Relationship of mesenteric panniculitis with visceral and subcutaneous adipose tissue

Abstract

Background/aim: Mesenteric panniculitis (MP) is an idiopathic benign disease characterized by fat necrosis, chronic inflammation and fibrosis. The relationship between obesity and chronic low-grade inflammation has been reported. This study investigated the relationship of MP diagnosed using multidetector computed tomography (MDCT) with visceral adipose tissue (VAT) and subcutaneous adipose tissue (SAT) areas.

Materials and methods: We retrospectively enrolled 104 patients with no radiological findings other than MP. Additionally, 76 individuals without any indicative radiological findings were included as controls. VAT and SAT were separately calculated (cm²) using a three-dimensional workstation. The abdominal circumference was measured (cm).

Results: The mean abdominal circumference was 99.9 ± 7.9 cm, SAT was 195.3 ± 89.1 cm², VAT was 203.9 ± 72.8 cm² in the MP group. The abdominal circumference, VAT and SAT were significantly higher in the MP group than those in the control group (p < 0.001).

According to the ROC analysis, a cut-off level VAT and SAT were 167.5 cm² (sensitivity 71%, specificity 69%) and 117.5 cm² (sensitivity 78%, specificity 51 %) respectively.

Conclusion: In this study, increased VAT and SAT were associated with MP, suggesting their role in the etiology of MP.

Key words: Mesenteric panniculitis, Fat tissue, Multidetector computed tomography.
1. Introduction

Mesenteric panniculitis (MP) is an idiopathic benign disease that affects the intestinal mesentery and is characterized by fat necrosis, chronic inflammation, and fibrosis [1,2]. MP has no specific presenting symptoms, is usually incidentally diagnosed and has a prevalence of approximately 0.6% [3].

Although MP usually involves the small bowel mesentery, it can affect the sigmoid mesentery and mesocolon as well [4,5]. However, the specific etiology of this disease remains unknown. The most commonly associated factors are malignancy, granulomatous disease, rheumatologic disease, and previous abdominal trauma or surgery. In addition, studies have reported the associations of MP with vasculitis, autoimmunity, pancreatitis, ischemic damage, and infection [3,6]. Recently, studies have reported a relationship between obesity and chronic low-grade inflammation and have found higher cytokine levels in patients with obesity [7-11]. However, the relationship of MP with visceral adipose tissue (VAT) and subcutaneous adipose tissue (SAT) are unclear.

Although there are several studies regarding the etiology of MP as well as those that use body mass index (BMI) in the etiology of MP [12] and its relationship with obesity in the literature, there are no studies about whether the etiology of MP is related to visceral or subcutaneous obesity.

In the present study, we investigated the effect of increase in VAT or SAT on the etiology of MP, which was incidentally diagnosed using multidetector computed tomography (MDCT).
2. Materials and methods

From our hospital information system, 18,850 patients who underwent abdominal computed tomography (CT) between January 2015 and May 2017 were retrospectively screened to identify those diagnosed with MP. The study was approved by the local ethics committee (approval no. 2019/162). Among these patients, a total of 104 patients with MP were identified. Furthermore, 76 individuals who underwent abdominal CT for any reason but did not have any indicative radiological findings were included as controls.

The inclusion criteria were as follows: patients who underwent abdominal CT for abdominal pain, side pain, or any other reason, such as abdominal bloating and/or nausea and the suspicion of renal stones, but had no CT findings other than incidental MP. The exclusion criteria were as follows: history of abdominopelvic surgery, malignancies causing intra-abdominal inflammation, lymphoproliferative or autoimmune diseases, gastrointestinal diseases (e.g., cholelithiasis, cirrhosis, pancreatitis, peptic ulcer, and retroperitoneal fibrosis), vascular diseases (e.g., mesenteric thrombosis, mesenteric arteriopathy, and abdominal aortic aneurysm), nephrolithiasis, primary abdominal trauma, and intra-abdominal hemorrhage.

All CT scans were performed using an 80-row detector CT (160 slice) scanner (Aquilion Prime, Toshiba Medical Systems, Nasu, Japan). The technique of CT imaging was not standardized because of a variety of different clinical indications. Fourteen patients underwent non-enhanced CT scans (renal stone protocol). Contrast-enhanced images were obtained at the portal venous phase with a start delay of 70 s after each patient received a total of 90–100 mL of nonionic contrast agent and 30 mL of saline injection at a flow rate of 2–3 mL/s. The CT protocol was as follows: peak kilovoltage 120 kVp, tube current, 150–165 mAs; maximum collimation, 2.5 mm; slice thickness, 2 mm; and rotation time, 0.75 s.
A positive CT diagnosis of MP was based on the observation of a well-defined mesenteric fatty mass lesion without infiltration of neighboring structures, observation of an increase in mesenteric fat attenuation, presence of lymph nodes within the mass, presence of a surrounding hyperdense pseudocapsule and limiting mesenteric fat, and presence of a hypodense fatty halo surrounding blood vessels and nodes [13] (Figure 1). All of the study cases satisfied a minimum of three of these five criteria.

In all patients, fat tissue was assessed from the cross-section of the L2 vertebrae using a three-dimensional workstation (Aquarius 3D Workstation, TeraRecon Inc., San Mateo, CA). The L2 vertebra reference point was selected to standardize the measurement location in all patients. VAT and SAT areas were separately determined (cm²). In addition, the abdominal circumference (cm) at the same level were calculated.

The measurements were performed by two radiologists. One of them was a radiologist with 9 years of experience and the other was a 5-year radiology resident. Measurements were repeated twice and averaged.

With this software, visceral and subcutaneous adipose tissue measurements are performed automatically. The software allows manual correction of incorrect drawings. In case of non-fat tissues were detected as fat during measurement, they were corrected manually.

BMI of all patients were noted. The localization and direction of MP were noted to originate from the small bowel or colon mesenteries (Figure 2).

2.1. Statistical analysis

All statistical analyses were performed with statistical Package for the Social Sciences (SPSS) Statistics software (version 24.0, IBM).
Quantitative data expressed as mean ± standard deviation (SD), median and range.

Categorical data expressed as percentage.

The age, BMI, VAT and SAT areas and abdominal circumference in patients with MP and controls were examined in terms of their distributions, using the Kolmogorov–Smirnov test. The age, BMI, VAT area, abdominal circumference were normally distributed and compared using the T test. SAT area were not normally distributed and compared using the Mann–Whitney U test. Chi-square test was used to compare gender distribution between the groups.

To determine VAT and SAT areas diagnostic cut-off, the ROC curve was applied.

3. Results

According to MDCT findings, 104 patients with MP were identified. Of the 104 patients, 50 were male (48.1%) and 54 were female (51.9%), and the mean patient age was 54.7 ± 11.5 years (range, 28–80 years). With regard to controls, of the 76 individuals, 38 were male (50%) and 38 were female (50%). The mean age of controls was 52 ± 11.3 years (range, 29–75 years) and were similar to the patients in terms of age and gender (Table 1).

Among the patients included in this study, MP was diagnosed incidentally and abdominal CT was performed in 13% of the patients owing to abdominal pain.

All cases of MP involved the small bowel mesentery and none originated from the colon mesentery. Among the 104 patients, MP was localized to the right lower quadrant in two patients, right upper quadrant in one patient, left lower quadrant in seven patients, midline at the para-aortic region in 29 patients, and left upper quadrant in 65 patients.

In the MP group, the mean BMI was 35.8 ± 4.77 kg/m² (range, 22.5–46.3 kg/m²). A total of 54 patients (51.9%) were classified as obese (BMI > 30 kg/m²), and 16 patients (15.4%)
presented with morbid obesity (BMI > 40 kg/m²). Further, 18 patients (17.3%) presented as overweight (BMI, 25–30 kg/m²), whereas 16 patients (15.4%) in the study population were normal weighted (BMI, 18.5–25 kg/m²). In the control group the mean BMI was 27.6± 3.23 kg/m² (range 19.5-35.7 kg/m²).

In the MP group, the mean abdominal circumference was 99.9 ± 7.9 cm, SAT area was 195.3 ± 89.1 cm², VAT area was 203.9 ± 72.8 cm².

In the control group, the mean abdominal circumference was 94.2 ± 12.9 cm, SAT area was 140 ± 106.5 cm², VAT area was 135.2 ± 76.1 cm².

The BMI, abdominal circumference, VAT and SAT were significantly higher in the MP group than in the control group (p<0.001) (Table 2).

According to the ROC analysis, a cut-off level VAT area was 167.5 cm² determined with 71% sensitivity, 69% specificity, and the area under the curve equaling 0.739 with a 95% confidence interval (CI).

A cut-off level SAT area was 117.5 cm² determined with 78% sensitivity, 51% specificity, and the area under the curve equaling 0.708 with a 95% CI (Figure 3).

4. Discussion

In the present study, we found that the abdominal circumference, VAT and SAT were significantly associated with MP.

The specific etiology of MP remains unknown. Walled et al. [14] reported that a history of abdominopelvic surgery was present in 49% of patients with MP. Additionally, the authors noted that the prevalence of MP was significantly higher in patients who underwent abdominopelvic surgery than in those who did not undergo abdominopelvic surgery.
However, in this previous study, there was no mention of BMI or visceral adipose tissue. Furthermore, a history of malignancy was present in 31% of patients with MP.

Daskalogiannaki et al. [3] reported that 57% of patients with MP had undergone previous abdominopelvic surgery, and of these, few patients presented with a mural thrombus in an abdominal aortic aneurysm and ischemic enteritis. The authors suggested that these vascular disorders might have triggered MP. In the present study, patients with a history of surgery and vascular disease were excluded and the relationship of MP with adipose tissue was investigated.

Unlu et al. [12] assessed 80 patients with MP and reported that the majority of these patients had a high BMI, with 57.5% being obese, 10% morbidly obese, 17.5% overweight, and 15% normal weight. Kaya et al. [15] reported that 54.7% of patients with MP had a BMI >30 kg/m$^2$ in their study on the diagnosis and treatment of MP. The authors suggested that obesity might affect immunity and might be an underlying disorder.

Several programs and tools can calculate visceral and subcutaneous fat by MDCT. Ryckman et al. [16] quantified visceral and subcutaneous abdominal fat using a validated semi-automated software tool. In their study, they investigated whether the visceral adipose tissue by CT in asymptomatic adults could predict the possibility of future cardiac events.

In the literature, no study has investigated the relationships of MP with visceral and subcutaneous adipose tissue, using similar CT-based techniques. In the present study, we noted a significant relationship of MP with the visceral and subcutaneous adipose tissue. Additionally, we estimated a cut-off value for visceral and subcutaneous adipose tissue that may be associated with MP.

In this study, greater than 167.5 cm$^2$ VAT area and greater than 117.5 cm$^2$ SAT area were determined to be significantly associated with mesenteric panniculitis.
In previous studies, obese people were compared with people with a normal weight, and the obese people were found to have higher levels of proinflammatory proteins/cytokines, such as acute-phase proteins (C-reactive protein and haptoglobin), interleukin 6, tumor necrosis factor-alpha, adipokines, and neuropeptides (e.g., substance P) [7-11]. All these proinflammatory factors are produced by adipocytes, as well as macrophages and lymphocytes found in mesenteric adipose tissue. Therefore, a systemic acute-phase response can be triggered with an increase in adipose tissue [8-11]. In addition, adipokines have been shown to be over-produced in the mesenteric adipose tissue of people with inflammatory bowel disease [17-19]. The fact that proinflammatory factors are produced in mesenteric fatty tissue supports the significant relationship between MP and the visceral adipose tissue noted in our study.

The main limitations of our study were that this was a retrospective study and that we had no histological confirmation. Therefore, prospective histological and endocrinological studies are needed to clarify the effects of increased visceral adipose tissue on MP findings.

In conclusion, increased abdominal circumference, visceral and subcutaneous adipose tissue were found to be associated with MP.

A cut-off level for VAT and SAT areas were 167.5 cm$^2$ and 117.5 cm$^2$, determined to be significantly associated with mesenteric panniculitis.
References


### Table 1. Demographic characteristics of patients with MP and controls

<table>
<thead>
<tr>
<th></th>
<th>Patient group (n=104)</th>
<th>Control group (n=76)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (median, mean±SD) years</strong></td>
<td>55, 54.7±11.5</td>
<td>52, 52±11.3</td>
</tr>
<tr>
<td><strong>Range (min-max)</strong></td>
<td>(28-80 years)</td>
<td>(29-75 years)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>54 (58.7%)</td>
<td>38 (41.3%)</td>
</tr>
<tr>
<td>Male</td>
<td>50 (56.8%)</td>
<td>38 (43.2%)</td>
</tr>
</tbody>
</table>

### Table 2. Findings in the mesenteric panniculitis group and control group

<table>
<thead>
<tr>
<th></th>
<th>Patient</th>
<th>Control</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI (mean, range) kg/m2</strong></td>
<td>35.8 ± 4.77 (22.5–46.3)</td>
<td>27.6± 3.23(19.5-35.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Abdominal circumference</strong></td>
<td>99.3 (99.9±7.9)</td>
<td>93.0 (94.2±12.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(cm)Median (mean±SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Visceral adipose tissue area</strong></td>
<td>199.0 (203.9±72.8)</td>
<td>131(135.2±76.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(cm²)Median (mean±SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subcutaneous adipose tissue</strong></td>
<td>183.0 (195.3±89.1)</td>
<td>117 (140±106.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>area (cm²)Median (mean±SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Figure 1.** Contrast-enhanced computed tomography scan shows a well-defined mesenteric fatty mass, lymph nodes within the mass, and a surrounding hyperdense pseudocapsule of mesenteric panniculitis in the left upper quadrant.

**Figure 2.** Computed tomography image at the L2 vertebral level shows segmentation of visceral (green) and subcutaneous (blue) adipose tissues by the automated tool.
**Figure 3.** Receiver operating characteristic (ROC) curve of visceral (A) and subcutaneous adipose tissue (B). AUC: Area under the curve. CI: Confidence Interval.

---

**Figure legends**

**Figure 1.** Contrast-enhanced computed tomography scan shows a well-defined mesenteric fatty mass, lymph nodes within the mass, and a surrounding hyperdense pseudocapsule of mesenteric panniculitis in the left upper quadrant.

**Figure 2.**Computed tomography image at the L2 vertebral level shows segmentation of visceral (green) and subcutaneous (blue) adipose tissues by the automated tool.

**Figure 3.** Receiver operating characteristic (ROC) curve of visceral (A) and subcutaneous adipose tissue (B). AUC: Area under the curve. CI: Confidence Interval.