

## Evaluation of mesenteric panniculitis with computed tomography: benign condition or paraneoplastic syndrome?

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**Background/aim:** This study aimed to investigate the prevalence and association of mesenteric panniculitis (MP) with other diseases and the clinicoradiological features of MP, and to examine computed tomography findings to estimate the presence of malignancy in patients with MP.

**Materials and methods:** Between September 2012 and August 2016, we used a keyword search to identify patients diagnosed with MP. Associated diseases and malignancies of patients were recorded. Cut-off values and diagnostic efficiencies of total MP scores and short and long diameters of the greatest lymph nodes were determined.

**Results:** Out of 22,033 patients, 309 were determined to have MP (prevalence 1.40%); 57.9% of these patients had a malignancy and 42.1% did not have a malignancy. The mean total MP scores and diameters of the greatest lymph nodes were significantly higher in the patients with a malignancy ( $P < 0.001$ ). AUCs were 0.728, 0.879, and 0.767 for the short diameter, long diameter, and total score, respectively. The diagnostic efficiencies of the long diameter of the greatest lymph nodes were significantly higher than the total MP scores and the short diameter of the greatest nodes.

**Conclusion:** MP is thought to be associated with abdominal and other system malignancies so MP may be a paraneoplastic syndrome in some patients.

**Key words:** Abdomen, computed tomography, malignancy, mesenteric panniculitis

### 1. Introduction

Mesenteric panniculitis (MP) is rare, chronic, idiopathic, and nonspecific inflammation of the bowel mesentery (1). Various terms have been reported in the literature depending on the predominant component, such as mesenteric lipodystrophy, sclerosing mesenteritis, mesenteric Weber-Christian disease, and retractile mesenteritis or mesenteric fibrosis (2). MP is histologically characterized by variable degrees of fat necrosis, chronic inflammation, and fibrosis (1). Although MP is usually seen at the root of the small bowel mesentery, it can rarely involve the large bowel mesentery, peripancreatic and omental fat, retroperitoneal space, and pelvic fat (3,4).

MP usually presents in middle and late adulthood with higher incidence in males. As it may be asymptomatic, abdominal pain, fever, nausea, vomiting, diarrhea, constipation, and weight loss can also occur in patients (5). A poorly defined abdominal mass may be revealed

during physical examination. Laboratory findings can be normal or nonspecific such as elevation in the erythrocyte sedimentation rate and white blood cell count and decrease in the hemoglobin level (6). Most patients with MP do not require any treatment. In symptomatic cases, a combination of corticosteroids and tamoxifen may be preferred for therapy (7).

With the increased use of abdominal imaging modalities, MP is diagnosed incidentally with increasing frequency during computed tomography (CT) imaging. However, there are conflicting results about the prevalence of MP and the reported prevalence rates range from 0.16% to 7.8% (8–12). CT is the most common diagnostic method among imaging modalities. At least three out of the following five typical signs are necessary for positive CT diagnosis of MP: a well-defined mass composed of inhomogeneous fatty tissue at the root of the small bowel mesentery displacing neighboring intestinal structures

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with mass effect; lymph nodes in this mesenteric fat tissue; increased attenuation in this area higher than retroperitoneal fat; hypodense halo around the blood vessels and nodes; hyperdense pseudocapsule surrounding the mesenteric fat tissue (11,13).

The causes and pathogenesis of MP are still unclear, but several possible causes have been postulated in the literature (13–16). It is difficult to determine the precise etiology of MP but it may be associated with various causes such as autoimmune disease, granulomatous disease, rheumatic disease, previous abdominal surgery, ischemia of the mesentery, smoking, hypertension, urolithiasis, and diabetes (13–16). MP has also been associated with various malignant diseases including lymphoma, lung cancer, melanoma, colon cancer, renal cell cancer, myeloma, gastric carcinoma, chronic lymphocytic leukemia, Hodgkin's disease, large cell lymphoma, carcinoid tumor, and thoracic mesothelioma (8–10). In such studies, the rate of association with malignancy has varied between 17% and 70% (8–16). For this reason, it has been suggested that MP may be a paraneoplastic syndrome in some patients.

There are conflicting results about the prevalence of MP and the role of malignant conditions in MP. In this study, we aimed to determine the prevalence of MP, document possible associated diseases, define the CT features of MP, and find possible CT criteria to estimate the presence of malignancy in 22,033 patients who underwent abdominal CT.

## 2. Materials and methods

### 2.1. Study population

With a keyword search in our database, patients who underwent abdominal CT and were diagnosed with mesenteric panniculitis between September 2012 and August 2016 were retrospectively researched. From 22,033 cases, 320 patients diagnosed with MP were documented. The patients' CT images were reevaluated by two radiologists and the MP grades for each sign were decided by consensus. Eleven patients were excluded from the study due to acute pancreatitis ( $n = 3$ ), ascites ( $n = 3$ ), portal vein thrombosis ( $n = 3$ ), and superior mesenteric vein thrombosis ( $n = 2$ ). Therefore, 309 patients were included in the study. The demographic characteristics, accompanying diseases, surgical histories, medical histories, and clinical indications of CT examinations were recorded. The study was approved by the institutional ethics committee.

### 2.2. CT protocol

All CT examinations were performed using a 160-slice scanner (Toshiba Aquilion, Toshiba Medical Systems, Japan) and a 16-slice scanner (SOMATOM Sensation 16, Siemens, Forchheim, Germany) with axial 2-mm-thick reconstruction images from diaphragm to pubic

symphysis. All patients were examined using the standard scanning protocol with intravenous and oral contrast when it was indicated; however, contrast agents could not be used in patients with renal failure, contrast allergy, or kidney stones. Contrast-enhanced images were obtained at the portal venous phase with a start delay of 70 s after each patient received a total of 100–120 mL of nonionic contrast agent and 30 mL of saline injection at a flow rate of 4 mL/s. The CT protocol was as follows: 120 kVp, tube current of 150–165 mAs, maximum 2.5 mm collimation, slice thickness of 2 mm, and 0.5 s rotation time.

### 2.3. Analysis of CT images

The CT images were reevaluated by two radiologists and the results were obtained by consensus. The diagnosis of MP was reached using the following five diagnostic criteria: a well-defined mass composed of inhomogeneous fatty tissue without infiltration; increased attenuation; increased number of lymph nodes; hypodense halo around the blood vessels and nodes; and hyperdense pseudocapsule. As Gögebakan et al. and Coulier classified, we described four possible grades for each typical sign as follows: absent (score 0), discrete (score 1), moderate (score 2), and marked (score 3) (10,11). Because the diagnosis requires at least three of these five CT signs, the minimum and maximum total MP score were 3 and 15, respectively. MP was classified as minimal (scores 3–4), moderate (scores 5–9), and marked (scores 10–15). CT findings including the short and long diameters of the greatest lymph nodes were recorded. In addition, the densities of mesenteric and retroperitoneal fat were measured by circumscribing the region of interest including at least 20 pixels. The vessels, nodes, and intestinal structures were not included in the measurement.

### 2.4. Statistical analysis

All of the data were analyzed using SPSS 13.0 (SPSS Inc., Chicago, IL, USA) and the MedCalc package (MedCalc Statistical Software version 16.8, MedCalc Software bvba, Ostend, Belgium). The means and ranges of age, density of the inhomogeneous fatty mass and retroperitoneal fat, and short and long diameters of the greatest lymph node were calculated. The Kolmogorov–Smirnov test was used to show deviation from normal distribution. The nonparametric Mann–Whitney U test and parametric Student's t-test were used to compare the CT findings of the patients with and without malignancy. The Mann–Whitney U test was used to analyze age and the long diameter of the greatest lymph node. Student's t-test was used to measure the short diameter of the greatest lymph node and total MP score. Furthermore, the differences between the attenuation values of the inhomogeneous fatty mass and retroperitoneal fat were assessed using a paired t-test. Optimal cut-off points of the short and long diameters of the greatest lymph node and the total

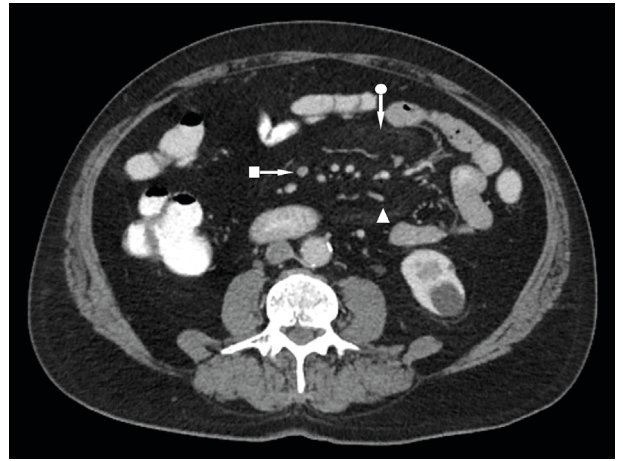
MP score for the probability of a malignancy were found with using ROC analysis. If the obtained value was less than the given cut-off value, the patient was considered to have no malignancy. If not, the patient was considered to have a malignancy. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of these parameters were calculated. The area beneath the fitted binormal ROC curve (AUC) was used to measure diagnostic efficacy. The AUC values were calculated and compared with these parameters.  $P < 0.05$  was considered to indicate a significant difference.

### 3. Results

In the present study, 22,033 patients underwent abdominal CT; MP was detected in 309 of those patients (132 males, 177 females; age range: 18–87 years; mean age: 53 years) with 1.4% prevalence. The main indications of the 22,033 patients in the initial CT were as follows: 10,157 follow-up or staging of malignancy (46.1%), 4583 abdominal pain (20.8%), 2423 traffic accident (10.9%), 1828 suspicion of ureterorenal stone (8.2%), 1652 falling from heights (7.4%), 528 abnormal laboratory findings (2.3%), 194 abscess (0.9%), 181 suspicion of inflammatory bowel disease (0.8%), and 487 other causes (2.2%). The main indications of the 309 patients with MP in the initial CT were as follows: 166 follow-up or staging of malignancy (53.8%), 105 abdominal pain (34.0%), 32 follow-up of known benign diseases (10.4%), and six abnormal laboratory findings (1.9%). Of these patients, 233 (75.4%) were evaluated using an initial contrast-enhanced CT and 76 (24.6%) were evaluated with noncontrast-enhanced scans. Of the 309 patients with MP, 179 (57.9%) had a malignancy and 130 (42.1%) did not have any known malignancy in this study. The total MP score revealed that 99 patients (32%) had mild MP, 151 (48.9%) patients had moderate MP, and 59 (19.1%) patients had marked MP (Figures 1–3). In addition, numbers of the mild, moderate, and marked grades of patients with and without a malignancy were mild grade: 31 and 68; moderate grade: 97 and 54, and marked grade: 51 and 8, respectively.

The mean ages of patients with and without malignancy were 57 years (range: 22–87) and 48 years (range: 18–78), respectively. The mean values of ages, short and long diameters of the greatest lymph nodes, and total MP scores for the patients with and without a malignancy are shown in Table 1. The patients' ages, short and long diameters of the greatest lymph nodes, and total MP scores were significantly higher in patients with a malignancy compared to patients without a malignancy ( $P < 0.001$ ). The mean attenuation values of the inhomogeneous fatty mass and retroperitoneal fat were  $-68.7$  HU and  $-112.2$  HU, respectively ( $P < 0.001$ ).

The ROC curves of the short and long diameters of the greatest lymph nodes and total MP scores are shown



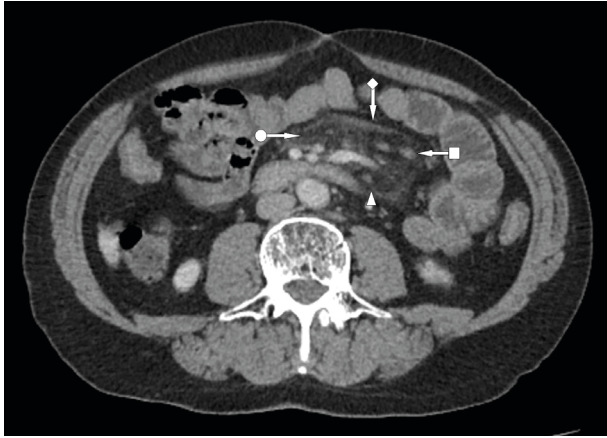
**Figure 1.** A 43-year-old woman presented with abdominal pain; the diagnosis included renal stones, left Bosniak type 1 renal cortical cyst, and mild MP (score 3–4). The contrast-enhanced axial CT image shows that the mesenteric fat is more hyperdense (circle) than the retroperitoneal fat, with small lymph nodes (square) and hypodense halo (arrow head) surrounding the blood vessels and nodes.



**Figure 2.** A 53-year-old woman presented with abdominal pain; the diagnosis was hepatic hemangioma, cholecystectomy due to cholelithiasis, and moderate MP (score 5–9). The contrast-enhanced axial CT image shows the hyperdense mesenteric fat (circle), lymph nodes (square), hyperdense pseudocapsule (diamond), and hypodense halo (arrow head) surrounding the blood vessels and nodes.

in Figure 4. The AUCs were 0.728, 0.879, and 0.767 for the short diameter, long diameter, and total MP scores, respectively. The AUC of the long diameter was significantly higher than the AUCs of the short diameter and total MP scores ( $P < 0.001$ ). The optimal cut-off values that provide the highest sensitivity and specificity for the short and long





**Figure 3.** A 41-year-old man with gastric cancer and a diagnosis of marked MP (scores 10–15). The contrast-enhanced axial CT image shows the hyperdense mesenteric fat (circle), lymph nodes (square), hyperdense pseudocapsule (diamond), and hypodense halo (arrow head) surrounding the blood vessels and nodes.

diameters and the total MP scores derived from the ROC analysis were 5.0 mm, 11.7 mm, and 5.0, respectively. With the use of these cut-off values, the obtained diagnostic values for these parameters are presented in Table 2. The highest diagnostic values obtained with the long diameter of the greatest lymph nodes were 81.1% sensitivity, 76.1% specificity, and 79.2% accuracy.

The most common malignancies recorded in 22,033 patients were gastric cancer (13.5%), breast cancer (12.7%), colorectal cancer (11.4%), lymphoma (11.0%), prostate cancer (7.7%), lung cancer (6.7%), pancreas cancer (5.9%), bladder cancer (4.7%), ovarian cancer (4.5%), endometrial cancer (3.8%), and other cancers (17.7%). Additionally, the most common malignancies in 309 patients with MP were lymphoma (9.3%), breast cancer (8.7%), endometrium cancer (6.7%), ovarian cancer (5.8%), colorectal cancer (4.2%), gastric cancer (3.2%), lung cancer (2.9%), renal cell carcinoma (2.6%), and leukemia (2.6%). Of 179 patients, 58 had concurrent malignancies and 121 had a previous malignancy. In 58 of the 130 patients with MP without

previous and/or concurrent malignancies, no reason could be found for abdominal pain. The most common accompanying benign disorders were as follows: ureteral stones (n = 13), kidney stones (n = 9), cirrhosis (n = 4), rheumatoid arthritis (n = 4), ulcerative colitis (n = 3), colon diverticulum (n = 2), systemic lupus erythematosus (n = 2), and acute appendicitis (n = 2). Of the 309 patients, 108 had a history of previous abdominal surgery for different conditions, 100 had followed hypertension, 56 had previous coronary artery disease, and 57 had known diabetes mellitus.

Of 124 patients, 112 with a malignancy and 12 without a malignancy underwent one to eight follow-up abdominal CTs between 1 month and 35 months from the initial CT examinations. CT findings of MP were stable in all of the patients. None of the 12 patients without a malignancy developed a new malignancy during the follow-up period. Six patients with malignancy developed a new malignancy as follows: colon cancer (n = 2), breast cancer (n = 1), endometrial cancer (n = 1), small bowel cancer (n = 1), and ureteral transitional cell carcinoma (n = 1). None of the patients were treated for MP and no biopsies were performed.

#### 4. Discussion

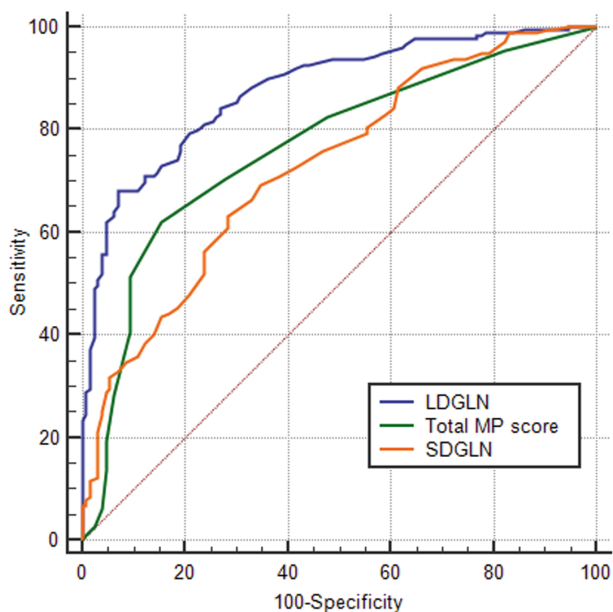
In the present study, we investigated the prevalence of MP, possible associated diseases, and CT features of MP. Our results showed that the prevalence of MP was 1.4% and 57.9% of these 309 patients had a concomitant malignancy. We found that the total MP score and the short and long diameters of the greatest lymph node could be useful in estimating the presence of a malignancy. The total MP score and the short and long diameters of the greatest lymph node provided 71.1%, 67.9%, and 79.2% accuracy for this purpose, respectively.

The prevalence of MP was found to be 1.4% in the present study. Wilkes et al. in their study of 118 MP cases reported that the prevalence of MP was 0.16%; however, Daskalogiannaki et al. revealed that the prevalence of MP was between 3.4% and 7.8% according to chosen CT criteria in 613 patients with MP (8,9). The prevalence of

**Table 1.** Comparison of age and computed tomography features between patients with and without malignancy.

	Patients with malignancy	Patients without malignancy	P-value
Total MP score	7.7 ± 2.9	5.1 ± 2.3	<0.001
Age (years)	56.5 ± 13.1	47.9 ± 14.8	<0.001
Short diameter of greatest lymph node (mm)	6.1 ± 1.8	4.7 ± 1.2	<0.001
Long diameter of greatest lymph node (mm)	14.5 ± 2.8	10.2 ± 2.2	<0.001

Values are mean values ± SD, P: significance level for all pairs.



**Figure 4.** Graph shows the receiver operating characteristic curve for the total MP score and the short diameters of the greatest lymph node (SDGLN) and long diameters of the greatest lymph node (LDGLN).

MP was usually reported at approximately 0.6% in other studies (10). These diverse values may be due to changes in the methods of patient documentation. In addition, increased abdominal diagnostic imaging, knowledge of specific signs of MP, and radiologist awareness may be causes for the increasing prevalence of MP. In our study, there was a female dominance with a 1.34 to 1 female to male ratio. Although male predominance was reported in most studies, Daskalogiannaki et al. showed female dominance with a 1.8 to 1 female to male ratio (8). The mean age at diagnosis of MP was 53 years, which is compatible with reported studies in the literature (5,6).

In our study, the total MP scores revealed that 99 patients (32%) had mild MP, 151 (48.9%) patients had moderate MP, and 59 (19.1%) patients had marked MP.

**Table 2.** Results of receiver operating characteristic analysis for total mesenteric panniculitis score and short and long diameters of the greatest lymph node.

	AUC	Cut-off level	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Total MP score	0.767	5	70.3	72.3	77.8	63.9	71.1
Short diameter of greatest lymph node	0.728	5.0 mm	69.2	65.3	73.4	63.7	67.9
Long diameter of greatest lymph node	0.879	11.7 mm	81.1	76.1	82.4	74.4	79.2

MP: Mesenteric panniculitis, AUC: area under curve, PPV: positive predictive value, NPV: negative predictive value.

Although mild MP was more common in patients without a malignancy, marked MP was highly observed in patients with a malignancy. Coulier and Gögebakan et al. reported that the mild, moderate, and marked grades of MP were 29%, 58%, and 13%, respectively (10,11). In addition, it was reported that patients were classified as having mild MP in 10.4% of cases, moderate MP in 58.3% of cases, and marked MP in 29.1% of cases (11).

Gögebakan et al. and Coulier reported that there was no difference between the mean total MP scores of patients with and without a malignancy (10,11). However, we found that total MP scores for the patients with and without malignancy were 7.7 and 5.1, respectively. There were also statistically significant differences between these two groups ( $P < 0.001$ ). We thought that it might be due to the differences between the patients' population distribution. The optimal cut-off level of the total MP score for estimating the presence of a malignancy was 5.0. The obtained sensitivity, specificity, and accuracy of the total MP score were 70.3%, 72.3%, and 71.1%, respectively. Also, the mean short and long diameters of the greatest lymph node were statistically higher in patients with a malignancy than those without a malignancy ( $P < 0.001$ ). The obtained sensitivity, specificity, and accuracy of the short and long diameters of the greatest lymph node were 69.2% and 81.1%, 65.3% and 76.1%, and 67.9% and 79.2%, respectively. In the present study, we found that the long diameter of the greatest lymph node was significantly more effective than the short diameter of the greatest lymph node and total MP score for estimating the presence of a malignancy.

There are inconsistent results in the literature about the relationship between malignancies and MP. Several studies reported that the rate of malignancy associated with MP varied between 17% and 70% (8–16). Of 309 patients, 179 (57.9%) had an accompanying malignancy in the present study. MP is usually seen later in adult life; in our study, the mean age at diagnosis was 53 years. Also, we found that the mean age of patients with a malignancy was significantly higher than that of patients without a

malignancy. This difference may be due to the increasing probability of cancer development with age. Additionally, the main purpose of abdominal CT in oncology centers is to diagnose and stage the cancer. In our opinion, these factors can change the relationship between MP and malignancies in studies.

Several studies reported that the most common malignancies accompanying MP were lymphoma, prostate cancer, lung cancer, melanoma, colon cancer, and gastric cancer (8–15). In the present study, most of the patients with MP (57.9%) were commonly suffering from lymphoma, breast cancer, endometrium cancer, ovarian cancer, colorectal cancer, and lung cancer. Lymphoma for Daskalogiannaki et al., colorectal cancer for Gögebakan et al., prostate cancer for Coulier, and prostate cancer for van Putte-Katier et al. were the most frequent coexisting malignancies (8,10,11,15). Of 179 patients, 58 had concurrent malignancies and 121 had a previous known malignancy at the time of MP diagnosis. We did not have access to previous abdominal CT examinations so we did not know whether or not the MP occurred before or after a malignancy. Abdominal surgery, autoimmune disease, granulomatous disease, rheumatic disease, ischemia of the mesentery, smoking, hypertension, urolithiasis, and diabetes are also other causes of MP (13,16). In our study, 34.9% of the patients underwent abdominal surgery for various conditions, 32.3% of them had hypertension, 18.4% of them had diabetes, 18.1% of them coronary artery disease, 7.1% of them had ureterorenal stone, and 1.9% of them had autoimmune disease. However, we could not evaluate the time interval between surgery and abdominal CT acquisition time and smoking addiction, which were not documented in the patients' clinical records.

The causes, pathogenesis, and mechanism related to malignancy of MP are still unclear. Kipfer et al. reported that MP is a nonspecific response to an underlying malignancy (17). Wilkes et al. in their study with 38% prevalence of malignancy suggested that MP could be an occult condition that might give rise to a malignancy over the years (9). Because of the relationship by up to 70% with malignancy, MP may be seen as a paraneoplastic syndrome in some patients.

The increase in the attenuation of mesenteric fat, also called misty mesentery, is one of the CT signs of MP (14). However, several conditions can change the attenuation of mesenteric fat such as early-stage lymphoma, carcinoid tumor, mesenteric hemorrhage, mesenteric inflammation and mesenteric edema due to cirrhosis, portal hypertension, and hepatic, portal, or mesenteric vein thrombosis (18). In our study, eleven patients were excluded from the study

due to acute pancreatitis (n = 3), ascites (n = 3), portal vein thrombosis (n = 3), and superior mesenteric vein thrombosis (n = 2). In such cases, CT examination may be useful for evaluating mesenteric attenuation changes and detecting underlying causes.

In the present study, the following were the most common causes for CT examinations: follow-up or staging of a malignancy (53.8%), abdominal pain (34.0%), follow-up for known benign diseases (10.4%), and abnormal laboratory findings (1.9%). Abdominal pain was a more frequent clinical symptom in the patients, especially those patients without a malignancy. The fatty mass at the root of the mesentery displacing the bowel, blood vessels, and lymphatics may be associated with abdominal pain (19). Because the detected cause of abdominal pain was MP in some of our patients, especially those without malignancy, MP may be the cause of abdominal pain in emergency departments.

Of our patients, 124 underwent follow-up abdominal CT between 1 and 35 months from the initial CT examinations. While none of the 12 patients without a malignancy developed a new malignancy, six patients with a malignancy suffered from one of the following new malignancies: colon cancer (n = 2), breast cancer (n = 1), endometrial cancer (n = 1), small bowel cancer (n = 1), and ureteral transitional cell carcinoma (n = 1). MP usually has a self-limiting process and good prognosis. Although Akram et al. reported up to 20% clinical deterioration in their study, the stability of CT findings has usually been described as in our study (19). The CT findings of MP were stable in all of our patients.

This study has a number of limitations. First, we did not evaluate inter- and intraobserver variability. Second, the diagnosis of MP was acquired with only CT findings and none of the patients had a histopathological diagnosis of MP. Third, there were not enough patients to investigate the effectiveness of CT findings for estimating the presence of a malignancy on subtypes of benign and malignant diseases. Finally, there was a lack of long-term follow-up results and a matched control group to compare probable confounding factors such as age and sex.

In conclusion, increased abdominal imaging modalities and radiologist awareness are related to increased diagnosis of MP. With an increased number of studies, MP is generally thought to be associated with abdominal and distal system malignancies, so it may be a paraneoplastic syndrome in some patients. However, extensive studies with larger populations are needed to clearly document the relationship between malignancy and MP, especially in patients without a malignancy.

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