

# Mild Pulmonary Valve Stenosis: the Possible Spontaneous Cure in the Natural History of the Defect

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## OBJECTIVE

To determine the long-term natural history of patients with mild pulmonary valve stenosis

## METHODS

Throughout a 24-year evolutive period (1980 a 2004), 83 patients with pulmonary valve stenosis were evaluated, with 29 of them presenting a mild form of the defect. Of these 29, 13 patients had a long-term follow up. The mean age at the first and last follow-up visits was 34 months (1 month to 15 years) and 10.5 years (3 to 24 years), respectively. In addition to evolutive elements, those regarding clinical, electrocardiographic and echocardiographic aspects were also assessed.

## RESULTS

All patients remained assymptomatic throughout the study. Regarding the pulmonary valve pressure gradient, 5 (38.4%) presented a decrease, 3 (23%) remained unchanged, 4 (30.7%) presented elimination and 1 (7.6%) presented accentuation to a moderate degree of involvement. The mean initial and final gradient was 24.2 mmHg (15-30) and 13.6 mmHg (0-54), respectively. The initial gradients of the 4 patients who achieved spontaneous cure were 30, 19, 30 and 20 mmHg. The systolic murmur and right ventricular overload had a direct correlation to the gradient pressure degree, subdivided at each 10 mmHg.

## CONCLUSION

The spontaneous cure of the mild pulmonary valve stenosis is possible to achieve, similarly to other acyanogenic anomalies.

## KEY WORDS

Pulmonary valve stenosis, congenital cardiopathy, natural history.

The mean longevity according to the natural history of pulmonary valve stenosis was estimated by Campbell<sup>1</sup> as being  $24 \pm 4.5$  years. At this evaluation, performed in 1969, regarding the moderate and severe degrees of the defect,  $19 \pm 7\%$  survived up to 40 years of age. It is thus demonstrated that these defects with a higher impact tend to worsen with age, and are responsible for an adverse evolution in case they are not subsequently improved by interventionist techniques, by balloon-catheter or even surgery itself<sup>2,3</sup>.

Dissimilarly, Samanek<sup>4</sup> subsequently stated in 1992, also by studying the natural history of congenital cardiopathies, that pulmonary stenosis is the most benign anomaly of all, with a survival rate of 94% up to 15 years of age.

On the other hand, when the defect has a mild impact, its natural history tends to be even more favorable<sup>2-13</sup>, although the "spontaneous cure" is a rare occurrence<sup>8</sup>.

This study reports the natural history of mild pulmonary stenosis in a small series of patients followed by the author, with some of them presenting a complete transvalvular pressure gradient reduction.

## METHODS

Eighty-three patients with pulmonary valve stenosis were followed from November 1980 to December 2004, by only one observer at the author's private clinic. Among them, 29 presented mild stenosis (pressure gradient lower than 41 mmHg), 27 had moderate stenosis (pressure gradient between 41 and 80 mmHg) and 27 presented severe stenosis (pressure gradient above 80 mmHg).

Of the 29 patients with mild pulmonary stenosis, 13 of them, all with gradient pressure  $< 30$  mmHg, had a long-term follow-up and comprise the series in this study. These patients were followed and evaluated regarding the natural history with emphasis on the presence/absence of symptoms, clinical complications, cardiac murmur type and intensity, always correlated with electrocardiographic findings, such as the electrical axis of the QRS complex and right ventricle overload, and mainly the pressure gradient between the right ventricle and the pulmonary trunk, evaluated by echocardiography.

Regarding the cardiac murmur, it was characterized as the ejection type, with the intensity varying from + to ++++ according to the degree, with + being mild, ++ moderate, and  $> +++$ , severe. The +/+ intensity refers from mild to moderate intensity. The echocardiography study was carried out by a skilled professional with broad experience in the specialty in hospital services and/or specialized clinics; the study was carried out randomly, regardless of the evolutive phase of the defect. The pressure gradient between the right ventricle and the pulmonary trunk was evaluated by transthoracic Doppler echocardiographic study, in a parasternal short axis view, or subcostal view. The size of

the right ventricle was disregarded, as all patients showed normal sized ventricles due to the mild obstruction effect at the pulmonary valve level.

The fact that the echocardiographic study was randomly performed by several examiners was not considered a limitation, given the professionals' experience in acquiring diagnostic images as well as the accurate evaluation of the defect, which was carried out homogeneous and consistently. In addition, this is a simple defect, which does not bring any difficulty for its routine diagnosis as well as its outcome analysis.

## RESULTS

Patients' mean ages at the initial phase ranged from 1 month to 15 years, with a mean of 34 months and a mean weight of 15.1 kg, ranging from 3.6 to 60 kg. At the last evaluation, mean age was 10.5 years, ranging from 3 to 24 years and a mean weight of 41.1 kg, ranging from 14 to 93 kg. Six patients were females and 7 patients were male. None of the patients presented another associated cardiac defect, even at the interatrial communication. Four of them presented a pervious foramen ovale (PFO).

Regarding the natural history of the pressure gradient, a decrease was observed in 5 patients (38.4%), corresponding to cases 4, 6, 8, 9, and 10; 3 patients remained unaltered (23%), corresponding to cases 3, 7 and 13; 4 patients (30.7%) presented elimination, corresponding to cases 1, 2, 5 and 12, and accentuation to a moderate degree was observed in just one patient (7.6%), case 11.

The mean pressure gradients between the right ventricle and the pulmonary trunk at the initial and final phases were 24.2 mmHg and 13.6 mmHg, respectively. Eliminating case 11, the only one that showed accentuation of the defect during the natural history of the disease, the mean initial and final gradients of the other 12 cases corresponded to 24.4 mmHg and 10.25 mmHg, respectively. The "spontaneous cure" of the cardiopathy occurred in patients with previous pressure gradients of 30, 19, 30 and 20 mmHg, corresponding to cases 1, 2, 5 and 12, respectively (Table 1).

All patients remained asymptomatic from the initial phase up to the last clinical consult. During follow-up, 4 patients presented interurrences such as bronchial asthma, bronchopneumonia, urinary infection, and renal lithiasis. No patient showed neuropsychomotor development alterations.

The intensity of the cardiac murmur and the presence or not of mild right ventricular overload had a clear correlation with the degree of pressure gradient at the pulmonary valve level. Thus, considering the initial and final periods and totaling 26 cardiovascular assessments, at the 13 occasions in which pressure gradients were below 19 mmHg, the systolic murmur was absent in 4 (30.7%), and had a mild intensity (+) in 8 (61.5%); at

**Table 1 – Pressure gradients between the right ventricle and the pulmonary trunk. related to age and weight. at the initial and the final evolutive phases**

Case	Pressure Gradient RV-PT (mmHg)		age		Weight (Kg)	
	Initial	Final	Initial	Final	Initial	Final
1	30	0	5 m	5 yr	7.8	18.8
2	19	0	4 m	7 yr	7	22.5
3	19	18	2 yr	5 yr	10	20
4	30	9	1 m	14 yr	3.6	50.5
5	30	0	15 yr	24 yr	60	93
6	15	10	6 m	4 yr	8	18
7	30	25	9 yr	22 yr	35	72
8	30	15	1 yr	9 yr	12	37
9	25	13	3 yr	16 yr	15	65
10	20	10	6 m	8 yr	8	34
11	22	54	4 yr	14 yr	16.8	68.5
12	20	0	6 m	6 yr	6	21
13	25	23	7m	3 yr	8	14
Means	24.2	13.6	34 m	10.5 yr	15.1	41.1

*yr- years; m- months; PT- pulmonary trunk; RV- right ventricle*

the 13 occasions in which pressure gradients were above 20 mmHg, the murmur had a +/++ intensity in 11 (84.6%) of them. The right ventricular overload evaluated by electrocardiogram, did not occur in 12 (93.3%) at the 13 occasions with pressure gradients below 19 mmHg, and was mild in 9 (69.2%) at the 13 occasions with pressure gradients above 20 mmHg. The electrical axis of the QRS complex was situated, among the 13 patients with gradients below 19 mmHg, between 0 and 90°. Among the 13 with gradients above 20 mmHg, 2 presented the QRS complex axis above 90°, 10 between 0 and 90°, and 1 at -20°. The latter was the only patient in the series with a higher orientation of the electrical axis of the QRS complex (Table 2).

## DISCUSSION

The knowledge of the natural history of pulmonary valve stenosis allows us to state that moderate and accentuated defects tend to undergo the intensifying of their effects<sup>2,3</sup> and the mild defects, their decrease<sup>2-13</sup>.

The mean longevity of this defect, when presenting its more accentuated effects, is  $24.5 \pm 4.5$  years, given the concurrent adverse events in the evolution responsible for the deterioration of the ventricular function, represented mainly by hypertrophy, fibrosis, cardiac failure and arrhythmias<sup>1</sup>.

However, Samanek<sup>4</sup> stresses that, during the study of the natural history of several congenital cardiopathies, pulmonary stenosis presents the most favorable evolutive course among all of them, with a survival rate of 97%, 96% and 94% at 1, 2 and 15 years of age, respectively. In this series, 3% of the patients died in the first year, with the safest evolutive period corresponding from the 3<sup>rd</sup> to the 10<sup>th</sup> year<sup>4</sup>.

Most of the publications also mention a favorable evolution in pulmonary valve stenosis when they present a mild degree of severity<sup>2-13</sup>. Few of these<sup>5,7</sup> show an unfavorable evolution of the mild defect, due to the rapid worsening of the condition, similar to what is observed in more severe defects, mainly when exteriorizing occurs

**Table 2 – Correlation of the intensity of the systolic murmur, presence of right ventricular overload, and QRS complex axis with the pulmonary transvalvular pressure gradient at the 26 evolutive cardiovascular examinations in the 13 patients**

Pressure Gradient RV-PT (mmHg)	N	Systolic Murmur			Mild RVO		ÂQRS°		
		Absent	+	+/++	No	Yes	<0	0 - 90	91 - 120
0 – 9	5	4	1	-	5	-	-	5	-
10 – 19	8	-	7	1	7	1	-	8	-
20 – 29	7	-	1	6	3	4	-	7	-
> 30	6	-	1	5	1	5	1	3	2

*RVO - right ventricular overload, : PT – Pulmonary trunk, RV – Right ventricle*

early in life. Mody<sup>5</sup> observed that the increase of defect severity was noticed in patients younger than 1 year, even those who presented mild effects, at a faster progression rate than in patients older than 1 year of age. The same type of evolution was observed by Anand and Mehta<sup>7</sup> in 6 (15%) of 40 infants, with a fast worsening of the mild defect at this age range. It is thought that such evolution is due to two reasons. The first, by the presence of a physiological pulmonary hypertension in the neonatal period, causing an initial underestimated gradient; and the second, due to the child's rapid growth in the first months of life, which would not be proportional to the pulmonary ring and the valvular elements. Tomita et al<sup>6</sup>, however, have contested such reports by observing a favorable evolution in patients with mild pulmonary valve stenosis younger than 1 one year of age.

On the other hand, no study in literature except that by Gielen et al<sup>8</sup>, has mentioned the total elimination of the pulmonary valvular pressure gradient. According to these authors<sup>8</sup>, this normalization occurred in 9 (28.1%) of 32 patients with pulmonary stenosis characterized as minor, with pressure gradients < 20 mmHg. These authors<sup>8</sup>, however, do not report, concomitantly with the elimination of the defect, on the other clinical events of this "cure", such as cardiac murmur elimination, electrocardiographic normalization, along with the total elimination of the pressure gradient between the right ventricle and the pulmonary trunk, as observed in 4 (30.7%) of our 13 patients.

Our remaining findings are in accordance to most of the other findings in literature, which show that 5 (38.4%) patients presented a gradient decrease, 3 (23%) remained unchanged and only 1 (7.6%) presented worsening of the defect to a moderate degree.

Regarding this aspect, Anand and Mehta<sup>7</sup> observed a gradient worsening in 15% (6 of 40) of asymptomatic infants, who needed surgical intervention or percutaneous

valvuloplasty. The same type of evolution was observed by Gielen et al<sup>8</sup>, who noticed worsening in 3 and 10% of minor and mild defects, respectively. Wennevold and Jacobsen<sup>2</sup> observed worsening in 1 (14.2%) of 7 patients with pressure gradient < 50 mmHg. Lueker et al<sup>12</sup> observed a mild worsening in 1 (12.5%) of 8 patients with pressure gradient < 50 mmHg during a mean period of 7.8 years, in children. Nugent et al<sup>9</sup> had also noticed worsening of the pulmonary transvalvular gradient in 14% of the patients evaluated by a hemodynamic study, during a period of 4 to 8 years.

Finally, it can be stated that, in mild cases of pulmonary stenosis with a pressure gradient < 30 mmHg, diagnosed and evaluated at any age range, except neonatal and first months of life<sup>5,7</sup>, the evolution is usually favorable up to the spontaneous cure of the defect, and complications that would necessitate some type of intervention are rarely observed in this group of patients in the course of the natural history.

Despite the favorable evolutive perspective, these patients must undergo the prophylaxis of infectious endocarditis, although it seldom occurs in patients with pulmonary stenosis, even in those cases with more severe defects, according to the current guidelines of the American Heart Association.

Thus, the pulmonary stenosis can be grouped with other congenital anomalies that can evolve to spontaneous cure, similarly to what occurs with other acyanogenic defects such as left-to-right blood flow, mainly represented by interventricular communication, but also by the arterial canal and interatrial communication.

This knowledge becomes fundamental when providing adequate assistance to these patients' families during daily clinical practice, allowing an early outline of a more appropriate perspective for mild pulmonary valve stenosis.

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