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ORIGINAL ARTICLE

HANDGRIP STRENGTH AND ITS ASSOCIATION WITH LEFT VENTRICLES EJECTION FRACTION AMONG CARDIAC PATIENTS

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Abstract

Background and objectives:*This study focused on exploring the relationship between handgrip strength and Left ventricular ejection fraction (LVEF) among cardiac disease patients.****Methods:****This is a cross-sectional study. The study conducted at KPJ Damansara Specialist Hospital. Subjects were recruited based on selection criteria as set by the study protocol involved 50 subjects and it was carried out in among conservative management cardiac patients. Main outcome measures was to measure the handgrip strength using Jamar hand dynamometer and the LVEF was assessed by echocardiography. Spearman-rank correlation and simple linear regression analysis were used to analyse the study results.* ***Results:****There was a relationship found between bilateral handgrip strength and LVEF among cardiac patients with dominant handgrip strength showed higher correlation value, ρ= 0.375 (p< 0.05) as compared to the non-dominant handgrip strength ρ= 0.334 (p<0.05). However, there was no significant relationship found between dominant and non-dominant handgrip strength and LVEF among male subject with ρ=0.102 (p0.546) and ρ0.155 (p0.360). There were also non-significant relationship between non-dominant handgrip strength and LVEF among female subject ρ=0.348 (p0.203) but significant positive relationship for dominant handgrip strength with LVEF ρ=0.500 (p0.030). Simple linear regression analysis demonstrated an interaction between non-dominant handgrip strength and LVEF (R^2=.081, p <0.05) with small effect size.****Conclusion:****The correlation analysis of the present study demonstrated relationship between bilateral handgrip strength with ventricular function. The subgroup analysis between the genders showed there was significant relationship found between dominant handgrip strength and LVEF among female subject only. Therefore, handgrip strength able provides valid information about ventricular function as the variables were related among female individuals with cardiac disease.*

Keywords:Handgrip strength, Left ventricular ejection fraction (LVEF), cardiac disease.

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INTRODUCTION

American Heart Association (AHA) reported that a total of 2150 American die of cardiac disease each day in which coronary heart disease alone accounted to about 1 of every 6 deaths (Go et al., 2013). This debilitating diseases causing limitation in daily physical activities and may lead to physiological and structural changes of musculoskeletal system. With regard to activity limitation, handgrip strength is known to be very important factor in daily functional activities (Anjum et al., 2012). Cardiac patients may have significant changes in muscle mass and strength which are predicted to lead to many problems (von Haeling et al., 2013; Loncar et al., 2013). Physiological changes cardiac patients are vascular and ventricular changes which will cause the heart to pump inadequately to fulfil the metabolic demand (Kemp & Conte, 2012) whereby it leads to decrease in cardiac output, stroke volume (Sullivan & Hawthorne, 1995) and reduction in peripheral blood supply (van Langen et al., 2001).

METHODOLOGY

This correlational study conducted at KPJ Damansara Specialist Hospital. Using purposive sampling methods involved 50 subjects diagnosed as coronary heart disease, heart failure or valve disease. Criteria for inclusion included left ventricular ejection fraction ≤50% (deFilippi et al., 2011), NYHA class II or III (Nyquist-Battie et al., 2007) and clinically stable for eight weeks before testing (Brassard et al., 2006). The exclusion criteria were peripheral or vascular problem of the upper limb, amputation of the upper limbs and unstable vital sign. Left ventricular function was assessed by echocardiography and this performed by laboratory technician using 2D echocardiography machine. A Jamar Hand Dynamometer was used for the measurement of handgrip strength for both sides based on American society of Hand Therapist (ASHT) recommendation with the subjects were seated in a comfortable position hip and knee flexed at 90°, shoulder adducted, elbow flexed at 90°, forearm rotation 0° and wrist in 0-30° flexion. The dynamometer was set at the second handle position for all subjects. A nonparametric analysis, known as Spearman rank correlation was used to explore the correlation among the variables. In order to predict and assess the strength of the factors affecting LVEF related to handgrip strength among the subjects analysed using simple linear regression analysis with significance at p value 0.05.

Analysis

Descriptive type of analysis were used to describe the demographic status and area of back pain. The demographic data used to determine association of occupational related back pain incidence is shipping port workers age, years of working, body mass index and waist circumference. Regression analysis was used to determine the association between demographic data and occupational related back pain.

RESULT

Descriptive analysis was presented as mean, standard deviation, frequency and percentage. The details include the subjects' profile based on variables such as age, BMI, dominant and non-dominant handgrip strength and LVEF. Subjects ranged from 32-80 years of age, with mean age of 58.46 (SD= 12.481). Mean BMI of the subjects were 25.66 kg/m² (SD=2.71). Based on the descriptive analysis, 18% of the subjects were categorized as normal BMI and 54% of the subjects were categorized as overweight and remaining 28% of the subjects were classified as obese. Among the subjects, mean and standard deviation for dominant handgrip strength

were 17.73 kg (SD= 5.93) which ranged between 7.6 kg until 34.0 kg. In comparison, non-dominant handgrip strength ranged between 7.0 to 33.6 kg with mean and standard deviation of 15.24 kg (SD= 5.60). Mean LVEF value for the study participants were 45.98% (SD= 5.85) ranging between 28 to 53%. Table1 describe the descriptive analysis of the subjects between genders. There was significantly moderate positive relationship between both handgrip strength and Left Ventricular Ejection Fraction (LVEF) among cardiac patient. The correlation for the dominant handgrip strength showed higher correlation value, ρ= 0.375 (p< 0.05) as compared to the non-dominant handgrip strength ρ= 0.334 (p<0.05).

Parameters (unit)	**Male (n=35) Mean (SD)**	**Female (n=15) Mean (SD)**	**Mean difference**	***p* value**
Age (years)	58.03 (*SD*=12.318)	59.47 (*SD*=13.233)	1.44	*p* 0.377
BMI (kg/m²)	25.18 (*SD*=2.510)	25.15 (*SD*=2.703)	0.003	*p 0.15*
Dominant handgrip strength (kg)	21.84 (*SD*=5.199)	14.31 (*SD*=3.623)	7.53	*p*<0.01
Non-dominant handgrip strength (kg)	18.74 (*SD*=5.695)	12.51 (*SD*=3.163)	6.23	*p*<0.01
LVEF (%)	47.09 (*SD*=4.448)	44.48 (*SD*=7.853)	2.61	*p*<0.05

Table 1: Descriptive analysis of the subjects between the genders

The correlation between dominant and non-dominant handgrip with LVEF among subjects which showed significant moderate relationship between dominant and non-dominant handgrip strength among subjects described in Table 2.

Parameters	**Correlation (ρ)**	***p* value**
LVEF		
Dominant handgrip strength	0.375	*< 0.05*
Non-dominant handgrip strength	0.334	*< 0.05*

***** Significant at p<0.05

Table 2: Relationship between dominant and non-dominant handgrip strength Ventricular Ejection Fraction (LVEF), MVO^2 index and FFMI among cardiac patient

The regression analysis of dominant and non-dominant handgrip strength and LVEF among subjects also performed. It can be concluded that dominant handgrip strength (B = 0.227, p 0.045) have positive significant effect towards LVEF with a small effect size of (R^2 = 0.047). The regression analysis between non-dominant handgrip strength towards LVEF showed no interaction and also interaction towards LVEF (B = 0.281, p 0.129).

DISCUSSION

The subgroup analysis between the genders showed there was significant relationship found between dominant handgrip strength and LVEF among female subject only. Physiologically this can be explained by a dynamic load which was imposed on a contracting muscle showed an association with contractile properties of cardiac muscle with different methodological perspective using echocardiography and tissue Doppler imaging technique (Avolio&Butlin, 2016). Besides that, another study conducted by Tischler, Nigel, Borowski, LeWinter, (1993), found out that changes in ventricular shape during activity will influence other elements such as peripheral and neuro-hormonal response of the skeletal system. The outcomes from the previous studies can be related with the result of the present study which explored an association between handgrip strength and ventricular function.

The ventricle chambers of the heart contract and functions to either push blood to the left side of the heart or push blood for systemic circulation. In this context, left ventricle function is one of the most important functions of the heart in which it pushes blood to both upper and lower limb (De Filippi et al, 2011). Hence, left ventricular function is considered as one of the important parameters to assess the function of the heart and this is assessed through a physiological parameter called ejection fraction. Hence, it can be concluded that the pathological state of the heart alters the normal function of this parameter.

Left ventricular function is of paramount importance in the diagnosis outcome, cardiovascular risk stratification, and assessment of future cardiac events and also for therapeutic purposes. Hence, left ventricular function was assessed by means of echocardiography which is gold standard method of choice due to wide availability and applicable practice. The finding of this present study indicated a relationship between ventricular function and handgrip strength for male and female subjects. Analysis of left ventricular function during task which was imposed by handgrip test suggests that it is a good measure to define the ventricular status of the patients. The normal cardiovascular response to isometric handgrip activity is reported in previous studies (Levinger, Bronks, Cody, Linton & Davie, 2005; Fisher, Nutter, Jacobs, &Schlant, 1973). This is in line with an earlier study in which the study demonstrated elevation in cardiac output during handgrip task which is due to an increase in heart rate and blood pressure (Lard, Fixxler, & Huffiness, 1979). Similarly, a study also reported that the performance of hand grip test influences the left ventricular wall motion (Creuder et al., 2012; Jones, Lahiri, Cashman, Dore &Raftery, 1986). Hence, from the present study and with the earlier studies it can be inferred that the peripheral strength have a significant interconnectivity with myocardial activity and peripheral circulation.

CONCLUSION

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