

Non-cardiac surgery and anaesthesia in children with congenital heart disease

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Summary

Children with Congenital Heart Disease (CHD) presenting for non-cardiac surgery have various physiological and functional abnormalities and thus pose great challenges to the anaesthetist. This one year prospective study was undertaken to determine the incidence of CHD in children presenting for non-cardiac surgery, the type of lesions and anaesthetic course.

Five patients (1.5%) out of a total of 324 children aged from birth to twelve years who had surgery during the study period were found to have CHD, ventricular septal defect (VSD) being the commonest cardiac lesion. Surgery was for cataract extraction and herniorrhaphy. Although all the children had been previously treated or were on current treatment for additional medical problems, surgery under closely monitored balanced general anaesthetic technique was found to be safe.

Key words: Congenital heart disease, Paediatric non-cardiac surgery, Anaesthesia.

Résumé

Des enfants avant une maladie de coeur congénitale (CHD) se présentant pour une opération chirurgicale ont des anomalies physiologiques et fonctionnelles variées, et par conséquent posent de grands défis à l'anesthésiste. Cette étude prospective d'un an a été effectuée pour déterminer l'incidence du CHD chez les enfants devant subir une opération chirurgicale non cardiaque, le type de lésion et le suivi anesthésique.

Cinq patients (1,5%) sur un total de 324 enfants âgés de moins de douze ans qui ont subi une opération chirurgicale pendant la période d'études avaient le CHD, une imperfection ventriculaire septale (VSD) étant la lésion cardiaque la plus commune. Les opérations chirurgicales portaient sur l'extraction de la cataracte et l'herniorrhaphie. Quoique tous les enfants aient été faite avec une technique d'anesthésie générale équilibrée, s'est avérée non dangereuse.

Introduction

Congenital Heart Disease (CHD) occurs in 6 to 10 of

100 live births^{1,2} and the incidence has been put at 0.35% of all live births in Nigeria.³ With advance in cardiac surgery and medical management, an increasing number of CHD, patients live into adulthood.⁴ When surgical intervention is for correction of specific cardiac lesions, such children are always referred to specialised tertiary centres where experienced or specialist cardiac anaesthetists and facilities for Intensive Care management are available.

For non-cardiac surgery, the general duty anaesthetist is often involved and is particularly faced with special problems as the children have a wide variety of functional and physiological abnormalities. The CHD may be uncorrected, partially repaired (palliated) or fully repaired and peri-operative morbidity as high as 47% has been reported.⁵ Hence, knowledge of pathophysiology of the underlying lesion, proper evaluation and good anaesthetic management are essential ingredients to successful outcome.

The purpose of this one year prospective study is to review the incidence of CHD in children presenting for non-cardiac surgery at the University College Hospital, Ibadan. The pathophysiology of the lesions, current issues of assessment and safe anaesthetic management are also discussed. This is of particular relevance in the West African sub-region where anaesthetic facilities are sub-optimal in many hospitals compared to availability of surgical expertise and facilities.

Materials and Methods

All children age from birth to twelve years with congenital heart disease who had non-cardiac surgery at the University College Hospital, Ibadan from 1st April, 1997 to 31st March, 1998 were studied prospectively. Information collected on each patient were Age, Sex, Weight, Type of Congenital Heart Disease and General Medical History, Surgery, Surgical Diagnosis, Pre-operative Preparation including Investigations. Anaesthetic Technique, Surgical Intervention and Peri-operative sequelae were also documented.

Results

Five children with congenital heart disease had non-

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cardiac surgery during the one year study period, constituting 1.5% of the 324 children age from birth to 12 years who had surgery during the same period. Three children had a total of six operations under general anaesthesia for bilateral cataract extraction while two children had inguinal herniorrhaphy. Those who had cataract constituted 12.5% of children aged from birth to 12 years who had eye surgery during the study period. All the children had congenital acyanotic heart disease confirmed by echocardiography with Ventricular Septal Defect (VSD) being the commonest defect (Table 1).

Associated medical conditions in these patients for which treatment had been given in the Paediatric Cardiology Unit included recurrent malaria in all children, congestive heart failure, bronchopneumonia, meningitis and aspiration pneumonitis. Those with congestive heart failure were still on anti-failure regime of digoxin, hydroflumethiazide and potassium chloride up to the time of surgery. The Packed Cell Volume range was 30–35%, although one of the patients (J. O.) had a PCV of 26% which improved to 32% on haematinics and supplementary diet after three weeks.

Following oral promethazine or diazepam premedication, all children received inhalational induction of Oxygen and Halothane after pre-oxygenation with 100% oxygen via face mask and the paediatric breathing system. Orotracheal intubation was achieved after muscle paralysis with intravenous pancuronium (0.1 mg/kg) or atracurium injection (0.4 mg/kg) and ventilation was manually controlled during maintenance of anaesthesia with Nitrous oxide and Oxygen (50: 50). Halothane 0.5% was also employed and Dipyrone or Pethidine for analgesia. The wound edges were infiltrated with 0.25% bupivacaine in those who had herniotomy done. Oxygen therapy was continued postoperatively until full recovery. The heart rate, electrocardiogram and arterial oxygen saturation were monitored in all patients.

Discussion

The role of the paediatric cardiologist is invaluable in helping the anaesthetist to make definitive diagnosis of congenital heart lesions. It is then easier to understand the pathophysiology and plan adequately for the anaesthetic management. Although all the children in this series had congenital heart disease, they were initially referred to hospital because of medical complication of the cardiac lesion, the only surgical option was for cataract extraction or hernia repair in these patients.

Ophthalmic conditions as in 3 of the patients in this series are commonly associated with congenital heart defects most especially in congenital rubella syndrome. An incidence of 7.4% ocular defects has been reported in

Nigeria in children with CHD.⁶ The commonest ophthalmic conditions are congenital cataracts, congenital glaucoma and microphthalmia. The first 2 conditions requiring urgent surgical intervention under general anaesthesia to allow for good surgical outcome.

The commonest cardiac lesion in this series is the ventricular septal defect and only the ten year old had palliative surgery. Shunting of blood through the left ventricle into the lower pressure right atrium (L to R shunt) causes increased pulmonary blood flow. This results in pulmonary over-perfusion but good ventilatory efficiency and gas exchange initially. Later, reactive pulmonary hypertension and congestive heart failure occurs as seen in three of the patients preoperatively. Increased pulmonary infections which occurred in all the patients is a sign of pulmonary volume overload and may be accompanied by retarded growth. It was not surprising that children were underweight for their age as they all had history of chronic ill-health and repeated hospital admission. Acute and chronic malnutrition in hospitalised children with congenital heart disease is quite common and Cameron et al⁷ reported occurrence in 33% and 64% of patients respectively. Malaria endemicity adversely contributed to the health problems in these children and anti-malaria prophylaxis with haematinics would have had obvious advantages.

Pre-operative evaluation of the child with CHD should identify the underlying heart lesion through history, clinical examination including previous complications related to the heart disease. The cardiologists' findings, chest x-ray, electrocardiogram, cardiac catheterisation and echocardiograph data and all previous records of drug and surgical treatment should be carefully reviewed.

In spite of palliative surgery on one of the patients with VSD, residual shunting and pulmonary hypertension was still present. In patients with elevated pulmonary vascular resistance, intra-cardiac shunting or mixed shunt/obstructive lesion, hypertension can become dramatically worse in response to hypoxaemia, pain or acidosis. Such triggering factors were avoided during the course of anaesthesia. Determination of serum electrolyte and correction of derangements is essential in those on diuretic and digoxin therapy, to prevent dysrhythmias.

Surgical and dental procedures, as well as laryngoscopy have been shown to cause a transient bacteremia.² Although, this may not be associated with endocarditis or other sequelae in most patients, we routinely administer a start dose of intravenous ampicillin 50mg/kg at induction of anaesthesia and six hours later in these children who are already prone to repeated systemic infections. As a general rule, for children with CHD

Table 1 Clinical summary of patients with CHD for non-cardiac surgery

Name	Age	Sex	Weight	Surgical Diagnosis	Congenital Heart Defect	Other Medical Problems	ASA	Anaesthetic Course
U.V.	7 months	M	5.5kg	Bilateral cataract	VSD±PDA (Decompensated)	Cardiomegaly. Treated for congestive heart failure, malaria, bronchopneumonia	II	Had uneventful general anaesthesia twice
O. J.	1 year, 4 months	F	8kg	Bilateral cataract	Inlet VSD	Congenital Rubella Syndrome microcephaly Hearing defect, Anaemia. Previous treatment for bronchopneumonia	II	Satisfactory
R. J.	1 year	M	6.7kg	Bilateral cataract	Inlet VSD 1st degrees A-V Block	Microcephaly Hypospadias, previous meningitis Malaria bronchopneumonia congestive cardiac failure	III	Uneventful general anaesthesia twice
B. O.	10 years	M	20kg	Ventral abdominal hernia	VSD pulmonary hypertension. Left atrial hypertrophy T wave inversion on ECG	Ventral hernia from healed omphalocele. Pulmonary artery banding at age 2 years	II	Satisfactory
B. A.	4 months	M	3.5kg	Left inguinal hernia	VSD	On Digoxin, Hydroflumethiazide following congestive heart failure and bronchopneumonia	III	Satisfactory

VSD - Ventricular Septal Defect
PDA - Patent Ductus Arteriosus

antibiotics prophylaxis is recommended for all operations that involve intestinal, genitourinary or respiratory mucosa.⁸

Although there is no perfect anaesthetic technique for patients with significant heart disease, there is evidence that a carefully titrated anaesthetic can be administered using a wide variety of agents. Thiopentone, Fentanyl, Ketamine, Halothane have been widely used taking into consideration specific disadvantages and advantages in relation to the patient's condition. There is no clinical evidence of increased pulmonary vascular resistance after nitrous oxide anaesthesia in children with CHD despite occurrence of such problem in adults.

In studies by Greeley and Laishley^{9,10} although there was more of a decrease in blood pressure with the volatile agents, arterial saturations, a measure of changes in shunting actually improved. The best method of treating the child with known pulmonary hypertension is to provide adequate anaesthetic depth, elevated inspired oxygen (FIO₂), hyperventilation and a small degree of positive end-expiratory pressure to maintain lung volumes.¹¹ Minimum monitoring would include heart rate, blood pressure, electrocardiogram, arterial oxygen saturation and end tidal carbon dioxide. Risk factors associated with post-operative mortality after general surgical procedures in patients with congenital heart disease have been found to include: Age, Low operative weight, Low apgar score, Presence of complex cardiac lesions, high ASA score, urgent or emergency operation, major operation and prolonged pre-operative and postoperative hospital stay.¹² The authors concluded that when patients with CHD are physiologically well compensated and adequately prepared preoperatively, elective operations are associated with low risk. This has been borne out in the patients in this series although the number of patients is small. In the West African sub-region, it is essential that such children should be managed in Centres where adequate anaesthetic and monitoring facilities are available.

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