Case Report

Continuous Cardiac Output Monitoring for Hemodynamic Management of a Case of Ruptured Cerebral Artery Aneurysm with Aortic Stenosis

Don Jose Palamattam, Srilata Moningi[1], Dilip Kumar Kulkarni[1], Gopinath Ramachandran[1]

Departments of Anesthesia and Critical Care, ESIC Super Speciality Hospital, [1]Nizam's Institute of Medical Sciences, Hyderabad, Andhra Pradesh, India

Abstract

The perioperative management of a patient diagnosed with ruptured cerebral aneurysm and aortic stenosis (AS) is a challenging task for the anesthesiologist. Continuous cardiac output (CO) monitoring devices such as the FloTrac™/Vigileo™ system is a reliable measure to avoid and minimize the adverse complications of hemodynamic instability, thus favoring the outcome.

Key words: Aortic stenosis, cardiac output, cerebral aneurysm, intraoperative monitoring, perioperative

Background

Aortic stenosis (AS) is frequently associated with increased morbidity and mortality and the perioperative risk increases further in the presence of a cerebral aneurysm. Currently, several continuous cardiac output (CO) monitoring devices are available to be used in critically ill patients with the primary goal of maintaining adequate tissue perfusion. We present a case of successful anesthetic management of a left middle cerebral artery (MCA) aneurysm in a patient of moderate AS using Flo Trac™ transducer and Vigileo™ monitor devices (Edwards Lifesciences, Irvine, CA, USA) for hemodynamic monitoring.

Procedure

A 55-year-old female, a known diabetic and hypertensive, was diagnosed with left MCA aneurysm (size: 6.1 mm × 5.2 mm) [Figure 1]. Clinically, she had no neurological deficit with stable vitals and was started on conservative treatment with nimodepine and phenytoin. Auscultation of the heart revealed an ejection systolic murmur in the aortic area, radiating to the carotid area. Transthoracic echocardiography revealed moderate AS, with peak pressure gradient (PG) of 69/34 mmHg, concentric left ventricular (LV) hypertrophy and good LV systolic function. Other laboratory investigations were within normal limits. Left craniotomy with clipping of aneurysm under neuronavigation guidance in a supine position was planned and executed.

After taking high risk informed consent, all emergency drugs such as dopamine, adrenaline, phenylephrine, labetolol, noradrenaline, dobutamine, and nitroglycerine, and equipment such as defibrillator and airway cart were made available and checked and the patient was shifted to the operation theater. After establishing noninvasive basic monitoring, two large bore 16G intravenous cannulae, an arterial cannula in the left radial artery, and a central line in the right subclavian vein were secured under local anesthesia and sedation with midazolam 1 mg + fentanyl 40 µg IV. Arterial pressure-derived continuous CO (APCO) was measured using Flo Trac™ transducer and Vigileo™ monitor device for guiding fluid and hemodynamic management. After adequate preoxygenation, anesthesia was induced with intravenous midazolam 5 mg and fentanyl 160 µg followed by rocuronium 60 mg and lignocaine 90 mg. After endotracheal intubation, the patient

Address for correspondence: Dr. Srilata Moningi, Flat No. G-3, Sujatha Sterling Homes, H. No. 8-2-403/A, Road No. 4, Banjara Hills, Hyderabad - 500 082, Andhra Pradesh, India. E-mail: srilata_m1973@yahoo.co.in

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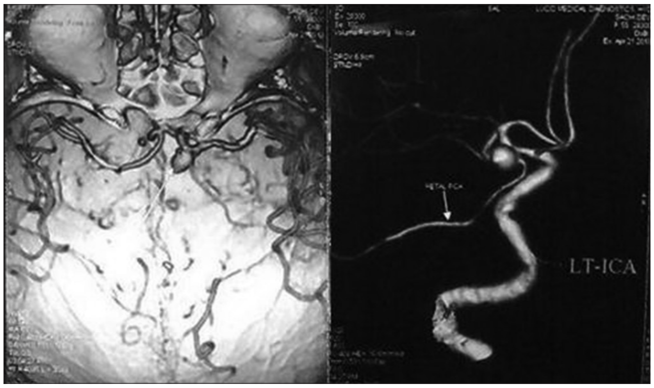

Figure 1: CT angiography depicting the middle cerebral artery aneurysm. CT = computed tomography

was put on volume controlled ventilation and ventilation was adjusted for normocapnia with end-tidal carbon dioxide monitoring. Anesthesia was maintained with isoflurane and air in oxygen (1:1), along with fentanyl-atracurium infusion and titrated according to hemodynamic response and depth of anesthesia monitoring (entropy). After induction and intubation, scalp block was instituted prior to scalp incision for analgesic supplementation. During surgery, dopamine infusion was started at 5 ug/kg/min as a background infusion and titrated following a fall in CO, cardiac index (CI), and systemic vascular resistance (SVR). Further fall in blood pressure, fluctuations in stroke volume variation, and increase in heart rate (HR) were managed with bolus administration of normal saline (100 mL) and intermittent aliquots of phenylephrine 10 μg to maintain SVR [Figure 2]. Intermittently, SVR was calculated every 30 min and as and when required. Total fluid requirement in the intraoperative fluid was 3 L of normal saline. CVP and CI were maintained at 5–10 mmHg and around 2.2–2.4 L/min/m^2, respectively with sinus rhythm. This 5-h surgery was uneventful, with application of a permanent clip to the neck of the aneurysm. At the end of the procedure, extubation was uneventful and the patient was shifted to the neurosurgical intensive care unit for observation. The hemodynamic monitoring was extended into the postoperative period for the next 48 h and the vitals were maintained. Ionotropic support was gradually tapered down with continuous monitoring of the dynamic variables. The patient was hemodynamically and neurologically stable. He was finally discharged after 2 weeks following cardiology consultation.

Discussion

AS is associated with increased perioperative morbidity such as myocardial infarction, ventricular tachycardia, and cardiac death. Revised cardiac risk index has shown high risk factors such as symptomatic AS with good discrimination for perioperative cardiac events.[1] These patients have poor or no cardiac reserve and may not tolerate the hemodynamic changes associated with anesthesia and surgery. The degree of stenosis and increasing PG is proportional to the level of risk. Ruptured intracranial aneurysm, the most common cause

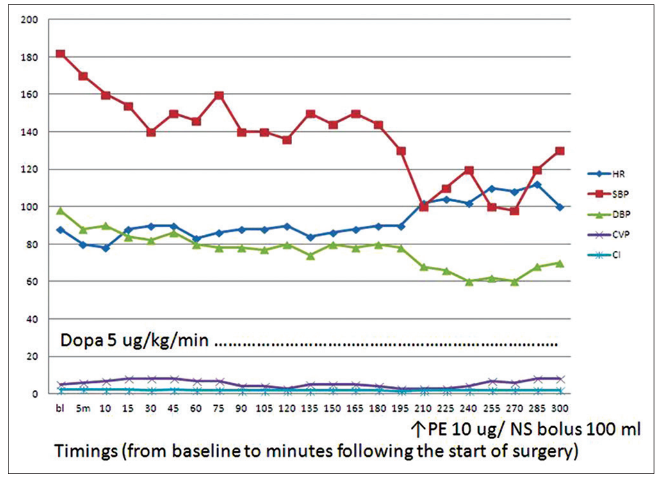

Figure 2: Trend of hemodynamics in the intraoperative period. HR = Heart rate in bpm, SBP = Systolic blood pressure in mmHg, DBP = Diastolic blood pressure in mmHg, CVP = Central venous pressure in mmHg, CI = Cardiac index in L/min/m^2, Dopa = Dopamine (in micrograms/kilograms/min), PE = Phenylephrine (in micrograms), NS = Normal saline, mL = Milliliters

of spontaneous subarachnoid hemorrhage (SAH), usually presents with headache, vomiting, meningeal signs with or without altered mental status. This is associated with high mortality, especially in stenotic heart lesions despite recent advancement in techniques and modalities for appropriate management.[2] This requires careful preoperative planning, aggressive intraoperative monitoring, and correction of hemodynamic instability for improving favourable outcome.[3]

There are few reported cases with this combination of AS and cerebral aneurysm in pediatric patients.[4,5] Recent literature has reported the successful management of such a case for endovascular intervention.[6] Continuous CO monitoring with the derived dynamic hemodynamic variables is an additional monitoring measure, which was utilized for successful surgical management of our case of ruptured aneurysm with AS. This helps the anesthesiologists to accept lower arterial pressures while assuring a normal blood flow (high normal SVR and normal cardiac index).

The current guideline in AS with symptoms is to undergo aortic valve replacement (AVR) before high risk noncardiac surgery.[7] This was not possible for our patient with ruptured intracranial aneurysm. Careful planning, preoperative optimization, and perioperative anesthetic goals play a crucial role in predicting the outcome in the management of such patients. The principal goals of the anesthetic management for aneurysm surgery with AS include control of the transmural PG of the aneurysm, preservation of adequate cerebral perfusion pressure and oxygen delivery, avoidance of large and sudden swings in intracranial pressure (ICP), and providing conditions that allow optimal surgical exposure with least brain retraction to maintain sinus rhythm, myocardial contractility, preload, SVR, and allow rapid awakening of the patient. Hemodynamic instability in the form of tachycardia, hypertension, and hypotension increase the risk of myocardial ischemia and should be avoided and/or rapidly corrected.[8]

Adequate levels of analgesia and anesthesia were maintained throughout the procedure and measures such as scalp block and lignocaine were used to obtund the hemodynamic responses to surgical and anesthetic manipulations. The FloTrac/Vigileo™ device uses an analysis of the arterial pressure waveform (pulse contour analysis) and specific demographic data to derive a continuous monitor of cardiac stroke volume and other hemodynamic variables such as CI, SVR, and stroke volume variation (SVV). Beat-to-beat continuous analysis of these variables helps in optimization of intravascular fluid volume and aggressive correction of hemodynamic swings and therefore, reduction of adverse cardiac events and postsurgical morbidity.[9,10] This cost-effective monitor is also effective in the titration of anesthetic drugs, and timely use of inotropic and vasodilator drugs.

Conclusion

The anesthetic management of patients with intracranial aneurysm with AS should be tailored to the individual patient and is centered upon the optimization of hemodynamic parameters and ICP within narrow ranges. Continuous CO monitoring devices such as the FloTrac™/Vigileo™ system provide reliable data that is used to manage perioperative patient hemodynamics and avoid cardiac decompensation.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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