

Non-Invasive Measurement of Pulmonary Capillary Wedge Pressure by Transthoracic Echocardiography in Local Population

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ABSTRACT

Aim: To find value of pulmonary capillary wedge pressure(PCWP) non-invasively using tissue Doppler and mitral inflow velocities by echocardiography in patients attending a tertiary care teaching hospital OPD or those who were admitted there.

Methods: 115 patients were selected for this retrospective observational study. These patients were referred for echocardiography for various indications .The data was statistically analyzed using SPSS v 25.

Result: Amongst 115 selected patients(48 males and 67 females) twenty had normal echocardiographic study. . IHD with preserved EF were 23(20%) (11 males, 12 females) IHD with reduced LV ejection fraction were 3(2.63%). Fifty three patients (46.5%) were having diastolic dysfunction. PCWP average value was 17 ± 5.86 .

Keywords: Echocardiography , pulmonary capillary wedge pressure, E, E', mitral inflow, Doppler

INTRODUCTION

Heart failure is relatively common clinical condition. It is end result of various diseases including ischemic heart disease, diabetes and hypertension. Two main varieties are heart failure with preserved ejection fraction and heart failure with reduced ejection fraction. The later variety results from damage to myocardium. The failure accompanied by preserved ejection fraction is due to impaired ventricular relaxation resulting in increased end diastolic filling pressure. The gold standard to measure this pressure is through the use of ventricular catheterization. This is an invasive technique which measures pulmonary Department of Medicine, Lahore Medical & Dental College . Gurki Trust Teaching Hospital Lahore, capillary wedge pressure serving as surrogate marker for left ventricle filling pressure¹. Increased pressures reflect heart failure. This is cumbersome during clinical practice in heart failure patients which are already critically ill. The catheterization using Swan- Ganz catheter results in increased morbidity and mortality amongst ICU patients².As an alternative , echocardiographic calculation of pulmonary capillary wedge pressure using mitral inflow and tissue Doppler velocities of mitral annular plane movements is a non-invasive ,safe and validated technique. In this technique the ratio of peak early mitral inflow velocity (designated by E) to peak early mitral annular velocity (E') is used in a formula to calculate the PCWP³. The normal value is below 8 mm Hg and a value above 15 mm Hg is considered abnormal. The values in between 8 and 15 mm Hg range fall in a grey zone where the doctor has to take in account of other factors before making a diagnosis of heart failure. There is paucity of local studies on this important technique. Therefore in this study we tried to find out whether values in our study population are similar to those found in international literature.

MATERIALS AND METHODS

In this study 115 patients above 18 years of age, both male and females were enrolled retrospectively . These patients were referred from OPD , ICU and surgical and medical wards of this hospital for transthoracic echocardiography

required due to various indications . From March 2018 to September 2018. These patients underwent transthoracic echocardiography using Toshiba Xario 100 dedicated echocardiography machine by same doctor during morning shift. Mitral inflow velocities , tissue Doppler placed at interventricular septum, Deceleration time (DT) and E:A ratio were noted. Sample volume of pulsed wave Doppler was placed at mitral tip for E and same was positioned at *septal* mitral annular plane for E'. A normal value of PCWP⁵ was less than 8 mm Hg and the value more than 15 mmHg was considered to be abnormal. The frequencies of different diagnoses were also calculated. Number of patients who had normal ejection fraction versus reduced ejection fractions were calculated. The data was recorded on report and given to patient. A backup copy was retained for future reference. The data from this backup was later entered into an excel sheet .This sheet was later analyzed using Statistical software package SPSS version 25. Statistical analysis was done by finding frequencies and percentages for categorical data and means and standard deviation for continuous data. Student t test was used to compare data using a p-value of <0.05 as significant. Pearson correlation co-efficient was used for linear correlation.

RESULTS

Out of two hundred and thirty seven patients 115 were selected on the basis of availability of required Doppler parameters. Out of these 48 were males and 67 were females. The average age was 56.4 years. Males were on average 59 years and females average age was 55 years. There was no statistically significant difference between age in both sexes (p Value 2.9). Twenty patients (17.3%) had normal echo study. Patients suffering from Ischemic heart disease with preserved ejection fraction were 23(20%) out of these 11 were males and 12 females. The total number of patients with IHD but having reduced LV ejection fraction were 3(2.63%). Fifty three patients (46.5%) were having diastolic dysfunction .The average value of pulmonary capillary wedge pressure found in this study was 17 ± 5.86 mmHg. When computed for relationship of increasing age with PCWP, no linear correlation was

identified, Pearson $r=0.007$. Thirty patients (26.3%) had varying degrees of concentric LVH ranging from mild to severe. Three patients (2.63%) had moderate degree of mitral regurgitation. Four patients (3.5%) had mild aortic regurgitation. Seven patients (6.14%) had dilated left atrium.

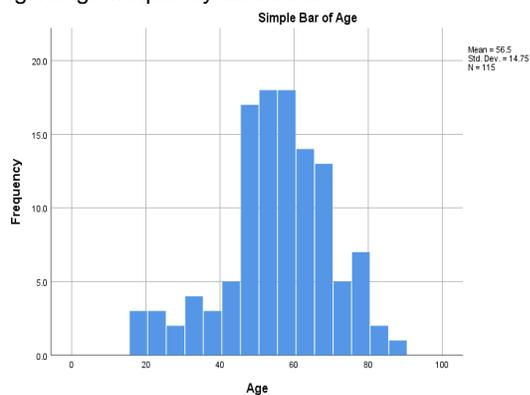
Table 1: Pulmonary Capillary Wedge Pressure value

Age	Valid	115
N	Missing	0
Mean		17.0624
Median		16.1600
Std. Deviation		5.86668
Range		28.62
Minimum		3.04
Maximum		31.66

Table .2: Age characteristics of study Population

Age	Valid	115
N	Missing	0
Mean		56.50
Median		58.00
Std. Deviation		14.750
Range		68
Minimum		18
Maximum		86

Fig. 1: Age frequency distribution



DISCUSSION

In this study objective was to find out value of pulmonary capillary wedge pressure in local population under study using transthoracic echocardiography. This value turned out to be 17 ± 3.5 in local population. The study population included patients both suffering from cardiac disease as well as those whose hearts turned out to be normal after echocardiographic study. The values were at higher end of normal compare to a study done by Abbas et al⁴, they wanted to know the correlation with Left ventricular end diastolic pressure. They found the value to average at 16 ± 7.4 . However they used cardiac catheterization for finding this value in place of non-invasive measurement using echocardiography. Their study sample consisted of 101 veteran patients who underwent this procedure primarily to characterize their pulmonary hypertension. Our observed

value was 1 mm Hg higher than their value primarily because we used echocardiography. In another study Desabndhu et al attempted to find out the PCWP correlation with LVEDP in patients of mitral stenosis before and after PTMC. In this study⁵ the value was 22 mm Generally the normal value of PCWP is <8 and >15 ⁶ is abnormal. In our study the value was at higher end because a significant number (46%) of our patients were suffering from diastolic dysfunction. This results in impaired ventricular relaxation and hence higher left ventricular diastolic pressure. Later entity then causes increased values of pulmonary capillary wedge pressure.

As far as the clinical implication of PCWP is concerned, it is obvious that The PCWP is an important parameter in decision making for IV fluid therapy in ICU setting where it is measured using Swan-Ganz catheter since 1970⁷. This method is invasive and studies show increased morbidity and mortality. Over past half century large body of data has accumulated identifying various in hospital complications of catheterization for measuring PCWP. Whereas the echocardiography based technique is non-invasive and inherently safe. Our study also showed that there was no significant difference between male and female gender for PCWP values. It was also observed that as age advances there is no linear correlation with PCWP value.

CONCLUSION

The observed values of PCWP observed in local population in this study co-related well with those depicted in international studies. Further studies will be required to find these values in other disease including diabetes, hypertension and IHD.

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