

**Review Article**

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Iatrogenic Obstruction of Superior Vena Cava During Cardiac Surgery

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With recent advances in cardiac surgery and advanced imaging modalities, many complex cardiothoracic surgeries are performed. These interventions involve Vascular procedures like CABG/aneurysm repair along with heart valve repair or replacement. These interventions are clubbed together to be completed in one theatre visit. Total cardiopulmonary bypass (CPB) during such operation becomes inevitable. Superior and Inferior Vena cava are cannulated with caval snares to direct venous return to bypass machine instead of the right side of the heart during CPB. Venous drainage from the head and neck region, including brain and upper limb, is dependent on superior vena cava (SVC). Any obstruction to SVC drainage can lead to venous engorgement and SVC obstruction syndrome. We encountered such complication due to Iatrogenic obstruction to SVC drainage.

Description

A 76 years old male weighing around 90kg, NYHA III, with a history of compensated congestive cardiac failure secondary to severe mitral stenosis, ischemic heart disease, triple vessel disease and aortic root aneurysm. His past medical history included Diabetes, Hypertension and COPD, which were optimized before surgery. Elective CABG requiring two vessels grafting with Mitralvalve repair/replacement with Aortic root replacement was planned. Induction of anesthesia by Total Intravenous Anaesthesia Technique (TIVA) with Propofol and Remifentanyl, intubation, advanced vascular access (Pulmonary Artery Catheter/ Arterial Line), Trans-oesophageal Echocardiography probe (TOE) placement for intra-op monitoring was uneventful. Bi-spectral index monitoring (BIS) was used to ensure depth of Anaesthesia during surgery. TIVA adjusted to maintain BIS value between 40-60.

After assessing the images from TOE, the surgeon decided to repair the mitral valve rather than replacement. Cannulation of SVC, IVC and Aorta, and Cardioplegia infusion was performed to facilitate total cardiopulmonary bypass. CABG followed by repair of

the mitral valve was completed. Regular monitoring of BIS, arterial blood gases, temperature monitoring was done during bypass as part of standard practice.

During this time, the BIS monitor started to alarm due to low BIS value. BIS value was consistently less than 10-20, and EEG trace was pathological. Depth of anesthesia was adjusted; however, the value started to dip down further. While checking BIS sensors on the forehead, it was noticed that patient had swollen head and face which was covered with the surgical drapes. The surgeon was informed about this change who found out that SVC had kinked due to traction of caval snare, obstructing the flow from SVC to CPB. This complication was managed with caval snare repositioning, medical treatment by Inj. Mannitol, head-up position, and induced hypothermia while on CPB to prevent ischemic and hypoxic brain damage. No pressure alarm ever was triggered by the CPB machine, which could have helped to pick up this problem sooner. Cerebral oximetry could have been helpful to know if this has affected the cerebral circulation and oxygenation, causing a constant low BIS

value. The surgeon proceeded to carry out aortic root replacement, and it was done successfully as planned.

At end of surgery, while weaning the patient from CPB, the patient had intractable VT/VF. This was managed by multiple direct cardiac shocks, direct cardiac massage and medical management with Amiodarone boluses and infusion, electrolytes were within normal limit on ABG. All reversible factors were ruled out for such cardiac event. Even after prolonged resuscitation & appropriate medical management, the patient could not be withdrawn from CPB. The patient was withdrawn from CPB and patient passed on operating table expired on the table.

Discussion

Neuro-cognitive dysfunction a known complication after cardiac surgery, especially after prolonged duration of cardiopulmonary bypass. It can be caused by embolic complications leading to stroke in the population older than 70 years from a severely atherosclerotic ascending aorta [1]. Most CPB patients do not experience peri-operative stroke; however, a high incidence of more subtle central nervous system dysfunction has been demonstrated to persist for up to 1 year after surgery [1].

There are case reports of iatrogenic obstruction of the Pulmonary artery [2] and Superior vena cava [3] during or after cardiac surgery in literature. Less common causes that would manifest acutely are usually iatrogenic, e.g., mechanical obstruction by a retractor and improper venous cannula placement [4]. A well-known complication during cardiopulmonary bypass, which can result in acute intraoperative SVC syndrome, is malposition of the SVC cannula. Poor SVC cannula position can either reduce or completely obstruct venous drainage from the upper body, which if not corrected may lead to increased intracranial pressure and cerebral oedema while on bypass, and we suspect this as the cause for intractable arrhythmias in our patient. Swelling of the face and upper extremity and dilated veins in the neck and chest wall can be seen with SVC obstruction [5].

Features of SVC obstruction also can lead to engorgement of veins causing oedema of the head, neck, upper extremities, profound collaterals in the chest wall and cyanosis [3]. In our patient, engorgement and swelling of the head, ears, eyes were visible. This could also have led to cerebral oedema, causing consistent low BIS value.

The second issue in this case was about reliability of BIS Values while on CPB. Optimal depth of anaesthesia is not easy to achieve in patients undergoing cardio-vascular procedures due to limited cardio-vascular reserves. Deep anaesthesia may lead to hemodynamic instability, while the light plane of anaesthesia may lead to awareness during surgery. Advanced cardiac and gas monitoring during surgery allows us to monitor cardiac and respiratory physiology. However, the lack of a gold standard for depth of anaesthesia complicates the evaluation and comparison of anaesthetic depth monitors [6].

A real-time processed EEG signal monitoring such as BIS shows a marked drop in electrical activity at the onset of CPB [7]. Similar drop was noticed with our patient. The bispectral index and index of consciousness values may be interchangeable. The interchangeability is better appreciated during normotension and hypotension but not during a non-pulsatile state of cardiopulmonary bypass [8]. The device manufacturer notes clearly that BIS is not intended as a monitor of ischemia. There are many articles which echo similar opinion about non-reliability of BIS during CPB and induced hypothermia [9,10].

However, in our case, consistent low BIS values were pointing towards possible ongoing cerebral insult. Hayashida et al. has expressed a similar opinion in their case series and suggest that if a change in BIS is not drug-induced, an acute decrease in BIS indicates cerebral hypoperfusion [11].

Summary

SVC obstruction during cardiac surgery is a rare yet grave complication that requires early recognition and prompt action to impede deleterious fatal complications. BIS, though, has a questionable use to monitor the depth of Anaesthesia while on CPB. Consistent low values may indicate cerebral ischemia. However, advanced monitoring like cerebral oximetry could be helpful to confirm the diagnosis and treat it.

Conflict of Interest

None.

Acknowledgement

None.

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