Original Article

CORRELATION OF NECK CIRCUMFERENCE WITH CONVENTIONAL ANTHROPOMETRIC RISK FACTORS AND CORONARY ANGIOGRAPHIC SEVERITY

Chakradhar Arepalli[1], Sharada Sivaram K[2*], Magesh Vadivelu[3], Aashish Arumugam[4], Harsha Sagar M[5], Arunachalam P[6]

[1] Junior Resident, Department of Medicine, Department of Medicine and Department of Cardiology, Meenakshi Medical College Hospital & Research Institute, Kancheepuram.
[2] Professor, Department of Cardiology, Department of Medicine and Department of Cardiology, Meenakshi Medical College Hospital & Research Institute, Kancheepuram.
[3,4] Associate Professor, Department of Cardiology, Department of Medicine and Department of Cardiology, Meenakshi Medical College Hospital & Research Institute, Kancheepuram.
[5] Assistant Professor, Department of Cardiology, Department of Medicine and Department of Cardiology, Meenakshi Medical College Hospital & Research Institute, Kancheepuram.
[6] Professor & Head, Department of Cardiology, Department of Medicine and Department of Cardiology, Meenakshi Medical College Hospital & Research Institute, Kancheepuram.

Corresponding author: Dr. Sharada Sivaram K, Professor, Department of Cardiology, MMCHRI, Kancheepuram.

DOI: 10.47750/pnr.2022.13.S01.270

Abstract

Adiposity is a risk factor for coronary artery disease (CAD) and fat distribution is an effective modifier that mediates metabolic risk factors like diabetes, hypertension, and dyslipidemia. This study was conducted to determine the relationship between the neck circumference with metabolic risk factors and their correlation with coronary angiographic severity using Gensini scoring.

Aim

The aims of the study was to evaluate ischemic heart disease (IHD) patients -

- To compare novel metabolic risk factors of upper body adiposity such as neck circumference (NC)/ mid upper-arm circumference (MUAC) with traditional cardiovascular risk factors [waist circumference (WC), waist-hip ratio (WHR), Body-mass index (BMI)] .
- To correlate these risk factors with angiographic severity assessed by coronary angiogram with Gensini score.

Material and methods

A cross-sectional study was conducted in the cardiology department of our institute. Consecutive patients undergoing coronary angiography (CAG) were included in the study. Their anthropometric indices (conventional and novel) known to correlate with metabolic syndrome were measured and the degree of coronary stenosis in epicardial vessels was assessed by Gensini scoring system. The data analysis was done using multiple logistic regression using statistical package for social sciences (SPSS) software. The mean and standard deviation for each continuous variable were calculated. Correlation of neck circumference with metabolic risk factors was tested by Karl Pearson's correlation coefficient method. Analytical statistics is given by correlation, regression. P-value<0.05 is considered to be significant.

Results

Our study included a total 41 patients who underwent CAG including 29 males and 12 females with mean age 55 (33-85) years. Study included >50% diabeticsand hypertensives, one-third smokers, ~40% dyslipidemics and consumers of alcohol

and one-fifth had positive family history of CAD. MUAC, WC, WHR and BMI were more elevated in females while males had higher NC.
There was a significant linear relationship between NC and other anthropometric indices. As the NC increases by one cm, weight increases by 0.5kg, WC increases by 0.3cm, MUAC increases by 0.5cm which were significant (p-value <0.05). While Gensini score was higher in males compared to females, NC did not correlate with Gensini score in either gender.

Discussion & conclusions
It was interesting that WHR was abnormal in all patients while other parameters too were elevated in majority of patients, with preponderance showing gender variation. Women had higher MUAC, WC, WHR than men, while the latter had higher NC & coronary angiographic severity. Novel anthropometric parameter of Neck Circumference was seen to be a reliable upper-body adiposity indicator, with positive correlation with conventional parameters of metabolic syndrome, while not being predictive of CAD extent, based on angiographic scoring.

Keywords: Neck circumference, Body mass index, Waist-hip ratio, mean upper-arm circumference, coronary angiographic scoring, Gensini scoring.

Introduction

Coronary artery disease (CAD) is the major cause of mortality and morbidity. Several studies have established a relationship between central obesity and the development of cardiovascular disease[1-3]. Obesity results in metabolic abnormalities, with upper-body obesity strongly associated with glucose intolerance, hyperinsulinemia, diabetes, hypertriglyceridemia, and gout than lower-body obesity[4]. Ischemic heart disease severity is conventionally evaluated with help of coronary angiogram which is gold standard but is an invasive procedure carrying a peri procedural risk[5]. The association between body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR), indices of general or central obesity, with increased cardiometabolic risk has been proved in numerous studies[6,7]. However, these measures need calibrated tools such as scale, or vary throughout a day. In contrast, neck circumference (NC) is easy to measure, constant, and time-saving measure to identify overweight and obese individual and it as an novel index of upper-body obesity, a simple screening method that can be used to identify overweight and obese individuals and is easy and time-saving measure to identify overweight and obesity[8,9,]. The association between neck fat and metabolic syndrome may be attributed to multiple mechanisms. It has been suggested that fat in the neck may be more similar to visceral fat, which is more strongly related with cardiometabolic risks compared to subcutaneous fat. An upper body distribution of fat, especially with increased visceral adipose tissue, is considered predictive of cardiometabolic conditions[10-14].

Hence the aim of this study is to compare the relative utility of neck circumference as a metabolic risk marker and correlate with angiographic severity in cardiac patients undergoing coronary angiogram (CAG) by using Gensini scoring[15].

Methodology

This was a prospective and cross-sectional study including 41 CAD patients undergoing coronary angiography in Meenakshi medical college. The study period as 6 months from May 1st 2021 to October 30th 2021. We included all stable cardiac patients who are aged between 18-85 years. We excluded patients with standard ccontraindications to invasive catheterization study, known contrast allergy, bleeding disorders, haemorrhagic stroke, decompensated heart failure, pregnancy, renal insufficiency, history of neck surgery, and thyroid disorders. After informed consent baseline data including name, age, gender, demographic, lifestyle, and comorbidities were collected using a standard questionnaire. Patients who underwent elective coronary angiography for symptomatic coronary artery disease were willing to be part of the study. The following parameters were assessed with the

patient wearing light clothing without shoes and measured using inelastic tape with one-millimetre precision.

A) Neck circumference was measured with the superior border of the tape placed below the laryngeal prominence midway of the neck between the mid-cervical spine and mid-anterior neck to within 1mm.[14]

Normal: Males -- <37 cm, Females -- <34 cm

B) Mid-upper arm circumference (MUAC) is the circumference of the right upper arm measured at the midpoint between the tip of the shoulder and the tip of the elbow. Normal <29.9cm.

C)Waist circumference measured at the midpoint between the lower margin of the last palpable rib and top of the iliac crest, in standing position after normal expiration.

Normal value in Indian male – 85cms, Indian female – 80 cms

E) Waist to hip ratio (WHR) [Males: <0.88, Females: <0.81]

F) Weight (in kgs) and Height (in meters)

G) Body mass index (BMI) was calculated as weight in kilograms divided by the square of standing height in meters. Patients are classified as underweight (<18.5kg/m^2), normal (18.5-22.9kg/m^2), overweight (23.0-24.9kg/m^2), obese (>25kg/m^2) based on revised consensus guidelines for India[13].

H) CAG severity to be done by Gensini scoring which accounts for the degree of artery narrowing as well as locations of narrowing. A method that assigns a different severity score depending on the degree of luminal narrowing and the geographical importance of its location[14].

Severity score	Percentage of obstruction
1	25
2	50
4	75
8	90
16	99
32	100

Lab measurements and blood samples for blood sugar and lipid profile were taken in the early morning after overnight fasting of 12 hours.

Data statistical analysis: Data was analyzed through multiple logistic regression using the statistical package for social science software. The mean and standard deviation for each continuous variable were calculated. The correlation of neck circumference with metabolic risk was tested by Karl Pearson's correlation coefficient method. Analytical statistics was given by correlation, regression. P-value<0.05 is considered to be significant throughout the study.

Results

Our study included a total 41 patients who underwent CAG of which males were 29 and female subjects 12 with mean age 55 (33-85) years.

Of 41 patients undergoing CAG, 23 (56%) were diabetics and equal number were hypertensives, 18 (44%) were dyslipidemic, 12 (29.3%) were smokers, 16 (39%) consumed alcohol and 9 (22%) had family history of CAD. Mean NC was 38.3 (33-46) cm (39 in males and 36 in females), mean WC was 95 cm (94 in males and 99 in females), mean WHR was 1.01 (1.00 in males and 1.44 in females), mean MUAC was 29 cm (29 in males and 30 in females), mean BMI was 25.4 (24.53 in males and 27.61 in females). and mean Gensini scoring 39.6 (44.1 among males and 28.8 in females). (Fig 1). Clinical diagnosis was unstable angina in 7 (17%), Non-ST elevation MI (NSTEMI) in 12 (29%) and STEMI in 21 (51%).

Through Spearmens correlation, there was significant linear relationship between neck circumference and other anthropometric indices; weight, BMI, mid upper arm circumference, waist circumference. (Fig2,3,4). As the NC increases by one cm, weight increases by 0.5kg, WC increases by 0.3cm, MUAC increases by 0.5cm which were significant (p-value <0.05). CAD severity measured by Gensini score, was significantly higher in males, compared to females but did not correlate with NC in either gender.

Discussion

In this high-risk population of established IHD, as expected, there was high prevalence of conventional coronary risk factors and the novel risk factor of NC correlated well with other cardio-metabolic parameters.

A central fat distribution is considered more atherogenic than peripheral obesity. Anthropometric parameters of central obesity, such as, WC and WHR correlate with IHD better than BMI. But waist circumference measurement varies with respiration and with post prandial distension of abdomen. It has been seen in previous studies that upper body subcutaneous fat has similar pathophysiological characteristics as abdominal visceral fat[1].

NC is simpler to use, easy to measure in sitting position, socially more acceptable than WC measurement, does not vary with postprandial state or respiration. Its correlation with other anthropometric parameters in Indian patients is still evolving in Indian IHD patients. Our study attempts to provide some important data in this context.

Both non-modifiable and acquired risk factors were high in the study population: More than half of the study population were diabetics, hypertensives and dyslipidemics, had family history of IHD, while more than a third were smokers and alcohol consumers. This underscores the importance of educating, preventing and early identification of risk factors in Indian patients.

We found that as shown in the Framingham substudy[1], NC is associated with increased cardiovascular disease (CVD) risk and upper-body subcutaneous fat was postulated to be a unique, pathogenic lipid depot. This may be attributable to disordered breathing during sleep, that is common in people with larger neck size. Obstructive sleep apnea has been shown to be associated with hypertension, insulin resistance and dyslipidemia.

MUAC is not a commonly used anthropometric parameter and in a Taiwan study MUAC correlated well with over-weight and obese status[16]. We found that females had a higher mean value of MUAC than males. We found that this parameter correlated well with NC, both being upper-body adiposity measures and for every 1cm increase in NC, there was 0.5cm increase in MUAC. (Fig 4).

WHR and WC are known to be better predictors of CAD risk than BMI among men and women above age 60, and BMI was more strongly associated with risk of CAD in younger compared to older people. WHR was found to be abnormal in all of our study population, whose mean age was 55 years. NC correlated well with this measure, and for every 1cm increase in NC, there was 0.3cm increase in WC. While others found significant correlation between WHR and Gensini score of CAD severity[17], our study did not find such observation.

In our study, there were gender-based variations in the parameters, with males having higher CAD severity and NC, while women had higher MUAC, WHR and BMI. Neither did NC correlate with CAG severity in our population, perhaps implicating other factors, such as infections/ inflammation, stress and genetic factors.

Conclusions

In our study of high-risk IHD patients, there was high occurrence of conventional risk factors of hypertension, diabetes, dyslipidemia, smoking, alcohol consumption and family history of CAD. Novel anthropometric measures of NC and MUAC, which are upper-body adiposity measures, correlated well with conventional visceral adiposity parameters of WHR, WC, as well as BMI. There was gender variation in preponderance of the various anthropometric measures with higher values of NC and CAD severity in males. CAD severity did not correlate with any of the above adiposity parameters.

Acknowledgement

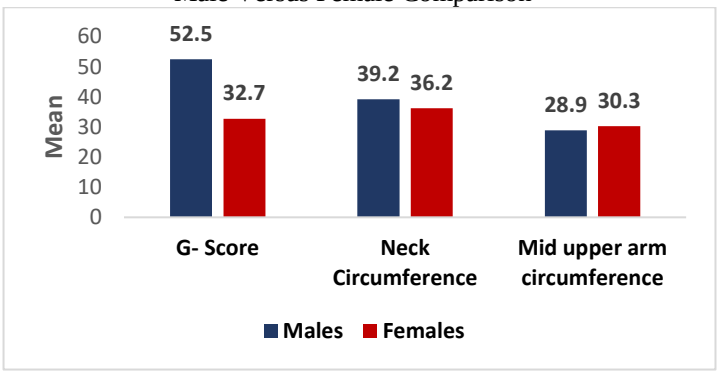
We gratefully acknowledge the statistical support provided by Ms. Dharani Sujini, Biostatistician, Department of Community Medicine, Meenakshi Medical College Hospital Research Institute, Kancheepuram.

References

1. Preis SR, Massaro JM, Hoffmann U, et al. Neck circumference as a novel measure of cardiometabolic risk: the Framingham heart study. *J Clin Endocrinol Metab.* 2010; 95: 3701–3710.
2. Kumar NV, Ismail MH, P M, M G, Tripathy M. Neck circumference and cardio- metabolic syndrome. Journal of Clinical and Diagnostic Research : JCDR. 2014; 8: MC23-5.
3. Caro P, Guerra X, Canals A, Weisstaub G, Sandaña C. Is neck circumference an appropriate tool to predict cardiovascular risk in clinical practice? A cross-sectional study in Chilean population. BMJ Open. 2019; 9: e028305
4. Zhou Jing-ya, GeHui, Zhu Ming-fan, Wang Li-jun, Chen Li, Tan Yao-zong, et al. Neck Circumference as an Independent Predictive Contributor to Cardio-Metabolic Syndrome. Cardiovascular Diabetology. 2013; 12:76
5. Patel VG, Kimberly M, Brayton MD, Tamayo A, Mogabgab O, Michael TT, et al. Angiographic success and procedural complications in patients undergoing percutaneous coronary chronic total occlusion interventions. *J Am Coll Cardiol Intv.* 2013; 6:128–136.
6. Handbook of Obesity (2nd Edition)-George A. Bray Claude Bouchard 0824747739-Informa Healthcare.pdf.
7. Despres JP, Lemieux I, Bergeron J, Pibarot P, Mathieu P, Larose E, et al. Abdominal obesity and the metabolic syndrome: contribution to global cardiometabolic risk. Arterioscler Thromb Vasc Biol. 2008;28(6):1039–1049.
8. Ben-Noun L, Sohar E, Laor A. Neck circumference as a simple screen- ing measure for identifying overweight and obese patients. Obes Res. 2001; 9(8):470–477.
9. Hingorjo MR, Qureshi MA, Mehdi A. Neck circumference as a useful marker of obesity: a comparison with body mass index and waist circumference. J Pak Med Assoc. 2012; 62(1): 36–40
10. Chaitanya Rangangouda Patil, Jyotsna S Deshmukh, Chandan R Lalwani, Harshad Bagde. Neck Circumference: An Alternative Tool for Screening Cardiovascular Risk among Adults. Journal of Clinical and Diagnostic Research. 2018;12.
11. Kissebah AH, Peiris AN. Biology of regional body fat distribution: relationship to non-insulin-dependent diabetes mellitus. Diabetes/metabolism Reviews. 1989; 5(2): 83-109.
12. Levine JA, Ray A, and Jensen MD. Relation between chubby cheeks and visceral fat. N Engl J Med 1998; 339:1946-1947
13. Ben-Noun LL, Laor A. Relationship between changes in neck circumference and cardiovascular risk factors. Exp Clin Cardiol. 2006; 11(1): 14–20
14. Sharada Sivaram K, Chakradhar Arepalli, Aashish Arumugam, Magesh Vadivelu, Arunachalam P. Correlation Of Neck Circumference With Waist Circumference And Body-Mass-Index In Ischemic Heart Disease: A Prospective Study. IJSR 2022;11(01): PRINT ISSN No. 2277 – 8179.
15. Gensini GG. A more meaningful scoring system for determining the severity of coronary heart disease. Am J Cardiol. 1983 Feb;51(3):606.
16. Rahel Dereje, Abel Girma , Abebaw Molla , Asnake Simieneh. Mid upper arm circumference as screening tool of overweight or obesity among adult employees of Mizan Tepi University, Southwest Ethiopia. Heliyon 2022; 8: e10793
17. Rashiti P, Behluli I, Bytyqi AR. Assessment of the Correlation between Severity of Coronary Artery Disease and Waist-Hip Ratio. Open Access Maced J Med Sci. 2017; 5: 929-933.

FIGURES

Fig 1: Gensini Score (G-Score), Neck Circumference and Mid -upper arm Circumference: Male Versus Female Comparison



.

Fig 2: LINE GRAPH SHOWING LINEAR RELATIONSHIP BETWEEN NC AND WC.

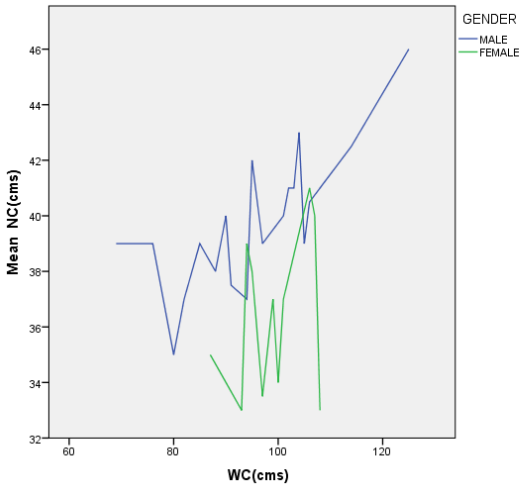


Fig 3: LINE GRAPH SHOWING RELATIONSHIP BETWEEN NC AND BMI.

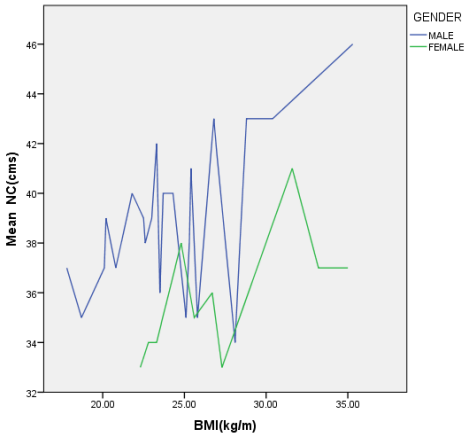


Fig 4: LINE GRAPH SHOWING RELATIONSHIP BETWEEN NC AND MUAC