Serum Procalcitonin for Predicting the Failure of Conservative Management and the Need for Bowel Resection in Patients with Small Bowel Obstruction

Cyril Cosse, PhD, Jean Marc Regimbeau, MD, PhD, David Fuks, MD, François Mauvais, MD, Michel Scotte, MD, PhD

BACKGROUND: Ischemia and necrosis are complications of small bowel obstruction (SBO) and require rapid surgical treatment. At present, there are no sufficiently accurate preoperative biomarkers of ischemia or necrosis. The objective of the current study was to evaluate the value of serum procalcitonin levels for predicting conservative management failure and the presence of intraoperatively observed bowel ischemia (reversible or not) in patients with SBO.

STUDY DESIGN: One hundred and sixty-six participants of 242 in a randomized controlled trial focusing on the management of SBO (Acute Bowel Obstruction Diagnostic study [ABOD], NCT00389116) had available data on procalcitonin and were included in the study. The primary study objective was to determine whether serum procalcitonin could identify patients in whom conservative management (CM) failed (the surgical management [SM] group) and the subset of SM patients with intraoperatively observed ischemia (reversible or not). For the analysis, the patients were divided into subgroups according to the success or failure of CM and (for surgically managed patients) the presence or absence of intraoperative ischemia (reversible or not).

RESULTS: Procalcitonin levels were higher in the SM group ($n = 35$) than in the CM group ($n = 131$) (0.53 vs 0.14 ng/mL; $p = 0.031$) and higher in the group managed surgically with ischemia ($n = 12$) than patients managed surgically without intraoperative ischemia ($n = 23$) (1.16 vs 0.21 ng/mL, respectively; $p < 0.001$). A multiple logistic regression showed that procalcitonin is a risk factor for CM failure (odds ratio = 3.5; 95% CI, 1.4−8.5; $p = 0.006$) and for ischemia (reversible or not) (odds ratio = 46.9; 95% CI, 4.0−547.3; $p < 0.001$).

CONCLUSIONS: Procalcitonin can help predict CM failure and occurrence of bowel ischemia (reversible or not) in SBO patients, but additional studies are needed. (J Am Coll Surg 2013;216: 997−1004. © 2013 by the American College of Surgeons)

Small bowel obstruction (SBO) is a major health issue and accounts for between 1% and 3% of emergency department admissions[1-3] and 75% of all obstructions. The condition can be complete or incomplete. In adults, SBO accounts for 4% to 9% of painful abdominal syndromes, and this figure might be as high as 30% in those older than 60 years of age. The mortality rate associated with surgery for SBO is between 2% and 8%.[4-7]

In developed countries, the main cause for SBO is adhesions (65% to 75%)[8] acquired after abdominal surgery (in 67% to 93% of all cases, depending on the series).[8,9] In addition, SBO is associated with serious adverse events (such as bowel ischemia and necrosis) that increase mortality rate. The treatment of SBO is based on 2 distinct approaches: conservative management (CM) with nasogastric tube suction or surgical management (SM), if there are clinical signs of intestinal ischemia[10] or if CM fails.

A major challenge in SBO management is the identification of preoperative biochemical characteristics, clinical signs, and imaging features that are reliable and accurate

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From the Department of Digestive and Metabolic Surgery, Amiens University Hospital (Cosse, Regimbeau, Fuks), INSERM U1088 (Cosse, Fuks), and EA4294 (Regimbeau), Jules Verne University of Picardie, Amiens, Department of Digestive Surgery, Beauvais Hospital, Beauvais (Mauvais), and Department of Digestive Surgery, Rouen University Hospital, Rouen (Scotte), France.

Correspondence address: Jean Marc Regimbeau, MD, PhD, Department of Digestive Surgery, CHU Nord Amiens and University of Picardie, Place Victor Pauchet, F-80054 Amiens Cedex 01, France. email: regimbeau.jean-marc@chu-amiens.fr

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Abbreviations and Acronyms

ABOD = Acute Bowel Obstruction Diagnostic study
AUROCC = area under the receiver operating characteristic curve
CM = conservative management
OR = odds ratio
PCT = procalcitonin
SBO = small bowel obstruction
SI− = managed surgically without ischemia
SI+ = managed surgically with ischemia
SM = surgical management

enough to detect ischemia as early as possible to avoid necrosis and resection.[11]

Procalcitonin (PCT) is a 116−amino acid precursor of calcitonin[12] that was first described in 1993 by Assicot and colleagues.[13] A number of clinical studies have shown that PCT is a marker for sepsis and inflammation[14] and for colonic ischemia after aortic surgery.[15] However, there is little information on the value of PCT in SBO.

The objective of the current study was to evaluate the value of serum PCT levels in predicting CM failure and the presence of small bowel ischemia (reversible or not) in SBO patients.

METHODS

Population

From October 2006 to August 2009, two hundred and forty-two patients with adhesion-related SBO were included in a prospective, multicenter (Amiens, Beauvais, Lille, and Rouen hospitals), randomized, clinical study (Acute Bowel Obstruction Diagnostic [ABOD] study, NCT00389116). The ABOD study's objective was to analyze the impact of systematic, Gastrografin-enhanced CT on the management of patients presenting with postoperative SBO. One of the ABOD study's secondary objectives was a serum PCT assay that should be scheduled for every participant. Only the patients (n = 166) for whom PCT data were available were included in our current study (referred to here as the "PCT study"). The inclusion criteria were SBO in the absence of fever diagnosed with CT, clinical examination, and history of abdominal surgery. The exclusion criteria were early postoperative obstruction, obstruction with neoplasia, obstruction with inflammatory bowel disease, colon obstruction, a history of abdominal radiotherapy, chronic kidney disease, presence of pneumoperitoneum, age younger than 18 years, pregnancy, guardianship, or inability to provide informed consent. Small bowel obstruction was diagnosed on the basis of standard clinical signs (abdominal pain and distension, nausea or vomiting, no passage of gas and/or stools, etc) and radiological signs. In terms of demographic data and medical history, there were no significant differences between ABOD study patients who were included in the PCT study and those who were not (data not shown). The PCT study's protocol was approved by the local independent ethics committee. Written informed consent was obtained from each patient before inclusion.

The PCT study participants were divided into 2 groups: patients in whom the CM was successful (the CM group, n = 131) and those in whom it had failed (SM group, n = 35). In turn, the SM group was broken down into 2 subgroups, according to the presence (SI+; n = 12) or absence (SI−; n = 23) of bowel ischemia (reversible or not) observed intraoperatively.

Management

Initially, each patient was managed conservatively with nasogastric tube suction and administration of either Gastrografin or 0.9% normal saline via the nasogastric tube, considering the randomization result. If a patient received Gastrografin, CT scans were performed. If Gastrografin was seen in the cecum on the CT scans, or if renewed passage of gas and stools was observed, the nasogastric tube was clamped and removed, oral nutrition was resumed, and the CM was considered to be a success. If Gastrografin was absent from the cecum or when faced with clinical signs (such as fever; hyperleukocytosis, ie, leukocyte count $\geq 10 \times 10^3$/mL; or the absence of gas and stools 48 hours after the initiation of CM), the conservative approach was considered to be a failure and the patient was scheduled for surgery.

Surgery

The open surgical procedure consisted of gut viscerolysis and (in some cases such as ischemia) bowel resection. An anastomosis was created as required. In each case, the presence or absence of intraoperative bowel ischemia or necrosis was noted. Any adherences were described by the surgeon and noted in the patient's case report form.

Study design

The study's main objective was to determine whether serum PCT could identify patients in whom CM failed (SM group) and the subset of SM patients with intraoperative ischemia (SI+). The study's patient disposition is shown in Figure 1.

The following items of patient data were collected: demographic information, body temperature, laboratory blood test results (white blood cell count, platelet count, C-reactive protein, creatinine, urea, lactate, ions, and PCT), comorbidities (diabetes, hypertension, chronic kidney disease, or angina), history of abdominal surgery,