Acute Abdominal Pain in Obese and Overweight Patients: A Different Clinical Scenario? A Prospective Study with MDCT Evaluation in an Urban Adult Population

Dolor abdominal agudo en pacientes obesos y con sobrepeso: ¿un escenario clínico diferente? Estudio prospectivo con tomografía computarizada multidetector

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Summary

Objective: Studies have reported an association between entities that cause acute abdominal pain, such as inflammation of the epiploic appendages, complicated acute diverticulitis, acute pancreatitis, and omental infarctions, and a high body mass index. Our hypothesis is that the diagnostic spectrum causing acute abdominal pain is different in the group of overweight and obese patients when compared to the group of normal weight patients. **Materials and methods:** In this prospective study, contrast-enhanced abdomino-pelvic CT was performed in 250 patients older than 18 years old. Patients with history of trauma, pregnancy, and recent surgery were excluded. Participants were divided into two categories: patients with normal BMI, and overweight and obese patients. **Results:** The prevalence of overweight and obesity was 49.6%. Inflammation of the epiploic appendages had the highest incidence in the group of overweight and obese patients. Incidence was not significant in the other entities. **Conclusion:** The group of obese and overweight patients had higher statistically significant difference in epiploic appendagitis. The probability of surgical intervention does not appear to be influenced by BMI.

Resumen

Objetivo: Se ha informado asociación entre entidades causantes de dolor abdominal agudo, como la inflamación de los apéndices epiplóicos, la diverticulitis aguda complicada, la pancreatitis aguda y los infartos del omento con un Índice de Masa Corporal alto. En esta hipótesis se considera que el espectro diagnóstico causante de dolor abdominal agudo es diferente en el grupo de pacientes obesos y con sobrepeso (OSP) comparado con el grupo de pacientes con IMC normal o bajo (NB). **Materiales y métodos:** Estudio prospectivo realizado con una tomografía computarizada (TC) con medio de contraste de abdomen y pelvis en 250 pacientes mayores de 18 años. Se excluyeron los pacientes con antecedente de trauma, en embarazo y los pacientes con cirugía reciente; se clasificaron en dos categorías: Un grupo de pacientes con IMC normal o bajo y otro grupo de pacientes

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obesos o con sobrepeso. **Resultados:** La prevalencia de obesidad y sobrepeso fue del 49,6 %. La mayor incidencia se encontró en inflamación del apéndice epiplóico en el grupo de los pacientes obesos y con sobrepeso. En las otras entidades la incidencia no fue significativa. **Conclusión:** El grupo de pacientes obesos y con sobrepeso tuvo una incidencia estadísticamente significativa mayor en inflamación del apéndice epiplóico. La probabilidad de intervención quirúrgica parece no estar influenciada por el índice de masa corporal.

Introduction

Obesity has become a global epidemic, and Colombia does not escape this reality. In 2005, 65 % of the adult population in the United States (1) and in 2008 about 1.9 billion of adults in the world were obese or overweight (2). In accordance with a recent report, the prevalence of obesity in Colombia in the year 2010 was 16.4 % (3). It has been reported that a high body mass index (BMI) may delay the diagnosis of some entities because obesity or overweight can limit the information that is obtained from the physical exam or some imaging tests (4-5). In obese or overweight patients with abdominal acute pain, the fact of not being able to identify certain clinical findings by imaging may delay the diagnosis of surgical pathologies, which increases the incidence of complications (4), or, at the same time may lead to an imprecise diagnosis, leading to unnecessary surgeries of non-surgical entities.

In quantitative terms, obesity in adults is defined by BMI, which is determined by the division of weight in kilograms (kg) to the square of the height in meters of the patient. A normal BMI is in the range of 18.5 to 24.9 kg/m^2; A BMI of 25 to 29.9 kg/m^2 is considered to be overweight, a BMI greater than 30 kg/m^2 is defined as obesity. In this study patients were divided into two groups according to their BMI; the first group included obese patients and overweight patients (OAOP), and in the second group, patients with normal or low weight (NWP).

Acute abdominal pain is a frequent complaint in the emergency department. The term acute abdominal pain can be applied if the pain has less than 72 hours of evolution. The differential diagnosis for acute abdominal pain includes a broad spectrum of clinical entities ranging from self-limited entities to severe diseases with high mortality rates.

There are some causes of acute abdominal pain that, according to some reports in the literature, have a greater incidence in obese or overweight patients; these include:

- Inflammation of the epiploic appendix (EA) (6,7)
- Infarction of the major omentum (OI) (8)
- The different hernia of the abdominal wall (9,10)
- Complicated acute diverticulitis (CAD) (11,12)
- Acute pancreatitis (AP) (13,14)

Based on the premises already discussed, the following research hypothesis was defined: The diagnostic spectrum causing abdominal pain may be different in the obese and overweight patient group (OAOP) with a possible higher incidence of entities such as EA, OI, CAD and AP in this group, compared to the group of patients with normal or low BMI (NWP). In case of confirmation of the hypothesis, the results would have important clinical implications, because the patients in the OAOP group would benefit from the routine performance of multi-slice CT (MCT) for the diagnosis of the prevalent entities in this group, which, usually, cannot be properly diagnosed and characterized only with the clinical history assessment and physical examination. In addition, OAOP patients are not good candidates to be evaluated with ultrasound.

We also assessed whether there was a difference in the need for surgery between the OAOP group and the NWP group.

Methodology

- *Design:* Prospective study approved by the Ethics Committee of the institution and carried out between March 2009 and September 2011. Informed consent was obtained in all patients.
- *Location:* Private urban clinic of fourth level of complexity with 160 beds, including emergency service, intensive care unit and special care Unit.
- *Patient selection:* 250 patients were included in the cohort (89 men [35.6 %] and 161 women [64.4 %]) 18 years old or above (average of 48.3 years, between 18 and 97 years of age) who consulted consecutively in the emergency department for acute abdominal pain of less than 72 hours of evolution and had no exclusion criteria. An abdomen and pelvis tomography was done with contrast medium, according to the criteria of the emergency doctor, based on the clinical history, physical examination findings, and lab results.
- *Exclusion criteria:* 1. Patients with a history of recent trauma. 2. Patients with contraindication to administration of iodinated contrast medium. 3. Pregnant women. 4. Patients on cancer follow-up. 5. Patients with recent surgery (last 2 months). 6. Patients younger than 18 year old.

The radiology personnel responsible for performing the CT scan of the abdomen of patients in the ER (radiology and diagnostic images technologist or nursing assistant) were responsible for entering patients which fulfilled the inclusion criteria into the study and to fill out the initial demographic research questionnaire of the study. As well, they were responsible for obtaining the values of weight and height of all patients.

- *BMI and patient classification:* Patients and their subsequent classification according to the already mentioned BMI division.
- *Tomography with contrast medium of the abdomen and pelvis:* For the study a multi-slice tomograph with

4 rows of asteion detectors (Toshiba Medical System, Japan) was used. All patients underwent CT scan of the abdomen and of the pelvis with oral contrast medium (800 ml of diluted iodinated contrast or dilute barite) and intravenous iodine contrast medium (volume ranging from 80 to 100 ml and concentration of 300 mg/ml). The intravenous contrast medium was applied in the antecubital vein, with a speed of 3 ml per second, and a delay time of 60 seconds. A portal phase of the entire abdomen and pelvis with 3 mm of collimation was obtained, which was the phase of the study for the evaluation of findings.

» *Interpretation of contrast-enhanced tomography studies of the abdomen and pelvis:* The studies were interpreted on a Vitrea workstation (Vital Images, Inc.). Two radiologists with subspecialized training on abdomen imaging and with more than 10 years of experience evaluated by consensus the CT images of abdomen and pelvis. The cause of abdominal pain and quality of examination were recorded.

» *Diagnostic tomographic criteria of possible pathologies causing acute abdominal pain:*

- *Acute diverticulitis:* Diverticula in the wall of the colon (wall-reinforcing images) associated with two of the following findings: thickening of the colon wall (greater than 4 mm), increased pericolonic fat density, pericolonic fluid, thickening of the lateral fascia, air or pericolonic focal collections..
- *Acute appendicitis:* Appendix with a transverse external diameter greater than 10 mm, associated with one of the following signs: Increased density of surrounding fat, peripheral liquid, peripheral liquid collection, thickening of the appendix wall greater than 3 mm, air pericolonic, positive 'arrowhead' sign (thickening of the colon wall in the margin of the origin of the outlined appendix by air or contrast, which simulates the head of an arrow), appendicular phlegmon (heterogeneous soft tissue component due to inflammatory mass in the topography of the appendix).
- *Acute gynecological pathology: E*ctopic pregnancy (hemoperitoneum associated with complex adnexal cystic lesion), hemorrhagic cyst (complex adnexal cysts with thickened walls, septa, dense liquid levels in its interior or dense heterogeneous content), inflammatory pelvic disease (complex cystic lesions, increased density and poor definition of pelvic fat, free fluid in the pelvis).
- *Acute pancreatitis:* Increased pancreas size associated with one or more of the following signs: The density of peripancreatic fat, (heterogeneous pancreatic density), pancreatic glandular necrosis (area with decreased density of the pancreas with density lower than 70 UH in the phase with contrast medium), signs of heterogeneous periglandular necrosis (peripancreatic fat).
- *Intestinal obstruction:* Dilation of the small intestine or colon (external diameter greater than 3 cm in the small intestine, 9 cm in the cecum and 6 cm in the rest of the colon) proximal to an intestinal gauge transition segment or of the colon with distal collapse which may be associated with thickening of the intestinal wall (thickness greater than 3 mm), with increased density of mesenteric or liquid free peritoneal fat.
- *Epiploic appendix inflammation:* Oval or round structure adjacent to the colon at its anterior border, which has fat density and a thin halo of soft tissue at its periphery, with a maximum diameter between 1 to 5 cm and increased peripheral fat density. It can also be associated with a central point image with soft tissue density (point sign) corresponding to the central thrombosed vein.
- *Acute cholecystitis:* Distended vesicle (antero-posterior / transverse greater than 5 cm) associated with 2 of the following signs: Thickening of the wall (thickness greater than 3 mm), increased perivesicular fat density, perivesicular fluid, gallstones inside the gallbladder or hyperemia in the peri-vesicular liver parenchyma.
- *Colitis:* Thickening of the colon wall. It may be diffuse, segmental or regional (thickness greater than 4 mm in the distended colon segment) associated with one of the following signs: pericolonic fluid or increased density of pericolonic fat.
- *Ileitis:* Thick, segmental or regional ileal wall thickening (thickness greater than 3 mm in the ileon) associated with one of the following signs: Free fluid, vascular engorgement or increase in density of the surrounding mesenteric fat.
- *Urinary tract infection:* Focal areas of nephronia manifesting in the renal cortex with a triangular configuration (in wedge), peripheral, with decrease of the density in the portal phase of the tomography and which may be associated with: Increase of perinephric fat density, perirenal fluid or striatum pattern of the renal cortex in the excretory phase (dense linear images due to retention of contrast in the renal tubules in the excretory phase).
- *Definitive diagnosis:* The definitive diagnosis was established in three ways: Surgical findings, diagnosis with CT or according to clinical evolution. Data was obtained through the medical history, using the radiology information system (RIS). When each patient was discharged, they were followed up one week and one month after the acute abdominal pain, to know the clinical evolution. The existence of hernias of the abdominal wall or abdominal cavity was evaluated.
- *Statistical analysis:* For the descriptive analysis of the patient's characteristics, measures of relative and absolute frequency for the qualitative variables were used. As for the quantitative variables, the averages were used. The relationship between qualitative variables was analyzed Using the $\chi 2$ test. The difference was also calculated for the quantitative variables and the results were considered statistically significant when the value of p was less than 0.05.

Results

The prevalence of obesity and overweight was 49.6 % (32 % with overweight and 17.6 % obese).

In general, the prevalent diagnoses were: 1. No acute pathology on CT, by clinical or evolution (30.4 %). 2. Acute diverticulitis (12.8 %).

3. Acute appendicitis (12 %). 4. Acute gynecological entity (6.4 %) and acute pancreatitis (5.2 %) (Table 1).

Table 1. Most frequent study cohort diagnoses*

Diagnosis	Percentage (%)	# of patients
1. Without acute pathology	30.4	76
2. Acute diverticulitis	12.8	32
3. Acute appendicitis	12	30
4. Acute gynecological pathology	6.4	16
5. Acute pancreatitis	5.2	13
6. Intestinal obstruction	4	10
7. Inflammation of epiploic appendix	3.6	9
8. Acute cholecystitis	3.2	8
9. Colitis	2.8	7
10. Ileitis	2.8	7
11. Urinary tract infection	2.8	7

* General population of 250 patients.

The OAOP patient group had a statistically significant increase in inflammation of the epiploic appendix (8/124) compared to the NWP group (1/126) with a p value = 0.0393 (Table 2).

The highest incidence of acute diverticulitis (p = 0.7366) and acute pancreatitis (p = 0.2424) in the OAOP group was not statistically significant (Table 2).

Although the diagnoses of major omentum infarction (2 patients) and mesenteric panniculitis (2 patients) were only present in the OAOP group, the low incidence of these entities and the low number of patients studied does not allow a statistically significant difference (omentum infarction p = 0.4707 / mesenteric panniculitis p = 0.4707) in this cohort (Table 2).

If the entities responsible for abdominal pain with intraperitoneal fat pathology are taken together (inflammation or necrosis), such as inflammation of the epiploic appendix, infarction of the major omentum or mesenteric panniculitis, a higher incidence of this group of entities in the OAOP group (12/124) compared to the NWP group (1/126) can be found with a statistically significant difference, p = 0.0040 (Table 2).

No statistically significant difference was found in the need of surgery between the OAOP and NWP groups (p = 0.8344).

In the OAOP group, the incidence of hernias was inguinal 19.4 % (24/124), umbilical 54 % (67/ 124), hiatal 8.9 % (11/124), in comparison with the NWP group: inguinal 9.5 % (12/126), umbilical 40.5 % (51/126), hiatal 6.3 % (8/126). A higher statistically significant incidence was found in the OAOP group of inguinal hernia (p = 0.04) and umbilical (p = 0.04) compared to the NWP group (table 2). Only one case of complicated hernia was presented, in one 74 year old patient with an incarcerated left obturator hernia with secondary intestinal obstruction.

Table 2. Comparison of the incidence of entities studied between the OAOP and NWP groups

Entity	OAOP %	OAOP #	NWP %	NWP #	*p* value
*Inflammation of the epiploic appendix	6.45	8/124	0.79	1/126	0.0393
Infarct of the greater omentum	0.8	2/124	0	0/126	0.4707
Acute diverticulitis	3.22	4/124	3.17	4/126	0.7366
Acute pancreatitis	7.25	9/124	3.17	4/126	0.2424
* Inguinal hernia	19.35	24/124	9.52	12/126	0.0420
* Umbilical hernia	54.03	67/124	40.47	51/126	0.0434
Hiatal hernia	8.87	11/124	6.34	8/126	0.6075
*Intraabdominal fat pathology	9.67	12/124	0.79	1/126	0.0040

*Result with statistically significant p value (less than 0.05).

Discussion

According to Kasper et al. (3) the prevalence of obesity (BMI greater than 30 kg/m^2) in Colombia has increased, from 13.9 % in 2005 to 16.4 % in 2010. In addition, these authors report that by 2010 obesity was associated with living in an urban area. The results of this study are similar to those reported By Kasper et al. (3) with prevalence of obesity in the cohort of 17.6 %, which allows to infer that the study sample is representative of the Colombian urban population.

As for the main causes of acute abdominal pain in the cohort (250 patients), there are several aspects to be analyzed. Similarly, in a previous literature report by Strömberg and collaborators (15) who evaluated with CT 2,222 older patients older than 15 years with acute abdominal pain, an important percentage of the patients did not have an acute CT pathology, 44.3 % in the Strömberg et al. (15) compared to the 30.4 % found In the investigation presented here. In addition, the main causes of acute abdominal pain have similar incidence rates in what was reported by this study compared with that of Strömberg and collaborators (15): Acute appendicitis 12 % vs. 15.9 %; Acute diverticulitis 12.8 % vs. 8.2 %; Acute gynecological pathology 6.4 % vs. 2.4 %; Acute pancreatitis 5.2 % vs. 3.2 % and intestinal obstruction 4 % vs. 8.6 %. The similarity in the results of this study and that of Strömberg and collaborators (15) shows that the two investigations were urban populations of adults and that all patients were evaluated with CT, and also allowed to infer that the cohort

presented here is representative of adult patients with acute abdominal pain.

Inflammation of the epiploic appendix (EA), in most cases is a self-limited entity and patients recover in less of ten days with conservative management, without need of surgery. Given that the clinical findings are not completely specific, it is frequent that the EA clinically simulates other entities, such as acute appendicitis or acute diverticulitis and, sometimes, unnecessary surgery due to an erroneous clinical diagnosis. Nowadays it is possible to make a reliable diagnosis of inflammation of the epiploic appendix with different diagnostic modalities such as MCT, ultrasound and MRI. However, MCT is the imaging modality of choice for diagnosis. It can be primary (idiopathic) or secondary to adjacent inflammatory processes (acute diverticulitis, appendicitis or cholecystitis). It manifests clinically with abdominal pain with a quick start and less than a week. Usually, it occurs in the 4th to 5th decades of life and is more frequent in men (16-17). In this study, patients with appendix had an average age of 55.88 years (between 36 to 92 years of age) and the distribution by sex was equivalent (5 men and 4 women), results similar to those of Sandrasegaran and collaborators (18) who in a retrospective study with 11 patients with inflammation of the epiploic appendix reported an average age of 59.6 years (38-79 years) (6 women and 5 men). The places with most frequent compromise are the sigmoid colon and the cecum. Choi and collaborators (7) reported the same incidence in the right colon and in the left colon; however, in the study presented here, eight patients had involvement in the left colon, 4 sigmoid colons and 4 descending colons (88.8 %) and one in the right colon, blind, findings similar to those of Son et al. (17) who reported inflammation of the left colon's epiploic appendix 87.5 %. With physical examination, the abdomen is usually tender, not distended and without defense, presents a pain very localized in the same place of the commitment. The characteristic findings of inflammation of the epiploic appendix CT scan are: oval or round lesion with fat density and diameters ranging from 1 to 5 cm, adjacent to the anterior wall (antimesenteric) of the colon, with a thin linear edge and soft tissue density that represents serous edema (peritoneum) and increased density of the surrounding fat (figure 1). Frequently thickening of the adjacent colon wall is observed. Sometimes you can identify one or two high signal points or a dense linear central image, representing the thrombosed central vein. The findings usually disappear when symptoms improve in one to two weeks (19). There may also be residual calcification in the site of EA and more rarely is a calcified free body in the peritoneal cavity (20). Treatment of inflammation of the epiploic appendix is conservative, with analgesics. In very rare occasions, surgery is required for abscess formation, peritonitis, or by adherential phenomenon with intestinal obstruction or of the secondary colon (21-22). In this study, no patient with EA required surgery.

An incidence of inflammation of the epiploic appendix has been reported in 2.3 to 7.1 % of patients with clinical suspicion of acute appendicitis and from 0.3 to 1 % of patients with clinical suspicion of acute diverticulitis (23). Other authors report that 8 % of abdominal CT of patients with clinical suspicion of appendicitis or diverticulitis had inflammation of the epiploic appendix (16-19). No studies are known to report their incidence in patients with acute abdominal pain in general in this investigation we found an incidence of 3.6 % of the general cohort (250 patients with acute abdominal pain).

Several authors have described a higher incidence of inflammation of the epiploic appendix in OAOP patients (6-7); however, they are anecdotal or the product of retrospective studies. Hence the value of these results that come from a prospective study. In this research we found a statistically significant higher incidence ($p = 0.0393$) of inflammation of the epiploic appendage in the group of OAOP patients (8/124) compared to the weight group NWP (1/126), which coincides with the previous literature reports (6-7) and confirms the postulate of the hypothesis raised at the beginning of this article.

Considering that the mean BMI of patients with EA (9 patients) in this study was 27.22 kg/m^2, and the fact that this were overweight patients, the data was analyzed to determine whether EA was more frequent in this group. For such a purpose the cohort was subclassified into 3 groups, according to the BMI, as follows: 1. Patients with normal or low weight, BMI less than 24.9 kg/m^2. 2. Overweight patients, BMI of 25 to 29.9 kg/m^2. 3. Patients with obesity, BMI greater than 30 kg/m^2. This showed the following incidence of inflammation of the epiploic appendix in the three subgroups: 1 patient with inflammation of the epiploic appendix of 126 patients with normal or low weight (0.79 %), 6 patients in the 80 patients with overweight (7.5 %) and 2 patients from the 44 obese patients (4.5 %), with a statistically significant difference of proportions and a value of $p = 0.03918$. In such a way that, according to the results in this prospective study, the inflammation of the epiploic appendix has a statistically significant higher incidence in overweight patients, who had not been specifically reported in the previously published studies on the subject, in which, in general, it was associated with obesity and overweight as a single group. Only 2 relatively recent publications report an average BMI in patients with inflammation of the epiploic appendix 25.9 kg/m^2 (31 patients with EA) in the study by Choi et al. (7) and 25.5 kg/m^2 (8 patients with EA) in the study by Son et al. (17); Although these results have not been analyzed more deeply by these authors, these figures are similar to those of this study (mean BMI in patients with studied appendix of 27.22 kg/m^2) with an average BMI corresponding to the overweight group.

Some authors explain the association of obesity with inflammation of the epiploic appendix through three theories: 1. Due to increase of the size of the epiploic appendices showing pediculated configuration, which predisposes them to torsion. 2. Association of obesity with increase in the size of the peritoneal cavity, which leads, also, to a greater risk of torsion of the epiploic appendages. 3. In obese or overweight patients, copious meals that cause splanchnic venous ectasia and increased risk of thrombosis. Further, other possible predisposing factors of EA have been described, such as strenuous exercise or abdominal stretching movements which favor the torsion of the epiploic appendices and produce venous engorgement.

As previously described in the results, the two patients with omentum infarction in this study belonged to the OAOP group; it was considered that due to the low incidence of this entity there was no statistically significant difference with respect to the incidence of omentum infarction in the NWP group. In addition, it is more frequent in children and adolescents, a population that was not included in this study, factor that could reduce the incidence of this entity in the investigation. Research with a larger number of patients is required and that also includes the child and adolescent population in order to obtain significant results regarding omental infarction.

Unlike several previous publications (11-14), in this investigation increased incidence of complicated acute diverticulitis or acute pancreatitis in the OAOP group was not found. It is likely that the association between obesity and some forms of presentation of these pathologies only occur in severe forms of obesity, with high BMI or with morbid obesity (BMI greater than 40 kg/m^2); taking into account that in this cohort, the population studied did not present very high BMI and that there were only two patients with morbid obesity, this factor may influence the results. Some authors report greater severity of biliary pancreatitis to a higher degree of obesity (13).

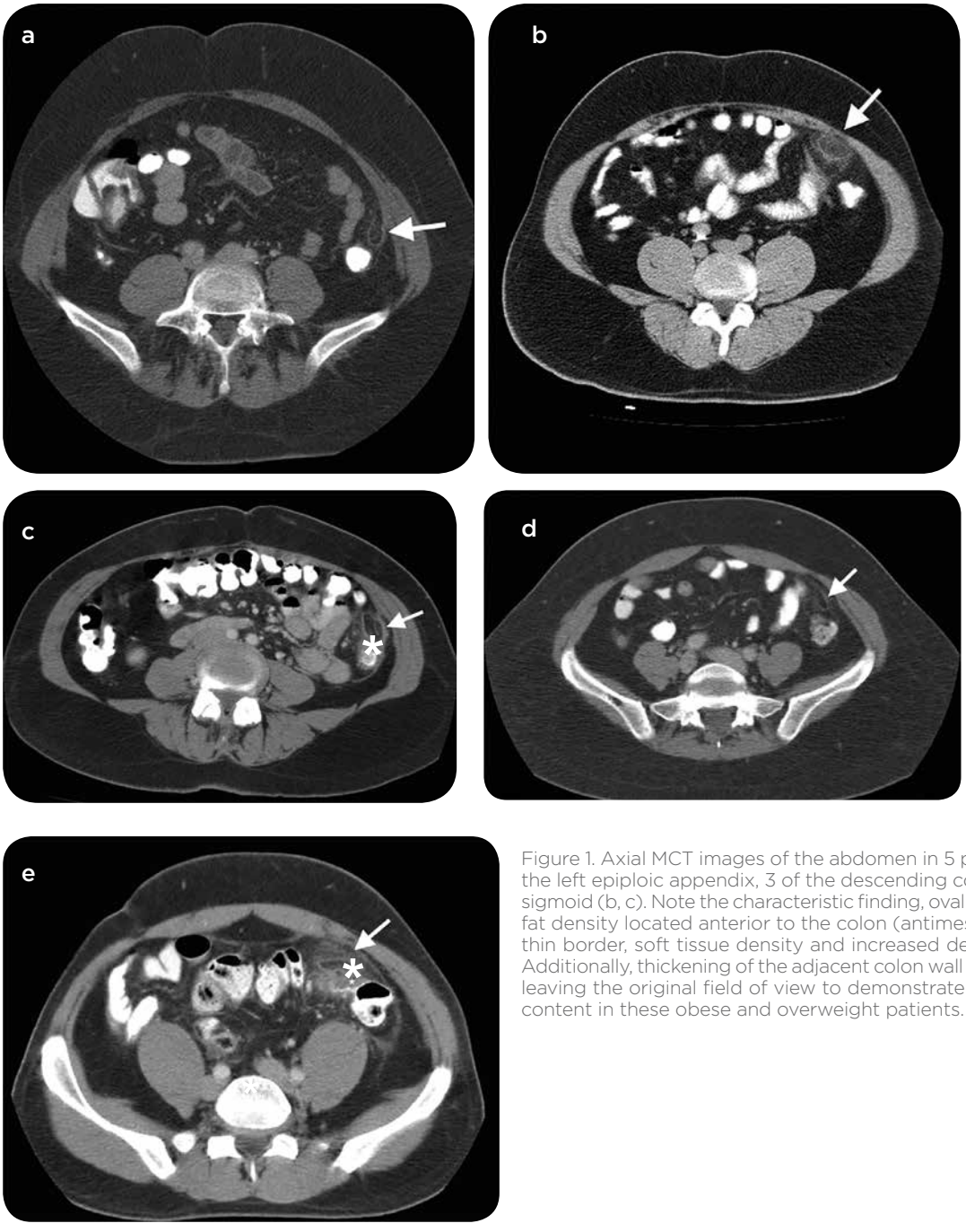

Figure 1. Axial MCT images of the abdomen in 5 patients with inflammation of the left epiploic appendix, 3 of the descending colon (a, d and e) and 2 of the sigmoid (b, c). Note the characteristic finding, oval or round image (arrows) with fat density located anterior to the colon (antimesenteric aspect) with a linear thin border, soft tissue density and increased density of the surrounding fat. Additionally, thickening of the adjacent colon wall (c, e) (asterisks). Intentionally leaving the original field of view to demonstrate intra and extraperitoneal fat content in these obese and overweight patients.

It is known that obese patients have a low grade chronic inflammatory state, characterized by high levels of leptin, tumor necrosis factor alpha, interleukin 2, 6, 10 and 15, inhibitor of activator of plasminogen-1 and C-reactive protein (24-25). This inflammation process contributes to insulin resistance, non-insulin dependent diabetes and cardiovascular disease (metabolic syndrome) (24). It has been reported that this inflammatory / metabolic condition of obese patients also predisposes them to the development of systemic inflammatory response syndrome and organic dysfunction in patients with acute pancreatitis (26). It appears that this chronic low-level inflammatory process and the production of inflammatory mediators (adipocytokines) described are associated with a central and visceral "android" fat distribution (27, 28). Recently, some authors have reported an association between central-visceral obesity and other entities such as Crohn's disease (29), abdominal aortic aneurysms (30, 31) and cardiorenal syndrome (32,33), and emphasize that intra-abdominal fat around the intestine and colon, periaortic fat and perirenal fat promote local chronic inflammatory processes that intervene in the development and perpetuation of those entities (34). The role that intraperitoneal (visceral) fat plays in acute and subacute inflammatory processes of the abdomen (inflammation of the epiploic appendix, omentum infarction, mesenteric panniculitis) has not been defined and no publications on this topic are known. Considering the important role of visceral fat in previously described systemic and abdominal inflammatory processes, it is important to evaluate in the future the role of visceral obesity in the acute and subacute inflammatory processes of the abdomen such as inflammation of the epiploic appendix, omentum infarction and mesenteric panniculitis. Additionally, Aguilar-García et al. (35) consider these entities together with inflammation and necrosis of intra-abdominal fat and highlight the role of the studies by images in the diagnosis and follow-up of these pathologies. Further, new studies are required to establish whether there is an association between them and an increase visceral fat, which would give light on the aetiology of these entities; MCT could be used for this purpose, which not only allows the diagnosis of the three entities, but also allows establishing the percentage of visceral fat through anthropometric measurements of the abdomen, comparing the percentage of intra-abdominal fat in relation to subcutaneous fat (36).

If the entities responsible for acute abdominal pain that occur with pathology (inflammation or necrosis) of intraperitoneal fat (IFP) are taken together, such as inflammation of the epiploic appendix, infarction of the omentum and mesenteric panniculitis there is a higher incidence Of this group of entities in the OAOP group (12/124) in comparison with the NWP group (1/126) with a statistically significant difference, with a value of $p = 0.0040$. The 9.67 % of the patients in the OAOP group showed one of the three entities previously named as IFP. Considering that the clinical and ultrasound evaluation of patients in the OAOP group with acute abdominal pain is usually limited and taking into account that up to a tenth of them present inflammation of the epiploic appendix, omentum infarction or mesenteric panniculitis, we believe that all patients in this group should undergo MCT in the emergency department, since this modality allows the diagnosis and avoids unnecessary surgeries, due to confusion of these pathologies with acute appendicitis, or treatment with antibiotics if acute diverticulitis is misdiagnosed.

It has been described in the literature that obese patients have greater intra-abdominal pressure, which increases the risk of abdominal wall hernias (9-10). In this study we found a statistically higher incidence of umbilical hernia ($p = 0.0434$) and inguinal hernia (0.0420) in the OAOP group. Only one patient was found in this series with a complicated hernia (left incarcerated obstructing hernia with secondary intestinal obstruction).

There is no statistically significant difference in this series ($p = 0.8344$) in the need for surgery between the OAOP groups (32/124, 25.8 %) and NWP (35/126, 27.8 %). This result coincides with a previous report of the literature (37) where they evaluate prospectively 971 patients with acute abdominal pain, with no statistically significant difference between the group of obese patients and the non-obese group in the need for surgery, in the need for diagnostic aids and in the time of hospital stay.

As for the distribution by sex (Table 3), the pathologies that had a higher percentage of commitment in women, were: acute diverticulitis, acute appendicitis, and intestinal obstruction. In the group of patients in whom the cause of abdominal pain was not found, the percentage of women was higher. On the other hand, a higher percentage of compromise was found in men on acute pancreatitis, inflammation of epiploic appendices and the pathologies of intraperitoneal fat (IFP). Hiatal and umbilical hernias were found in a higher percentage in women, while inguinal hernias in men (Table 4).

Patients with acute appendicitis (36 years) with no cause of acute abdominal pain (46.8 years) and with acute gynecological pathology (34.9 years) had a mean age lower than the average of the total cohort for this investigation (48.3 years), while in the rest of the entities the mean age of the patients was higher in comparison to the average overall age. The entity where the patients had a mean age was intestinal obstruction (64.5 years) (Table 5).

Limitations

- *Number of patients studied:* We believe an investigation with a greater number of patients is required to obtain statistically significant results with respect to the highest incidence of omentum infarction and mesenteric panniculitis in patients of the OAOP group, because although these entities only appeared in the OAOP group (2 cases of OI and 2 cases of MP), due to their low incidence, no significant p values were obtained.
- *Non inclusion of adolescent patients:* We believe that due to the inclusion of the adolescent population, the higher incidence of omentum infarction in this age group may increase the number of patients with this entity and in this way facilitate obtaining statistically significant results.
- *Characteristics of the study population:* Our cohort is representative of the Colombian urban population, and does not include a large number of individuals with very high BMI or with morbid obesity, unlike other populations in the world, such as the American one, for example, where the incidence of morbid obesity is very high. These characteristics of our population can limit the identification of the effect of these severe forms of obesity in the manner of presenting some entities and in the presence of complications, such as in complicated diverticulitis or acute pancreatitis.
- *No assessment of the percentage of abdominal visceral fat:* In our study we found a higher statistically significant incidence of pathologies with structures with fat content that we call IFP in the OAOP group. It would also be important to know whether these entities are also associated with a higher percentage of visceral fat (metabolic syndrome), by means of the MCT titration of the visceral / subcutaneous fat percentage, which was not evaluated prospectively In our research.

Table 3. Distribution by sex and age of the main causes of acute abdominal pain

Causes of pain	Sex				Age (years)	
	Women		Men		Average	Range
	#	%	#	%		
1. Without acute pathology	59/76	77.6	17/76	22.3	46.8	18-94
2. Acute diverticulitis	19/32	59.3	13/32	40.6	56.1	29-81
3. Acute appendicitis	16/30	53.3	14/30	46.6	36	18-68
4. Acute gynecological pathology	16/16	100			34.9	19-49
5. Acute pancreatitis	5/13	38.4	8/13	61.5	48.7	24-79
6. Intestinal obstruction	6/10	60	4/10	40	64.5	41-91
7. Epiploic appendix inflammation	4/9	44.4	5/9	55.5	56.7	30-92
8. Pathologies of intraperitoneal fat	5/13	38.4	8/13	61.5	53	21-92
Total group of patients (250)	161/250	64.4	89/250	35.6	48.3	18-97

Table 4. Distribution by sex and age of patients with hernias

Type of hernia	Sex				Age (years)	
	Women		Men		Average	Range
	#	%	#	%		
Umbilical hernia	74/118	62.7	44/118	37,2	47,2	18-92
Inguinal hernia	8/36	22.2	28/36	77,7	57,6	18-94
Hiatal hernia	14/19	73.6	5/19	26,3	61,9	40-80
Total group of patients (250)	161/250	64.4	89/250	35,6	48,3	18-97

Table 5. Distribution by sex and age of the normal/low (NWP) and obese / overweight (OAOP) groups

Weight groups	Sex				Age (years)	
	Women		Men		Average	Range
	#	%	#	%		
Normal or low weight (NWP)	89/126	70.6	37/126	29.3	43.3	18-94
Obese or overweight (OAOP)	72/124	58	52/124	42	52.9	19-97
Total group of patients (250)	161/250	64.4	89/250	35.6	48.3	18-97

Conclusion

The group of obese and overweight patients had a statistically significant inflammation of the epiploic appendix. We did not find a statistically significant difference in the need for surgery between the OAOP group (obesity and overweight) and the NWP group (normal or low weight).

The group of entities that produce inflammation/necrosis of structures with intra-abdominal fat content, inflammation of the epiploic appendix, omentum infarction, and mesenteric panniculitis had a higher statistically significant incidence in the OAOP (obesity and overweight) group.

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