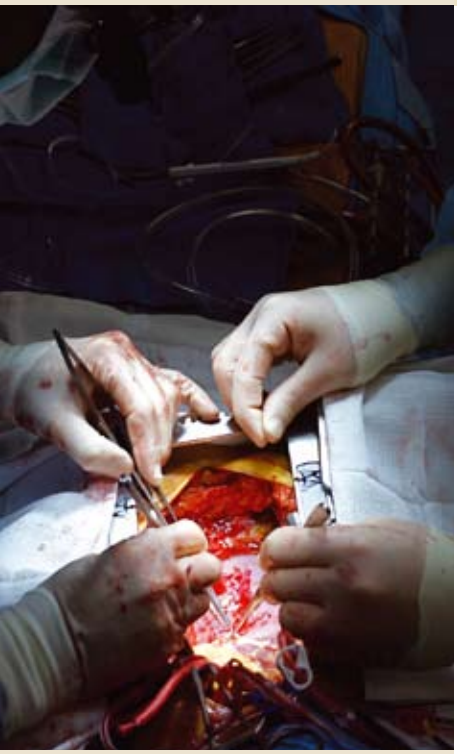
Mortality of Pulmonary Artery Banding



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Abstract:

Background:Although pulmonary artery banding (PAB) seems to be a technically simple procedure it presents several peculiarities and is related to a significant morbidity and mortality. We lack information on this procedure in our center.

Methods: Seventy patients who were randomly allocated into two groups underwent anesthesia by Total IV anesthesia, midazolam, fentanyl and atracurim and, in end of surgery each group received morphine sulfat 0.2 mg/kg after arrived in ICU, morphin PCA was started with demand (bolus) dose 1mg, lockout interval 10 minutes. The Tramadol group after separated from cardiopulmonary bypass received an intra operative initial loading dose of Tramadol (1mg/kg) and a postoperative infusion of Tramadol at 0.2 mg• kg-1• h-1. The control group received an intra operative equivalent volume of normal saline and a postoperative saline infusion (placebo). The demographic data of both groups were the same. Post-operative data were recorded in the cardiac intensive care unit at 30 min, 1 h, 2 h, 4 h, 12 h and 24 h after extubation by the same anesthesiologist, who had no knowledge of the groups, and the side-effects were also evaluated.

Results:From January 2003 to December 2009, 100 patients underwent PAB due to congenital heart disease with increased pulmonary blood flow at Imam Reza hospital. They were assessed as for hospital mortality and complications.

Conclusions:WWe found no improvement in the hospital mortality of pulmonary artery banding. These results will support the preference for primary repair of intracardiac anomalies in small infants.

Introduction

Muller and Dammann introduced pulmonary artery (PA) banding in clinical practice in 1951. Since then, this operation has been used as a palliative procedure for small infants with congenital heart defects, to be followed by definitive repair at an older age [1].

In children with congenital heart disease and increased pulmonary blood flow, pulmonary artery banding remains a useful palliative procedure when the risk of primary repair is unacceptably high or when a corrective surgical procedure is not feasible [2-4].

The mortality of PA banding improved dramatically in the 1980s[5-6].However, the pulmonary artery banding (PAB) is currently still accompanied by high morbidity and mortality, with significant complication rates[7-9]. This fact is due to the difficulty of assessing the degree of pulmonary constriction to be produced, considering that this assessment is performed in very special circumstances, since the patient is under general anesthesia, muscle relaxant, with the chest opened and ventilation controlled. Thus, what could be considered an appropriate adjustment in these circumstances, can be shown excessive or inefficient when the patient recovers his physiological condi-

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tion. The complexity of heart disease also interferes with the mortality of the procedure, ranging from 3% to 25% in the literature [10-12].

The aim of this study is to assess the service experience in PAB surgery, detailing and correlating the main aspects observed as for its distribution and clinical outcome.

Methods:

Between May 2003 and December 2009, 108 patients underwent PA Banding at Imam Reza hospital for treatment of various congenital heart diseases with pulmonary hyperflow. The clinic and hospital records of these patients were retrospectively reviewed. 8 patients were excluded from analysis due to the lack of data. The study included 100 patients, including 46 female. The distribution of heart disease is shown in Figure 1. The main heart disease was ventricular septal defect (VSD), by 36% of patients. These children, specifically, had undergone PAB for not presenting clinical conditions for total correction at some point (malnutrition, infection) and/or due to unfavorable anatomy of the VSD (apical, multiple, etc)

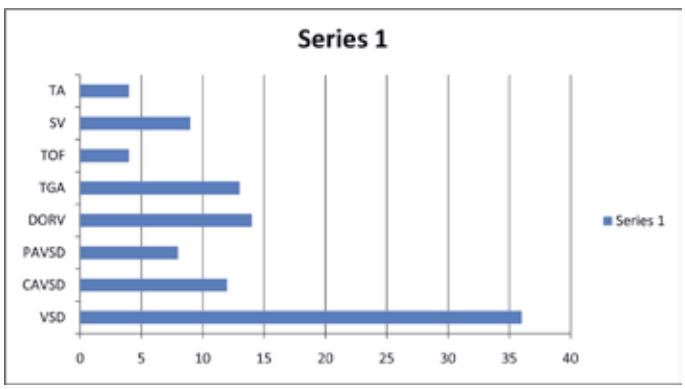

Fig.1 Distribution by heart disease.VSD =ventricular septal defect ; CAVSD =complete atrioventricular septal defect ; PAVSD =partial atrioventricular septal defect ; DORV=double outlet right ventricule; TGA =transposition of great arteries ; TOF=tetralogy of fallot ; SV=single ventricule ; TA=tricuspid atresia

Surgical procedure:

The patients underwent surgery under general anesthesia and orotracheal intubation (OTI). A standard surgical technique was used for most of the patients. The pulmonary artery was approached through a median sternotomy or lateral thoracotomy. In patients with a ductus arteriosus, coarctation, or an interrupted arch present, posterolateral thoracotomy was performed. A tape was placed around the pulmonary artery just above the sinus of the pulmonary valve. The band material preferred in operations has been polytetrafluoroethylene. The circumference of the band in millimeters was set equal to the child's weight in kilograms plus 20. This formula is a modification of that suggested by Trusler and Mustard [13]. This circumference was used as a starting point for the banding; additional adjustments to the band were made based on measurements of the pulmonary artery pressure distal to the band. The pulmonary artery pressure was reduced to one-third of the systemic blood pressure and The minimal arterial oxygen saturation was allowed at least 75%-80%, with fraction of inspired oxygen of 40%. . Then the band was secured to the adventitia to prevent its migration to the distal pulmonary artery.

Statistical Analysis:

Statistical analyses were performed using the SPSS software.The data for weight, age and time were described as mean ± standard deviation. For the relationship between weight of the patients who died and those who survived, we applied the Student's t test for analysis of unknown and equal variances. The chi-square test was applied to contingency tables, assessing the relationship between associated procedure and complications.

Results:

1-Weight and age: In this study we considered 100 patients with ages ranging from 1 - 36 months (6.58 ± 7.5) and weighing from 1.8 to 13.5 kg(4.24 ± 3.11) .Based on the physical growth NCHS percentiles ,only 17% of the patients had normal weighing range.

2-Incidence of reoperations for adjustment of banding: It was required in 8 cases (8%)

3-Respiratory failure: In 8 (8%) patients presented respiratory failure, in three of them peritoneal dialysis was required.

4-Heart failure: In 7 (7%) patients, there was a significant degree of heart failure in their evolution.

5-Severe complications (considering heart and respiratory failure): 40 severe complications were found in this group, affecting 24 (24%) patients. There is significant relation between the inappropriate weight gain and complication ($P<0.05$). The distribution of all complications is shown in Table 1.

Table 1. Sever complications after the procedure

Complication	Total
Arrythmia	5
Respiratory failure	8
Heart failure	7
Renal failure	3
Bleeding (reoperation)	4
Chylothorax	1
Pneumothorax	4
Hypoxia	6
Seizure	2

6-Deaths: 18 (18%) patients died.

Analysis results:

There is a significant difference between the weights of died children and those who survived ($P<0.05$).

In the patient with a normal weight (17%), no mortality was recorded.

There is a significant relation between the pateint with inappropriate weights and early postoperative complication, shown in Table2.

There is no significant difference between the type of CHD and the age of died children and those who survived ($P>0.05$) .

Table 2. Influence of weights on hospital mortality and early complication

Weight	Mortality	complication
Normal (17%)	0 (0%)	6(25%)
Low(83%)	18(100%)	18(75%)

Discussion:

Improvements in surgical and cardiopulmonary bypass techniques, as well as perioperative care, allowed surgeons to successfully perform early repair of CHD in infants[14-17]. Nevertheless, there are situations in which early repair in infants is not feasible or is accompanied by unacceptable risk because of the presence of unfavorable intracardiac anatomy (unbalanced ventricles, associated lesions, or both) and/or poor clinical condition (infection, chronic lung disease, or associated noncardiac malformation). In these situations palliation with PAB procedure followed by late repair is recognized as a viable surgical option. PAB is still a necessary procedure, for the protection of the increase of pulmonary vascular resistance in congenital heart disease [18-21].

PAB is usually not a low-risk procedure, particularly in small infants. Hospital mortality of 8.6% (47/711 patients) has been reported in the European Congenital Data-Base (www.eactscongenitaldb.org) for all patients who underwent isolated PAB for any congenital heart defect. A mortality rate of 13% (12/92 patients) has been recorded in the Society of Thoracic Surgeons Congenital Database (www.sts.org). In our retrospective study we observed a high mortality rate(18%).Historically, when palliation with PAB instead of primary repair was widely used to treat congenital heart defects, the mortality with PAB was higher (59%) in infants less than 3 months of age when compared with that seen in infants greater than 3 months of age (21%) [22]. A recent analysis of the Society of Thoracic Surgeons Congenital Heart Database18 showed that cardiac surgery in infants with low birth weight is associated with increased mortality.

Takayama et al analyzed the mortality of the PAB in their series since 1966, decade by decade. They noted progressive reduction in mortality, stabilized in the last two decades around 13.5%. No single variable such as gender, weight or diagnosis, represented a significant risk factor [13].

In our retrospective study, there was no relation between mortality and complication with variables such as age , gender and diagnosis ,but lower weight patients(base on the physical growth NCHS percentiles) correlated with high mortality and post operative complication.

Conclusion:

In our study mortality rates compatible with the ones of the world literature. Despite the advances in perioperative management, we found no improvement in the hospital mortality of pulmonary artery banding. These results will support the preference for primary repair of intracardiac anomalies in small infants. However, we believe that pulmonary artery banding has a role in the treatment of congenital cardiac anomalies.

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