CT PREDICTIVE FACTORS FOR SURGERY NEED IN PATIENTS WITH SMALL BOWEL OBSTRUCTION: A COHORT STUDY

Factores predictores en tomografía computarizada de necesidad de cirugía en pacientes con obstrucción del intestino delgado: estudio de cohorte

Key words (MeSH)

Bowel obstruction
Small intestine
Tomography, X-Ray computed

Palabras clave (DeCS)

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Summary

Background*:** The obstruction of the small intestine is one of the main causes of acute abdomen. Surgical management is usually reserved in cases that do not respond to conservative treatment; however, this can lead to a higher complication rate. ***Objective: To identify the findings in computed tomography of the abdomen that predict the need for surgical intervention in patients with small bowel obstruction at Hospital Universitario Nacional de Colombia between May 1, 2016 and May 30, 2018. ***Methodology:*** A retrospective, analytical, observational, cohort type study was conducted. 55 patients with small bowel obstruction were included. We performed a descriptive analysis and a logistic regression. The Odds Ratio (OR), sensitivity and specificity of tomography findings were estimated to predict the need for surgery. ***Results:*** A total of 55 patients were included, 22 (40%) which were women. The average age was 51.75 +/- 17.8 years. The median of past surgeries was significantly higher in women (women 2, men 1, p = 0.009). The most frequent symptoms were abdominal pain (100%), vomiting (85.5%) and other symptoms that showed frequency below 40%. Surgery was performed in 52.7% of patients. Among the tomographic findings, mesenteric edema showed association with the need for surgery (OR 5,13 CI95% 1,41–18,66), with a specificity of 84,6% and sensitivity of 48,3%. ***Conclusion:*** In tomography, mesenteric edema predicts the need for surgery in patients with small bowel obstruction with good specificity and low sensitivity.

Resumen

Antecedentes: La obstrucción del intestino delgado es una de las causas de abdomen agudo. El manejo quirúrgico suele reservarse para los casos que no responden al tratamiento conservador; sin embargo, esto puede conducir a una mayor tasa de complicaciones. ***Objetivo*:** Mediante tomografía computarizada, identificar los hallazgos de abdomen predictores de la necesidad de intervención quirúrgica en los pacientes con obstrucción del intestino delgado, del Hospital Universitario Nacional de Colombia entre el 1 mayo de 2016 y el 30 de mayo de 2018. ***Métodos***: Se realizó un estudio observacional

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analítico retrospectivo tipo cohorte. Se incluyeron 55 pacientes adultos con obstrucción del intestino delgado. Se realizó un análisis estadístico descriptivo y de regresión logística. Se estimó el OR, la sensibilidad y la especificidad de los hallazgos de la tomografía para predecir la necesidad de cirugía. ***Resultados*:** Se incluyeron 55 pacientes, 22 (40 %) mujeres. La edad promedio fue de 51,75 +/- 17,8 años. La mediana de cirugías previas fue mayor en mujeres (2:1, *p*=0,009). Los síntomas más frecuentes fueron dolor abdominal (100 %), vómito (85,5 %) y otros síntomas mostraron frecuencia menor al 40 %. La cirugía se realizó en el 52,7 % de los pacientes. Dentro de los hallazgos tomográficos, el edema mesentérico mostró asociación con la necesidad de cirugía (OR 5,13, IC 95 %, 1,41-18,66), una especificidad de 84,6 % y una sensibilidad de 48,3 %. ***Conclusión*:** En tomografía, el edema mesentérico predice la necesidad de cirugía en pacientes con obstrucción del intestino delgado con una buena especificidad y baja sensibilidad.

Introduction

Small bowel obstruction (SBO) is a common pathology that generates 300,000 to 350,000 hospitalizations in the United States each year, with high cost to the health system and high morbidity and mortality rates associated with complications (1).

The management of SBO is usually conservative, holding on surgery only for refractory cases in which it is not useful. About 90% of patients with no evidence of peritonitis resolve without the need for surgical treatment (2).

However, conservative management increases the risk of emergency laparotomy, with an increased mortality rate of up to 25% (3-4). Surgical management of SBO implies a direct increase in the costs of care of the disease due to increased hospital stay, hospitalization in the intensive care unit and parenteral feeding (5).

Computed tomography (CT) of the abdomen is the gold standard for the diagnosis of small bowel obstruction, with a sensitivity of 90% to 96% and a specificity of 96%. The advantages of CT over other diagnostic modalities include locating the site of the obstruction, identifying the cause and detecting complications (6).

There are some studies that describe tomographic findings with statistical significance. For example, free fluid in the abdomen (OR: 2.59, p = 0.023, 95% CI: 1.13-5.90) and a high degree of obstruction (OR: 2.44, p = 0.028, 95% CI: 1.10-5.43) have been identified as predicting the need for early surgical intervention in patients with SBO (7). The objective of this study was to identify the CT findings that predict the need for surgical intervention in adult patients with small bowel obstruction.

1. Methods

A retrospective analytical observational cohort study was conducted at the Hospital Universitario Nacional de Colombia. Data were obtained from clinical history records and images of patients admitted with a diagnosis of SBO between May 2016 and May 2018.

Patients who met the following criteria were included: older than 18 years, diagnosis of small bowel obstruction by clinical findings (abdominal pain, vomiting, abdominal distension and non-ejection of stool or gas) and imaging, CT scan within 48 hours of admission.

Patients with these criteria were excluded: history of intra-abdominal cancer, abdominal surgery within 30 days prior to admission, history of pelvic or abdominal irradiation, and patients referred from another institution in whom the complete medical history could not be accessed.

In the selected patients, we evaluated demographic characteristics, history (including previous surgeries and comorbidities), mode of presentation, origin of the SBO, tomographic findings (Table 1) and outcomes. The need for surgery within 72 hours after the onset of the SBO was considered as the primary outcome, and the need for surgical reintervention and days of hospitalization were considered as secondary outcomes.

The images were obtained with a Toshiba multi-detector tomograph with 80 rows of detectors from the pubic symphysis to the diaphragm, with 3 mm axial and coronal cuts and 5 mm sagittal cuts. At least 6 hours of fasting were required with administration of oral (Gastroview®) and endovenous contrast medium (1 to 3 cm3/kg iopramide). The images were exported in DICOM format and analyzed using OsiriX PRO® software. The images were reviewed by an expert radiologist with 35 years of experience and by a senior resident in the specialty of radiology and diagnostic imaging.

2. Statistical Analysis

Data were analysed for two groups: patients with medically managed small bowel obstruction and those requiring surgical treatment.

A descriptive statistical analysis of the information was performed. For this purpose, absolute and relative frequencies were obtained for qualitative variables. For quantitative variables, we calculated the mean and median according to the distribution of the variable by applying the Shapiro-Wilks test.

The sample size was calculated taking into account a 66% probability of surgery, according to the reports of the Hospital's general surgery service. The sample size was estimated for a logistic regression model that included three CT findings. The method proposed by Peduzzi and collaborators was used. The calculated sample size was a minimum of 45 patients (8).

A univariate and multivariate analysis was performed using logistic regression including the CT radiological findings, the outcome of which was the need for surgery. The Odds Ratio (OR) value, the 95% confidence intervals and p values for each variable were determined.

The operating characteristics (sensitivity, specificity and likelihood ratios) of the mesenteric edema observed by CT were calculated to determine the need for surgery. The statistical program Stata 13 was used.

This study was approved by the ethics committee of the School of Medicine of the Universidad Nacional de Colombia and the ethics committee of the Hospital Universitario Nacional de Colombia.

Table 1. Description of radiological findings

Transition point	Site from which there is a change in the caliber of the intestinal lumen.
Degree of obstruction	High degree or complete obstruction: Degree of retrograde dilation, associated with collapse of the cecum and ascending colon with minimal or no gas or liquid in the distal lumen. Or when there is a 50 % or more difference in calibre between the two segments.
Small bowel dilation > 4 cm	Identification of the dilation of the intestinal loop.
Mesenteric edema	Increased attenuation of mesenteric fat in the dilated small intestine.
Fecalization of the small intestine	Bubbles and traces of gas inside the obstructed lumen of the small intestine.
Abnormal vascular course	"Swirl sign" Thickening of the mesenteric vessels and convergence of the mesenteric vessels with inversion of the normal relationship between the mesenteric artery and vein and rotation around a fixed point.

Source: Own elaboration based on Peduzzi and collaborators (8) and Díte and collaborators (9).

3. Results

Fifty-five patients were included, 22 (40%) were women and 33 (60%) were men. The average age of patients was 51.75 +/- 17.8 years. No significant differences in age by sex of patients were documented (p=0.430).

92.7% of the patients had a history of abdominal surgery. When evaluating the number of previous abdominal surgeries, a median of 1 (IQI 1-2) was found. The 54.5% of the patients had a history of surgery, 38.2% more than a previous abdominal surgery within the surgical history, only 7.3% of the patients had no surgical history in the abdominal region. The median of previous surgeries was significantly higher in women (women 2, men 1, p=0.009).

The history of intestinal obstruction was identified in 12.7% of patients. Abdominal pain was the most frequent symptom in 100%, vomiting occurred with a frequency of 85.5%, absence of stool was 38.2 % and absence of flatus was 38.2%.

The most frequent cause of intestinal obstruction was caused by adhesions (76.4%), followed by hernias (10.9%), inflammatory causes (7.3%), malrotation (3.6%) and dehiscence (1.8%). 5.5% of patients suffered from systemic inflammatory response syndrome. Table 2 shows the distribution of the general variables of the patients according to the need for surgery. The average age was 52 years (SD: 18). Most of the population included were men (53%); however, women received surgery in a higher proportion (68%). The other demographic and clinical variables did not show important differences considering the group that required surgery and the conservative management group. Regarding tomographic variables, figures 1-4 illustrate some of the findings by image. The transition point was observed in 96.4%, intestinal dilatation greater than 4 cm in 78.2%, free fluid in 54.5%, mesenteric edema in 30.9%, fecalization in 26.4% and abnormal vascular course in 3.6%.

The degree of intestinal obstruction was classified as partial obstruction in 74.5% and total obstruction in 25.5% of patients. Considering the degree of bowel obstruction (total or partial), there was no significant difference between the surgery group and the conservative management group.

The need for surgery was observed in 29 patients (52.7%), of which 7 (12.7%) required reintervention, 7 patients (12.7%) had surgical complications and there was one case (1.8%) of mortality. Additionally, the median time of hospitalization was 7 days (IQI 4-15). Finally, a statistically significant association was found between mesenteric edema and the need for surgery (OR: 5.13 p=0.01). No association was found between the need for surgery and the other tomographic findings (transition point, degree of obstruction, small bowel dilation greater than 4 cm, small bowel fecalization, abnormal vascular course, and free intraperitoneal fluid) (table 3). In multivariate analysis, the association between mesenteric edema and need for surgery was maintained (table 4). The specificity of mesenteric edema was 84.6 % with a positive predictive value of 78 % and a low negative likelihood ratio of 0.6 (Table 5). On the other hand, the sensitivity of this radiological finding was 48.

Table 2. Demographic and clinical variables according to the need for surgery

Variables	No need for surgery (*n* = 26)	Performing surgery (*n* = 29)	Total (*n* = 55)
Female (n, %)	6 (23)	20 (68)	26 (47)
Male (n, %)	20 (77)	9 (32)	29 (53)
Age (average +/- SD) in years	53.7 (18.9)	49.5 (16.5)	51.7 (17.8)
Previous abdominal surgery (median, IQI)	1 (1-2.7)	1 (1-2)	1 (1-2)
History of bowel obstruction (n, %)	4 (15.4)	3 (10.3)	7 (12.7)
Abdominal pain (n, %)	26 (100)	29 (100)	55 (100)
Vomit (n, %)	21 (80.8)	26 (89.6)	47 (85.4)
Absence of deposition (n, %)	7 (26.9)	14 (48.3)	21 (38.2)
Absence of flatus (n, %)	9 (34.6)	12 (41.2)	21 (38.2)
Systemic inflammatory response (n, %)	0 (0)	3 (10.3)	3 (5.4)

Source: Own elaboration.

Table 3. Univariate analysis. Relationship between

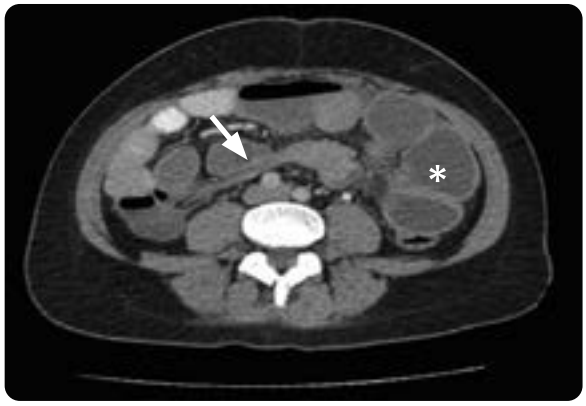

Figure 1. CT with contrast medium: axial image with distension of thin intestinal loops (asterisk) and transition point (arrow).

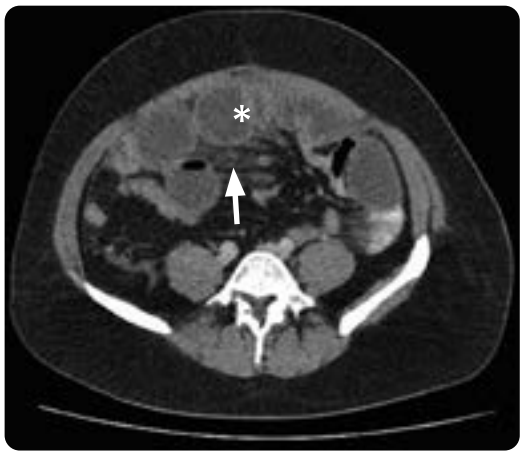

Figure 2. CT with contrast: axial image with distension of thin intestinal loops (asterisk) and mesenteric edema (arrow).

Figure 3. CT scan with contrast: coronal image with distension of small intestinal loops (asterisk) and sign of fecalization of the small intestine (arrow).

Figure 4. a) Coronal image with partial obstruction of the small intestine and gas in the descending colon (arrow). b) Complete or high-grade obstruction: complete collapse of the transverse and descending colon and rectal ampulla (not shown).

CT findings and the need for surgery

Tomographic finding	OR	CI 95 %	P value
Transition point	1.12	0.07-18.86	0.937
Degree of obstruction	1.89	0.54-6.62	0.319
Dilation of the small intestine > 4 cm	1.15	0.32-4.14	0.831
Mesenteric edema	5.13	1.41-18.66	0.013*
Fecalization of the small intestine	0.67	0.16-2.83	0.588
Free intraperitoneal liquid	2.59	0.87-7.72	0.087
Abnormal vascular course	2.92	0.68-12.48	0.148

*With statistical significance. OR: Odds Ratio, CI 95 %: 95 % Confidence Interval.
Source: Own elaboration.

Table 4. Multivariate analysis. Relationship between CT findings and the need for surgery

Tomographic finding	OR	CI 95 %	P value
Transition point	1.72	0.07-41.63	0.736
Degree of obstruction	2.24	0.49-10.27	0.319
Dilation of the small intestine > 4 cm	0.64	0.14-2.90	0.564
Mesenteric edema	6.42	1.33-31.00	0.021*
Fecalization of the small intestine	0.30	0.05-1.80	0.190
Free intraperitoneal liquid	1.82	0.54-6.06	0.331
Abnormal vascular course	1.45	0.67-8.13	0.674

*With statistical significance. OR: Odds Ratio, CI 95 %: 95 % Confidence Interval.
Source: Own elaboration.

Table 5. Operational characteristics of mesenteric edema by CT and the need for surgery

Feature	Value	CI 95 %
Prevalence of surgery (%)	53	39-66.3
Sensitivity (%)	48.3	29.4-67.5
Specificity (%)	84.6	65.1-95.6
Positive predictive value (%)	77.8	52.4-93.6
Negative predictive value (%)	59.5	42.1-75.2
Positive likelihood ratio (LR+)	3.14	1.18-8.34
Negative Likelihood Ratio (LR-)	0.61	0.41-0.90
OR diagnosis	5.13	1.46-17.7

CI 95%: 95% Confidence Interval
Source: Own elaboration.

4. Discussion

CT is increasingly used as a diagnostic and predictive tool in patients with SBO (9). Although high sensitivity of CT has been described in cases of complete intestinal obstruction, it decreases in cases of partial intestinal obstruction (10). For this reason, many diagnostic protocols and experts consider that this imaging should be performed when the index of suspicion of the diagnosis is high or when the radiographic study has not confirmed the diagnosis (11).

Conservative treatment of SBO is indicated in mild cases and surgery is reserved for suspected intestinal ischemia or in cases in which the symptoms do not remit despite medical management (12). It has been shown, however, that delays in definitive management, i.e. postponement of surgery, lead to increased morbidity and mortality and adversely affect patient prognosis.

In one study it was found that the time of hospitalization (11 days), proportion of complications (36%) and the risk of bowel resection increased significantly with delayed surgery (13). Delay in definitive treatment after 24 hours is associated with increased mortality (OR 1.9 95% CI 1.4-2.7). The training of the medical team and the development of new diagnostic and therapeutic techniques have allowed a reduction in mortality and the appearance of complications in these patients (14).

Many studies have attempted to describe the role of tomography in predicting surgery in patients with small bowel obstruction. One study found that the transition point, complete bowel obstruction and free air in the abdominal cavity, individually reach specificities of 100%; however, their sensitivity is less than 70% (15, 16). Another study found that the combination of intraperitoneal fluid presentation, mesenteric edema, absence of fecalization and complete obstruction allows the prediction of the need for surgery with a sensitivity of 98% and a specificity of 90% (17).

The sign of fecalization shows an inverse relationship to the need for surgery (7,16-20). In our study it was observed that the sign of fecalization of the small intestine behaved as a protective factor on the outcome, but without statistical significance.

In this study we found that mesenteric edema was the only factor that predicted the need for surgery with good specificity and risk estimates similar to those described in the literature (OR 5.62 CI 95% 1.52-20.70) (21).

It is possible that these findings are due to variations in the study population. For example, it is important to take into account that the tomography was performed during the first 48 hours at admission and that other findings reported in the literature are of a later appearance, therefore, the mesenteric edema found in this investigation is probably an early sign of intestinal ischemia and allows the identification of complex cases early (22).

The evaluation of patients with SBO using a tomographic approach in isolation should be taken with caution and other factors need to be taken into account. Future studies should explore tomography findings in the context of their combination with clinical variables, blood chemistry or interaction between tomographic variables, in order to improve diagnostic and predictive capabilities.

5. Conclusions

The most frequent cause of intestinal obstruction was adhesions (76.4%), and 93% of patients with intestinal obstruction were found to have a history of abdominal surgery. Mesenteric edema predicts the need for surgery in patients with small bowel obstruction with good specificity and low sensitivity.

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