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Original Article

Correlation of pulmonary capillary wedge pressure with left atrial pressure in patients with mitral stenosis undergoing balloon valvotomy

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ABSTRACT

Aims: We sought to evaluate the correlation between PCWP and LAP and to compare transmitral gradients obtained with LAP and PCWP in MS, before and after balloon mitral valvotomy (BMV).

Methods: Consecutive patients with MS for BMV were included in this prospective cohort study. Simultaneous PCWP and LAP were recorded followed by simultaneous left atrium–left ventricular (LA–LV) and pulmonary capillary wedge pressure–left ventricular (PCWP–LV) gradients before and after BMV.

Results: There were 30 patients with a mean age of 41 yrs (males 10 (33.3%), females 20 (66.7%)). There was no significant difference between mean LAP and mean PCWP before BMV (21.3 mmHg and 22.3 mmHg, respectively) or after BMV (15.3 mmHg and 17.3 mmHg, respectively). There was excellent correlation between mean PCWP and mean LAP before BMV ($r = 0.95$) ($p < 0.001$) and after BMV ($r = 0.85$) ($p < 0.001$). The phasic components of the pressures (a and v waves) of LAP and PCWP also showed good correlation before and after BMV. Further, transmitral gradients assessed by LA–LV and PCWP–LV pressures showed excellent correlation before BMV ($r = 0.95$) ($p < 0.001$) and after BMV ($r = 0.95$) ($p < 0.001$).

Conclusion: In patients with MS undergoing balloon valvotomy, PCWP shows good correlation with LAP. Transmitral gradients obtained with PCWP and LAP also correlate well after correction of phase lag in PCWP tracing. Hence, PCWP can be used for reliable measurement of transmitral gradient.

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1. Introduction

Simultaneous measurement of left atrial pressure (LAP) and left ventricular diastolic pressure (LVDP) is the ideal method for determination of the mean mitral valve gradient in patients with mitral stenosis (MS). However, many invasive laboratories use pulmonary capillary wedge pressure (PCWP) instead of LAP because of the inherent risks of transseptal catheterization.[1,2] It has remained controversial ever since, with some investigators attesting to the concept that PCWP accurately reflects LAP[3,4] but others disagreeing, particularly in the setting of mitral valve disease or raised pulmonary vascular resistance.[5–8]

Two previous studies have argued against the use of PCWP in patients with MS and prosthetic mitral valves, because a clinically significant overestimation of true transmitral gradient may result.[9,10] This was attributed to inherent delay in PCWP traces.[10] In a subsequent study, it was observed that time-adjusted PCWP accurately reflects LAP; however, transmitral gradient was overestimated even after correcting the phase lag in PCWP traces.[5] Without correction for the delay in PCWP trace, there was 53% overestimation of transmitral gradient. Correction of this delay decreased the error, though some overestimation persisted.[11] However, recently in a study by Krishnamurthy et al., it was found that after correction for the phase lag, transmitral gradient obtained using PCWP was comparable to that obtained using LAP both before and after balloon mitral valvotomy (BMV).[12]

The present study was prompted by the disparities seen in previous studies. Our study aimed at evaluating the correlation between PCWP and LAP in patients with MS in normal sinus rhythm or atrial fibrillation. The transmitral gradients obtained with LAP and that obtained with PCWP were also compared. Assessments were done both before and after BMV.

2. Materials and methods

In this prospective cohort study, we included consecutive patients with MS admitted to a tertiary care hospital for BMV during a period of one year. Exclusion criteria were significant chronic respiratory illness or aortic valve disease.

Baseline data were collected regarding demographic and clinical characteristics, electrocardiogram, chest X-ray manifestations, and echocardiographic features. Procedure was done in fasting state. Through femoral vein access, a 6F Cournand catheter was positioned in the pulmonary artery under fluoroscopic guidance and pulmonary artery pressures were recorded. The catheter was then pushed into the left lower pulmonary artery in each case as far as possible during deep inspiration and PCWP was obtained. For measuring LVDP, a 6F pigtail catheter was placed retrogradely into the left ventricle. Catheter over-damping and under-damping were avoided and the shortest possible transducer connection was used. PCWP was accepted only when: (1) the pressure contour was distinctly different from that recorded in the pulmonary artery on a pullback determination and both the phasic and mean wedge pressures were lower than that of the pulmonary artery; (2) there was fluoroscopic demonstration of wedge position; and (3) there were two separate a and v waves in the tracing.

Transseptal left heart catheterization was performed percutaneously through the right femoral vein using Brockenbrough needle and a transseptal catheter introducer set. An 8F transseptal sheath was placed in the left atrium. Simultaneous PCWP and LAP (mean and phasic) were recorded. Following this, simultaneous LA–LV and PCWP–LV gradients were recorded. Patients underwent BMV by the method described by Inoue et al.[13] Similar measurements were repeated after BMV.

To correct the phasic delay in PCWP trace, pressure tracing was manually shifted so that the peak of the v wave of PCWP coincided with the descending limb of the left ventricular pressure tracing. The mean transvalvular pressure gradients were determined from the measured diastolic filling periods after planimetry of three consecutive beats (in patients with sinus rhythm) or 5 consecutive beats (in patients with atrial fibrillation).

Statistical analysis was performed using Statistical Package for Social Science software (SPSS Inc Chicago, Illinois version 18). Qualitative variables, expressed as numbers and percents, were compared by the Chi-square test. A p-value less than 0.05 was considered statistically significant. Correlation was assessed with Pearson's correlation coefficient.

3. Results

There were 30 patients with a mean age of 41 yrs [males 10 (33.3%), females 20 (66.7%)]. Baseline patient characteristics are listed in Table 1. There was no significant difference between mean LAP (21.27 ± 9.1 mmHg) and mean PCWP (22.43 ± 9.5 mmHg) before BMV. Post BMV also, similar result was obtained with a mean LAP (15.3 ± 7.9) and mean PCWP (17.23 ± 7.6). There was good correlation between the mean PCWP and mean LAP before BMV ($r = 0.95$) ($p < 0.001$) and after BMV ($r = 0.85$) ($p < 0.001$). The phasic components of the pressures of LAP and PCWP also showed good correlation before and after BMV. Comparison of mean LAP, mean PCWP, and phasic components is shown in Table 2. Furthermore, transmitral gradients assessed by LA–LV and PCWP–LV pressures showed excellent correlation before BMV ($r = 0.95$) ($p < 0.001$) and after BMV (0.95) ($r = p < 0.001$). Comparison of mean transmitral gradients obtained with PCWP and LAP components is shown in Table 3. A representative tracing is displayed in Fig. 1.

Table 1 – Baseline characteristics ($n = 30$).

Age, yrs, mean (SD)	41.5 (13.5)
Male/female n (%)	10 (33.3)/20 (66.7)
Atrial fibrillation, n (%)	6 (20)
Mitral valve area, cm^2, mean (SD)	0.913 (0.14)
Left atrial diameter, mm, mean (SD)	45.2 (8.07)

SD: standard deviation.