Circulation*. 2017;136:1–46.
9. Yeole BB. Trends in the brain cancer incidence in India. *Asian Pac J Cancer Prev*. 2008;9(2):267–70.
10. Ostrom QT, Gittleman H, Liao P, Rouse C, Chen Y, Dowling J, et al. CBTRUS statistical report: Primary brain and central nervous system tumors diagnosed in the United States in 2007-2011. *Neuro Oncol*. 2007;16(Suppl 4):1–63.
11. Burkhard C, DiPatre PL, Schuler D, Schuler G, Yasargil MG, Yonekawa Y, et al. A population-based study of the incidence and survival rates in patients with pilocytic astrocytoma. *J Neurosurg*. 2003;98(6):1170–4.
12. Lee KJ, Marchan E, Peterson J, Harrell AC, Quinones-Hinojosa A, Brown PD, et al. Management and survival of adult patients with pilocytic astrocytoma in the national cancer database. *World Neurosurg*. 2018;112:881–7.
13. Ellis JA, Waziri A, Balmaceda C, Canoll P, Bruce JN, Sisti MB. Rapid recurrence and malignant transformation of pilocytic astrocytoma in adult patients. *J Neurooncol*. 2009;95(3):377–82.
14. Stuer C, Vilz B, Majores M, Becker A, Schramm J, Simon M. Frequent recurrence and progression in pilocytic astrocytoma in adults. *Cancer*. 2007;110(12):2799–808.
15. Khairy P, Landzberg MJ. Adult congenital heart disease: Toward prospective risk assessment of a multisystemic condition. *Circulation*. 2008;117:2311–2.
16. Feldt RH, Avasthey P, Yoshimasu F, Kurland LT, Titus JL. Incidence of congenital heart disease in children born to residents of Olmsted County, Minnesota, 1950-1969. *Mayo Clin Proc*. 1971;46(12):794–9.
17. Cannesson M, Earing MG, Collange V, Kersten JR. Anesthesia for noncardiac surgery in adults with congenital heart disease. *Anesthesiology*. 2009;111(2):432–40.
18. Lovell AT. Anaesthetic implications of grown-up congenital heart disease. *Br J Anaesth*. 2004;93(1):129–39.
19. Lee MG, Ko JS, Yoon HJ, Kim KH, Ahn Y. An unusual presentation of an atrial septal defect. *J Cardiovasc Ultrasound*. 2009;17(4):151–2.
20. Hines RL, Marschall KE. Stoelting's anesthesia and co-existing disease. 6th ed. Livingstone C, editor. India: Elsevier; 2008.
21. Cruz LMV, Cayre R, Park YS, Kim JY. Anesthetic management of a patient with large atrial septal defect undergoing laparoscopic cholecystectomy: A case report. *Saudi J Anaesth*. 1999;14(2):249–52.
22. Park YS, Kim JY. Anesthetic management of a patient with large atrial septal defect undergoing laparoscopic cholecystectomy: A case report . *Saudi J Anaesth*. 2020;14(2):249–52.
23. Young MJ, Gorlin AW, Modest VE, Quraishi SA. Clinical implications of the transversus abdominis plane block in adults. *Anesthesiol Res Pract*. 2012;2012:731645. doi:10.1155/2012/731645.

Author biography

Deepak Chandrakant Koli, Consultant Anaesthesiologist https://orcid.org/0000-0002-9190-2653

Poonam Gupta, Clinical Associate

Sandip Katkade, Consultant Cardiac Anaesthesiologist

Ankit Gupta, Deputy Consultant Anaesthesiologist

Hemant H Mehta, Director and HOD

Cite this article: Koli DC, Gupta P, Katkade S, Gupta A, Mehta HH. Anaesthethetic management of craniotomy for recurrent astrocytoma in case of large atrial septal defect with severe pulmonary hypertension: A case report. *Indian J Clin Anaesth* 2022;9(4):518-522.