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Transcatheter closure of patent Ductus Arteriosus: report of the first case in Nigeria

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Abstract

Background: Since the first report on device closure of Patent Ductus Arteriosus (PDA) by Porstmann *et al* in 1967, the procedure has gained wide acceptance and has been used all over the world, including parts of Africa. The advantages when compared to surgical closure include shorter procedure time and hospital stay and no scar being left. This mode of treatment was not available in Nigeria prior to this with patients having to travel abroad to benefit.

Patient and method: Cardiac catheterisation laboratory became available in Lagos, Nigeria in 2009 and in October 2010, the laboratory collaborated with Lagos State University College of Medicine (LASUCOM) and /Lagos State University Teaching Hospital (LASUTH), to perform a device closure on a 3-year old girl with PDA who had presented to LASUTH with heart failure at the age of 6 months. To the best of our knowledge, this is the first time the procedure has been performed in Nigeria

Results: The patient made a successful recovery and is haemodynamically stable, on no medications.

Conclusion: Device closure of PDA is now safe and available in Nigeria.

Keywords: Patent ductus arteriosus, transcatheter closure, Nigeria.

Abstrait

Contexte: Depuis le premier rapport sur la fermeture par dispositif du canal artériel (PDA) par Porstmann *et al* en 1967, la procédure a été largement acceptée et a été adoptée partout dans le monde, y compris certaines parties de l'Afrique. Comparant les avantages

à ceux de la fermeture chirurgicale, on y trouve des procédures à courte durée et des hospitalisations à court séjour et aucune trace. Ce type de traitement n'existait pas au Nigeria et les patients devaient voyager à l'étranger pour en bénéficier.

Patient Et methode: Le laboratoire cathétérisme cardiaque a débuté à Lagos, au Nigeria en 2009 et en Octobre 2010, le laboratoire a collaboré avec la faculté de médecine de l'Université de Lagos (LASUCOM) et le Centre hospitalier universitaire (LASUTH) de l'Etat de Lagos pour effectuer une fermeture par dispositif sur une fillette de 3 ans avec un PDA, qui a été présentée à LASUTH comme souffrant d'une insuffisance cardiaque depuis l'âge de 6 mois. Pour autant qu'on le sache, c'est la première fois que cette procédure a été effectuée au Nigeria.

Résultats: Le patient a fait une récupération réussie et est hémodynamiquement stable, n'ayant utilisé aucun médicament.

Introduction

The first report on transcatheter closure of Patent Ductus Arteriosus (PDA) was in 1967 by Porstmann *et al* [1]. The procedure has the advantage over surgical ligation; of shorter procedure time, shorter hospital stay and no surgical scar being left behind. It has since gained wide acceptance worldwide and is routine in many countries including some centres in Africa but before this, has never been performed in Nigeria. In October 2009, a private cardiac catheterisation laboratory was opened in Lagos, Nigeria and in October 2010, in collaboration with the Lagos State University College of Medicine (LASUCOM)/Lagos State University Teaching Hospital (LASUTH), a successful PDA device closure was performed on a 3-year-old girl with PDA, who had presented to LASUTH with heart failure at the age of 6 months.

To the best of our knowledge, this is the first time the procedure was performed in Nigeria and the

case is thus presented to create awareness that the facility is now available in the country, as there are many children who suffer from this cardiac defect, who could now benefit from the procedure without having to travel abroad.

Case report

VO was a 3 year old female patient of LASUTH who presented in April, 2008 at six months of age, with difficulty in breathing, recurrent respiratory tract infections and failure to thrive since birth. Physical examination showed a small-for-age child weighing 5kg, with tachypnoea, tachycardia, bounding peripheral pulses, wide pulse pressure and a grade 3/6 continuous murmur maximal at the left upper sternal border. A clinical diagnosis of PDA in congestive cardiac failure was made.

Chest X-ray (CXR) showed situs solitus, laevocardia, cardiomegaly (cardiothoracic ratio = 0.65), left atrial enlargement and left ventricular enlargement with pulmonary plethora. Electrocardiogram (ECG) showed features suggestive of left atrial enlargement and left ventricular hypertrophy, whilst 2-dimensional (2-D) echocardiography revealed normal intracardiac connections, left atrial dilatation, left ventricular hypertrophy and dilatation with intact interatrial and interventricular septa. There was a moderate sized (3mm) PDA with left to right shunt and a pressure gradient of 70/40 mmHg (Figure 1).

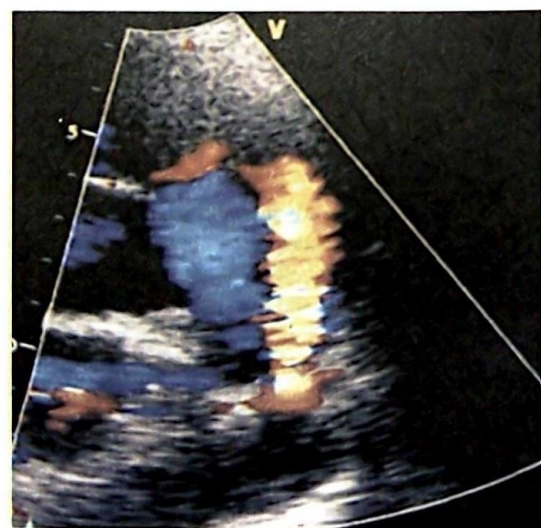


Fig.1: Parasternal short axis echocardiographic view of the aortic valve showing the right ventricular outflow tract and the pulmonary main artery (PA). Colour flow imaging of systolic left-to-right shunt (red) through the patent ductus arteriosus (PDA)

The patient was commenced on frusemide and spironolactone whilst awaiting definitive intervention (device closure or surgery), which was however delayed because the parents initially could not afford the cost of either treatment.

Closure of the PDA was eventually performed in October 2010 through collaboration with the Reddington Multi-specialist Hospital, Lagos. The procedure was done free of charge.

Table 1: Haemodynamics

Site	Pressure	Normal
Right Atrium	6	3-5
Right Ventricle	42/8	25/10
Pulmonary Artery	35/18/25	25/10/13
Ascending Aorta	135/80/106	100/60/83

NB. Pressure measured in mmHg.

**Mean right atrial pressure*

Right ventricle pressure presented as systolic/diastolic.

Pulmonary artery and ascending aorta pressures are presented as systolic/diastolic/mean

Table 2: Oxygen saturations in the various chambers

Site	Saturation (%)	Normal values(%)
Superior Vena Cava	82.8	75-80
Inferior Vena Cava	90	75-80
Right atrium	88.2	75-80
Pulmonary Artery	98.1	75-80
Ascending Aorta	99.8	95-100
Descending Aorta	99.7	95-100

Saturation is the percentage of dissolved oxygen (SO₂) expressed in percent.

SVC- Superior Vena Cava

IVC-Inferior Vena Cava

RA- Right atrium

PA- Pulmonary Artery

AAO- Ascending Aorta

DAO-Descending Aorta

Table 3: Pulmonary and systemic blood flow

Site	Values	Normal Values
Pulmonary blood flow	47	5
Systemic blood flow	6	5
Ratio of Pulmonary blood flow/systemic blood flow	7.5:1	1:1

QP = Pulmonary blood flow in L/min/M²

QS= systemic blood flow in L/min/M²

The patient was sedated with intravenous Midazolam and Ketamine. Using multipurpose and pigtail catheters, a percutaneous approach through the right femoral artery and vein was used after antisepsis and infiltration of local anaesthesia into the site. Anticoagulation was achieved by using heparin. Right heart pressures were measured and recorded (Table 1). Two samples each were taken from the inferior vena cava (IVC), superior vena cava (SVC), right atrium (RA), pulmonary artery (PA), ascending aorta (AAO), descending aorta (DAO), and an average of their oxygen saturations (SO_2) were recorded (Table 2). The QP and QS ratios were calculated and recorded (Table 3).



Fig. 2: Aortography showing the I-french pigtail catheter in the descending aorta (AO) with contrast filling the pulmonary artery (PA through the duct (PDA) (arrowed)

An arch/descending aortogram was performed in the lateral anterior oblique 60° (LAO 60) position and a 2 mm PDA was seen filling the PA (Figure 2). The PDA was crossed with the multipurpose catheter from the venous end. A 6 mm x 4mm Secas Patent Ductus Arteriosus occluder (Lifetech Scientific Company Ltd, Shenzhen) was implanted. This device has Certification of Europe (CE). Repeat angiography demonstrated that the device was in good position (Figure 3), with no residual leak.



Fig.3: Cine showing the device (arrowed) in situ.

The patient made an uneventful post-procedure recovery and was discharged home the following day. She has been symptom free since then, and is stable on follow up, not requiring any drugs for support. She has gained 3kg in the first 6 months following the procedure.

Discussion

PDA is the fifth or sixth most common congenital cardiac defect observed in most surveys carried out in different centres of the world [1]. The incidence of isolated PDA has been estimated at 1:2000 to 1:5000 births which is about 10 to 12 percent of all varieties of congenital heart disease [1,2]. In Nigeria, Antia [3] in his clinical and necropsy study of 260 cases of congenital heart disease documented an incidence of 18% while Okoromah *et al* [4] about 34 years later documented an incidence of 5.7%. Surgical closure of PDA is a well-established procedure in many centres in Africa, including Nigeria.

It remains the treatment of choice for premature infants and for children with very large PDAs. The traditional surgical approach to closure of the PDA involves division or transection of the ductus through a lateral thoracotomy. Suture ligation without division has the potential for recanalization, particularly following single-suture ligation. Surgery is extremely safe with minimal mortality and morbidity. Hospital stays can range from 1 to 2 weeks

with return to full activity within 3 weeks. A recent surgical advance is Video Assisted thoracoscopic surgical closure during which several surgical clips are placed on the PDA under direct visualization through a thoracoscope. Obvious advantages of this technique include less operative lung manipulation, less chest wall pain, faster recovery, and a smaller scar. This technique remains in limited use, but the preliminary results are encouraging with similar efficacy and shorter hospital stay, but in at least one study a higher rate of laryngeal nerve injury compared with standard thoracotomy was reported [5,6].

Catheter closure is the preferred treatment of choice for small to moderate sized PDA. This procedure is performed using conscious sedation allowing the children to return to full activity by the next day. Transcatheter closure of PDA is less complicated than thoracotomy and leaves no large operative scar on the chest. The absence of a scar is desirable because patent ductus arteriosus is more common in females [7]. The procedure time is also shorter and followed by a shorter hospital stay [5].

Side effects of Transcatheter closure of PDA include Death (0.3%), dislodgment of the device (0.3%), Blood Clot (Thrombus) (0.3%), Partial Obstruction of Pulmonary Artery (0.3%), haemolysis, small residual shunts. It is contraindicated in patients with allergy to nickel, infants less than 6 months of age, weight of less than 6kg, presence of thrombus at the intended site of implant, or documented evidence of venous thrombus in the vessels through which access to the defect is gained, active endocarditis or other infections producing bacteremia, patients whose vasculature, through which access to the defect is gained, is inadequate to accommodate the appropriate sheath size, and patients with pulmonary hypertension with pulmonary vascular resistance of >8 Woods units or Rp/Rs of >0.4 [8-10].

Though the procedure is now routinely done in other parts of the world, it is not yet popular in Africa. To the best of our knowledge, this is the first reported case in Nigeria.

Before now patients with PDA in Nigeria have been unable to achieve definitive non-surgical cure locally, often having to face the severe financial burden of seeking this mode of treatment abroad. Such patients can now benefit from this definitive cure in their natural environment at much less cost. Another advantage of being treated in their natural environment is the speedier recovery due to removal of the stress of travel and strange environment. It is

also hoped that patients with congenital heart defects such as secundum atrial septal defect, ventricular septal defect, aortic stenosis, pulmonary stenosis and also acquired lesions such as mitral stenosis, which are amenable to cure using cardiac catheterisation techniques, will similarly soon begin to benefit from this non-surgical means of cure locally.

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