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Is Pulmonary Artery Banding for Common Congenital Heart Lesions Still Justified in the West African Sub-Region?

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Abstract Patients with congenital heart lesion with large left to right shunts have pulmonary flooding with leads to repeated respiratory tract infection, pulmonary hypertension, congestive cardiac failure and Essenmenger's syndrome if not treated. In our environment, definitive surgery for these congenital cardiac lesions is not readily available. Pulmonary artery banding was widely accepted in the past as a palliative procedure for these children but has limited indications today in developed world. In our environment where definitive treatment is not available, pulmonary artery banding can still play a vital role in these children who have no immediate hope of getting definitive surgery.

Keywords Congenital heart diseases, Pulmonary artery banding, Sub-saharan Africa

1. Introduction

Congenital heart lesions with large left-to-right shunts lead to pulmonary flooding. Pulmonary oedema and congestive heart failure ensure in the acute setting. Within the first year of life, if this pulmonary flooding is allowed to continue, it will lead to medial hypertrophy of the pulmonary arterioles and fixed pulmonary hypertension [1,2]. Pulmonary artery banding (PAB) is a palliative procedure to reduce pulmonary over circulation when a definitive repair is not possible [3,4]. Pulmonary artery banding was first reported by Muller and Danimann in 1952 [5]. It was noticed to reduce pulmonary over-circulation where definitive repair is not possible. This was widely accepted as a palliative procedure for these patients then and a good outcome was reported [6,7]. In developed countries today PAB has a limited role in congenital heart surgery because of increased experience in cardiopulmonary bypass in newborn, better expertise in the intra-cardiac repair of congenital lesions, better neonatal anaesthesia and postoperative care [8,9]. Today PAB is referred more as a historical procedure in children with straightforward septal defects [10]. In the West African sub-region, can we abandon this procedure even in straightforward ventricular septal defects with a large left-to-right shunt that were hitherto indications for PAB?

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2. Materials and Methods

A literature review of pulmonary artery banding in congenital heart diseases was done from 1960 to date using library search, journal publications on the subject and Medline using terms "pulmonary artery banding", "sub-Saharan Africa", "congenital heart lesions" or "congenital heart diseases". Full texts of the materials, including those of relevant references, were collected and studied. Information relating to the distribution of cardiac centres in West African Sub-region, cardiac surgery activity in West African Sub-region, indications for pulmonary artery banding were extracted from these materials.

3. Results

Distribution of cardiac centres in west African sub-region

West African countries are Benin Republic, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra-Leon, Saint Helena, Sou Tome and Principe and Togo.

Of all the West African countries, there is documented evidence of open-heart surgery in only 6 countries. These are Nigeria, Senegal, Cote d'Ivoire and Ghana [11]. Recently first open-heart surgeries were performed in Mauritania and

Mali.

Cardiac care requires sophisticated equipment and infrastructure, above all fully trained, competent and committed manpower. That is why only very few West African countries have the resources to provide cardiac care to their teeming population. Even in these few countries where cardiac care is available, only a few patients can afford the treatment because it is generally expensive and there is no insurance coverage in most of these countries. Payments for these services are mainly 'out of pocket' except for very few that can get support from the government [12]. Rising incidence of congenital heart diseases has been reported and mostly attributed to improvement in personnel training in congenital heart disease, acquisition of echocardiographic machines by most centres and increase awareness on the part of the patients [13].

As far back as 1967, the incidence of congenital heart diseases was reported to be 3.5 per 1000 birth in Nigeria [14]. In recent reports, it has risen to between 14.4 per 1000 birth which implies that either these cases are on the increase or availability of diagnostic tools as described above [15]. In other parts of the world, the incidence is 4-10 per 1000 live birth [16,17]. From the above, one can infer that we have a good number of children with congenital heart diseases but we have only very few centres that can manage these children.

Indications for pulmonary artery banding

Pulmonary artery banding was initially proposed as a therapeutic procedure for patients with a large left-to-right shunt, with pulmonary hypertension not amenable to total correction. This is thought to lower the pulmonary artery pressure, the size of the left-to-right shunt will reduce, heart failure will improve and the development of pulmonary hypertension will be delayed [18]. In developed societies where cardiac surgery is well developed, pulmonary artery banding is referred to as more of a historical procedure in the treatment of straight forward ventricular septal defect.

Indications for pulmonary artery in its original role today are small infants with

1. Swiss-cheese type of muscular ventricular septal defect.
2. Postponing the choice between biventricular and univentricular repair in atrioventricular or ventricular septal defect with ventricular imbalance.
3. Complex anatomical defect where a biventricular repair may be better when cardiac structures are bigger.
4. Univentricular physiology with unrestricted pulmonary blood flow to drop pulmonary artery pressure and pulmonary vascular resistance to levels suitable for future univentricular palliation.
5. Extreme marasmus and sepsis.
6. Contraindication to cardiopulmonary bypass like recent intracranial bleed.

Newer indications include

1. Left ventricular training for an arterial switch operation in simple D-TGA presenting late.
2. Left ventricular preparation and/or reduction of tricuspid regurgitation (TR) in the congenitally corrected transposition of the great arteries (CCTGA) with tricuspid incompetence without sizeable VSD.
3. Pulmonary artery banding as an adjunct to another procedure, eg., 1. bidirectional Glenn shunt to maintain antegrade flow with acceptable superior caval pressures, 2. as part of a palliative arterial switch operation.

Controversial indications would include

1. Routine initial PAB for CCTGA VSD in a proposed strategy towards preserving left ventricular function following anatomic repair.
2. Adjunctive PAB along with physiological correction of late presenting simple TGA for future conversion to anatomic repair.
3. PAB for reversing the advanced pulmonary vasculopathy of unoperated CHD with Eisenmenger's syndrome.

4. Discussion

From the above current indications, one can easily conclude that it is now reserved for more complex congenital heart lesion. These complex cases are not regularly performed even in our active cardiac centres in the West African sub-region. Active centres in the sub-region are struggling to cope with straight forward congenital cardiac lesions like VSD, ASD, atrioventricular canal defect, tetralogy of Fallot, etc. Of all the active centres in West African sub-region, Ghana is the only centre that does regular congenital cardiac surgeries including complex cases [19]. The number of open-heart surgery cases performed by most of these centres are very low and mainly on a mission basis, as such straight forward simple cases are likely to be taken. In University College Hospital Ibadan, a total of 18 cases were operated in 3 years which is very small compared to the number of patients requiring these service [20]. So many factors have contributed to this low number of cases [21].

It is a known fact that without surgical intervention, the prognosis of children with congenital heart lesions with a large left-to-right shunt is very poor due to pulmonary flooding and irreversible pulmonary hypertension [22]. The advent of pulmonary artery banding as a palliative measure was widely accepted because it reduces pulmonary blood flow, reducing the risk of developing pulmonary hypertension, reducing the frequency of admissions for pulmonary infection and cardiac failure and also delaying intra-cardiac repair especially in very sick children that may not withstand cardiopulmonary bypass. It is far more beneficial in developing countries where there is a paucity of expertise and equipment for intra-cardiac repair and more importantly in children with complex anormalies [23].

A multicenter echocardiographic study reported 605 children with congenital heart lesions over 42 months in Nigeria. Of these number only 42 (6.9%) had definitive surgery and most of them outside Nigeria [24]. Out of 39 patients studied by Abah et al, only 2 (5.1%) had access to corrective surgery. One had the surgery within Nigeria while the other had it in India. Over 60% of their patients were lost to follow-up [25]. Preliminary data from the National paediatric cardiac data registry, a total of 1296 patients were enrolled, only 208 had definitive surgery, of this number, only 43 (20.7%) had their surgery within Nigeria [26].

From the above, it can be inferred that only very few of our patients get the opportunity to have definitive surgery and most of them had their surgeries outside Nigeria. So what is the fate of the remaining patients that cannot afford to travel outside Nigeria or cannot have their surgery within Nigeria? Do we fold our arms and watch them develop Eisseimenger's syndrome or die from repeated respiratory tract infection or cardiac failure? The cost of open-heart surgery in Nigeria is beyond the reach of a common man. An atrial septal defect is said to be the cheapest and is over $6,000.0012. The cost of pulmonary artery banding in our environment is approximately is between $400 and $500. Once properly performed, complications of pulmonary over flooding can be averted. This will allow the child to grow while waiting for definitive repair.

National cardiothoracic centre in Ghana is said to be the only centre with regular open heart surgery in the West African sub-region. They have a steady training program where most surgeons in the sub-region train. They reported that most patients are unable to afford primary intracardiac repair of congenital heart lesions as such palliation becomes necessary [27].

From the above, it can be deduced that pulmonary artery banding though reserved for more complex cardiac lesions in developed countries, is still a viable option for our patients that have no access to definitive care. The goals of pulmonary artery banding are to the reduction of pulmonary blood flow, which will, in turn, reduce the risk of pulmonary vascular disease, congestive cardiac failure and repeated respiratory tract infections. It can also be used in the training of the left ventricle in anticipation of arterial switch operation.

5. Conclusions

In West African sub-region where patients with congenital heart lesions have no access to definitive repair, the pulmonary artery banding can be performed. This will reduce pulmonary flooding, risk of heart failure and development of Eisenmenger's syndrome.

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