



## Research Brief

# V-FAT study – A correlation between novel markers of obesity and coronary artery disease severity assessed by Syntax score in patients presenting with acute coronary syndrome

Anurag Bahekar <sup>a</sup>, Varghese George <sup>b,\*</sup>, Kiran Jacob <sup>c</sup>, Sultan R. Salih <sup>d</sup>, Ancy Thannikkal Joseph <sup>b</sup>, Cherian Koshy <sup>b</sup>, Amol Gautam <sup>e</sup>, Geena Benjamin <sup>f</sup>, Krishnan Nair Venugopal <sup>b</sup>

<sup>a</sup> Consultant Interventional Cardiologist, Gondia Care Hospital, Gondia, Maharashtra, India

<sup>b</sup> Department of Cardiology, Pushpagiri Institute of Medical Sciences & Research Centre, Thiruvalla, Kerala, India

<sup>c</sup> Consultant Interventional Cardiologist, Elite Mission Hospital, Thrissur, Kerala, India

<sup>d</sup> Consultant Interventional Cardiologist, Sevana Hospital, Palakkad, Kerala, India

<sup>e</sup> Department of Radiodiagnosis, Krishna Institute of Medical Sciences, Karad, Maharashtra, India

<sup>f</sup> Department of Radiodiagnosis, Pushpagiri Institute of Medical Sciences & Research Centre, Thiruvalla, Kerala, India



## ARTICLE INFO

## Article history:

Received 8 May 2020

Accepted 7 July 2020

Available online 17 July 2020

## Keywords:

VFAT

SFAT

Syntax scoring

## ABSTRACT

Our aim was to evaluate the role of traditional versus newer markers of obesity, in risk assessment of CAD. 50 consecutive ACS patients and 20 controls were enrolled. Visceral and Subcutaneous fat (VFAT and SFAT) analysis was done using multi-slice abdominal MRI. Syntax score was calculated from coronary angiogram. In our study, BMI and Waist/Hip ratios showed poor correlation with Syntax score. VFAT and SFAT showed strong correlation with Syntax score ( $p=0.01, 0.03$ ) and a more significant correlation was noted with their areas at L3-L4 levels ( $p=0.01, 0.05$ ). Statistically significant ROC- area under curve was observed with Indexed SFAT.

© 2020 Cardiological Society of India. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

In the recent decades, the prevalence of obese patients has been increasing in an overwhelming proportion. Undoubtedly, increased adiposity leads to the worsening of all cardio vascular diseases and coronary artery disease, conspicuously.<sup>1</sup> At the same time, there has been a mention of obese patients doing well compared to their leaner counterparts, also known as the “obesity paradox.”<sup>2</sup> But the correlation of visceral fat, subcutaneous fat, Body Mass Index (BMI) and Waist Hip ratio (WHR) to Syntax score in coronary angiogram has not been studied well.

Magnetic Resonance Imaging (MRI) can be considered as a gold standard for the estimation of abdominal adiposity and has similar accuracy to CT scan.<sup>3</sup> It has a high acceptance rate, being radiation free, not necessitating any pre-medications or contrast. Also, being an objective assessment there is less inter-observer variation and the images can be re-evaluated or verified at a later date.

## 2. Methodology

Fifty consecutive patients with ACS (NSTEMI/STEMI) were enrolled in the study. Abdominal MRI of twenty patients with no clinical, electrocardiographic or echocardiographic evidence of Coronary Artery Disease (CAD), who took this test for other reasons, were taken as controls. Traditional markers of obesity like BMI and WHR were measured using standardized equipments under strict supervision.<sup>4,5</sup> Visceral and Subcutaneous fat (VFAT and SFAT respectively) analysis was done using multi-slice abdominal MRI (1.5T GE MRI), obtained using a T1-weighted fast-spin echo pulse sequence (TR 322 ms, TE 12 ms). A breath-hold sequence ( $\approx 15$  s per acquisition) was used to minimize the effects of respiratory motion on images and the measurements were done offline by two observers. Syntax score was calculated from the coronary angiogram, for all cases by two observers and differences if any were re-evaluated and confirmed.

Statistical analysis was done using SPSS version 20. A student's-t test was used to evaluate the differences between high vs. low

\* Corresponding author.

E-mail address: [drvcardio@outlook.com](mailto:drvcardio@outlook.com) (V. George).

**Table 1**  
SFAT/VFAT groups and Mean Syntax scores.

SFAT	VFAT	Mean Syntax
Normal	Normal	9
High	Normal	14
Normal	High	17
High	High	23

VFAT-SFAT sub-groups and categorical variables were compared using Chi-square test.

**3. Results**

The mean age of study population was 59 years. Out of the fifty subjects, 50% (n = 25) had diabetes, 54% (n = 27) had systemic hypertension, 6% (n = 3) had renal disease and 30% (n = 15) were smokers. 10% (n = 5) patients had non-obstructive CAD on angiogram.

On the basis of 20 control patients and data from a previous study, VFAT of >150 cm<sup>2</sup> and SFAT of >190cm<sup>2</sup> were considered as cut-offs for excess body fat.<sup>6</sup> When analysed across the groups, BMI and WHR showed poor correlation with Syntax score. Subcutaneous fat and visceral fat showed a strong correlation with Syntax score (p-0.03, 0.01) (Table 1). Subcutaneous fat and Visceral Fat at the L3-L4 level showed a more significant correlation with CAD severity (p-0.05, p-0.01). Our subjects with normal BMI had higher VFAT-SFAT levels and surprisingly had the highest Syntax scores.

ROC curve plotted for various obesity markers showed a statistically significant ROC – area under curve for Indexed Subcutaneous Fat (Fig. 1).

Patient sub-group with VFAT more than 150 cm<sup>2</sup> and SFAT more than 190 cm<sup>2</sup> were found to have statistically significant increase in their mean Syntax scores when compared to patients with lower values(Fig. 2).

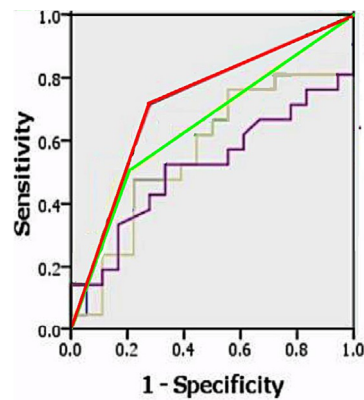
**4. Discussion**

In our study, there was a lack of correlation between BMI or WHR with CAD severity, which was similar to the findings by Parsa et al<sup>7</sup> In the latter study of 414 patients, it was demonstrated that there was an inverse correlation between BMI and severity of coronary artery disease. Similarly, in a study of 928 patients by Rubinshtein et al,<sup>8</sup> a negative correlation was found between high risk coronary anatomy and obesity, whereas other comorbidities like diabetes, dyslipidemia and male gender had a good correlation with CAD severity. Likewise Niraj et al<sup>9</sup> studied the relationship between BMI and extent of CAD, which was assessed using Duke score and demonstrated a paradoxical association between the two. We found that there was poor correlation between WHR and CAD severity, in contrary to the study by Parsa et al, where they could demonstrate good correlation between the two.

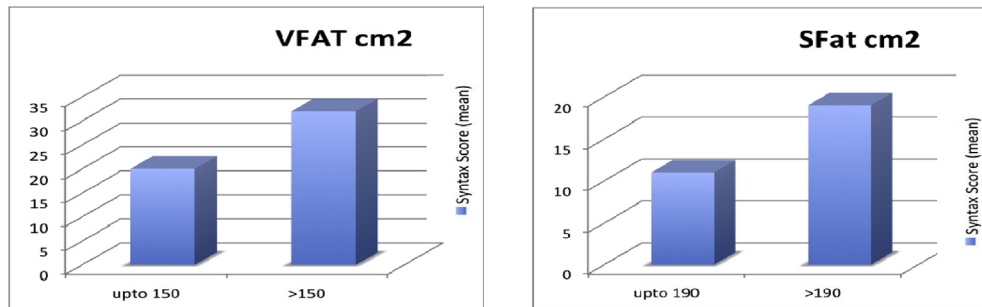
The relationship of BMI and coronary atherosclerosis has always been controversial. Although it may seem reasonable that obese patients are more prone for severe CAD, multiple studies have shown a paradoxical relationship. The reason may be, inability of BMI to precisely identify harmful fat deposits. In our group of patients with established CAD, sub-group with normal BMI were found to have higher levels of visceral and subcutaneous fat. This was distinct from the study by Gadekar et al,<sup>10</sup> which showed a modest linear correlation for BMI and VFA in males.

Based on our study, VFAT >150 cm<sup>2</sup> seems to be a promising surrogate marker for presence of severe CAD. If this can be validated in a larger heterogeneous population, VFAT values can be used as an excellent target for future therapeutic interventions. Comparably, in publications by Nakamura et al<sup>13</sup> and Ahn et al,<sup>14</sup> they observed that visceral fat area correlated significantly with the severity of coronary stenosis even in sub-sets of patients without CAD.

Area Under Curve		
COLOUR	TEST	AREA
RED	Index SFAT	0.72
GREEN	Index VFAT	0.66
BROWN	BMI	0.5
PURPLE	WHR	0.5



**Fig. 1.** Receiver operating characteristic (ROC) curve for various obesity markers.



**Fig. 2.** Correlation of mean VFAT and SFAT with Syntax scores (p- 0.01).

In a recent publication by Tanaka et al,<sup>11</sup> they concluded that higher SFAT and lower VFAT inversely correlated with severity of coronary artery plaques in asymptomatic patients without history of CAD. Correspondingly, in a study by Otagiri, et al<sup>12</sup> it was found that visceral fat accumulation revealed by higher visceral fat/subcutaneous fat ratio could be a more important risk factor for severe CAD, unlike our observations. However, we found a modest linear correlation of both VFAT and SFAT to the extent of CAD.

The findings in our study are distinct when compared to the previous studies which analyzed abdominal adiposity and CAD severity. It could be due to the difference in body fat distribution and fat composition in Indian patients. In contrast to other studies, our study enrolled patients having established CAD, which might also have contributed to the unique findings.

Our study had some limitations. It was a single centre study. The sample size was statistically sufficient to analyze the correlation of obesity markers with CAD. However, it was not sufficient to analyze the sub-groups of patients according to the BMI. A larger study needs to be planned to validate these findings in the various sub-groups of BMI. Other confounding factors need to be studied in detail.

## 5. Conclusion

Estimation of VFAT and SFAT definitely has an edge over the conventional markers of obesity in estimating CAD severity. Techniques like MRI make abdominal fat estimation easy, accurate and safe. Our findings need to be confirmed in a larger population for validating this tool as a predictor of CAD severity.

## Declaration of competing interest

There are no conflicts of interest.

## References

1. Lavie CJ, De Schutter A, Milani RV. Healthy obese versus unhealthy lean: the obesity paradox. *Nat Rev Endocrinol*. 2015;11:55–62.
2. Bastien M, Poirier P, Lemieux I, et al. Overview of epidemiology and contribution of obesity to cardiovascular disease. *Prog Cardiovasc Dis*. 2014;56:369–381.
3. Klopfenstein BJ, Kim MS, Krisky CM, Szumowski J, Rooney WD, Purnell JQ. Comparison of 3 T MRI and CT for the measurement of visceral and subcutaneous adipose tissue in humans. *Br J Radiol*. 2012;85:826–830.
4. U.S. Department of Health & Human Services. Centers for Disease Control and Prevention. Available from: <https://www.cdc.gov/healthyweight/assessing/index.html>. Accessed date 21 March 2020.
5. U.S. Department of Health & Human Services. CDC. National Health and Nutrition Examination Survey. Available from: [https://www.cdc.gov/nchs/data/nhanes/nhanes\\_07\\_08/manual\\_an.pdf](https://www.cdc.gov/nchs/data/nhanes/nhanes_07_08/manual_an.pdf). Accessed date 21 March 2020.
6. Marques Mateus D, Santos Raul D, Parga Jose R, et al. Relation between visceral fat and coronary artery disease evaluated by multidetector computed tomography. *Atherosclerosis*. 2010;209:481–486.
7. Parsa AF, Jahanshahi B. Is the relationship of body mass index to severity of coronary artery disease different from that of waist-to-hip ratio and severity of coronary artery disease? Paradoxical findings. *Cardiovasc J Afr*. 2015;26(1):13–16. <https://doi.org/10.5830/CVJA-2014-054>.
8. Rubinshtein R, Halon DA. Relation between obesity and severity of coronary artery disease. *Am J Cardiol*. 2006;97:1277–1280.
9. Niraj A, Pradham JT, Fakhri H, Veeranna V, Afonsoo L. Severity of coronary artery disease in obese patients undergoing coronary angiography: "obesity paradox". *Clin Cardiol*. 2007;30:391–396.
10. Tukaram Gadekar, Puja Dudeja, Ipsita Basu, Shruti Vashisht, Sandip Mukherji. Correlation of visceral body fat with waist–hip ratio, waist circumference and body mass index in healthy adults: a cross sectional study. *Med J Armed Forces India*. 2020;76(1):41–46.
11. Tanaka T, Kishi S, Ninomiya K, et al. Impact of abdominal fat distribution, visceral fat, and subcutaneous fat on coronary plaque scores assessed by 320-row computed tomography coronary angiography. *Atherosclerosis*. 2019 Aug;287:155–161.
12. Otagiri Kyuhachi, Yui Hisanori, Nakamura Chie, Sakai Takahiro, Kitabayashi Hiroshi. TCT-503 impact of visceral fat accumulation on coronary artery disease severity stratified by computed tomography-derived SYNTAX score. *J Am Coll Cardiol*. 2016 Nov;68(18 Supplement):B202.
13. Nakamura T, Tokunaga K, Shimomura I, et al. Contribution of visceral fat accumulation to the development of coronary artery disease in non-obese men. *Atherosclerosis*. 1994 Jun;107(2):239–246.
14. Ahn S, Lim H, Joe D, et al. Relationship of epicardial adipose tissue by echocardiography to coronary artery disease. *Heart*. 2008;94:e7.