

Challenges in diagnosing adhesive small bowel obstruction

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Abstract

Adhesive small bowel obstruction (ASBO) is the most frequently encountered surgical disorder of the small intestine. Up to 80% of ASBO cases resolve spontaneously and do not require invasive treatment. It is important to identify such patients that will benefit from conservative treatment in order to prevent unnecessarily exposing them to the risks associated with surgical intervention, such as morbidity and further adhesion formation. For the remaining ASBO patients, timely surgical intervention is necessary to prevent small bowel strangulation, which may cause intestinal ischemia and bowel necrosis. While early identification of these patients is key to decreasing ASBO-related morbidity and mortality, the non-specific signs and laboratory findings upon clinic presentation limit timely diagnosis and implementation of appropriate clinical management. Combining the clinical presentation findings with those from other diagnostic imaging modalities, such as abdominal X-ray, computed tomography-scan and water-soluble contrast studies, will improve diagnosis of ASBO and help clinicians to better evaluate the potential of conservative management as a safe strategy for a particular patient. Nonetheless, patients

who present with moderate findings by all these approaches continue to represent a challenge. A new diagnostic strategy is urgently needed to further improve our ability to identify early signs of strangulated bowel, and this diagnostic modality should be able to indicate when surgical management is required. A number of potential serum markers have been proposed for this purpose, including intestinal fatty acid binding protein and α -glutathione S transferase. On-going research is attempting to clearly define their diagnostic utility and to optimize their potential role in determining which patients should be managed surgically.

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Key words: Adhesive small bowel obstruction; Diagnosis; Clinical management; Biological markers; Intestinal fatty acid binding protein; α -glutathione S transferase

Core tip: Adhesive small bowel obstruction (ASBO) is a frequently encountered disorder of the small intestine following abdominal surgery. Accurately predicting whether ASBO patients can be treated conservatively is required to prevent exposing patients unnecessarily to surgery-related risks, including morbidity and further adhesion formation. Although recent technological developments have improved the ability to identify those patients most fit for conservative management, the remaining patients with moderate findings upon clinical presentation remain a problem. Serum markers of intestinal ischemia are promising candidates for improving early diagnosis and identification of patients with strangulated bowel, who will benefit most from surgical management.

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INTRODUCTION

Small bowel obstruction (SBO) leading to strangulation and potential bowel necrosis is a serious condition that mandates surgical intervention^[1-3]. Timely diagnosis is essential to prevent the associated morbidity and mortality that manifest as operative management is delayed^[4]. This fact was highlighted by the adage among surgeons citing “never let the sun rise or set in the case of small bowel obstruction”.

Since up to 80% of SBO cases resolve without incident under conservative treatment^[5,6], identification of patients whose obstruction will spontaneously resolve is important to prevent unnecessary surgical intervention and exposure to the risks of procedure-related morbidity and further formation of adhesions^[6,7]. Recent technological advances in diagnostic modalities have improved the ability to identify patients who are most likely to benefit from conservative treatment; however, accurate and early identification of those patients who will ultimately require surgical intervention remains a challenge, especially when the clinical symptoms are moderate^[2].

BACKGROUND

SBO is the most frequently encountered surgery-related disorder of the small intestine. In up to two-third of SBO cases, adhesions from prior abdominal surgery are implicated as the direct cause, having manifested as adhesive small bowel obstruction (ASBO)^[2,6,8]. Although the majority of ASBO present within one year after surgery, up to 21% can develop up to ten years later^[9]. In addition, other causes of SBOs exist, including neoplasia, herniations, inflammatory disease, or congenital disorders. Regardless of the cause, however, obstructed bowel eventually becomes edematous, which leads to bowel ischemia, inflammation, and necrosis in the end-stage and requires surgical resection.

Clinical presentation

Patients with SBO usually present with a wide range of complaints, such as nausea, vomiting, and intermittent abdominal pain. In most cases, a history of prior abdominal surgery is present^[6,10]. However, the clinical symptoms only contribute partially to diagnosis of ASBO, and studies have calculated the symptom-related sensitivity and specificity of acute abdominal pain as 75% and 99%^[11]. One of the more recent studies, evaluating the current diagnostic technologies and clinical routines, found a higher overall sensitivity (88%) but a lower specificity (41%) for this parameter^[12]; thus, improved diagnostic modalities are still needed. Unfortunately, the clinical symptoms of SBO are also not reliable predictors of the optimal disease management strategy, and distinguishing patients with bowel strangulation who

require prompt surgical intervention remains a particular challenge to clinicians.

Laboratory findings

Laboratory tests are often used to confirm clinical suspicions and evaluate the degree of illness. The commonly measured inflammatory markers, such as white blood cell (WBC) count and C-reactive protein (CRP)^[13], however, cannot distinguish inflammation due to obstruction from other inflammatory syndromes and are therefore of little value in the early diagnosis of ASBO^[14]. Even in the case of bowel ischemia, as would be seen in bowel strangulation, studies have detected no significant differences in the WBC or CRP levels of patients who benefit from conservative management and those who require surgical intervention, making these markers useless for distinguishing these two categories of patients^[14-16].

When progression to ischemia occurs, L-lactate, lactate dehydrogenase (LDH) and creatine kinase (CK) can rise due to hypoperfusion of the intestinal tissue^[15]. However, large quantities of L-lactate are cleared by the liver during splanchnic hypoperfusion, resulting in L-lactate being increased at a very late stage of the process, when extensive intestinal infarction is already well established^[17]. From a clinical perspective, a rise in L-lactate level increases sensitivity for detecting bowel ischemia up to 100% and is considered a strong indicator for emergency surgical intervention^[18]. In contrast, LDH and CK levels rise in any ischemic condition, and are therefore unspecific. D-dimer, however, may serve as an exclusionary indicator for the presence of ischemia, due to its role as an enzymatic degradation product of fibrin, but it also lacks specificity since it can be elevated in numerous other conditions^[14].

Since the above-mentioned markers are not specific enough for diagnosis of SBO they are also not useful for determining whether surgical intervention is needed for any particular case. Instead, these markers can be used to simply reflect severity of the disease and may contribute “circumstantial evidence” to support or deny a decision based upon a wide array of clinical findings.

Imaging techniques

The 2010 Bologna Guidelines for Diagnosis and Management of ASBO arose from an international consensus statement. According to these guidelines, all suspected cases of ASBO should be evaluated by abdominal X-ray (level 2b)^[7]. Specifically, the presence or absence of classical signs, such as distension, > 3 cm diameter dilatation of the small bowel, perturbed air-fluid levels and absence of colonic gas, is considered a sufficient means of diagnosis, and studies have calculated this approach to have overall sensitivity and specificity ranging from 60%-85%^[6,7].

In contrast, Laméris *et al*^[12] showed that evaluating patients presenting with acute abdominal pain with plain radiography provided no benefit towards improving the above-mentioned sensitivity and specificity, presuming

that there is no role in the diagnostic work-up. Adding ultrasonography (US) after clinical diagnosis, however, was shown to increase the specificity from 41% to 85%. In suspected SBO cases, US can differentiate between ileus and mechanical obstruction, since peristalsis can be observed by this imaging modality^[19]. Extra-luminal fluid findings are of major clinical importance as they are commonly used to make clinical decisions as to which surgical approach will be most tolerable and beneficial to a particular patient^[20]. In contrast to these findings, the Bologna Guidelines state that there is limited value for US (level 2c), since entrapment of air in ASBO limits ultrasound transmission, making it a useful diagnostic tool only when applied by technical experts^[27].

Using computed tomography (CT)-scan as an additional imaging platform to evaluate all patients with inconclusive plain radiologic films has proven highly useful for diagnosing SBO^[27,21,22]. CT-scan has high sensitivity and specificity for SBO (> 92% and 93% respectively); in addition, the additional information provided by CT scanning can help to detect signs of intestinal ischemia or perforation^[6,23-25]. However, Maglante *et al*^[26] reported that CT-scan can be just as sensitive as a plain abdominal x-ray for differentiating between obstruction and non-obstruction (86% *vs* 82% detection levels). It is important to note that the group with possible signs of ischemia remains a clinical challenge, and making a decision for clinical management is still a problem^[10,23,27,28].

Magnetic resonance imaging (MRI) seems to have a limited role in diagnosing ASBO. MRI provides similar sensitivity and specificity as CT-scan, but no current guidelines have been established or implemented for applying MRI in standard clinical practice^[2,7,29]. Interestingly, when combining abdominal films with water-soluble contrast medium, the approach can both make a diagnosis and safely rule-out the presence of a complete obstruction. In this manner, patient evaluation by water-soluble contrast studies can help to predict whether their ASBO can be treated conservatively or will require surgical intervention^[7,10,22,30]. Besides being a useful diagnostic tool, water-soluble contrast may also have therapeutic potential; its ability to draw fluid into the lumen reduces edema in the gut wall, thereby relieving the obstruction and stimulating peristalsis^[31]. A randomized controlled trial by Burge *et al*^[5] showed an appreciable therapeutic effect when gastrografin was applied as the contrast agent to evaluate ASBO patients; specifically, a significantly accelerated resolution of the obstruction was seen in up to 75% of the patients within 24 h after the application. This result may be attributed to the hyperosmolar quality of gastrografin or other contrast mediums. While the precise benefit of contrast mediums reducing the need for surgery have yet to be systematically proven^[30,32,33], their relation to reduced length of hospital stay has been demonstrated in several trials^[5,28,31,32]. Certainly, however, those ASBO patients who show no contrast being able to enter the colon will require surgical treatment.

NEW DEVELOPMENTS

The limitations of the above-mentioned diagnostic modalities are likely to cause a delay in diagnosis. In recent years, several serum markers with potential to detect ischemic small bowel have been identified^[13,14]. These markers include factors that are released by damaged enterocytes, such as intestinal fatty acid binding protein (I-FABP) and α -glutathione S transferase (α -GST). Enterocytes are rapidly shed in the early phases of intestinal injury and can be readily detected in both urine and plasma, providing promising possibilities for their use as early detection markers^[33].

Plasma levels of the cytosolic protein α -GST rise in conjunction with ischemic intestinal damage; yet, this protein provides variable results as a diagnostic tool, with reported sensitivity ranging from 20%-100% and pooled specificity of 85%^[14,15,34]. Therefore, α -GST may be more useful as an exclusion criterion, rather than as an indicator for surgical intervention. The other marker I-FABP, a cytosolic protein found in tissues involved in uptake and consumption of fatty acids, is released immediately by damaged small bowel, making it a very specific marker^[35]. Patients presenting with SBO but without ischemia show normal levels of serum or urine I-FABP^[36]. A recent clinical trial of patients with acute abdominal pain demonstrated that serum I-FABP levels were significantly higher in those patients with small bowel ischemia than in either those with non-ischemic small bowel disease or those without small bowel disease^[16]. Furthermore, a majority (57.7%) of these ischemic patients had strangulated bowel. Thus, I-FABP may have a role in selecting candidates for surgical intervention. Other putative candidate markers are D-lactate and claudin^[15,37,38]; however, the low specificity of D-lactate and lack of substantial evidence for a role of claudin 3 in SBO makes it difficult to clearly define their potential.

Besides these plasma markers, the prediction model developed by Komatsu *et al*^[39] has identified older age, presence of ascites, and high-volume nasogastral tube drainage on day 3 as critical factors in patients who initially received conservative treatment. Unfortunately, this study did not include findings from radiographic imaging or oral water-soluble studies in the analysis. Although the prediction model is promising, it is necessary to consider the potential impact of markers specifically released by the obstructed small bowel in an earlier stage.

CONCLUSION

Despite the remarkable technological advances in diagnosis of ASBO, the challenge of determining how to most effectively and safely manage these cases remains. Our ability to identify patients who can be treated conservatively has improved greatly, but the same has not been achieved for patients who will require emergency surgery, especially when their presenting symptoms are moderate. Serum markers have emerged as promising

candidates for early diagnosis of strangulated bowel, but further research is necessary to clarify their clinical value in the disease management.

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