Assessment of Visceral Fat Volume and Its Correlation with the Severity of Hepatic Fibrosis in Patients with NAFLD

Jijo Varghese1, Krishnadas Devadas2, Rathan Cyriac Joseph3, Tharun Tom Oommen4, Atul Hareendran5, Nibin Nahaz6, Vijay Narayanan7, Bony George8

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Abstract

Introduction: Nonalcoholic fatty liver disease (NAFLD) is one of the leading causes of chronic liver disease. The spectrum of NAFLD includes simple steatosis, nonalcoholic steatohepatitis (NASH), advanced fibrosis, and cirrhosis. Our study aimed to calculate visceral fat volume at the L3–L4 vertebral level and its association with hepatic fibrosis assessed by transient elastography.

Methods: All patients above 18 years undergoing computed tomography (CT) abdomen in the Department of Radiodiagnosis of Medical College Thiruvananthapuram during the study period with NAFLD were included. Transient elastography was done. Patients were categorized to advanced fibrosis (>10 kPa) and without advanced fibrosis (<10 kPa). The area under the receiver operating characteristic (AUROC) curve was plotted.

Results: Sixty-four patients comprised 36 males and 28 females. Thirty-one (46%) were having advanced fibrosis (transient elastography >10 kPa) and 34 (54%) patients were without advanced fibrosis. About 0.733 was the AUROC for visceral fat in predicting advanced fibrosis. The cutoff was 167.5 cm³ (sensitivity was 77.4% and specificity was 51.5% in predicting advanced fibrosis).

Conclusion: About 0.733 was the AUROC for visceral fat in predicting advanced fibrosis. The cutoff was 167.5 cm³ (sensitivity was 77.4% and specificity was 51.5% in predicting advanced fibrosis).

Introduction

Nonalcoholic fatty liver disease includes simple steatosis, advanced fibrosis, and cirrhosis. Previous studies have shown that visceral fat is closely associated with inflammation and hepatic fibrosis. If visceral fat is incorporated along with contrast-enhanced CT findings, it could potentially predict the development and severity of hepatic fibrosis in NAFLD patients. Visceral fat volume correlates with severity of fibrosis in NAFLD, independent of insulin resistance. The aim was to measure visceral fat volume at the L3–L4 level using four 2.5 mm cuts and to determine its association with liver fibrosis assessed by transient elastography.

Research Question

• Does visceral fat volume correlate with liver fibrosis in patients with NAFLD?

Objectives of This Study

• To evaluate the association between visceral fat volume calculated at the L3–L4 level from CT abdomen with hepatic fibrosis severity in NAFLD as determined by vibration-controlled transient elastography (VCTE).

Materials and Methods

A cross-sectional study. The study was conducted in the Department of Medical Gastroenterology along with the Department of Radiology, Medical College Thiruvananthapuram over a study period of 2 years (2016–2018).

Study Population

Every consecutive patient undergoing CT abdomen, with findings suggestive of NAFLD in the imaging was included.

Sample Size Calculation

A similar study conducted by van der Poorten et al. published in the Journal of Hepatology vol 2, August 2008, was utilized in calculating where the study included 38 patients and the sample size was 64.

Inclusion Criteria

Patients >18 years undergoing routine CT abdomen in the Department of Radiodiagnosis who were found to have NAFLD on CT.

Exclusion Criteria

Patients unwilling to give consent for the study.

Method of Data Collection

The study was done in the Department of Medical Gastroenterology, Medical College Thiruvananthapuram. Adult patients aged 18 years and above undergoing CT abdomen in the Department of Radiodiagnosis who were incidentally to have NAFLD were enrolled.

CT criteria for fatty liver:

• The liver attenuation was 10 HU less than that of the spleen or,
• The attenuation of the liver was less than 40 HU.

Visceral fat volume at L3 and L4 levels was calculated. Visceral fat was measured as follows.

Prerequisites

Axial slices at the level of the L3/L4 vertebral body.

Slice thickness of 2.5/1.25 mm. Minimum of four slices are required.

Steps in analyzing the visceral fat volume

• Select slices and open in Reformat.
• Change view 1 to axial.
• Segment → Threshold move the min and max sliders to highlight fat alone in green (typically –200 to ~30).
• Apply Threshold.
• Double click on view 2 so that it is highlighted with red borders and no other viewports are selected. Click on keep object and click on subcutaneous fat on view 2. This will remove the cradle.
• Segment—Scalpel—draw around the visceral fat in view 2 → cut inside.
• Double click on view 2. Now view 1 is in red and view 2 in green borders.
• Segment—Advanced processing—Subtract.
• In view 1—Use scalpel and draw around the visceral fat and select cut outside.
• Display—Measure volume and click on view 1 and view 2. You can see the volume

1,3–6Senior Resident; 2Professor and Head of the Department; 7Medical College Thiruvananthapuram; 8Senior Resident, Department of Medical Gastroenterology, Medical College Thiruvananthapuram, Thiruvananthapuram, Kerala, India; *Corresponding Author

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Assessment of Visceral Fat Volume

of visceral fat in view 1 and subcutaneous fat in view 2.

Patients diagnosed to have NAFLD as per imaging were subjected to FibroScan using VCTE within 2 weeks.

Grading of NAFLD fibrosis was done as:

- F0 and F1 → 2–7 kPa.
- F2 → 7.5–10 kPa.
- F3 and F4 → ≥10 kPa (also known as advanced fibrosis).

**Ethical Consideration**

Ethical committee clearance was obtained and written consent was taken from the study population both in English and Malayalam.

**Discussion**

The mean body mass index (BMI) in patients with advanced fibrosis was more than in patients without advanced fibrosis. Previous studies have also shown that BMI is a predictor of advanced fibrosis. BMI is a component of advanced fibrosis predictor scores like the BARD score. Advanced fibrosis patients had an increased visceral fat volume than those without. van der Poorten et al. have shown that visceral fat volume was a predictor of fibrosis and inflammation of the liver. Hemoglobin A1c (HbA1c) and fasting blood sugar (FBS) were higher in patients with advanced fibrosis. Diabetes mellitus is in fact a component of well-validated established scoring systems of advanced fibrosis.

Patients with advanced fibrosis were shown to have elevated ferritin levels. Ferritin is an acute phase reactant and it will be increased in the background of inflammation and increase in ferritin in those with advanced fibrosis suggest two things, first thing is that those with advanced fibrosis have more necroinflammation than those without advanced fibrosis and second thing is that those with advanced fibrosis have a secondary iron overload in liver. This could result in higher ferritin levels.

Visceral fat in our study population ranged from 140 to 360 cm³. In Michalis Mantatzis et al.'s study, mean visceral fat volume at L3–L4 level was 189 cm³.

About 0.733 was the AUROC for visceral fat in predicting advanced fibrosis. Cutoff was 167.5 cm³ (sensitivity was 77.4% and specificity was 51.5% in predicting advanced fibrosis).

Among the variables analyzed, BMI, weight, serum glutamic pyruvic transaminase, serum glutamic oxaloacetic transaminase (SGOT), cholesterol, triglycerides, FBS, and HbA1c had a significant positive correlation but height had a negative correlation with visceral fat volume at L3–L4 level. A study by Janssen et al. also suggests that BMI has a positive correlation with visceral fat volume.

Age was not shown to be a predictor of advanced fibrosis in the female population in our study probably because of the small sample size and narrow age spread of the sample. Higher weight, SGOT, and FBS predicted advanced fibrosis. Platelet count, cholesterol, and low-density lipoprotein (LDL) were less in patients with advanced fibrosis. Lower levels of cholesterol and LDL in advanced fibrosis are due to mitochondrial and endoplasmic reticulum dysfunction in advanced fibrosis resulting in abnormal lipoprotein synthesis and folding.

Twenty patients had BMI ≤25 (nonobese NAFLD) in our study. Lean NASH is an important emerging entity, so the indicators of advanced fibrosis in patients without NAFLD were analyzed. Mean values of height, weight, and triglycerides were more in patients with advanced fibrosis in comparison to those without advanced fibrosis. Mean values of albumin and cholesterol were low in patients with advanced fibrosis. Visceral fat also turned out to be not a predictor of advanced fibrosis in patients with BMI ≤25. In obese male patients, 0.754 was the AUROC (at a cutoff of 180 cm³ had a sensitivity of 75% and specificity of 60% in predicting advanced fibrosis).

**Conclusions**

- Visceral fat volume measured at L3–L4 level ≥167.5 cm³ predicted advanced fibrosis.
- Visceral fat volume predicted advanced fibrosis in obese males at a cutoff of 180 cm³.
- Age, weight, BMI, and visceral fat volume measured at L3–L4 level, HbA1c, FBS, and ferritin were independent predictors of advanced fibrosis.

**References**