Prognostic value of serum lipase levels in patients with small bowel obstruction

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ABSTRACT

Elevated serum pancreatic enzymes have been described among patients with small bowel obstruction (SBO) initially misdiagnosed as having pancreatitis. We studied whether serum lipase elevation carries prognostic value in patients with SBO. Patients with SBO and at least one serum lipase level measured were included. Demographic, laboratory, and imaging information, as well as need for surgery or intensive care unit and mortality, were evaluated. Of 344 patients, 38 (11%) had elevated serum lipase levels. Patients with radiographic diagnosis of pancreatitis were excluded. Patients with elevated lipase had significantly higher levels of creatinine and lactic acid levels, length of stay, need for intensive care monitoring, and death than patients with normal lipase levels. The need for surgical intervention was not significantly different between the two groups. Logistic regression analysis showed elevated serum lipase and serum creatinine >1.5 mg/dL as predictors for mortality. We conclude that, in SBO, elevated serum lipase is a risk factor for higher serum creatinine and lactate, use of intensive care unit, and mortality. The strength of this association justifies studying it prospectively.

KEYWORDS Lipase; pancreatic enzymes; small bowel obstruction

Small bowel obstruction (SBO) occurs when there is an interruption in the passage of intestinal contents through the lumen of the gut. Among many causes, such interruptions can result from adhesions, hernias, tumors, or inflammatory conditions such as Crohn's disease.¹ Patients with SBO classically present with nausea, vomiting, and abdominal pain along with constipation and/or obstipation. These symptoms lack specificity and can also be present in acute pancreatitis.² Therefore, radiological findings of obstruction become essential in the differentiation of those conditions. In acute pancreatitis, the diagnosis can be based solely on clinical presentation and elevated serum lipase levels. Imaging studies are necessary when alternative diagnoses are considered. In SBO, the diagnosis is both clinical and radiologic.¹ Elevation of pancreatic enzymes in SBO has been reported in some cases,^{3,4} and a retrospective review of patients who underwent surgery for SBO showed elevation of serum lipase in half of the cohort.⁵ None of these articles addressed the implications of serum lipase elevation in the setting of SBO. This study examined the frequency of serum lipase elevations among patients with SBO and whether this association carries prognostic value.

METHODS

This study was performed at Lyndon Baines Johnson Hospital, a large tertiary care center in Houston, Texas, after obtaining institutional review board approval. The electronic medical records of all adult patients diagnosed with SBO between September 2013 and September 2016 were retrospectively reviewed. Patient consent requirements were waived.

We screened our electronic database for patients 18 years old and older, with International Classification of Diseases, Ninth Revision and Tenth Revision, codes for SBO. Of those, we selected those whose diagnoses were confirmed by abdominal x-ray or computed tomography using established guidelines.¹ Finally, we enrolled those with at least one serum lipase level measured on the day when the imaging studies were obtained ± 24 hours. We excluded patients who did not have a lipase level drawn during their hospital course, as well as those with large bowel obstruction or paralytic ileus.

Obstructive findings on abdominal x-ray or computed tomography of the abdomen/pelvis included dilated loops of proximal bowel with distal collapsed bowel and the presence of air-fluid levels located within the duodenum, jejunum, or ileum.

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We gathered data on demographic information (age and gender), laboratory results (serum lipase level, white blood cell count, serum creatinine, and lactic acid), imaging studies supportive of SBO, cause of the obstruction when known, need for operative management, length of hospital stay, need for intensive care unit (ICU) care, and mortality. Inconsistent documentation in the reviewed records limited our ability to calculate disease severity scores such as Sequential Organ Failure Assessment or Acute Physiology and Chronic Health Evaluation II.

The normal range in our hospital of serum creatinine is 0.6 to 1.3 mg/dL; of lactic acid, 0.4 to 2 mmol/L; and of serum lipase, 73 to 393 U/L. Any serum lipase level above 393 U/L was considered elevated. Whenever surgery occurred, all laboratory tests were drawn preoperatively.

We calculated statistics using MedCalc version 12.3.0 (MedCalc Software, Mariakerke, Belgium). Categorical variables were analyzed using Fisher's exact test, and discrete variables were analyzed using the Student's *t* test for unpaired samples. A two-sided *P* value < 0.05 was considered statistically significant. We used logistic regression to calculate factors that influenced mortality.

RESULTS

Of 498 patients with mechanical SBO, 344 patients (69%) with serum lipase levels measured were included. The reviewed records did not explain the reason for measuring serum lipase levels. Baseline characteristics are described in *Table 1*. The cause for SBO was known in 229 patients (67%) and included mostly adhesions (96 patients, 42%), strictures (65 patients, 28%), and tumors (54 patients, 24%).

Thirty-eight patients (11%) had elevated serum lipase levels (range 394–2740 U/L). Eleven (3%) had levels three times above normal or higher. Eight patients also had radiographic evidence of acute pancreatitis; these patients were excluded

Table 1. Patients' baseline characteristics (n = 344)

Variable	n (%)
Age (years)	56 ± 15
Men	173 (50%)
Imaging supportive of pancreatitis	8 (2%)
Surgical resolution of SBO	141 (41%)
Known cause of SBO	229 (67%)
Serum creatinine > 1.5 mg/dL	73 (21%)
Patients with end-stage renal disease	7 (2%)
Patients with WBC > 15,000/ μ L	72 (21%)
Patients with lactate > 2 mmol/L	110 (32%)
Length of hospital stay (days)	8.5 ± 8
Intensive care unit use	26 (8%)
Death during the same admission	14 (4%)

SBO indicates small bowel obstruction; WBC, white blood cells.

Table 2. Comparison of patients with SBO and normal or elevated serum lipase

Variable	Serum lipase levels		<i>P</i> value
	Elevated (n = 34)	Normal (n = 302)	
Age (mean ± SD) (years)	53 ± 15	54 ± 15	0.76
Men	20 (59%)	148 (49%)	0.37
Serum creatinine > 1.5 mg/dL ^a	17 (50%)	55 (18%)	<0.001
Serum lactate > 2 mmol/L ^b	16 (47%)	89 (29%)	0.009
WBC count > 15,000/ μ L	7 (21%)	62 (21%)	1.00
Need for surgery	12 (35%)	127 (42%)	0.47
Length of stay (days)	17 ± 17	8 ± 7	<0.001
Need for ICU care	11 (32%)	15 (5%)	<0.001
In-hospital mortality	7 (21%)	7 (2%)	<0.001

SBO indicates small bowel obstruction; WBC, white blood cells; ICU, intensive care unit.

^aPatients with end-stage renal disease were excluded from this calculation.

^bForty-eight patients did not have lactic acid levels drawn.

from the comparative analysis between patients with normal and elevated lipase presented in *Table 2*.

Patients with elevated serum lipase were more likely to have concomitant elevations of serum lactate and serum creatinine. Though elevated serum lipase did not predict the need for surgical intervention, it did predict increased mortality, prolonged inpatient length of stay, and increased utilization of critical care resources.

In our series, 14 patients (4%) died during the hospitalization. *Table 3* compares patients who died and those who did not die. In univariate analysis, elevated serum lipase, elevated serum creatinine and lactate, and admission to the ICU predicted mortality. Lipase three or more times above normal, a finding used to define acute pancreatitis, did not significantly differ between groups. Because ICU need usually portends a worse prognosis, we excluded this finding from a logistic regression model. The use of this model showed that the following elements predicted mortality: elevated serum lipase (*P* < 0.001) and serum creatinine > 1.5 mg/dL (*P* < 0.001). A serum lactate level > 2 mg/dL (*P* = 0.09) did not predict mortality.

DISCUSSION

Our study found that elevated serum lipase levels carry negative prognostic implications, including concomitant elevations of serum lactate and creatinine levels, increased use of ICU, and higher mortality. To our knowledge, this is the first study that assesses the prognostic value of this association.

Serum lipase level elevation has been described in patients with SBO requiring surgery for SBO after gastric bypass surgery. However, the authors did not specifically address the influence of lipase levels on patient outcome.³⁻⁵ Moreover, our cohort included patients with any mechanical obstruction, regardless of whether they had bariatric surgery.

Table 3. Comparison of patients with SBO who died during the admission and those who did not

Variable	Serum lipase levels		P value
	Elevated (n = 14)	Normal (n = 330)	
Age, years (mean ± SD)	58 ± 16	54 ± 15	0.31
Men	9 (64%)	165 (50%)	0.41
Elevated serum lipase	7 (50%)	31 (9%)	<0.001
Serum lipase >3 times above normal	2 (14%)	9 (3%)	0.07
Serum creatinine > 1.5 mg/dL ^a	9 (64%)	64 (19%)	<0.001
Serum lactate > 2 mmol/L ^b	9 (69%)	101 (36%)	0.02
WBC count > 15,000/μL	3 (21%)	69 (21%)	1.00
Need for surgery	3 (21%)	138 (42%)	0.17
Length of stay, days (mean ± SD)	12 ± 10	8 ± 8	0.12
Need for ICU care	12 (86%)	14 (4%)	<0.001

SBO indicates small bowel obstruction; WBC, white blood cells; ICU, intensive care unit.

^aPatients with end-stage renal disease were excluded from this calculation.

^bThirty-four patients did not have lactic acid levels drawn.

Decreased glomerular filtration rate <50 mL/min is described as a cause of elevated serum pancreatic enzymes, although this association seems more evident for serum amylase than lipase.⁶⁻⁸ Furthermore, a combination of amylase response to secretin and autopsy findings among patients with end-stage renal disease (ESRD) suggests that pancreatitis, found in up to 50% of those cases, is not responsible for all cases of hyperamylasemia in that complex cohort.⁹ In our cohort, after exclusion of patients with ESRD, we found that patients with elevated serum lipase levels more frequently had serum creatinine levels >1.5 mg/dL. The range of creatinine elevation went from 1.5 to 8.4 mg/dL in the non-ESRD group. Only four of these patients had a glomerular filtration rate barely above 50 mL/min when calculated using the Modification of Diet in Renal Disease equation.¹⁰

Although we could not calculate disease severity indices in our cohort, we believe that the most likely explanation for elevated lipase in our cohort is pancreatic ischemia, which is supported by concomitantly elevated serum lactate levels. A study showed elevated serum lipase levels in 40% of severely ill patients admitted to the ICU, of whom 5% carried the diagnosis of acute pancreatitis. This finding was associated with longer mechanical ventilation and longer ICU length of stay but not higher mortality.¹¹ Visceral hypoperfusion and pancreatic ischemia are the proposed underlying mechanisms in conditions like SBO, where hypovolemia is commonly present.^{1,12,13}

Another hypothesis explaining the elevation of pancreatic enzymes comes from studies including patients with bariatric surgery. It is thought that the lipase elevation results from increased intraluminal back pressure caused by the obstruction.

This can lead to a reflux of intestinal content into pancreatic and biliary ducts that subsequently activates pancreatic zymogens. This concept is referred to as reflux pancreatitis, and in the referenced study, it did not carry increased mortality or risk of pancreatic necrosis.⁵ Interestingly, experimental bowel obstructions in animal models showed that the necrotic intestinal epithelium of strangulated obstruction releases amylase. This was not noted in mild obstruction unless the animals were moribund; in this study, the canine pancreas showed no micro- or macroscopic evidence of pancreatitis.¹⁴

We found no difference in the need for surgical intervention in patients with normal or elevated serum lipase levels. However, factors such as the nature and chronicity of the obstruction (acute vs subacute vs chronic and proximal vs distal) were not taken into account, and further studies may be needed before this conclusion is made.

Our study has many limitations: its retrospective nature prevents us from understanding why serum lipase was drawn, though we presume that the reason was to assess the patients' abdominal pain, the main reason for presentation among patients with SBO. Though we tried to eliminate from analysis patients with radiological evidence of acute pancreatitis, the spectrum of presentation of this disease is broad and includes normal aspects of the pancreas.¹⁵ This means that in practical terms, such exclusion is not possible. Though we could have reviewed these images after the fact, we believe that this would have skewed our findings, not representing the reality of the patients' presentations. Finally, follow-up serum lipase levels were drawn too irregularly to reliably see an association between resolution of the SBO and those results. This issue might require further investigation.

In conclusion, in patients with SBO, elevated serum lipase is a risk factor for higher serum creatinine and lactate levels, use of ICU, and mortality. Our findings merit a prospective evaluation of this association.

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Avocations

“Rising at dawn” in White Sands by Jay Hoppenstein, MD. Dr. Hoppenstein (e-mail: navigato@aol.com) is a surgeon who was on the medical staff at Baylor University Medical Center at Dallas from 1971 until his retirement in 2005. He also served as chairman of the Department of Surgery at Presbyterian Hospital of Dallas. Photo © Jay Hoppenstein, MD.