Commentary

Interventional Cardiology

The role of history of disease factors in the congenital heart disease in adults

The present report focuses the role of history of different disease factors such as history of diabetes, hypertension, myocardial infraction, coronary artery bypass surgery and angioplasty in the congenital heart disease in adults. Specifically, the effects of different history of disease factors on the cardiac parameters such as basal blood pressure, systolic blood pressure, maximum blood pressure, basal heart rate, peak heart rate, maximum heart rate, baseline cardiac ejection fraction and the ejection fraction on dobutamine dose have been examined in the current report.

Keywords: Baseline cardiac ejection fraction; Blood pressure; Cardiac parameters; Heart rate; History of disease

Rabindra Nath Das*

Department of Statistics, University of Burdwan, West Bengal, India

*Author for correspondence:

rabin.bwn@gmail.com

Tel: +91 3422656566

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Role of History of Disease for Congenital Heart Disease

The congenital heart disease indicates the heart problems that are present from birth such as Aortic valve stenosis, Atrioventricular septal defect, Atrial septal defect, Common truncus, Coarctation of aorta, Ebstein's anomaly, Hypoplastic left heart syndrome, Pulmonary valve atresia and stenosis, Total anomalous pulmonary venous return, Tetralogy of Fallot, Tricuspid valve atresia and stenosis, Transposition of great arteries, Ventricular septal defect [1-4]. The congenital heart disease may or may not be genetic. If it is not genetic, it may be the outcome of an insult to the fetus or embryo that occurred at a very specific time during inutero development. Consequently, the birth defects may occur, which indicate abnormal development of heart, or cardiovascular system, or heart function. The defects may be prenatal or postnatal, which are broadly classified as structural and metabolic defects [5,6].

Congenital heart diseases (an abnormal heart development before a child is born) can be classified as cyanotic or acyanotic which are defined based on abnormal blood circulation through the heart. Normally, deoxygenated blood is transported to the right atrium of the heart and then to the right ventricle. From the right ventricle, deoxygenated blood is transported to the lungs through the pulmonary artery. The de-oxygenated blood becomes oxygenated in the lungs. From lungs, oxygenated blood flows to the left atrium and then the left ventricle. From the left ventricle, the oxygenated blood is moved to the rest of the body through the aorta.

Cyanotic and acyanotic heart diseases are defined based on how blood moves through the heart and occur due to abnormal openings or defects in the heart. In cyanotic heart disease, de-oxygenated blood moves from the right side of the heart to the left side through abnormal openings or defects. It mixes there with oxygenated blood and is then distributed to the body through the aorta. As a result, blood is not rich in oxygen and nutrients, which is delivered to all the organs in the body. In acyanotic heart disease, oxygenated blood moves from the left side of the heart to the right side and then to the lungs. This occurs as a result of a hole between the left and right atria. In acyanotic heart disease, the body receives oxygenated and non-de-oxygenated blood from the heart [5,6].

The congenital heart defects have been well described from the late 1800's in different textbooks [5-7]. The causes of the congenital heart disease can be identified in approximately 10% of children, but they

are unknown in most of the cases [8-10]. The causes can be broadly grouped into four categories: single gene defects, chromosomal abnormalities, history of familial and disease factors and environmental factors. The patients with a history of cardiac surgery for complex congenital heart disease or the patients with a history of a ventricular septal defects in childhood should have long-term follow-up with a cardiologist dedicated to the management of patients with congenital heart disease [11,12].

The current report focuses on the association between the history of disease factors and the cardiac parameters such as basal blood pressure, systolic blood pressure, maximum blood pressure, basal heart rate, peak heart rate, maximum heart rate, baseline cardiac ejection fraction and the ejection fraction on dobutamine dose of 558 subjects who underwent dobutamine stress echocardiography (DSE) [13]. The earlier studies have examined the association between the history of disease factors and the cardiac parameters based on statistical tools such as simple correlation, multiple correlation, Chi-square test, odds ratio, regression analysis, logistic regression, analysis of variance, classification and regression tree analysis [13,14], which are not appropriate as the considered responses are positive, heteroscedatic and non-normal [15,16] for the DSE data set [13]. Recently, some associations between the history of disease factors and the cardiac parameters of the DSE data set [13] have been pointed in some articles [17-20].

The considered DSE data set of 558 subjects with 31 characters (obtained from the University of California, Los Angeles (UCLA) Adult Cardiac Imaging and Hemodynamics Laboratories for DSE between March 1991 and March 1996) is given in [13]. For ready reference, the factors/ variables of the DSE data set is reproduced as follows: Basal blood pressure (BBP), Age, Gender (male=0, female=1), Systolic blood pressure (SBP), Basal heart rate (BHR), Peak heart rate (PHR), Double product of BBP & BHR (BDP), Double product of PHR & SBP (DPHS), Maximum heart rate (MHR), Dobutamine dose given (DOSE), Maximum blood pressure (MBP), Double product of maximum DOSE & MBP (DPMDOBP), Percent maximum predicted heart rate (PMHR), Dobutamine dose at maximum double product (DOBDOSE), Baseline cardiac ejection fraction (BEF), Ejection fraction on dobutamine (DOBEF), chest pain (yes(y)=0, no(n)=1) (CPAIN), positive stress on echocardiogram (y=0, n=1) (POSE), recent angioplasty (y=0, n=1) (newPTCA), resting wall motion abnormality on echocardiogram (y=0, n=1) (RWMAE), recent bypass surgery (y=0, n=1) (newCABG), new myocardial infraction (MI) (y=0, n=1) (newMI), death (y=0, n=1) (DEATH), history of hypertension (y=0, n=1) (histHT), history of diabetes (y=0, n=1) (histDM), history of MI (y=0, n=1) (histMI), history of coronary artery bypass surgery (y=0, n=1) (histCABG), history of angioplasty (y=0, n=1) (hsitPTCA), history of smoking (no=0, medium=1, high=2) (histCIG), death due to newMI or newPTCA or newCABG (death=0, no=1) (EVENT), baseline electrocardiogram diagnosis (normal=0, equivocal=1, MI=2) (ECG). Note that there are 08 cardiac parameters and 05 history of different disease factors in the DSE data set. This data set is very useful to examine the association of each cardiac parameter with the different disease factors. We do not have any current data with many cardiac parameters and history of disease factors. So, we have used the DSE data set for our present study.

The DSE data set [13] contains 08 cardiac parameters (basal blood pressure, systolic blood pressure, maximum blood pressure, basal heart rate, peak heart rate, maximum heart rate, baseline cardiac ejection fraction and the ejection fraction on dobutamine dose) and 05 history of disease factors (history of hypertension, history of diabetes, history of myocardial infraction, history of coronary artery bypass surgery, history of angioplasty). Based on separate analysis (using both the joint Log-normal and gamma modeling) of each cardiac parameter (treated as the dependent variable) on the remaining all other covariates (treated as explanatory variables), the following association between the history of disease factors and the cardiac parameters can be observed. Here the responses are positive, non-normal and heteroscedatic, so they should be modeled using both the joint Log-normal and gamma models. The detailed derivations are given in [18-20].

The analysis of basal blood pressure shows that the mean BBP is positively associated with the history of hypertension (P=0.1124) [18]. It indicates that the DSE cardiac patients with no hypertension have high mean BBP. The SBP analysis shows that the mean SBP is negatively associated with the histHT (P=0.0541) [18], indicating that the mean SBP is higher of the DSE cardiac patients with hypertension. In addition, the variance of SBP is positively associated with the histHT (P=0.0003) [18], indicating that the SBP variance is higher of the DSE cardiac patients with no hypertension. The maximum blood pressure analysis shows that the mean MBP is negatively associated with the history of myocardial infraction (P=0.0860) and the history of coronary artery bypass surgery (P=0.0529) [18]. These reveal that the DSE cardiac patients with histMI or histCABG have higher mean MBP.

The baseline cardiac ejection fraction analysis shows that the mean BEF is negatively associated with the history of myocardial infraction (P=0.0658), indicating that the BEF is higher of the cardiac patients with DSE who have histMI [19]. In addition, the mean BEF is positively associated with the history of angioplasty (P=0.0384), indicating that the mean

BEF is higher of the DSE cardiac patients with no histPTCA [19]. The variance of BEF is positively associated with the history of hypertension (P=0.1894) and the history of coronary artery bypass surgery (P=0.0375), indicating that the BEF variance is highly scattered of the DSE cardiac patients with no histHT or histCABG [19]. The ejection fraction on dobutamine dose analysis shows that the variance of DOBEF is negatively associated with the history of angioplasty (hsitPTCA) (P=0.1521), and it is positively associated with the history of coronary artery bypass surgery (histCABG) (P=0.1392), indicating that the DOBEF variance is higher of the DSE cardiac patients with having histPTCA or no histCABG [19].

The basal heart rate analysis shows that the variance of BHR is negatively associated with the history of angioplasty (P=0.0741), indicating that the BHR variance is higher of the DSE cardiac patients with having histPTCA [20]. The peak heart rate analysis shows that the mean of PHR is positively associated with the history of diabetes (P=0.0030), indicating that the mean PHR is higher of the DSE cardiac patients with no histDM [20]. In addition, the PHR variance is negatively associated with the histDM (P<0.001), and histCABG (P=0.0751), indicating that the PHR variance is higher of the DSE cardiac patients having histDM, or histCABG [20]. The maximum heart rate analysis shows that the mean of MHR is positively associated with the histDM (P=0.0562), and histPTCA (P=0.0011), indicating that the mean MHR is higher of the DSE cardiac patients with no histDM or histPTCA [20]. On the other hand, the MHR variance is negatively associated with the histDM (P<0.001), and histPTCA (P<0.001), indicating that the MHR variance is higher of the DSE cardiac patients having histDM, or histPTCA [20]. The analyses of BHR, PHR and MHR [20] show that the absence of the history of diabetes, and the history of angioplasty increases the mean PHR and MHR, while their presence along with the history of coronary artery bypass surgery increases the variance of BHR, or PHR, or MHR. The above associations of cardiac parameters with the history of disease factors are summarized in Table 1.

Table 1: Association of cardiac parameters with the history of disease factors.

Model	Cardiac parameter	Associated with the disease factor	Type of association	P-value
Mean Model	Basal blood pressure	histHT	positive	0.1124
	Systolic blood pressure	histHT	negative	0.0541
	Maximum blood pressure	histMI	negative	0.0860
	Maximum blood pressure	histCABG	negative	0.0529
	Baseline cardiac ejection fraction	histMI	negative	0.0658
	Baseline cardiac ejection fraction	histPTCA	positive	0.0384
	Peak heart rate	histDM	positive	0.0030
	Maximum heart rate	histDM	positive	0.0562
	Maximum heart rate	histPTCA	positive	0.0011
Variance Model	Systolic blood pressure	hsitHT	positive	0.0003
	Baseline cardiac ejection fraction	histHT	positive	0.1894
	Baseline cardiac ejection fraction	histCABG	positive	0.0375
	Ejection fraction on dobutamine dose	histPTCA	negative	0.1521
	Ejection fraction on dobutamine dose	histCABG	positive	0.1392
	Basal heart rate	histPTCA	negative	0.0741
	Peak heart rate	histDM	negative	<0.0010
	Peak heart rate	histCABG	negative	0.0751
	Maximum heart rate	histDM	negative	<0.0010
	Maximum heart rate	histPTCA	negative	<0.0010

The associations between the cardiac parameters and the history of disease factors have been obtained based on the joint mean variance gamma models [16]. The

above results indicate that the cardiac parameters are highly associated with the disease factors. These results support that the history of disease factors are definitely a risk factor of congenital heart disease. These results may help the medical practitioners to understand the congenital heart patients. Medical practitioners and researcher are advised to consider the history of disease factors for better treatment.

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Executive Summary

The present report focuses the role of history of different disease factors such as history of diabetes, hypertension, myocardial infraction, coronary artery bypass surgery and angioplasty in the congenital heart disease in adults.

Specifically, the effects of different history of disease factors on the cardiac parameters such as basal blood pressure, systolic blood pressure, maximum blood pressure, basal heart rate, peak heart rate, maximum heart rate, baseline cardiac ejection fraction and the ejection fraction on dobutamine dose have been examined in the current report.

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