



## Establishing an Indigenous Cardiac Anaesthesia Service in Enugu: Report of two cases of Atrial Septal Defect (ASD) closure

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### Abstract

**Background:** Open heart surgery program require enormous resources and commitment to establish. In low and middle income countries like Nigeria it is quite a difficult task. The surgery requires highly sophisticated equipment and specially trained professional teams. The training is done abroad and requires long term planning.

**Case report:** We report two cases of two patients, aged 20 and 30-years diagnosed with Atrial Septal Defect (ASD) scheduled for surgical closure under general anaesthesia and cardiopulmonary bypass carried out by a completely indigenous team. The anaesthetic management and the strategy necessary for developing a sustainable open heart program are discussed.

Key words: Atrial septal defect, surgical closure, general anaesthesia.

### Introduction

Congenital heart disease (CHD) account for nearly one-third of all major congenital anomalies worldwide and the birth prevalence of this disease has increased overtime.<sup>1</sup> Survival of this diseased has increased dramatically due to improvements in the field of cardiothoracic surgery and anaesthesia. The same cannot be said about countries of low and middle incomes such as Nigeria. Nigeria relies on foreign cardiac missions for management of its cardiac surgical burden as only very few patients who can afford it seek medical treatment abroad.

Major challenges in establishing a viable and sustainable open heart surgery services in this part of the world require adequate funding, manpower training, team building and staff retention. Over the years our centre (University of Nigeria Teaching Hospital UNTH Ituku-Ozalla Enugu) has engaged in manpower training and also collaborated with

foreign cardiac missions.<sup>2</sup>

The Open Heart Surgery (OHS) services is slowly but steadily being established in our centre and we report two cases of Atrial Septal Defect (ASD) closure under general anaesthesia and cardiopulmonary by-pass carried out by a completely local team.

### Case report: 1.

JAA was a 30 year old male (body weight 71kg, 1.76m height) patient referred to University of Nigeria Teaching Hospital (UNTH) Ituku Ozalla Enugu, from a tertiary hospital on account of Atrial Septal Defect. The patient was asymptomatic; an incidental findings of a heart murmur on routine medical examination resulted in a follow up echocardiography. The mummur was a grade 2 ejection systolic murmur loudest at the pulmonary area (P2) and fixed splitting of P2. An echocardiography showed ASD (ostium secundum), with left to right shunt but no significant pulmonary hypertension. Bi-atrial dilation, Left Ventricular (LV) diastolic and Right Ventricular (RV) systolic functions were preserved. Overall left ventricular systolic function was preserved (Left

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Ventricular Ejection Fraction (LVEF) was 62%). Chest X-ray done showed prominent pulmonary vessels and, mildly enlarged cardiac silhouette. Electrocardiogram (ECG) revealed a sinus rhythm, prolonged PR interval and RV hypertrophy.

Anaesthetic assessment revealed Mallampati class II and American Society of Anesthesiologist physical status (ASA) class III. A high risk consent was obtained, and he was fasted overnight. In the theatre, the patient was connected to a multiparameter monitor (DASH 4000; GE Medical systems Inc, Wisconsin USA) and Electrocardiogram (ECG), arterial oxygen saturation (SpO<sub>2</sub>) and Non Invasive Blood Pressure (NIBP) were initially monitored. Peripheral line was secured using 16G intravenous (IV) cannula and 1 gram of cefazolin was administered. Midazolam 6mg was administered as a premedicant, he was preoxygenated with 100% oxygen (O<sub>2</sub>) for 3 minutes before induction of anaesthesia was performed using IV fentanyl 200mcg and propofol 50mg. Muscle relaxation was achieved using IV vecuronium 7mg. Patient was then intubated using a 7.5mm ID cuffed endotracheal tube and the cuff inflated. Correct endotracheal tube placement was confirmed by the presence of equal breath sounds over the lung zones using a stethoscope and also by capnography (end tidal carbon dioxide EtCO<sub>2</sub>). The tube was then secured using adhesive tape.

Anaesthesia was maintained using sevoflurane 2%vol, and 50%O<sub>2</sub> in air mixture. Arterial line was secured with 20G arterial cannula (Teflon) in the left radial artery (for Invasive Blood Pressure IBP monitoring; blood sampling for arterial blood gas ABG and electrolyte monitoring using I-stat Analyzer ABBOTT 2010 USA). Central venous pressure was monitored using a central venous catheter size 7.5 FG (multi lumen) placed in right internal jugular vein. Patient's body temperature was monitored using nasopharyngeal thermometer (thermistor), Trans-esophageal echocardiography (TEE) probe (GE Vingmed ultrasound A/S 2009 Norway) was also inserted. Urine output was monitored by inserting a urethral catheter. Baseline activated clotting time (ACT) was measured and a value of 120 seconds was recorded. Before the cannulation of the aorta 28000 units of heparin was administered and after 3 minutes ACT was repeated and a value of 472 seconds was recorded.

During cardiopulmonary bypass (CPB), using Maquet HL 20 Heart-Lung machine Germany manned by trained Perfusionists, the following were administered: vecuronium 10mg, fentanyl 150mcg, tranexamic acid 1gram, sodium bicarbonate 8.4% 10ml and calcium chloride 10% 10mmol. The ASD, using autologous pericardial patch, and the PFO were closed. Pump time was 276minutes, while aortic cross clamp time was 99minutes. Post CPB ACT measured 3minutes after administering 350mg of protamine sulphate was 124 seconds. Vecuronium 5mg and fentanyl 200mcg were also administered. Intravenous adrenaline 0.05ug/kg/min was started using a syringe pump. Additional cefazolin 1 gram and tranexamic acid 1 gram were also given. Three units of whole blood were administered. Surgery lasted 8½hours and patient was transferred to the cardiac Intensive Care Unit (ICU).

Post-operative transthoracic echocardiography showed no residual leaks, good global myocardial contractility and LVEF of 69.5%. Three units of fresh whole blood and one unit of platelet were transfused in the ICU. The epinephrine was tapered off 10 hours postoperative and the patient was extubated 12 hours post-operative. Patient was discharged 10 days postoperative.

### Case report: 2.

AO was a 20 year-old male (body weight 61kg) referred to UNTH Ituku Ozalla Enugu, from a Federal Medical Centre on account of echocardiographic findings which showed Atrial Septal Defect. Examination revealed hyperactive precordium, left parasternal heave, loud P2, and ejection systolic murmur at 2nd left intercostal space. A repeat echocardiography showed ostium secundum ASD with right heart dysfunction, normal pulmonary pressure and, ejection fraction was 61.93%. Sinus rhythm was seen on ECG with incomplete right BBB, left atrial enlargement and right axis deviation. The patient was placed on once daily oral medications: spirinolactone 25mg, enalapril 2.5mg and frusemide 20mg for 2 weeks and allowed to go home.

Patient was admitted into the hospital a day before surgery and preoperative assessment and review of investigation results were carried out. Further clinical evaluation showed a Mallampati score of I

and ASA class III and he was certified fit for surgery. In the operating room peripheral venous access was secured on the right forearm with size 16G IV cannula, and the patient was given 2gram cefazolin. Intravenous midazolam 5mg and fentanyl 100ug were administered as premedicants. The arterial line was inserted using size 20G cannula (Teflon) on the left radial artery and the right internal jugular vein was cannulated with size 7 FG (multi lumen) central venous catheter. Patient was preoxygenated with 100% O<sub>2</sub> for 3minutes, anaesthesia was induced with IV midazolam 7mg and fentanyl 150ug. Vecuronium 7 mg was administered for muscle relaxation, and a size 7.5mm ID cuffed endotracheal tube was inserted and secured. Tracheal and centrality of intubation was confirmed. Maintenance of anaesthesia was with sevoflurane 2.5%vol and 50%O<sub>2</sub> in air. Morphine 8mg IV and tranexamic acid 1 gram were administered. Baseline ACT was measured and a value of 131 seconds was recorded. Before the cannulation of the aorta 24500 unit of heparin was administered and after 3 minutes ACT was repeated; 481seconds was recorded. During cardiopulmonary bypass, vecuronium 10mg, morphine 7mg and tranexamic acid 1gram were given. ASD was closed using autologous pericardial patch. Pump time was 220minutes and aortic cross clamp time was 90minutes.

Post CPB, 300 mg protamine sulphate was administered and ACT measured after 3 minutes was 125 seconds. Repeat doses of vecuronium 5mg, fentanyl 100mcg and adrenaline 0.05ug/kg/min were given as clinically indicated. Additional cefazoline 1gram was also given. Surgery lasted 7hours and patient was transferred to ICU and electively ventilated. Adrenaline was tapered off 3 hours postoperative and patient was extubated 5 hours later. Patient was discharged on the 8th postoperative day.

## Discussion

Atrial septal defect (ASD) is the most prevalent congenital cardiac anomaly in adults,<sup>3</sup> accounting for approximately 35% of all congenital heart defects. Late presentation is due to the insidious development of right ventricular remodeling, with enlargement of right cardiac chambers.<sup>3</sup> There are 3 major types of ASDs or interatrial communications:

ostium secundum, ostium primum, and sinus venosus defects. The ostium secundum is a true defect of the atrial septum and involves the region of the fossa ovalis.<sup>4</sup> Surgical closure is required for patients with ostium primum and sinus venosus ASDs, as well as for patients with secundum ASDs whose anatomy is unsuitable for device closure.<sup>5</sup>

The patients had ASD, with Left to Right shunt but no significant pulmonary hypertension. Anaesthetic management of an ASD involves reducing the magnitude of the shunt across the defect and also preventing the establishment of a hypoxic shunt phenomenon (right to left shunt as a result of low systemic vascular resistance, SVR, relative to pulmonary vascular resistance PVR).<sup>6</sup> Therefore during general anaesthesia for ASD closure the goal is to avoid hypotension, hypoxaemia, hypercarbia, reversal of shunt and fluid overload. Anticipated problems during general anaesthesia include, Air embolism during vascular access and arrhythmias. Although it is not uncommon to find atrial flutter and fibrillation in older patients with sizeable ASDs, both patients had sinus rhythm perioperatively.

Benzodiazepines and opioids are appropriate for the anaesthetic management of these patients as they are typically haemodynamically stable. Therefore in the index cases the induction of anaesthesia was opioid based plus midazolam. The induction and maintenance of anaesthesia was smooth without bulking or bronchospasms that could increase the PVR with resultant hypoxaemia. Anaesthetics such as propofol, barbiturates, and possibly etomidate may lead to decreases in SVR. In order to prevent this, adequate volume resuscitation and careful titration of general anaesthetic agents must be done as was observed in the first case. A medication to generally avoid would be ketamine, as the increases in sympathetic stimulation can lead to sustained increases in SVR.<sup>6</sup>

Sevoflurane was administered with 50% O<sub>2</sub> in air for maintenance of anaesthesia. The use of nitrous oxide reportedly increases PVR and favours right to left shunt. High FiO<sub>2</sub> for long periods may decrease PVR and favour an increase in left to right shunting. Monitoring of patient is an integral part of patient management. In the cases presented standard monitoring was carried out including serial blood gases, serum electrolytes, urea, creatinine and ACT. Daily chest X-ray check and full blood counts were

also carried out in the ICU.

The operation time, aortic cross clamp time and the pump time were very high in both cases and this must be improved upon as prolonged surgery time is a major factor increasing morbidity and mortality in OHS.<sup>7</sup> This accounted for the use of ionotrope in both cases in the immediate post-operative period to improve cardiac contractility.

Treatment of this condition is expensive, and in our environment where patients pay directly from their pocket, it becomes difficult to get treatment for indigent patients and also sustain the programme. Establishing an OHS programme is capital intensive. Provision of infrastructure and training of a complete cardiac team require huge funding and takes a long time. Maintenance of equipment and provision of consumables is equally important. To achieve all these, the hospital management must be committed to providing the funds necessary and enact policies that will create the enabling environment for the programme to thrive.

Open heart surgery programme is multidisciplinary and cardiac anaesthesia service is an integral part of it. Team building is important as every member of the cardiac team is relevant and must be carried along for success to be achieved.

### Conclusion

Congenital heart diseases are a significant group of diseases in our environment. There is however limited room for definitive intervention in the management of these lesions in the country. Efforts should be made to establish a sustainable OHS programme.

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