ARTIGO ORIGINAL ORIGINAL ARTICLE

ARTERIAL SWITCH OPERATION: VARIABLES PREDICTING REOPERATION

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Abstract

Objectives: *Jatene surgery or arterial switch is performed at our institution since the late nineties. We reviewed our results to identify the main causes of reoperation and, more importantly, to determine what variables predict the need for reoperation.*

Methods: *: In this retrospective analysis were included all the 91 patients with d-TGA who underwent an arterial switch operation at our institution between 1995 and 2016.*

Results: *Mean follow-up was 10 years (range 5-25 years). Seventy-one percent of patients had simple TGA and 29% had complex TGA. The need of reoperation was 21% (n=19 patients). Right ventricle outflow tract obstruction was the main indication for reoperation (58%). The overall mortality was 9.9%. The gender (P= 0.8), diagnosis (simple or complex TGA) (P= 0,5) or the existence of palliative surgeries (P=0.9) were unable to predict the need for reoperation. The presence of anomalous coronary pattern was the only variable reaching statistical significance (P< 0.05), both in univariate and multivariate analysis.*

Conclusions: *In our series, the main indication for reoperation after arterial switch operation was right ventricle outflow tract obstruction and the only predictive variable was the presence of anomalous coronary pattern.*

INTRODUCTION

Transposition of the great arteries, defined by the presence of ventriculo-arterial discordance, accounts for 5% to 7% of all congenital heart defects, with a prevalence of 0.2 per 1,000 live births and male preponderance.[1] The diagnostic of TGA, regardless of age, constitutes an indication for surgery. Jatene surgery, performed successfully for the first time in 1975, is the treatment of choice. It is performed, at our institution, since the early nineties. Between 1995 and 2016, a total of 91 cases were performed, with 19 requiring reoperations. It is mandatory review our results and understand the indications for reoperation. Most importantly, we aimed to identify what variables better predict the need for reoperation.

MATERIAL E METHODS

In this retrospective analysis were included all patients submitted to arterial switch, between 1995 and 2016, with a total number of 91 cases. All data were analyzed using SPSS software. Categoric variables were presented as absolute values and percentages. Continue variables were presented using mean and standart-deviation or median and inter-quartile range, if they had normal distribution or not. Univariate analysis of categoric variables was done with Fisher test or qui-square. The ones reaching statistical significance, with a p-value equal or inferior to 0.05, were tested in a binary logistic regression model. Freedom from reintervention was analyzed using actuarial method.

RESULTS

Descriptive analysis of population data shows that 60% (n=53) were males. The median age at operation was 11 days. Almost all patients were assyndromic. All patients had the diagnostic of TGA, with 71% having simple TGA and 29% complex TGA, with only four patients presenting with aortic coarctation. The mean follow-up is 10 years (minimum 5 years, maximum 25 years). Eight patients (8,8%) had anomalous coronary arteries, with anomalous origin (n=7) or intramural segments (n=2). One of them had both an anomalous origin and an intramural segment.

Twenty six percent(n=24) were submitted to previous surgery or catheter interventions. The most common surgery was pulmonary artery banding (n=6). LeCompte maneuver was performed in 90 patients. After corrective surgery, 10% (n=9) required percutaneous intervention, while 21% (n=19) required reoperation, all considered late

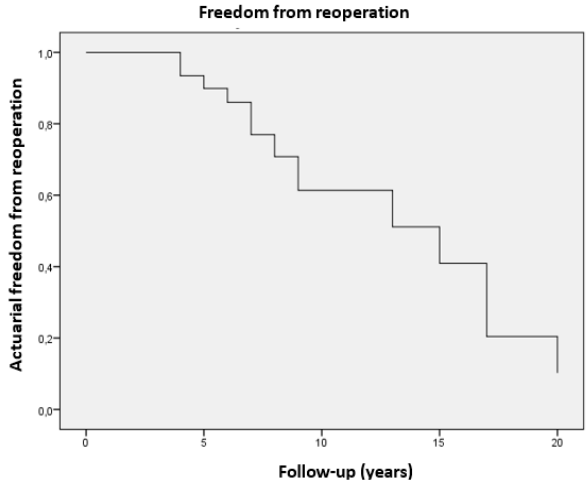

Figure 1 *Kaplan-Meier Curve for Survival (Log-rank test, p=0.173).*

reoperations. Median freedom from catheter intervention was 3,8 years. Median freedom from reoperation was 6,6 years. Figure 1 shows the actuarial curve concerning freedom from reoperation.

Cumulative mortality was 9.9% (n=9), 4 cases representing hospital mortality. Considering only the cases of hospital mortality, one case was an intra-operatory death, while the remaining three resulted from hemorrhagic complications, while on ECMO support.

DISCUSSION

Arterial switch is the treatment of choice for TGA, including TGA with intact interventricular septum or with interventricular septum defect.[2] Nowadays, this procedure has a reduced intra-operatory mortality with good long-term results. Currently, most treated patients live to adulthood, with a 20-year survival rate of nearly 90%.[1] With this improvement in surgical results, concerns are directed to coronary ischemia, neo-aortic valve disfunction and pulmonary stenosis, all possible causes of reoperation.[3] In our series and accordingly with most published results, the main cause of reoperation was right ventricle outflow obstruction, including main pulmonary artery and its branches.[1,3] Right ventricle outflow obstruction represents 58% (n=11) of all reoperations. Sixteen percent (n=3) had aortic insufficiency, 11% (n=2) had coronary lesions and 11% were reoperated because of inter-atrial communications. One patient had residual aortic coarctation (Table 1).

In published series, the incidence of pulmonary artery stenosis or its branches after arterial switch operation ranges between 10-17%.[1,4] The need of balloon angioplasty varies between 17-28% and the need of reoperation is 2-6%.[5] Pulmonary stenosis after arterial switch operation can occur at the infundibulum or at a supravalvular level, while valvular stenosis is rare. There are various mechanisms related to pulmonary stenosis, namely, the three-dimensional conformation of the great vessels associated with this disease and surgical related factors. Although Jatene surgery corrects ventriculo-arterial discordance, it does not achieve a normal spiral configuration of the great arteries. With the LeCompte maneuver the pulmonary bifurcation is mobilized anteriorly, but the great arteries remain parallel to each other and the bifurcation of the pulmonary is possibly compressed posteriorly by the aorta.[6]

The main objective of this retrospective analyze is to determine with variables better predict the need of reoperation. There was not a significant statistical difference between the median age at operation between the patient who needed reoperation and those who did not ($p = 0,1$). We tested the influence of sex, diagnosis (simple TGA versus complex TGA) and previous surgery and we were not able to find a significant statistic association ($p = 0,8$; 0,5; 0,9 respectively). The presence of anomalous coronary arteries was the only variable with a significant statistical association with reoperation ($p < 0.05$). It was, therefore, tested on multivariable analyze, achieving the same statistical significance ($p < 0.05$). Eight patients presented with anomalous coronary arteries. One of them presented with both an anomalous origin and an intramural segment. Of the remaining 7 patients, one had an intramural segment, three had type E, two had type D and one had type C anomalous coronary origin, accordingly with Yacoub's classification.[7] Considering patients with anomalous coronary arteries who underwent reoperation, only one was because of coronary ischemia. In the group of patients who underwent reoperation, the main cause was right ventricle outflow tract obstruction (n=11).

Coronary button transfer to neo-aorta (Figures 2 and 3) represents a crucial step of switch arterial surgery.[8] However, in our series, despite the association between the presence of anomalous coronary artery and reoperation, most patients were not reoperated because of coronary ischemia.

Table 1 **Causes of reoperation in patients submitted to arterial switch operation**

Cause of reoperation	Percentage	Number of patients
Right ventricle outflow tract obstruction	58%	11
Aortic insufficiency	16%	3
Coronary lesions	11%	2
Inter-atrial communications	11%	2
Residual aortic coarctation	5%	1

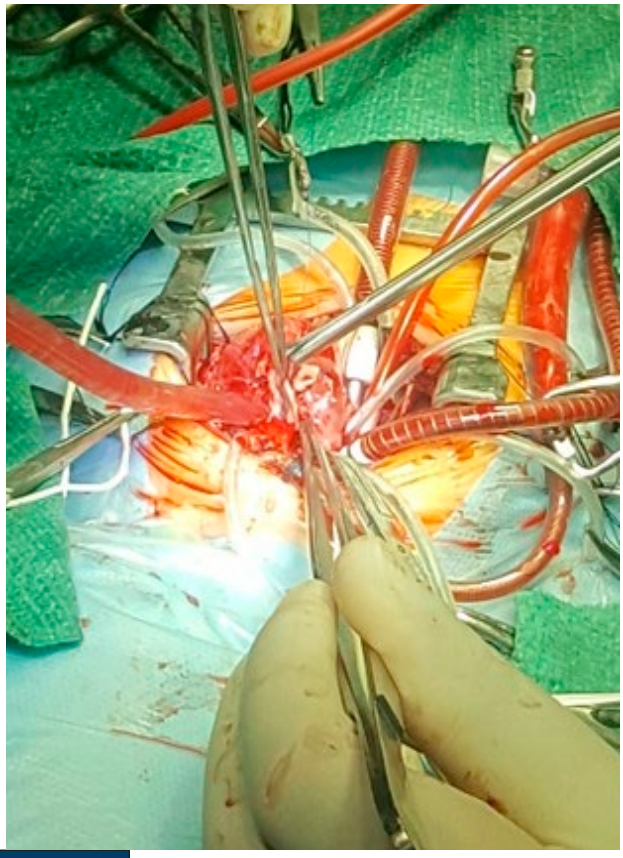

Figure 2 *Excision of the coronary buttons with the button technique.*

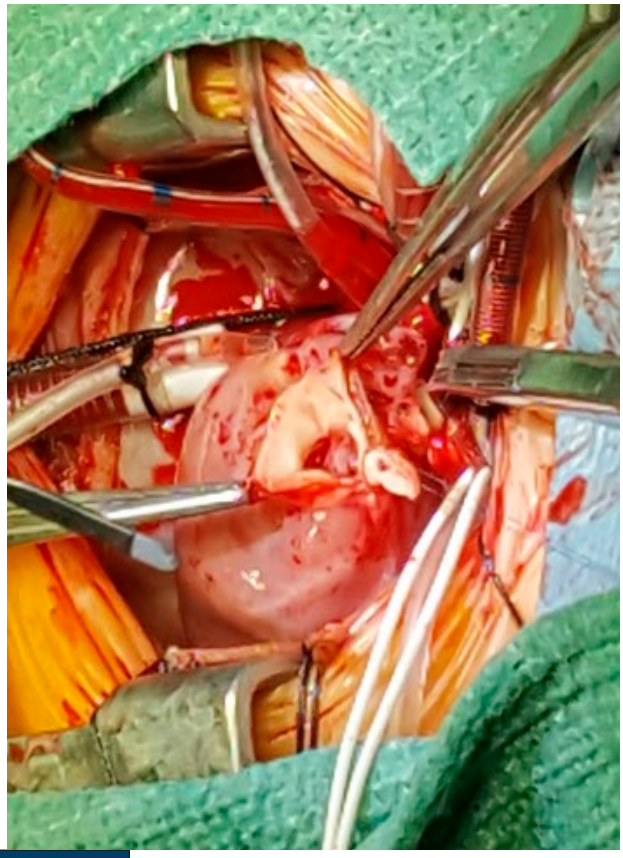

Figure 3 *Coronary button before implantation in the neo-aorta.*

On the contrary, most were reoperated because of supra-pulmonary stenosis. The presence of anomalous coronary patterns frequently requires a larger button, which might lead to sub-optimal reconstructions of the neo-pulmonary. From another perspective, the coronary anatomy depends on aortopulmonary rotation, meaning that those patterns are more frequently associated to side-by-side and antero-posterior relation of the great arteries. The limitations of our study result from the retrospective character, based in the results of a single institution.

CONCLUSION

Supra-pulmonary artery stenosis is the most frequent cause of reoperation after arterial switch operation. In our series, univariate analysis identified an association between the presence of coronary artery anomalous and reoperation, association that remained statistically significant in multivariate analysis.

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