ANESTHETIC MANAGEMENT OF A CASE OF ASCENDING AORTIC ANEURYSM

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Abstract: In ascending aorta aneurysm the conventional Aorto caval cardiopulmonary bypass is not feasible as the segment for aortic canulation is diseased and requires surgical repair. Henceforth a femoral vein-femoral artery cardiopulmonary bypass is useful to achieve surgical ease for correction. But, cerebral perfusion is not ensured with a normothermic or hypothermic circulatory arrest. Hence, a Deep Hypothermic Circulatory Arrest (DHCA) can be used. We are describing the successful management of a patient with ascending aorta aneurysm using femoro-femoral cardiopulmonary bypass and Deep Hypothermic Circulatory Arrest.

Keyword: Femoro-Femoral bypass, Deep hypothermic circulatory arrest, Ascending Aortic

INTRODUCTION:
An Aortic aneurysm is a dilatation of the aorta of all the three layers of the vessel wall that has a diameter of 1.5 times more than that of the normal expected diameter of the aortic segment. Most thoracic aorta aneurysms are asymptomatic and is diagnosed incidentally on a regular medical work-up. Atherosclerosis is the major cause of aneurysms. Other causes are Aortic dissection, trauma, connective tissue disorders such as Marfan’s syndrome, Takayasu arteritis, Cystic medial necrosis and Syphilitic aortitis. Other co-morbid illnesses such as diabetes mellitus, hypertension and risk factors such as hypercholesterolemia, smoking contribute to the severity of the disease. Thoracic aorta aneurysms are classified based on their size, shape, location and etiology. Among thoracic aorta aneurysms descending thoracic aorta aneurysms are most common, followed by ascending aorta aneurysms and then aortic arch aneurysms. Surgical repair is required for aneurysms which exceeds diameter of 6 cm to avoid spontaneous rupture.

CASE REPORT:
48 yr old male patient, known hypertensive for 2 yrs on T.enalapril 2.5 mg BD and T.atenolol 50 mg 1 OD was admitted with h/o chest pain radiating to the back associated with sweating, palpitations and dyspnoea on mild exertion since 1 week. He was diagnosed to have **ASCENDING AORTA ANEURYSM** and was evaluated for surgical correction. **PRE-OPERATIVE ANAESTHETIC ASSESSMENT:** No h/o Diabetes Mellitus/ Tuberculosis/Bronchial Asthma / Ischemic Heart Disease / Epilepsy ; No h/o previous surgeries and any drug allergies. Effort tolerance < 4METS. O/E: Patient conscious, oriented BP-130/80 mmHg PR-90/min Cardiovascular System – first and second heart sounds heard, no murmurs heard ; Respiratory System - bilateral air entry present ,equal on both lung fields and no added sounds were heard. Weight – 62 Kg ; Height – 168 cm. Airway: Mallampatti score -I ; Thyromental distance > 6cm; Interincisor distance > 3cm ; Sternomental distance > 12 cm with normal dentition. **Investigations:**Hemoglobin -11.5gm/dl; Random Blood Sugar -70 mg/dl; Urea-29mg/dl; Creatinine-0.9mg/dl; Sodium -138mEq/l; Potassium -3.6mEq/l; Liver Function Test –Total Bilirubin-0.7 mg/dl; Direct Bilirubin -1.0 mg/dl ;Alanine Transaminase -45 U/L ; Aspartate Transaminase - 70 U /L;Alkaline Phosphatase -65 U/L Chest X-ray - Cardiomegaly ; Electrocardiogram – LAD and LVH present ; Echocardiography -concentric LVH,Dilatation of aortic root and ascending aorta ,Normal valves, no Regional Wall Motion Abnormality ; Left Ventricular function- Normal with Ejection Fraction - 70% ; Magnetic Resonance Imaging - aortic aneurysm of 5.5cm at the level of ascending aorta above the aortic root; Pulmonary Function Test - moderate restriction. T.Enalapril was stopped day before surgery.

**Fig.1 MR Angiogram**

Patient was taken up for surgery under ASA physical status - III

**INTRAOP EVENTS:**

Monitors – ECG , Pulse oximetry, Non-invasive blood pressure were connected and two IV line access with 16 G venflon obtained. Premedication : Inj.Glycopyrrolate -0.05mg/kg i.v., Inj.Morphine 0.2 mg/kg i.v., and Inj.Midazolam 0.05mg/kg i.v.,. Supplemental Oxygen was given through ventimask @ 4 L/min. Central venous line : Under strict aseptic precautions and skin infiltration with 2% lignocaine, the right side Internal Jugular Vein canulated with 7 Fr triple lumen catheter using seldinger’s technique and secured after aspiration of blood. Transducer was connected and CVP was measured 8 mmHg. Arterial line : Under strict aseptic precautions left sided (non-dominant) radial artery and left dorsalis pedis artery were canulated by Seldinger’s technique and connected to Invasive blood pressure monitors. Baseline arterial blood pressure was 127/89 mmHg.
Patient was induced with Inj Thiopentone sodium 5 mg/kg i.v and Inj.Vecuronium 0.1 mg/kg and Inj.Xylocard 1.5 mg/kg i.v was given and intubated with 8.0 sized cuffed endotracheal tube. The patient was connected to the ventilator in Intermittent Positive Pressure Ventilation with Tidal volume – 500 ml; Respiratory rate – 12 breaths /min; Positive End Expiratory Pressure – 3 cm H2O.

Maintanence: Nitrous oxide : Oxygen ratio – 2:1; Sevoflurane 0.6% with muscle relaxant – Inj.Vecuronium (1mg every half an hour). Bladder catheterisation, Ryles tube insertion and Nasopharyngeal temperature placement were done. Heparinisation done @300 units/kg and the Activated Clotting time was 402 seconds. Femoral artery and Femoral vein were canulated. Sternotomy was done.

Femoral artery and Femoral vein cannula were connected to the extra-corporeal circulatory circuit and the line pressure of the arterial line was 80 mm Hg. Venous canula placed in right atrium too.

**Fig.2 Aneurysm of the Ascending Aorta**

Aortic cross clamp was placed and Cardiopulmonary bypass was started after ensuring the absence of air bubbles with carotid compression, trendlenburg position of patient (Nitrous Oxide was stopped). Ventilation was stopped and the infusion lines were closed. The first cardioplegia was given through aortic root canula. The heart was arrested. The arterial pressure was 50 mmHg in a non-pulsatile wave form. Inj.Nitroglycerine @ 0.5 µ/kg/min given in the extracorporeal circuit to maintain the arterial pressures around 50 mmHg. Further cardioplegia was given directly into the Left Coronary Artery and Right Coronary Artery. (Totally 5 Cycles were given). Deep hypothermic circulatory arrest was maintained at a temperature of 18°C by infusion of cold cardioplegia and placing ice-packs surrounding the heart. Inj. Heparin @ 100 Units/kg was administered with a hourly target Activated Clotting Time of > 400 seconds. Arterial Blood Gas analysis and Activated Coagulation Time were done every hour. **PROCEDURE**: The aneurysm was excised and a synthetic graft was placed.
The cardioplegia cannula was removed from the excised area and a new cannula was placed in the graft. (Fig.3)

![Image](image1.png)

**Fig.3 Synthetic Graft in-situ**

After completion of the procedure re-warming was started. Temperature was brought to 36.5ºC. Heart regained its sinus rhythm with no arrhythmias. Ventilation was begun with a smaller tidal volume of 300 ml and respiratory rate of 20 breaths per min with oxygen alone. Aortic cross clamp was removed and patient was ventilated with oxygen. The blood pressures started to rise from 80/40 mmHg to 140/90 mmHg. Inj.Nitroglycerine 0.5µ/kg/min was started to decrease the work load of the heart. After the completion of the **support time** (1/3rd of cross clamp time) patient was weaned out of the Cardiopulmonary bypass and was started on ventilation with Pre cardiopulmonary by-pass tidal volume. Reversal of Heparin was done with Inj. Protamine in a ratio of 1:1.2mg. Packed cells, FFP and platelets were transfused to restore coagulation profile. Activated Clotting Time was 94 seconds. Decanulation (Femoral artery, femoral vein, right atrium and neo ascending aorta) was done, Intercostal Drainage tube’s placed and sternotomy was closed with wires after obtaining thorough hemostasis.

**DURATION:**
Skin incision to Skin closure was 5 hours and 30 minutes. Aortic cross clamp duration was 152 mins. 

**FLUIDS:**
1500 ml Ringer lactate solution 3 units of Packed red blood cells, 2 units of Fresh frozen plasma and 2 units of platelets. Urine output was 200 ml per hour.

**POST OP:** Patient was shifted to cardiothoracic post-op unit and was planned for elective post-op ventilation and was connected to the ventilator in **Controlled mode Ventilation** (Tidal Volume – 600 ml; Respiratory rate- 12 breaths/min; Positive end expiratory pressure – 5 cm H2O and **Fractional inspired Oxygen Concentration** was tapered from 100 % to 60 %. Inj.Morphine 2 mg/hr Inj. Midazolam 1 mg/hr were used for sedation and analgesia. Patient was then weaned from controlled mode to **Synchronised Intermittent Mandatory Ventilation** mode based on Arterial Blood Gas analysis. Next day patient was put on T-piece for a few hours of Spontaneous Breath Trial and extubated. Patients neurological status was normal. After 4 days of observation patient was shifted from the intensive care unit.

**DISCUSSION:**
Ascending aorta aneurysm is usually an incidental finding on regular medical work up. The most common initial symptom is chest or back pain caused by aneurysmal expansion, rupture or bony erosion. The mass effect of the aneurysm can cause
Hoarseness from stretching or compression of the recurrent laryngeal nerve.

Atelectasis due to compression of the lung

Superior vena cava syndrome from compression of superior vena cava or innominate vein.

Dysphagia from compression of oesophagus.

Dyspnoea from compression of trachea, main bronchus or pulmonary artery

Atherosclerotic mural aneurysms can present as embolism, stroke, mesenteric ischemia, renal insufficiency or limb ischemia. The objective of surgical repair is to replace the aneurysmal segment with a tube graft. Indications for surgical repair are:

- Aneurysm diameter of 5.0 to 5.5 cm for ascending aortic aneurysm and 6.0 to 7.0 cm for descending aorta aneurysm.
- Increase in diameter greater than 10 mm/yr.
- Patients with Marfan’s syndrome, family history and aortic dissection require early surgical intervention. Complications of the ascending aorta aneurysm are:
  - Rupture
  - Aortic regurgitation
  - Trachea or left main bronchus compression

Right pulmonary artery or right ventricular outflow tract obstruction. Oesophageal compression.

The surgical options of repair of ascending aorta aneurysms depend on the presence of aortic valve disease, aneurysm of sinuses of valsalva and distal expansion into the aortic arch. The most common valvular disease associated are bicuspid aortic valve or aortic regurgitation caused by dilatation of aortic root. In this case since the aortic valve and the aortic root were normal only a Prosthetic graft was placed. Anesthetic Management:

The conduct of anesthesia for aneurysm repair requires specific attentions:

- Right sided radial artery catheter is preferred to monitor arterial blood pressures.
- Nasopharyngeal, bladder and tympanic membrane temperature probes are important for estimating core body temperature.
- Balanced anesthesia is provided with opioids, a low dose of volatile anesthetic, a benzodiazepine and a long acting muscle relaxant.

Induction should be slow and hypertension has to be avoided prevent rupture of the aneurysm.

Femoral vein to Femoral artery cardiopulmonary bypass is preferred to provide clear surgical field.

### Arterial Blood Gas:

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>PaO₂</th>
<th>PaCO₂</th>
<th>HCO₃⁻</th>
<th>Na⁺</th>
<th>K⁺</th>
<th>Cl⁻</th>
<th>SaO₂</th>
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<tbody>
<tr>
<td>Pump-on</td>
<td>7.62</td>
<td>581.9</td>
<td>19.1</td>
<td>22.6</td>
<td>135</td>
<td>4.12</td>
<td>28.1</td>
<td>99.9</td>
</tr>
<tr>
<td>Pump-off</td>
<td>7.53</td>
<td>411.9</td>
<td>26.3</td>
<td>24.1</td>
<td>137</td>
<td>4.2</td>
<td>25.0</td>
<td>99.8</td>
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In this case a right atrium venous cannula was also placed to empty the venous circulation.

Cardioplegic solutions can be given using both antegrade via aortic root and retrograde technique via the coronary sinus. In this case, first cardioplegia was given via the aortic root. Subsequent cardioplegia was given through the right and left coronary arteries.

Retrograde blood flow through the diseased aorta as a consequence of cardiopulmonary bypass with femoral artery canulation can cause retrograde cerebral embolization.

Strategies to provide neurologic protection:

Deep systemic hypothermia

Topical cerebral cooling

Retrograde cerebral perfusion

Selective antegrade perfusion

Prevent cerebral hyperthermia during rewarming DEEP HYPOTHERMIC CIRCULATORY ARREST\(^1,2\).

This neuroprotective strategy is to decrease the cerebral metabolic rate and oxygen demand to withstand the ischemia during circulatory arrest.

A 10°C reduction in core body temperature decreases cerebral metabolic rate by factor of 2.6 commonly referred as Q\(_{10}\).

It provides an ischemic tolerance of 20 to 34 mins at a temperature of 17°C or 55 to 88 mins at a temperature of 7°C. Deep hypothermic circulatory arrest provides better end organ and spinal cord function.

Pharmacological deep hypothermic circulatory arrest is intravenous administration of 1 g methylprednisolone, 100 mg dexamethasone, magnesium sulphate 1 to 2 g, lidocaine 200 mg or mannitol 25 g. However it is not reliable and not an alternative. RETROGRADE CEREBRAL PERFUSION\(^1\):

It is performed by infusing cold oxygenated blood into the superior vena cava canula at a temperature of 8°C to 14°C.

The internal jugular venous pressure is maintained at 25 mmHg to prevent cerebral edema. Flow rates should be 200 to 600 ml/min.

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