Study of Efficacy of Various Parameters in Predicting Strangulation Obstruction

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Abstract

Introduction: Strangulation is the most dreaded complication of bowel obstruction and has a great bearing on morbidity and mortality. Early diagnosis remains great concern to a surgeon, as strangulation carries considerable mortality. *Aims & Objectives:* To evaluate efficacy of various parameters in predicting strangulation obstruction. *Material and Methods:* Present study was a prospective, hospital based study involving 100 patients admitted for acute bowel obstruction. All patients were classified into strangulated and non-strangulated bowel obstruction. The incidence of 4 parameters: fever, tachycardia, rigidity and leucocytosis were calculated in all patients. The sensitivity, specificity, positive and negative predictive value of these parameters was calculated and results were analyzed. *Results:* Of the total 100 cases, 31% had strangulated bowel. The evidence of strangulated bowel due to obstructed hernia was seen in 36.84% cases and 29.62% cases of adhesive obstruction. Fever was present in 54% cases, tachycardia in 46%, leucocytosis in 36% and rigidity in 32% cases. These individual parameters were not statistically significant. If a combination of 2 parameters is used instead of single parameter, then rate for predicting strangulation increases to 20% and it rises to 71.42% when all the 4 parameters are considered. *Conclusion:* Amongst the clinical parameters for strangulation (tachycardia, fever, rigidity, and leucocytosis), none is sensitive or specific for prediction of strangulated bowel obstruction. Preoperative definitive diagnosis of strangulation cannot be made reliably by any clinical and laboratory parameters included in the present study. However, a reasonable prediction about strangulation can be made if all parameters are considered together.

Keywords: Strangulated Bowel Obstruction; Leucocytosis; Adhesive Obstruction; Obstructed Hernia.

Introduction

Strangulation is the most dreaded complication of bowel obstruction and has a great bearing on morbidity and mortality. So, early diagnosis remains a great concern to a surgeon, as strangulation carries considerable mortality. Predicting its possibility in a patient of acute bowel obstruction is a great challenge for any surgeon. The ability of prediction of strangulation obstruction or impending strangulation in bowel obstruction will therefore lead to earlier treatment, subsequently reducing morbidity and mortality. The inability of various clinical parameters and laboratory investigations to predict strangulation accurately has been emphasized repeatedly by many studies in the past. Many researchers still advocate surgery for all cases of acute bowel obstruction. Treatment decisions have to be finely balanced between hazards of strangulation and risks of surgery. We undertook the study of acute intestinal obstruction in adults with special attention to strangulation and its predictors. We reevaluated preoperative diagnostic capability of some clinical and laboratory parameters to predict strangulation in cases of acute bowel obstruction.

Aims & objectives

To evaluate efficacy of various parameters in predicting strangulation obstruction.

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Material and Methods

Present study was a prospective, hospital based study involving 100 patients admitted for acute bowel obstruction. All patients who were suspected to have bowel obstruction were admitted through Outpatient department or casualty. They were evaluated on the basis of detailed clinical history and physical examination. Leucocyte counts and serum electrolytes were done in all patients. After thorough resuscitation, those patients who had clear cut evidence of acute bowel obstruction on the basis of clinical examination and plain abdominal radiograph were explored surgically. Intraoperative findings were noted and appropriate surgical procedure was carried out. Postoperatively patients were monitored and managed in ward. The recovery and complications were noted.

All patients were classified into strangulated and non-strangulated. The incidence of 4 classical parameters viz. fever > 100°F, tachycardia (pulse rate > 100/min), rigidity and leucocytosis (WBC count > 10,000/cu mm) was calculated in strangulated and non strangulated patients. The statistical test applied was Chi square test. The sensitivity, specificity, positive and negative predictive value of each of these parameters for prediction of strangulation was calculated and significance was determined. The results were analyzed accordingly.

Results

Amongst the 100 cases studied, 31% cases showed evidence of strangulated bowel, of these 29.62% cases were of adhesive obstruction and 36.84% cases were of obstructed hernia. There were 2 cases of superior mesenteric artery (SMA) thrombosis, both of which showed evidence of strangulation i.e. 100% strangulation rate (Table 1).

Considering the duration of symptoms and strangulation rate, it was seen that patients presenting within the first 24 hours of the onset of symptoms were 19, of these 1 (5.26%) had strangulation. Patients presenting within 24-48 hours were 12, of these 1 (8.33%) had strangulation. Patients presenting within 3-4 days were 38, of these 13 (34.21%) had strangulation. Patients presenting after a period of more than 5 days were 31, of these 16 (51.61%) had strangulation (Table 2).

Table 1: Incidence of strangulation in various etiologies

Etiology	No. of Cases	Cases with Strangulation	Rate
Adhesions	27	08	29.62
Obstructed Hernia	19	07	36.84
Colonic malignancy	08	0	0
Carcinoma rectum	05	0	0
Internal Hernia	01	0	°
Koch's abdomen	04	02	50
Appendicular perforation	04	0	0
Volvulus	15	07	46.66
Stricture	03	02	66.66
Meckel's Diverticulum	05	01	20
SMA thrombosis	02	02	100
Obstructed Umbilical hernia	01	01	100
Intussusception	03	01	33.33
Pseudo obstruction	03	0	0
Total	100	31	31

Table 2: Duration of symptoms and strangulation rate

Duration	No. of cases	Strangulation (%)
<24 hours	19	1 (5.26)
24-48 hrs	12	1 (8.33)
3-4 days	38	13 (34.21)
>5 days	31	16 (51.61)

Table 3: Incidence of strangulation in patients with positive classical parameters

Parameter	No. of cases	Strangulation	Strangulation absent	p- value
Fever	54	21	33	0.103
Tachycardia	46	19	27	0.066
Rigidity	32	14	18	0.097
Leucocytosis	36	16	20	0.051

Table 4: Leucocytosis as a predictor of strangulation

| Leucocytosis | Strangulation | | Total |
	Yes	No	
Yes	16	20	36
No	15	49	64
Total	31	69	100

Table 5: Fever as a predictor of strangulation

| Fever | Strangulation | | Total |
	Yes	No	
Yes	21	33	54
No	10	36	46
Total	31	69	100

Table 6: Tachycardia as a predictor of strangulation

| Tachycardia | Strangulation | | Total |
	Yes	No	
Yes	19	27	46
No	12	42	54
Total	31	69	100

Table 7: Rigidity as a predictor of strangulation

| Rigidity | Strangulation | | Total |
	Yes	No	
Yes	14	18	38
No	17	51	62
Total	31	69	100

Table 8: Single and Combination of parameters in prediction of strangulation

No. of Parameters	No. of cases	Strangulation	Rate
None	16	02	12.50
Any 1	30	08	26.66
Any 2	30	06	20.00
Any 3	17	10	58.82
All 4	07	05	71 42
Total	100	31	31

The case distribution of the 4 parameters (fever, tachycardia, rigidity, and leucocytosis) was as follow: Fever (54), tachycardia (46), rigidity (32), and leucocytosis (36) cases. All the 4 parameters had p-value > 0.05, which was not significant for strangulation (Table 3).

Amongst 31 cases of strangulated obstruction, 16 (51.61%) had leucocytosis. Amongst 69 cases of simple obstruction, 20 (28.98%) had leucocytosis. Leucocytosis was more common in patients with strangulated obstruction than in simple obstruction and it was statistically not significant. [Chi square test = 3.822 with 1 degree of freedom p value = 0.051] (Table 4).

Fever was observed in 21 (67.74%) cases with strangulation obstruction and 33 (47.82%) cases with simple obstruction and it was statistically not significant. [Chi square test = 2.661 with 1 degree of freedom p value = 0.103] (Table 5).

Tachycardia was observed in 19 (61.29%) cases with strangulation obstruction and 27 (39.13%) cases with simple obstruction and it was statistically not significant. [Chi square test = 3.384 with 1 degree of freedom p value = 0.066] (Table 6).

Rigidity was observed in 14 (45.16%) cases with strangulation obstruction and 18 (26.08%) cases with simple obstruction and it was statistically not significant. [Chi square test = 2.754 with 1 degree of freedom p value = 0.097] (Table 7).

On evaluating the role of single and combination of parameters for prediction of strangulation, it was observed that if a combination of parameters was used instead of a single parameter, then rate for predicting strangulation increased.

It was 20% when any 2 parameters were considered and it increased to 71.42% when all the 4 parameters were considered in a single patient (Table 8).

Table 9: Effect of strangulation on mortality

Outcome	Strangulation		Grand Total
	Present	Absent	
Discharge	28	68	96
Expired	03	01	04

In the present study, the overall mortality of acute obstruction was 4%. Amongst the 31 cases of strangulated obstruction 3 (9.67%) showed mortality. In 69 cases of simple obstruction mortality was seen in 1 (1.44%). The observations suggest that strangulated obstruction has high mortality than simple obstruction (Table 9).

Discussion

Strangulated intestinal obstruction represents a considerably more complex problem than does the simple obstruction, because in addition to all the physiological disturbances associated with simple obstruction, the body has to cope also with impending or actual death of tissue within the strangulated segment. Loss of blood and plasma in strangulated loop causes hypovolemic shock, ischemia and gangrene of the intestinal wall that leads to increased permeability, followed by passage of bacteria and toxins into peritoneal cavity, culminating into peritonitis. Systemic absorption of various endotoxins finally leads to septicemia. Necrosis first appears in the mucosal surface as pointed out by Bussemaker and Lindeman [1], because of relative vulnerability of intestinal epithelium to anoxia. Eventually perforation of the necrotic segment takes place.

Occasionally, a strangulated loop of bowel released before actual perforation may subsequently undergo ischemic fibrosis with resultant stricture formation (Barry's strictures). This condition is particularly seen when reduction by taxis is carried out in strangulated hernia and following injury to the intestine as a consequence to mesenteric embolism. The peritoneal exudate from strangulated bowel is responsible for the occasional unexpected deaths from intestinal obstruction similar to the fatal collapse which may accompany any form of coliform peritonitis [2].

The toxic effects of strangulation resemble those of moist gangrene; intestinal strangulation is in fact an intra abdominal form of wet gangrene; its toxicity is due to bacterial invasion of the infarcted bowel, and its rapidly lethal effect is due to the presence of an area of wet gangrene within the peritoneal cavity [3]. In strangulation, high amounts of 5-HT (Serotonin) and histamine were detected in the peritoneal transudate [4].

Blood loss factor is significant in strangulating type of obstruction, particularly where venous obstruction factor predominates. There is often considerable hemorrhage into the bowel lumen. The important clinical point here is that blood transfusion is strongly indicated in the presence of strangulation obstruction particularly where the affected segment is long, as the blood loss factor may produce actual shock [5].

After strangulation, the colicky pain of simple bowel obstruction is converted into a continuous and well localized pain. The classical signs of strangulation are fever, tachycardia, and signs of peritoneal irritation like guarding and rigidity and occasionally bleeding per rectum. However these signs are not sensitive or specific for strangulation. Unfortunately, the presence of one or more of these findings is common in patients with simple obstruction.

In a clinical study of 30 patients in Japan, it was found that SIRS (systemic inflammatory response syndrome), abdominal tenderness, and signs of peritoneal irritation were detected more often in patients with strangulated bowel obstruction than simple bowel obstruction [6].

In a study done by Takeuchi K *et al* [7] peritoneal signs, base deficit, shock and leucocytosis were more common in strangulation but no preoperative clinical parameter was specific for strangulation. The study showed that early operation is essential for most cases clinically diagnosed as intestinal obstruction.

In some series raised temperature, tachycardia, abdominal tenderness, absence of bowel sounds, feculent vomiting and a white blood count >18,000/cu mm are positively correlated with strangulation [8,9].

Zollinger and Kinsey [10] in a review of 349 patients found no significant difference in the incidence of the classic signs of strangulation i.e. tachycardia, fever, leucocytosis, and constant, non-crampy abdominal pain. Similar results were found by Shatila AH *et al.* [11] and Davis and Sperling [12] in reviews of 103 and 165 consecutive patients, respectively. Silen W *et al.*[13] reviewed retrospectively 480 patients with

small bowel obstruction and concluded that it was impossible to recognize patients with strangulation, and thus, the optimal management should be surgical intervention after initial resuscitation.

In our study out of 100 cases, 31 showed evidence of gangrenous bowel i.e. strangulation Chen XZ *et al* [14] found the incidence of strangulation to be 17.4% as compared to Osuigwe [15] who found strangulation percentage as high as 55.26%. Incidence of strangulation in adhesive obstruction was found to be 29.62% in our study. While the incidence in obstructed inguinal hernia was 36.84%, volvulus had strangulation percentage of 46.66%. Both the cases of SMA thrombosis had gangrene of the entire small bowel and part of large bowel making the strangulation rate of 100%. Intussusception had strangulation rate of 33.33%. Obstruction due to Meckel's diverticulum with adhesive band had evidence of gangrene in 20% patients though resection of the diverticulum with ileoileal anastomosis was done in all cases. Chen XZ *et al* [14] had strangulation rate of 19.67% in postoperative adhesive obstruction and 26.92% in obstructed inguinal hernia. Strangulation in SMA thrombosis

was also found to be 100%, while in intussusception cases strangulation percentage was 25%.

Adhikari *et al*.[16] found that the strangulation rate is 28.07% and 21.96% in post operative adhesive obstruction and obstructive inguinal hernias respectively. Ohene-Yeboah *et al.* [17] found the incidence to be 16.03% in post operative adhesive obstruction and 27.8% in obstructed inguinal hernia Haridimos *et al.*[18] found the strangulation rate to be 21.4% in adhesive obstruction and 42.8% in obstructed hernias . Lawal OO *et al.* [19] found strangulation rate of 13.63% and 72.72% in adhesive obstruction and obstructed hernias respectively. They found the rate to be 40% in cases of volvulus and 37.5% in cases of intussusception, both of which are comparable with our results.

Strangulation rate in adhesive obstruction is around 20-30% in most studies. Strangulation rate in obstructed external hernias was around 25-40% in most studies except in the study by Lawal *et al.*, who found a very high rate of 72.72%. This may be due to the fact that there were very few patients of hernias (11) in their study, majority of whom probably reported late (Table 10).

Table 10: Strangulation rate in various etiologies

Etiology	Present Study	Chen XZ et al. [14]	Adhikari et al. [16]	Ohene et al. [17]	Haridimos et al. [18]	Lawal et al. [19]
Adhesions	29.62	19.67	28.07	16.03	21.4	13.63
Obstructed hernia	36.84	26.92	21.96	27.8	42.8	72.72
Koch's	50	—	—	--	—	-
Volvulus	46.66	100	—	—	7.2	40
Meckel's	20	—	—	—	—	—
Stricture	66.60	—	—	—	—	-
SMA thrombosis	100	100	—	—	—	—
Intussusception	33.33	25	—	—	—	37.5

In our study it was seen that 31 patients presented within 48 hrs of onset of symptoms, out of which only 6.45% patients had strangulation. 38 patients presented within 3-4 days of onset and had a strangulation rate of 34.21%. When patients presented 5 days or more after onset of complaints (31 patients), the strangulation rate was as high as 51.61%. When compared with similar study carried out by Chen XZ *et al.*[14] it was observed that in their study the strangulation rate of patients presenting within 24 hrs was 18.18%. The rate when patients presented from 24 – 48 hours was 19.4% and when presented on the 3rd day, the rate was 26.3%. When patients presented after 3 days of onset of symptoms the strangulation rate was as high as 52.9%. When the strangulation rate was calculated with respect to duration of symptoms, it was found that the more the

duration between onset of symptoms and presentation, the more the strangulation rate.

In our study patients with strangulation had fever in 67.74% of the cases, tachycardia in 64.5%, rigidity in 45.16% and leucocytosis in 64.5% patients. Syphax, Leffal *et al.*[9] evaluated 74 patients with strangulation obstruction, tachycardia was found in 70% cases, shock in 28%, fever in 50%, rigidity in 30%, tenderness in 82% and leucocytosis in 64% of cases. In an article by Shatila *et al.*[11] classic signs of gangrenous bowel were also absent in many cases. In 50 patients with strangulation obstruction there was no tachycardia in 42% patients, no fever in 70% and no leucocytosis in 42% of the cases. In a retrospective study carried out by Leffal Jr. *et al.*[20] tachycardia was noted in 78% cases, shock in 24%, fever in 55%, rigidity in 29%, tenderness in 82% and leucocytosis in 63% of the cases.

Accurate and early recognition of presence of intestinal strangulation in patients with bowel obstruction is important to allow safe, non-operative management of selected patients. Traditionally such recognition is based on the presence of one or more classic signs of vascular compromise including continuous (as opposed to colicky) pain, fever, tachycardia, signs of peritoneal irritation, leucocytosis, hyperamylasemia and metabolic acidosis. The routine clinical and laboratory evaluations have proved repeatedly to be unreliable in identifying strangulation obstruction. In our study 3 clinical parameters (fever > 100°F tachycardia >100/minute, rigidity) and one laboratory investigation (leucocytosis > 10,000/cu mm) were studied in all patients with respect to strangulation. It was found that though these parameters were more prevalent in patients with strangulation obstruction than in patients with simple obstruction, the difference was not statistically significant as per the p-value when each one of them was considered. We also calculated the combination of these 4 parameters in all patients to see whether any two or any three or any 4 parameters can predict strangulation. The strangulation rate was definitely higher when all four parameters were considered together as opposed to the cases when only single parameter or any 2 or any 3 were considered.

In the prospective study conducted in 51 consecutive patients by Sarr MG *et al.* [21] they evaluated quantitatively the diagnostic capability of the initial preoperative clinical evaluation, certain specific laboratory parameters, and most interestingly, "experienced clinical judgment" of the senior attending surgeon in differentiating strangulation from simple obstruction. No preoperative clinical parameter, including the presence of fever, continuous abdominal pain, peritoneal signs, acidosis, leucocytosis, or any combination thereof, was sensitive, specific, and predictive for strangulation. Routine laboratory evaluation was of little help. Furthermore, the senior surgeon recognized strangulated bowel in only 10 of 21 patients (sensitivity of 48%); only 25 of 36 preoperative assessments of simple obstruction proved correct. Overall, the preoperative assessment was correct in only 35 of 51 patients (efficiency of 70%).

Table 11: Comparison of the four parameters with other study [21]

Lab markers	Sensitivity		Specificity		Positive predictive value		Negative predictive value	
	Our	Sarr	Our	Sarr	Our	Sarr	Our	Sarr
Leucocytosis	51.61	81	71.04	37	44 44	47	76.56	73
Fever	67.74	24	52.17	70	38.88	36	78.26	57
Tachycardia	61.29	52	60.86	43	41.30	39	77.77	57
Rigidity	45.16	29	73.91	97	43.75	86	75	65

Present study was compared with Sarr *et al.* for the 4 parameters. In our study, fever was the most sensitive parameter for prediction of strangulation and rigidity was most specific. The positive and negative predictive values of almost all the parameters were same for predicting strangulation (Table 11).

In our study postoperative complications like wound infections occured with almost the same frequency in patients with or without strangulation but the complications like anastomotic leak, burst abdomen and septicemia were much more common in patients with strangulation.

In the present study the overall mortality was 4%. In cases of strangulation obstruction, the mortality rate was 9.67% while in simple obstruction, it was 1.45%. Malik *et al* [22] found the mortality rate to be 3.49%, that is comparable with our results. J. Khan *et al.*[23] found it to be 7%, while Osuigwe[15] found it to be 9.2%. Ohene-Yeboah *et al.*[17] found it to be 12%. Chen XZ *et al.*[14] found a comparatively lower rate of 1.6%.

Conclusions

Among the clinical parameters for strangulation (tachycardia, fever and rigidity) and leucocytosis, none is sensitive or specific for prediction of strangulated bowel obstruction. As the duration from the onset of symptoms to presentation increases, the chance of strangulation also increases. The rate of complications as well as mortality from strangulated bowel obstruction is much more than simple bowel obstruction. Preoperative definitive diagnosis of strangulation cannot be made reliably and at the same time cannot be excluded by any clinical and laboratory parameters included in the present study. However, a reasonable prediction about strangulation can be made if all parameters are present together in a single patient. In patients with strangulation without presence of any clinical or laboratory parameter, non operative management if undertaken, carries a high risk of delaying definitive treatment for

intestinal ischemia, thereby increasing morbidity and mortality. It is the strangulation and not the etiology which decides the overall morbidity and mortality. Surgical exploration therefore still remains the preferred and gold standard management of acute intestinal obstruction in adults.

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