

Cardiac Risk Factors for Patients under DSE

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Abstract

This article focuses the cardiac risk factors who underwent Dobutamine stress echocardiography (DSE), based on the data set in UCLA Statistics Web Site. Only the risk factors of different blood pressures, cardiac ejection fractions, and heart rates are discussed for the awareness of the healthy individuals, cardiac patients, and medical practitioners.

Keywords: Blood pressure; Cardiac ejection fraction; Coronary heart disease; Gamma model; Heart rate; Non-constant variance

Cardiac Risk Factors

Hypertension is associated with stroke for 54%, and 47% of ischaemic heart disease [1], and it affects 30% of the adult population [2]. An important risk factor of the severity of the systolic heart failure is the ejection fraction (EF) which indicates to the percentage of blood that is pumped (or ejected) out of the ventricles with each heartbeat. A low EF is always associated with the heart disease. Generally, healthy individuals have EF between 50% and 65% [3]. Practically, normal values depend on the modality being used to compute the EF, and it may depend on the person's physical, biochemical, lifestyle, working nature, dietary parameters, etc. [4]. Some articles consider the normal values of EF are between 55% and 75% [4,5]. For a normal healthy individual, heart beats 60 to 80 times per minute, while for an athletic or very active, basal heart rate may be lower as the heart pumps more efficiently [6,7].

We seek answers to the following questions: What are the causal factors of different blood pressures, cardiac ejection fractions, and heart rates? What are the association of the risk factors with these cardiac disease markers? These answers are identified based on the data set of 31 variables on 558 subjects (UCLA stress echocardiography data). A detailed description of the data set, collection method, patient population, and the DSE is given in [8]. Effects of dobutamine stress echocardiography have been described in many articles [9-12]. The variables/ factors of this study are Basal heart rate (bpm) (coded as bhr), Basal blood pressure (mmHg) (coded as basebp), Basal double product (DP) ($bhr \times basebp$) ($bpm \times mmHg$) (coded as basedp), Peak heart rate (bpm) (coded as pkhr), Systolic blood pressure (mmHg) (coded as sbp), DP $pkhr \times sbp$ ($bpm \times mmHg$) (coded as dp), Dobutamine dose (DD) given (coded as dose), Maximum heart rate (bpm) (coded as maxhr), Percent maximum predicted heart rate (coded as pctMphr), Maximum blood pressure (mmHg) (coded as mbp), DP on max DD ($bpm \times mmHg$) (coded as dpmaxdo), DD at max double product (mg) (coded as dobdose), Age (years) (coded as age), Gender (male=0, female=1) (coded as gender), Baseline cardiac ejection fraction (coded as baseEF), Ejection fraction on dobutamine (coded as dobeEF), Chest pain (yes (y)=0, no (n)=1) (coded as chestpain), Resting wall motion abnormality on echocardiogram (ECDG) (y=0, n=1) (coded as

restwma), Positive stress ECDG (y=0, n=1) (coded as posSE), New myocardial infraction (MI) (y=0, n=1) (coded as newMI), Recent angioplasty (y=0, n=1) (coded as newPTCA), Recent bypass surgery (y=0, n=1) (coded as newCABG), death (y=0, n=1) (coded as death), History of hypertension (y=0, n=1) (coded as hxofHT), History of diabetes (y=0, n=1) (coded as hxofDM), History of smoking (non-smoker=0, moderate=1, heavy=2) (coded as hxofCig), History of MI (y=0, n=1) (coded as hxofMI), History of angioplasty (y=0, n=1) (coded as hxofPTCA), History of coronary artery bypass surgery (y=0, n=1) (coded as hxofCABG), Death, newMI, newPTCA or newCABG (death=0, no=1) (coded as any event), Baseline electrocardiogram diagnosis (normal=0, equivocal=1, MI=2) (coded as ecg). This data set has been analyzed by the joint Gamma models [13]. The risk factors of the cardiac markers (blood pressures, cardiac ejection fractions, and heart rates) are as follows.

The mean basal blood pressure (basebp) is separately negatively associated with bhr ($P < 0.01$), dpmaxdo ($P < 0.01$), any event ($P = 0.03$). If bhr or dpmaxdo is low, basebp is high. Basebp is high for the cardiac patients who are close to death. Basebp is separately positively associated with basedp ($P < 0.01$), maxhr ($P < 0.01$), mbp ($P < 0.01$), age ($P = 0.01$). If at least any one of basedp, maxhr, mbp, age is high, basebp is also high. Mean systolic blood pressure (sbp) is separately negatively associated with bhr ($P < 0.01$), pkhr ($P < 0.01$), pctMphr ($P = 0.03$), dpmaxdo ($P < 0.01$), hxofHT ($P = 0.05$). So, sbp is high if bhr or pkhr or pctMphr or dpmaxdo is low. Sbp is higher for the cardiac patients having history of hypertension (hxofHT). Sbp is separately positively associated with basedp ($P < 0.01$), dp ($P < 0.01$), dose ($P = 0.03$), maxhr ($P < 0.01$), mbp ($P < 0.01$). If any one of basebp, dp, dose, maxhr, mbp is high, sbp is also high. Mean maximum blood pressure (mbp) is separately positively associated with pkhr ($P < 0.01$), sbp ($P < 0.01$), dpmaxdo ($P < 0.01$), age ($P = 0.13$), posSE ($P = 0.03$). If at least any one of pkhr, sbp, dpmaxdo, age is high, mbp is also high. The cardiac patients with no positive stress ECDG (posSE) have high mbp. Mean mbp is separately negatively associated with dp ($P < 0.01$), maxhr ($P < 0.01$), newPTCA ($P = 0.02$), hxofMI ($P = 0.09$), hxofCABG ($P = 0.05$). If dp or maxhr is low, mbp is high. The cardiac patients with newPTCA or hxofMI or hxofCABG have high mbp.

The mean baseline cardiac ejection fraction (baseEF) is separately negatively associated with dp ($P < 0.01$), dose ($P = 0.02$), newPTCA ($P = 0.01$), hxofMI ($P = 0.06$), ecg ($P = 0.05$). So, baseEF is low if dp or

dose is high. The cardiac patients with no newPTCA or hxofMI or ecg with MI have low baseEF. The mean baseEF is separately positively associated with pkhr ($P=0.02$), sbp ($P<0.01$), dobEF ($P<0.01$), restwma ($P<0.01$), posSE ($P<0.01$), hxofPTCA ($P=0.03$). If pkhr, sbp, dobEF are low, baseEF is also low. The cardiac patients with restwma or posSE or hxofPTCA have low baseEF. The mean ejection fraction on dobutamine (dobEF) is separately negatively associated with sbp ($P<0.01$), posSE ($P<0.01$), newMI ($P<0.01$), newCABG ($P<0.01$), hxofCig ($P=0.02$). If sbp is high, dobEF is low. The cardiac patients with heavy smoking status or with no posSE or newMI or newCABG have low dobEF. The mean dobEF is separately positively associated with dp ($P<0.01$), dose ($P=0.01$), baseEF ($P<0.01$), newPTCA ($P=0.07$). If dp or dose or baseEF is low, dobEF is also low. Also the cardiac patients with newPTCA have low dobEF.

The mean basal heart rate (bhr) is separately negatively associated with basebp ($P<0.01$), dobdose ($P=0.074$), age ($P=0.003$), posSE ($P=0.056$). If basebp or dobdose or age is high, bhr is low. The cardiac patients with no posSE have low bhr. The mean bhr is separately positively associated with basedp ($P<0.01$), pctMphr ($P<0.01$), mbp ($P<0.01$), dpmaxdo ($P<0.01$). If basedp or pctMphr or mbp or dpmaxdo is low, bhr is also low. The mean peak heart rate (pkhr) is separately negatively associated with sbp ($P<0.01$) and gender ($P=0.08$). The cardiac patients with high sbp or female sex have low pkhr. The mean pkhr is separately positively associated with maxhr ($P<0.01$), dpmaxdo ($P<0.01$), restwma ($P=0.04$), hxofDM ($P=0.003$). If maxhr or dpmaxdo is low, pkhr is also low. The cardiac patients with restwma or hxofDM have low pkhr. The mean maximum heart rate (maxhr) is separately positively associated with pkhr ($P<0.01$), sbp ($P<0.01$), pctMphr ($P<0.01$), dpmaxdo ($P<0.01$), dobEF ($P=0.06$), hxofDM ($P=0.06$), hxofPTCA ($P<0.01$). If at least any one of pkhr, sbp, pctMphr, dpmaxdo, dobEF is low, maxhr is also low. The cardiac patients with hxofDM or hxofPTCA have low maxhr. The mean maxhr is separately negatively associated with dp ($P<0.01$), mbp ($P<0.01$), and age ($P<0.01$). If at least any one of dp, mbp and age is high, maxhr is also low.

The above results are derived based on joint Gamma models [13]. Here only the mean parameters of the responses are very shortly discussed. All the derivations along with many mean and dispersion parameters will be discussed in the full research papers. The complete research papers will be submitted very soon. The above mentioned cardiac risk factors are associated with DSE patients. This report recommends the following for all individuals. Care should be taken for blood pressures at older ages. Male individuals have higher hypertension risk than females. Blood pressures and heart rates are highly associated. Smoking should be stopped. Medical practitioners should be care on dobutamine dose, and its interaction effects with other risk factors. For better medical treatment, cardiac events and the

history of the disease should be considered by the medical practitioners.

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