

Accuracy of Physical Examination for Diagnosing Pulmonary Arterial Hypertension in Congenital Heart Disease Children

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Abstract

Background: Pulmonary Hypertension is a complex problem characterized by non-specific signs and symptoms and having multiple potential causes. Delays in the diagnosis of PAH lead to postponement of treatment and thus may have deleterious effects. *Aims:* To determine the accuracy of physical examination (palpable second heart sound, dullness over pulmonary area, loud second heart sound) for diagnosing pulmonary hypertension in Congenital Heart Disease Children. *Materials and Methods:* A Cross Sectional Study in Department of Pediatrics at AVBRH, Sawangi, Wardha. 3 pediatric residents, trained by a cardiologist for detection of Pulmonary Hypertension in CHD cases assessed 140 clinically suspected CHD cases, looked for palpable second heart sound (P2), Dullness over pulmonary area, Loud second heart sound on auscultation. Their findings were correlated with 2 Dimensional Echocardiography. Data was entered into SPSS for Windows, Version 22 and Graph pad Prism 6.0 version for statistical analysis. To know the true positive cases, true negative cases, probability that the cases with positive physical examination truly have PAH probability that the cases with negative physical examination truly don't have PAH for which 2x2 contingency tables were formed. *Results:* Out of 140 cases of CHDs, 41 cases (29.2%) had Pulmonary hypertension. All the Physical markers are equally effective in analyzing pulmonary hypertension as predictive values are nearly equal, and there is no significant difference in their findings. *Conclusions:* we demonstrate that physical examination are effective in diagnosing the presence of PAH in CHD children.

Keywords: Pulmonary Hypertension; Heart Sound; Palpable Second Heart Sound (P2); Echocardiography.

Introduction

Pulmonary Arterial Hypertension (PAH) is a progressive and lethal pulmonary vascular disease and is a common complication of Congenital Heart Disease (CHD). Echocardiography predicts Pulmonary Arterial Pressure (PAP) and Pulmonary Vascular Resistance (PVR) and is a valuable routine tool. Early detection with physical examination of clinically silent pulmonary hypertension patients, is associated with improved long term survival as the disease remain incurable disease with an unacceptably high early mortality, despite advances in therapeutic options [1]. Hence this study helps us

for the early detection, and is cost effective, and could improve the survival rate.

Subjects and Methods

It was a Cross Sectional (Diagnostic) Study conducted in Department of Pediatrics at Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe), Wardha. The study duration was 2 years, from August 2015 to August 2017. Children with clinically suspected Congenital Heart Disease were included in the study. Children who are critically ill, not willing to participate, and with severe anemia,

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(blood hemoglobin level ≤ 6 g/dl) were excluded. There were total of 140 cases, were examined by three different pediatric residents, trained to assess pulmonary hypertension clinically by a cardiologist. Parents of all the subjects were enquired about the detailed history. Anthropometry and examination was done in each case. The three observers, document their clinical examination findings for detection of PAH separately.

Physical Examination of CVS for Detecting PAH Included Three Methods

Palpable P2, Dullness over pulmonary area on percussion, Loud second heart sound on auscultation. The residents evaluated each child independently and were blinded and the interval between the observer's examinations ranged between 60-90 minutes. Palpable P2 was assessed in patient in supine position and was examined with the help of index finger, kept over the pulmonary area i.e. over the left second intercostal space. Normally no tap is felt, palpable tap of pulmonary valve closure, was felt in cases of Pulmonary Hypertension. Percussion was done by keeping the examiner's middle finger of left hand over the left second intercostal space, the middle finger of examiner's right hand was used to hit the middle phalanx of the left hand percussion was also done on the opposite side, for comparison, normally resonant note is found, dullness over the left second inter costal space suggest pulmonary hypertension. Second heart sound is best appreciated in the pulmonary area, and was heard using the diaphragm of the stethoscope. A2 is widely heard all over the chest, so if second heart sound is appreciated over mitral area, it is generally the A2 component, P2 is generally soft, and is best heard over the pulmonary area, and when the P2 is loud, it suggest pulmonary hypertension [2]. Data was obtained and used to construct 2x2 contingency tables for clinical variables. We then used this published data to

calculate sensitivity, specificity and summary positive and negative likelihood ratios (LR) along for each maneuver in our study.

Results

In this study the data of 140 cases with CHD were analyzed of which 15% males and 16.4% females in age group of 0-6 years, 22.8% were male and 20% were female in age between 6-10 years, and 8.6% males and 17.1% female in age group between 10 to 16 years. The percentage of females were more than males, but there were more males in age group of 6-10 years. 75.8% Cases of PAH were severely under weight, and severely stunted and 68.9% cases were severely wasted. All the three physical findings are reliable, for diagnosing pulmonary hypertension, and loud P2 is the most reliable amongst the three. As the P value is 1, means there is no significant difference between the three observers. The sensitivity, specificity, positive predictive value, negative predictive value, negative LR for palpable P2 and loud second heart sound by the first observer was 70.73% , 100%, 100%, 89.19% , 0.29, for dullness over pulmonary area was 70.73% , 98.99%, 96.67%, 89.09% and 0.3, which was almost equal with the findings of other two observer . Table 1 demonstrates the Comparison of predictive values of the three physical findings. And Table 2 demonstrates the Reliability of physical examination. All the three physical findings are reliable, for diagnosing pulmonary hypertension, and loud P2 is the most reliable amongst the three. As the P value is 1, means there is no significant difference between the three observers.

The commonly associated congenital heart disease with pulmonary hypertension is VSD i.e. out of 54 cases of VSD, 25 cases had Pulmonary Hypertension. The number of PAH cases amongst CHD children was 41 cases (29.28%), amongst 140 cases of CHD.

Table 1: Comparison of predictive values of the three physical findings

1 st observer	Sensitivity	Specificity	PPV	NPV	Positive LR	Negative LR
Palpable P2	70.73%	100%	100%	89.19%	-	0.29
Dullness over pulmonary area	70.73%	98.99%	96.67%	89.09%	70.02	0.3
Loud p2	70.73%	100%	100%	89.19%	-	0.29
2nd observer						
Palpable P2	70.73%	98.99%	96.67%	89.09%	70.02	0.3
Dullness over pulmonary area	70.73%	98.99%	96.67%	89.09%	70.02	0.3
Loud P2	70.73%	100%	100%	89.19%	-	0.29
3rd observer						
Palpable P2	68.29%	96.97%	90.32%	88.07%	22.54	0.33
Dullness over pulmonary area	63.41%	97.98%	92.86%	86.61%	31.39	0.37
Loud P2	65.85%	97.98%	93.10%	87.39%	32.60	0.35

Table 2: Reliability of physical examination

Physical examination	1 st Observer	2 nd Observer	3 rd Observer	P value
Palpable P2	29	30	31	0.88, reliable
Dullness over Pulmonary area	30	30	28	0.85, reliable
Loud P2	29	29	29	1 (most reliable)

Discussion

The present study was conducted to assess the accuracy of physical examination (Palpable P2, dullness over pulmonary area and loud P2) for diagnosing pulmonary hypertension in Congenital Heart Disease Children. All the children with suspected congenital heart disease were assessed for these three physical examination by three different observers and then the findings were compared with the findings of 2 D Echocardiography.

In the present study, the maximum number of cases were in age group of 1 to 6 year, which is 52% of the total study cases. Sharma M et al [3] studied the prevalence of pulmonary arterial hypertension among the congenital heart disease children, in their study, maximum number of cases were in age group of 7- 12 months. The difference between the observations could be because of the selection of cases and their age groups.

In our study, there were more females than males, 46.4% were males and 53.6% were females, male to female ratio was 0.86:1. Out of 65 males 19 had PAH and out of 75 females 22 had PAH. The study conducted by Kevin D et al [4] also showed that there were more females than male, from the total case of 105, (male :female 0.59:1).

(P2) can be assessed in 29 cases, by the first two observers, and in 28 number of cases by the 3rd observer, out of 41 cases of pulmonary hypertension. And is 70.73% sensitive, 100% specific, with positive predictive value of 100%, with negative predictive value of 89.19% and negative LR of 0.29, according to the assessment of 1st observer, and the sensitivity, specificity, positive predictive value, negative predictive value, and positive LR, negative LR by the second observer being, 70.73, 98.99%, 96.67%, 89.09%, 70.32, 0.30 and by third observer being 68.29%, 96.97%, 90.32%, 88.07%, 22.54%, 0.33 respectively. The second heart sound (S2) is a short burst of auditory vibrations of varying intensity, frequency, quality, and duration. It has two audible components, the aortic closure sound (A2) and the pulmonic closure sound (P2), which are normally split on inspiration and virtually single on expiration. Pulsations of a dilated pulmonary artery may be seen

or felt in the second or third left intercostal space near the sternum. Marangu D et al [5] reported that palpable P2 on examination had an area under the curve > 0.6 (0.61-0.65) for diagnosis of pulmonary hypertension.

In our study, total of 140 patients suffering from congenital heart disease were examined for dullness in the pulmonary area, by the three observers in which the first two observers could assess dullness in 29 number of cases, and the third observer could assess in 26 cases and the findings were 70.73% sensitive, 98.99% specific, with 96.67% positive predictive value, 89.09% negative predictive value, 70.02 positive LR and 0.3 negative LR in case of first examiner, 70.73%, 98.99%, 96.67%, 89.09%, 70.02, 0.3 respectively in case of second and 63.41%, 97.98%, 92.86%, 86.61%, 31.39 and 0.37 respectively in case of third observer. In study conducted by Colman R et al [6] they examined S4 on inspiration, a loud P2 on inspiration, an RV lift on inspiration. They had high specificities 88% for an S4 on inspiration, 85% for a loud P2 on inspiration, 84% for an RV lift on inspiration, the sensitivities were low 12%, 29% and 21% respectively. The physical sign with the highest positive LR was a loud P2 on inspiration with positive LR 1.9 and all negative LRs were approximately 1.0. There was lack of data in diagnosing Pulmonary Hypertension by assessing dullness over pulmonary area in children.

A systematic review showed that the most specified thus greatest predictive finding of PAH was a loud P2 (positive likelihood ratio 56.4, 95% CI 7.9–401.7) In a prospective cohort study, however, the same authors found that an accentuated P2 was only weakly predictive (positive likelihood ratio 1.9, 95% CI 1.2–3.1). In our study, loud second heart sound could be assessed in 29 cases by the 1st and 2nd observer and in 27 cases by the 3rd observer, after correlating with the 2 D echo findings, the findings were 70.73% sensitive in case of first and second observer, and 65.85% by third with specificity of 100%, 100%, 97.98% and positive LR 32.60 by third observer, negative LR. 29, 0.29, 0.35 respectively in each case respectively. The study done by Sokunbi OJ et al [7] found that the loud second heart sound in 20.6% cases of the sickle cell anemia children.

Zhang J et al [8] reported that the increased

pulmonic second heart sound (P2) and right-sided third and/or fourth heart sounds were found in 90% and 30% of patients respectively. Dong L et al [9] found that fatigue and dyspnea are the most common symptoms and accentuated pulmonic second sound (P2) is the most common sign.

In our study, the commonly associated murmur with cases of pulmonary hypertension is pansystolic murmur, which is 22 in number of as observed by the 1st examiner, 27 by the 2nd examiner and 26 by the 3rd examiner according to the three examiners. Presence of Pansystolic murmur could be either because of a large VSD or, a murmur of TR, leading to pulmonary arterial hypertension. Study conducted by Colman R et al [6] showed presence of murmur of tricuspid insufficiency and right-sided 4th heart sound at rest and during a slow inspiration. A pansystolic murmur of tricuspid regurgitation (TR), a diastolic murmur of pulmonary insufficiency and a third or fourth heart sound originating in the RV was also noted. In study conducted by Kevin D et al [4] they noted tricuspid regurgitation and extra-physiologic splitting of S2.

It is estimated that pulmonary vascular disease develops in 15% (10–18%) of all CHD. The size and location of the septal defect are an important determinant of PAH in the presence of CHD both in children and adults. Simple defects are considered in two groups according to location, pre tricuspid and post tricuspid shunts [10]. Pre tricuspid lesions (ASD) are associated with a later onset and a lower-frequency PAH in response to the increase in pulmonary circulation compared to the post tricuspid shunts (VSD, PDA). Post tricuspid shunts, VSD and PDA, lead to both pressure and volume overload. Defect size is of importance equal to that of location. Patients with large defects are more prone to development of PAH than those with smaller ones. PAH develops in only 3% of small and middle-sized VSD, while it reaches up to 50% in frequency with large defects [11].

Conclusions

We demonstrate that physical examination are effective in diagnosing the presence of PAH in CHD children. Amongst all physical examination loud P2 is the most reliable.

Key Message

PAH is a lethal disease, early detection with physical examination of clinically silent pulmonary hypertension patients, is associated with improved long term survival. Physical examination i.e palpable

P2, dullness over pulmonary area, loud second heart sound are equally effective in diagnosing Pulmonary Hypertension in CHD children.

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