Pulmonary Valve Pressure Gradient in Pulmonary Stenosis: Before and After Balloon Valvuloplasty

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Abstract

Pulmonary valve stenosis is common among other congenital heart diseases. The need to treat the stenosis was based on the presence of symptomatic signs. Balloon valvuloplasty is commonly used because it is less invasive than surgery. However, the study about decreased pressure gradient in pulmonary stenosis after balloon valvuloplasty was still limited. Thus, this article review aimed to see how much the reduction of pressure gradient after balloon valvuloplasty in pulmonary stenosis. The search engine used in this study was PubMed, then the articles were selected according to PICO (population, intervention, comparison, and outcomes). Only articles containing data about patients with pulmonary stenosis who underwent balloon valvuloplasty and comparing before and after mean pressure gradients to see the outcomes after balloon valvuloplasty was included in this literature review. The mean of pressure gradient from all the data before treatment was grouped into <50mmHg, 50 - 80 mmHg, >80 mmHg, then we combined the mean, and the result was 42.28 mmHg; 77.43 mmHg; 92.62 mmHg, respectively. The mean after treatment was also grouped into <50mmHg, 50 – 80 mmHg, >80 mmHg, and the result were 12.96mmHg; 26.78mmHg; 30.65mmHg, respectively. The reduction in gradient pressure was more than 50% in all groups. Thus, balloon valvuloplasty is an efficient treatment for pulmonary stenosis.

Keywords: balloon valvuloplasty; CHD; heart defects; pulmonary valve stenosis

1. Introduction

Balloon valvuloplasty is a procedure to correct stenotic or stiffened valves. The primary mechanism of balloon valvuloplasty was by opening up the valve. It can be used in some stenotic valve cases, such as pulmonary, tricuspid, mitral, and aortic valves [1], [2]. Pulmonary valve stenosis, often called right ventricle outflow tract obstruction, accounts for 7% – 10% of other congenital heart defects. It is often asymptomatic and can be found late in adulthood. However, pulmonary stenosis was also associated with other congenital heart defects and thus became symptomatic such as TOF [3], [4].

In treating pulmonary stenosis, balloon valvuloplasty is preferably used in moderate to severe cases [1], [2]. However, clinicians still need to consider whether balloon valvuloplasty is suitable for treating pulmonary stenosis. The magnitude of the decrease in pressure gradient needs to be evaluated if all functions have returned to normal [5]. Unfortunately, there were still limited studies

that can answer whether balloon valvuloplasty is worth the decrease in pressure gradient in treating pulmonary stenosis. Thus, this literature review aims to determine how much the pressure gradient could decrease after balloon valvuloplasty in patients with pulmonary stenosis.

2. Methods

This literature review used PubMed as a search engine. This review used PICO (Patients, Intervention, Comparison, and Outcomes) method to select the articles. Only study of patients with a history of pulmonary valve stenosis who underwent balloon valvuloplasty was included in this literature review. The study must have before and after mean gradient pressure of pulmonary artery data. This literature review searched for the outcomes of gradient pressure after balloon valvuloplasty in pulmonary valve stenosis. The range of publication time of five years was used.

One hundred fifty-five articles were found in PubMed, but only 10 met the criteria during abstract screening. After reading the articles, eight articles fit the PICO method.

3. Result

Table 1. Results of article reviews

Author	Participant	Materials and Method	Study Design	Other Heart Defects	Result
El–Saeidi [6]	1200 patients were included and grouped into neonates (n = 282), infants (n = 362), and children (n = 556)	Catheterisation, medical records	Retrospective cross-sectional study	Yes	Gradient pressure of pulmonary valve in : Neonates - Before : 92.9±29.2 - After : 30.1±18.3 Infants - Before : 90.1±28.9 - After : 29.7±18.8 Children - Before : 79.3±27.1 - After : 26.2±13.9
Parent [7]	53 children were included.	Medical records, echocardiogram, catheterisation, peak to peak gradient	Retrospective analysis	No	Gradient pressure of pulmonary valve : Echocardiogram : - Before : 60.6±14.7 - After : 25.5±12.1 Catherisation : - Before : 42.5±19.6 - After : 13±7.7
Choi [8]	46 patients with a mean age of 5.7 years were included. Their primary diagnosis varied (TOF with pulmonary stenosis, pulmonary atresia with VSD, TGA with VSD.	Medical records	Retrospective study	Yes	Gradient pressure of pulmonary valve : Before : 55.3±18.5 After : 33.8±21.5
Sener [9]	A 23-year-old mother came to do a medical	Medical record,	Case report	No	Peak pressure gradient : Before : 122 mmHg

	check-up and found out that she had severe pulmonary valve stenosis				After : 48 mmHg Mean pressure gradient : Before : 68 mmHg After : 26 mmHg
Agha [10]	41 infants born with critical pulmonary stenosis	Follow up to 1 year after balloon valvuloplasty	Prospective cohort study	No	Transvalvular pressure gradient : Before : 112.92±4.1 After : - 1 week : 42.69±1.3 - 1 month : 38.15±1.6 - 3 months : 30.10±1.9 - 6 months : 27.38±1.3 - 1 year : 22.69±1.1
Ishii [11]	A 59-year-old woman came to the hospital with symptomatic pulmonary stenosis. She was diagnosed with pulmonary stenosis at 14 year old, but there were no symptoms.	Medical record, a case	Case report	No	Pressure gradient of pulmonary valve : Before : 84 mmHg After : 37 mmHg
Cagdas [12]	A 42-year-old woman came to the hospital with progressive dyspnea	Medical record, a case	Case report	No	Transvalvular pulmonary pressure gradient : Before : 105 mmHg After : - 1 day : 31 mmHg - 6 months : 35 mmHg
Ohnishi[13]	Case report of 2 patients. A 3-month-old girl with pulmonary stenosis and neonates (male) with pulmonary stenosis and PDA.	Medical records	Case report	Yes	Patient A : Before : 71 mmHg After : 32 mmHg Patient B Before : 31 After : 11

Table 2. Combined mean of all the article based on gradient pressure of pulmonal valve

Mean Gradient Pressure of Pulmonal Valve Before Balloon Valvuloplasty	Total Data	Combined Mean Gradient Pressure	
		Before Balloon Valvuloplasty	After Balloon Valvuloplasty
<50 mmHg	54	42.28 mmHg	12.96 mmHg
50 – 80 mmHg	604	77.43 mmHg	26.78 mmHg
>80 mmHg	687	92.62 mmHg	30.65 mmHg

4. Discussion

The severity of pulmonary stenosis was based on how great the gradient pressure of the pulmonal valve. The gradient then would be grouped into three (<50mmHg, 50 – 80mmHg, >80mmHg) [5]. The mean of all the gradient pressure of the pulmonary valve is shown in table 2. The combined average gradient pressure showed in group >80mmHg before balloon valvuloplasty has the bigger

pressure gradient left after the treatment. According to Puruhito, the larger the gradient, the less gradient pressure will drop in a short amount of time after treatment [5]. The greater gradient pressure of the pulmonal valve resulted from right ventricle dysfunction. When the right ventricle is inadequate for systolic function, the pressure produced does not overcome the stenosis [14]. As shown in Table 2, in the <50mmHg group, the pressure gradient decreased by 69.3%. While in the 50 – 80 mmHg group, there was a 65.4% reduction after balloon valvuloplasty. In addition, in the last group, the pressure gradient reduction after balloon valvuloplasty was 66.9%.

However, a successful balloon valvuloplasty is defined as decreased pressure gradient to 50% or more of the pre-balloon valvuloplasty [6]. Thus, despite a large residual pressure gradient in larger group, the treatment was considered a success. However, there was a limitation to this study. The study was limited in combining all the data despite the patient's age. Further study with a more precise method, such as meta-analysis and systematic reviews, is needed.

5. Conclusion

Balloon valvuloplasty is an efficient treatment for pulmonary stenosis. After balloon valvuloplasty, there was more than a 50% reduction in pulmonary valve gradient pressure.

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