

# Predictors of Intestinal Ischemia in Small Bowel Obstruction - A Prospective Study

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## Abstract

**Background:** The purpose of this prospective study is to assess the predictors of intestinal ischemia in small bowel obstruction.

**Materials and Methods:** This study comprises of 92 cases of acute small bowel obstruction managed in the surgery department in Government Medical College, Jammu, over 12 months from 1<sup>st</sup> November to 31<sup>st</sup> October. The diagnosis of acute intestinal obstruction was made in these cases by detail history, clinical examination, and radiological investigation. A detail history and a thorough clinical examination were recorded as per pro forma attached.

**Aims and Objectives:** The aims of this study are (1) to define various clinical, laboratory, and radiological predictors of intestinal ischemia in acute bowel obstruction, (2) to correlate the predictive factors with operative findings of intestinal ischemia in acute bowel obstruction, and (3) to formulate the protocol for the management of bowel obstruction with suspected intestinal ischemia.

**Results:** Intestinal obstruction affects patients of all age groups from <1 year to more than 80 years. The highest incidence was in the age group of <20 years. However, there was no association found between age group and presence or absence of ischemia. Most common etiology of obstruction found was adhesion, followed by hernia. Males were more commonly affected than females, but again no association was found between gender and ischemia.

**Conclusion:** To summarize, patients with bowel obstruction should initially be managed conservatively. The presence of predictors which have a positive correlation with ischemia should raise an alarm of underlying bowel ischemia and prompt the surgeon for need of surgical intervention.

**Key words:** Bowel, Intestinal, Ischemia, Obstruction

## INTRODUCTION

Mechanical bowel obstruction term is used to define intestinal obstruction caused by a physical blockage of the intestinal lumen. Partial obstruction occurs when the intestinal lumen is narrowed but still allows the transit of some intestinal content aborally. On the other hand, complete obstruction implies that the lumen is totally obstructed, and none of the intestinal contents can move distally. Complete obstruction carries a markedly

increased risk of strangulation (vascular compromise). Complete intestinal obstruction can be categorized as simple obstruction, closed-loop obstruction, or strangulation obstruction. Strangulation occurs when the blood supply to the affected segment is compromised.<sup>1-10</sup> The strangulation is either reversible (i.e., the viability of the bowel is maintained with relief of the obstruction) or irreversible when the vascular obstruction has caused irreversible ischemia of the bowel that will progress to transmural necrosis whether or not the strangulation is relieved. The causes of bowel obstruction can be divided into three categories: Obstruction arising from extraluminal causes (e.g., adhesions, hernias, carcinoma, and abscess), obstruction intrinsic to bowel wall (e.g., malrotation, tuberculosis, Crohn's disease, and neoplasms), and intraluminal obturator obstruction (e.g., gallstones, enteroliths, foreign bodies, and bezoars). Laboratory data, although non-diagnostic, may be helpful in determining

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the condition of the patient and guide the resuscitation. A complete blood cell count and differential, electrolyte panel, blood urea nitrogen, creatinine, and urinalysis should be obtained to evaluate fluid and electrolyte imbalance and to rule out sepsis.<sup>11-18</sup>

Computed tomography (CT) findings diagnostic of bowel obstruction include intestinal loops >25 mm in diameter and a transition zone between dilated and collapsed bowel loops. In addition, because CT can demonstrate changes in the intestinal wall and associated mesentery, as well as showing enhancement or lack thereof by the intravenously administered contrast, some evidence about the severity of the local vascular changes and the presence or absence of strangulation may also be available.

CT angiography using multidetector CT is frequently used technique in patients suspected to have bowel ischemia. The most valuable advantage of using CT angiography includes not only obtaining information about presence or absence of thromboembolism and/or vascular narrowing in mesenteric vessels but also demonstrating the hemodynamic changes in the involved bowel segments.

Contraindications to non-operative management include suspected ischemia, large bowel obstruction, closed-loop obstruction, strangulated hernia, and perforation. A relative contraindication to non-operative management is a complete small bowel obstruction.

If a patient being treated non-operatively develops evidence of a complicated obstruction, operative intervention is indicated.

The timing of conversion to operative management in a patient with a small bowel obstruction who is not improving with non-operative management is more controversial. Some surgeons advocate surgical intervention in any patient who fails to show improvement within 48 h of initiating therapy. Others advocate a more liberal use of non-operative therapy, citing a mean time to successful resolution of up to 4.6 days. It is important for the surgeon to remember that non-operative management always carries a calculated risk of overlooking an underlying complicated obstruction.<sup>15,19-31</sup>

## MATERIALS AND METHODS

This study comprises of 92 cases of acute small bowel obstruction managed in the surgery department in Government Medical College, Jammu, over 12 months from 1<sup>st</sup> November 2014 to 31<sup>st</sup> October 2015. The diagnosis of acute intestinal obstruction was made in these cases by detail history, clinical examination, and radiological

investigation. A detail history and a thorough clinical examination were recorded as per pro forma attached.

Different investigations were undertaken in all cases of acute intestinal obstruction, which included routine hemogram, urine analysis, blood urea, creatinine, serum electrolytes, electrocardiography, blood grouping, cross matching, and radiological examination (usually X-ray abdomen and abdomen ultrasonography). Contrast studies including contrast-enhanced CT abdomen were done in selected patients. After resuscitating these patients by conventional methods of intravenous fluids, nasogastric suction, broad spectrum antibiotics were started. Keeping in view the urine output and other hemodynamic parameters, prompt resuscitation and early surgery were undertaken in patients of suspected strangulation.

### Inclusion Criteria

All the patients with intestinal obstruction were included in the study.

### Exclusion Criteria

All the patients with intestinal obstruction will be included except:

1. Patients with suspected perforation,
2. Patients with gross comorbid conditions such as ischemic heart disease and uncontrolled diabetes mellitus.

## RESULT

The following clinical observations were made from clinical data.

### Incidence of Ischemia

Out of 92 patients included in the study, ischemia was present in 16 of them with the incidence of 17.39%.

### Age and Gender Incidence

Intestinal obstruction although common in all age groups, the age spectrum in our clinical study ranged from 3 months to 85 years. The study showed peak incidence of cases in the age group of <20 years of age. Maximum cases of ischemia were seen in the same age group, but distribution of age showed no statistical correlation with ischemia in the present study (Table 1).

The study included 11 male patients and 5 female patients who showed intraoperative findings of ischemia. Yet again, no correlation was found between ischemia and gender.

### Presentation

The type of pain sometimes gives a clue to diagnosis of intestinal ischemia.

In the present study, 11 out of 16 patients had continuous pain as compared to 5 patients who had colicky pain. Although strongly associated, this predictor had a low sensitivity and specificity for ischemia (Table 2).

Fever as a symptom was reported by only 2 out of 16 patients with ischemia and showed no association with it ( $P = 0.1704$ ) (Table 3).

On examination, tachycardia was found in 18 patients in our study. Out of these, 12 were found to have ischemia on intraoperative findings. Tachycardia thus showed strong association with ischemia and specificity (Table 4).

The findings of guarding and rebound tenderness indirectly suggested peritonism and were found in 13 patients in our study. Out of these, 12 had ischemia showing strong association and high specificity (Table 5).

In the present study, sluggish bowel sounds were found in 24 patients, out of which 10 had ischemia. This showed a

high association of ischemia and sluggish bowel sounds (Table 6).

**Investigations**

Apart from routine investigations, total leucocyte count (TLC), acidosis, and amylase were studied as a predictor of ischemia. TLC was found in 14 patients, out of which 13 had ischemia. TLC thus showed high correlation with ischemia (Table 7).

Arterial blood gas (ABG) samples were sent to look for acidosis which was reported in 14 patients. When followed with laparotomy, ischemia was present in 13 of them, showing highly significant association (Table 8).

Amylase, although non-specific for ischemia, is usually found raised in cases of small bowel obstruction with

**Table 1: Distribution of small bowel obstruction based on gender**

Gender	Ischemia present	Ischemia absent	Total
Male	11	39	50
Female	5	37	42
Total	16	76	92
Chi-square value		1.16	

$P=0.108$  (not significant)

**Table 2: Association of ischemia with type of pain**

Type of pain	Ischemia present	Ischemia absent	Total
Colicky	5	68	73
Continuous	11	8	19
Total	16	76	92
Chi-square value		23.91 (yate's correction)	
Fisher's exact		$P<0.001$ (highly significant)	
Sensitivity		33.25%	
Specificity		10.53%	
PPV		6.85%	
NPV		42.11%	

**Table 3: Association of ischemia with fever**

Fever	Ischemia present	Ischemia absent	Total
Present	2	3	5
Absent	14	73	87
Total	16	76	92
Chi-square value		0.585 (yate's correction)	
Fisher's exact		$P>0.001$ (not significant)	
Sensitivity		12.50%	
Specificity		96.05%	
PPV		40.00%	
NPV		83.91%	

**Table 4: Association of tachycardia with ischemia**

Tachycardia	Ischemia present	Ischemia absent	Total
Present	12	6	18
Absent	4	70	74
Total	16	76	92
Chi-square value		0.33.68 (yate's correction)	
$P<0.001$ (highly significant)			
Sensitivity		75.00%	
Specificity		92.11%	
PPV		66.67%	
NPV		94.59%	

**Table 5: Association of peritonism with ischemia**

Peritonism	Ischemia present	Ischemia absent	Total
Present	12	1	13
Absent	4	75	79
Total	16	76	92
Chi-square value		53.23 (yate's correction)	
Fisher's exact		$P<0.001$ (highly significant)	
Sensitivity		75.00%	
Specificity		98.68%	
PPV		92.31%	
NPV		94.94%	

**Table 6: Bowel sounds as a predictor of ischemia**

Type of bowel sounds	Ischemia present	Ischemia absent	Total
Sluggish	10	14	24
Exaggerated	6	62	68
Total	16	76	92
Chi-square value		11.13 (yate's correction)	
$P<0.001$ (highly significant)			
Sensitivity		62.65%	
Specificity		81.58%	
PPV		41.67%	
NPV		91.18%	

**Table 7: Association of TLC with ischemia**

TLC	Ischemia present	Ischemia absent	Total
Raised	13	1	14
Normal	3	75	78
Total	16	76	92
Chi-square value		65.46	
Fisher's exact		$P < 0.001$ (highly significant)	
Sensitivity		81.25%	
Specificity		68.68%	
PPV		92.86%	
NPV		96.15%	

TLC: Total leucocyte count

**Table 8: Acidosis as a predictor of ischemia**

Acidosis	Ischemia present	Ischemia absent	Total
Present	13	1	14
Absent	3	75	78
Total	16	76	92
Chi-square value		65.46	
Fisher's exact		$P < 0.001$ (highly significant)	
Sensitivity		81.25%	
Specificity		68.68%	
PPV		92.86%	
NPV		96.15%	

ischemia. In our study too, all the 8 patients with raised amylase (>150) had ischemia as an intraoperative finding. Apart from being significantly associated with ischemia, raised amylase also had 100% specificity for ischemia in our study (Table 9).

**Ultrasonographic (USG) Findings**

All the patients included in our study were taken for USG. Apart from other findings of dilated bowel loops and type of peristalsis, the correlation between the presence of ascites and intraoperative findings of ischemia was studied. Ascites was present in 37 patients and ischemic seen in 13 of them. Ascites thus had a strong association with ischemia but with a low sensitivity and specificity (Table 10).

Thus, almost all the predictors, included in the study, were associated with ischemia with variable sensitivity and specificity, but gender and fever were not found to be associated with ischemia in a case of bowel obstruction.

**DISCUSSION**

Despite striking advances in the various disciplines of medicine, intestinal obstruction continues to remain a problem of utmost complexity. The determination of level and cause of obstruction often elude the surgeon, who is many times ignorant about the presence or absence of ischemia.

**Table 9: Association of ischemia with amylase**

Amylase	Ischemia present	Ischemia absent	Total
Raised	8	0	8
Normal	8	76	84
Total	16	76	92
Chi-square value		35.16	
$P < 0.001$ (highly significant)			
Sensitivity		50%	
Specificity		100%	
PPV		100%	
NPV		90.48%	

**Table 10: Distribution of small bowel obstruction based on USG evidence of ascites**

Ascitis	Ischemia present	Ischemia absent	Total
Present	13	24	37
Absent	3	52	55
Total	16	76	92
Chi-square value		13.56	
$P < 0.001$ (highly significant)			
Sensitivity		81.25%	
Specificity		68.42%	
PPV		35.14%	
NPV		94.55%	

Age-wise distribution of patients with obstruction showed no association of age with presence or absence of ischemia. This was contrary to Bizer *et al.* and Tsumura *et al.* who reported that the presence of bowel strangulation shows a positive correlation with age. Similar correlation was advocated by studies done by Aldemir *et al.* and Komatsu *et al.* where the latter took the age limit as more than or equal to 65 years.

No association was found between ischemia and gender in the present study contrary to the result of Tsumura *et al.*, in which association was found between female gender and ischemia. Continuous abdominal pain was present in 11 out of 16 patients with ischemia and was strongly associated with it as was also seen by Otamiri *et al.* and Aldemir *et al.* The result contradicted the study of Bizer *et al.*, which reported no correlation between continuous pain and bowel ischemia.

2 out of 16 patients with ischemia had fever as presenting complaint, and thus, fever showed no statistical association with ischemia as was observed by Bizer *et al.*

Although the study done by Bizer *et al.* showed no correlation, in the present study, tachycardia had a strong association with ischemia and was highly specific, with specificity of around 92%. Feza *et al.* also showed similar association as did Aldemir *et al.*

The specificity of peritonism for predicting ischemia was around 98%, with around 12 patients with ischemia having peritonism, suggesting strong association. Similar association was reported by Feza *et al.*, Tsumura *et al.*, Takeuchi *et al.*, Zielinski *et al.*, and Aldemir *et al.*, and Jancelewicz *et al.* also reported that guarding was moderately predictive for bowel strangulation.

Bowel sounds were found to be sluggish in 10 out of 16 patients with ischemia suggesting strong association as observed by Aldemir *et al.*

Laboratory investigations showed a raised TLC in 13 out of 16 patients of ischemia. This predictor was strongly associated with ischemia similar to various previous studies done by Bizer *et al.*, Otamiri *et al.*, Feza *et al.*, Takeuchi *et al.*, Aldemir *et al.*, Tsumura *et al.*, Jancelewicz *et al.*, and Schwenter *et al.*

As observed by Takeuchi *et al.*, acidosis had a strong association with ischemia in the present study as ABG analysis showed acidosis in 13 out of 16 patients with ischemia.

Raised serum amylase levels were found in 8 out of 16 patients with ischemia showing a strong association. This test showed high specificity of 100% but a low sensitivity of 50%.

13 out of 16 patients had USG findings of ischemia thereby proving a strong association between them. Similar association was also observed by Komatsu *et al.* and Kenji *et al.*

Literature concerning various aspects of predictors of bowel obstruction has been reviewed. Observation of 92 cases of bowel obstruction, admitted over 12 months from 1<sup>st</sup> November 2014 to 31<sup>st</sup> October 2015, have been made. The present study is summarized as under: Intestinal obstruction affects patients of all age groups from <1 year to more than 80 years. The highest incidence was in the age group of <20 years. However, there was no association found between age group and presence or absence of ischemia. Most common etiology of obstruction found was adhesion, followed by hernia. Males were more commonly affected than females, but again no association was found between gender and ischemia.

Continuous abdominal pain was significantly associated with ischemia but with a low sensitivity and specificity. Fever was absent in most cases of obstruction and showed no correlation with ischemia.

Clinically, the presence of tachycardia and peritonism was significantly associated with ischemia with high specificity.

Sluggish bowel sounds, though significantly associated with ischemia, have a low sensitivity and specificity for the same.

On investigating the patients in our study, raised TLC and presence of acidosis were associated with presence of ischemia; however, these predictors have low sensitivity and specificity. The most specific predictor of ischemia was raised amylase. USG findings of ascites were also found to be significantly associated with ischemia but with low sensitivity and specificity.

## CONCLUSION

Patients with bowel obstruction should initially be managed conservatively. The presence of predictors which have a positive correlation with ischemia should raise an alarm of underlying bowel ischemia and prompt the surgeon for the need of surgical intervention.

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