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Outcome and Evaluation of Intestinal Obstruction Due to Bands in Virgin Abdomen: A Prospective Study

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Abstract **Original Research Article**

Introduction: Some major hospitals and clinics still insist on exploratory surgery when they evaluate a case of Intestinal obstruction in a patient with an otherwise virgin abdomen. Objective: The purpose of this research is to identify the causes of SBO in people who have never performed abdominal surgery. ***Materials and Methods:*** Multicentered based nonrandomized quasi experimental prospective study was performed in Northern International Medical College, Dhaka, Bangladesh from January 2018 to December 2021.Total number of patients n=60 treated for Intestinal obstruction due to bands in virgin abdomen. Follow up data, operative and pathologic findings were examined to determine the etiology of SBO. ***Results:*** Sixty patients met inclusion criteria; abdominal exploration was performed in 50 patients (83%) and 10 patients (17%) were managed non-operatively. Exploration was therapeutic in 29 (58%), negative in 20 (40%) and non-therapeutic in one patient (2%). Overall, 8 patients (13%) were diagnosed with a malignancy: right-sided colon cancer (n=3), small bowel (SB) neuroendocrine tumor (n=2), SB lymphoma (n=2) and carcinomatosis peritonei (n=1); six patients were diagnosed at the time of the initial exploration and two patients were diagnosed during follow up. Upon Prospective Study, both SB neuroendocrine tumors and one SB lymphoma were visible on the initial imaging. Leukocytosis (p=.03) and no recent weight loss (p=.04) were associated with negative exploration. ***Conclusion:*** Patients with a "virgin abdomen" generally have a non-threatening form of Intestinal obstruction in its earliest stages. Careful evaluation of imaging investigations is required for spotting early warning symptoms of a more serious illness. If the patient prefers non-surgical treatment, they will need to have a recent colonoscopy and give relevant examination findings history.

Keyword: Intestinal obstruction, Virgin abdomen, Laparotomy, Surgery.

INTRODUCTION

Intestinal obstruction is a common surgical problem arising in about 4.6% of patients with a prior abdominal procedure and is responsible for up to 300,000 hospital admissions every year in North America. The most common etiology for SBO is adhesions, with up to 70% prevalence. Approximately 80% of patients with adhesive SBO have a history of prior intraabdominal surgery [1]. Suspicion of malignancy in patients with SBO is heightened by an un- operated abdomen with surgical exploration considered mandatory by some large centers [2, 3]. The data supporting this approach, however, are not contemporary. Small retrospective studies suggest that majority of SBO's in patients with virgin abdomen have benign etiology, and that as many as 75-82 % might have been managed non-operatively and spared the morbidity of a laparotomy [4]. Furthermore, improvements in imaging technology might have resulted in increased ability to identify malignant etiology of the SBO. The aim of this study is to determine the etiology of small bowel obstruction in patients without prior abdominal operation.

METHODS

A Prospective Study of the patients treated for Intestinal obstruction in the setting of virgin abdomen at Northern International Medical College, from January 2018 to December 2021 was performed. The requirement to obtain informed consent from the study subjects was approved considering the minimal risk of the study.

Free text search of electronic medical records was performed for "bowel obstruction" and phrases

describing virgin abdomen. Only patients without prior abdominal operations and with CT confirmation of the diagnosis of SBO were included. The diagnosis of SBO was established if an attending surgeon documented interpretation of CT imaging and was in agreement with the diagnosis. Exclusion criteria were presence of diffuse peritonitis, incarcerated transabdominal or inguinal hernia, preoperative diagnosis of inflammatory bowel disease, obstructing malignancy, preoperative suspicion for mesenteric ischemia or CT findings suggestive of closed loop bowel obstruction. Concern for closed loop obstruction was considered to be the primary reason for operative intervention only if this was documented as such in the attending surgeon's note and supported by attending radiologist's interpretation of CT images. Concern for bowel ischemia had to be clearly documented in the attending surgeon's notes as the primary reason for operative intervention.

Operative findings and pathologic data were examined to determine the etiology of SBO. The findings were correlated with imaging results including intra-abdominal masses, mesenteric lymphadenopathy, ascites, small bowel wall thickening or hyperenhancement, presence of transition point, mesenteric edema, small bowel feces sign and mesenteric swirling. Clinical characteristics including fever, tachycardia, abdominal distension, obstipation, vomiting, recent unintentional weight loss (loss of >5% of body weight over 6 months) leukocyte count and lactate blood levels were also recorded and correlated with intraoperative findings. Number of therapeutic, non-therapeutic and negative abdominal explorations was determined. Intraoperative findings and postoperative morbidity were described for each group. A documented visit with primary care provider or surgeon was considered as acceptable follow up. Followup data were described including rates of recurrent obstructions and subsequent diagnosis of malignancy or inflammatory bowel disease (IBD).

Statistical analysis was performed using SPSS v.23. Continuous variables were reported as mean ± standard deviation (SD). For analysis of categorical variables, Pearson's $\chi 2$ or Fisher's exact test was used. Differences between means were tested with the t test. A P-value of less than 0.05 was used to determine statistical significance.

RESULTS

The initial search identified 280 patients. Upon review of the medical records, 220 patients were excluded and reasons for exclusion are provided in Table 1. Majority of excluded patients (n=162, 74%) did not meet criteria for diagnosis of acute small bowel obstruction. Sixty patients meeting inclusion criteria were identified over 3 years (2018-2021), including 50 men (83%) and 10 women (17%), with a median age of 65±14 years. Median time from presentation to operating room was 1 day (SD=2.8 days). Median follow up for the entire cohort was 12±24 months (range 0-36 months); thirty-nine patients (65%) had minimum follow up duration of 12 months. Abdominal exploration was performed in 50 patients (83%, completed laparoscopically in 18 (35%) and 10 patients (17%) were managed non-operatively. The exploration was therapeutic in 29 patients (58%), negative in 20 patients (40%), and diagnostic but non-therapeutic in one patient (2%) with carcinomatosis peritonei due to metastatic breast cancer without preoperative confirmation of distant disease.

Patients with negative exploration

Abdominal exploration was negative in 20 patients (40%). Median follow up in this group of patients was 14±22 months (range 0-36 months) with 15 (75%) patients followed for at least 12 months. One centimeter SB NET was found in a patient who underwent re-exploration for a recurrent SBO 3 months after the initial laparoscopy. There were no other patients in this group who were subsequently diagnosed with malignancy or IBD. Motility disorder and angioedema were subsequently diagnosed in one patient each (5%). Leukocytosis was more commonly associated with negative exploration (mean white blood cell count 12.5±1 vs. 9.6±0.8, p=0.03), and history of recent weight loss was associated with therapeutic exploration, as 4 patients in the therapeutic exploration group (14%) had a history of recent (<6 months) unintentional weight loss (13% of body weight on average, range 9-19%) vs. none of the patients who had negative exploration (p=.04). Two of four patients with recent weight loss were diagnosed with malignancy (one small bowel neuroendocrine tumor and one colon cancer). There were no other history data, physical, laboratory (Table 2) or imaging findings (Table 3) associated with negative exploration. Compared to the group of patients with therapeutic exploration, patients with negative exploration had significantly shorter duration of hospital stay (5.4 vs. 14.4 days, p<.01), significantly lower short-term morbidity rate (10% vs. 34% p=.04), and more explorations were completed laparoscopically (65% vs. 14%, p<.01). Morbidity (n=2, 10%) included one episode of aspiration pneumonia and one superficial surgical site infection. Three patients (15%) from this group developed recurrent SBO: one patient who was eventually found to have a small bowel neuro- endocrine tumor; one patient required laparotomy for adhesive disease at 2 years postoperatively and another patient developed recurrent SBO after 3 years, which was treated non-operatively.

Table 1: Patients identified on initial free text search, excluded after chart review

Reason for exclusion	N (%)	Diagnosed with malignancy (n, %)
No diagnosis of acute bowel obstruction	162 (74%)	-
Suspected closed loop obstruction	13 (6%)	**0**
Prior abdominal surgery	13 (6%)	-
Concern for ischemia	10 (5%)	**0**
Previously diagnosed Crohn's disease	8 (4%)	-
Previously diagnosed advanced intraabdominal malignancy	5 (2%)	-
Incarcerated hernia	5 (2%)	-
Suspected gallstone ileus	2 (<1%)	**0**
Patient pursued comfort care	2 (<1%)	**No evidence of malignancy on imaging**
Total	**220**	-

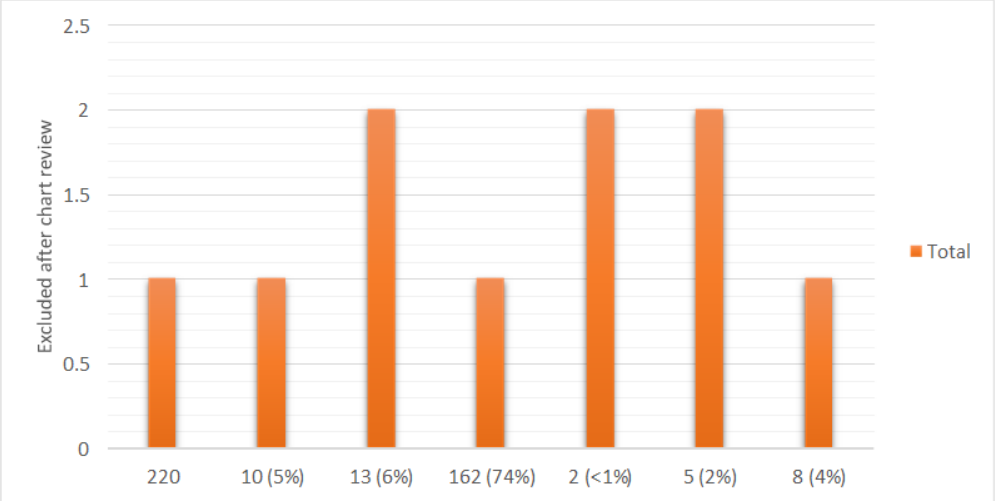

Fig 1: Upon review of the medical records, 220 patients were excluded and reasons for exclusion are provided in Table 1

Table 2: History, physical examination and laboratory findings

	Negative exploration (n = 20)	Therapeutic exploration (n = 29)	p
Duration of symptoms (days, mean ± SD)	6.7 ± 3.6	7.7 ± 3.0	0.8
WBC (mean ± SD) Fever (n)	12.5 ± 1 0	9.6 ± 0.8 0	0.03
Prior episodes of obstruction (n)	3	5	0.8
Distension (n)	15	20	0.6
Vomiting (n)	12	21	0.4
Constipation documented(n)	6	9	0.9
Tachycardia (n)	5	3	0.2
Lactate (mmol/dl, mean ± SD)	1.5 ± 0.3	1.5 ± 0.2	0.9
History of malignancy (n)	1	4	0.3
Weight loss (n)	0	4	0.04

Table 3: Computed tomography findings, number of patients

	Negative exploration (n = 20)	Therapeutic exploration (n = 29)	p
Ascites	6	10	**0.7**
Swirling	1	1	**0.8**
Transition point	16	26	**0.3**
Mesenteric edema	1	5	**0.2**
Feces sign	4	7	**0.7**
Bowel thickening/enhancement	**4**	**4**	**0.6**

Patients managed non-operatively

Among patients who were dismissed on general diet following initial non-operative management (n=10, 17%), one patient was subsequently diagnosed with transverse colon cancer on elective colonoscopy 3 months after dismissal, two patients developed recurrent SBO and one required small bowel resection due to endometriosis without recurrent SBO. Median follow up in this group was 53 months (range 7– 108 months). One patient with a prior history of prolonged use of naproxen underwent segmental resection of an ileal stricture 9 months following the initial presentation. Pathologic examination demonstrated a stricture with focal chronic mucosal injury. Another patient had a recurrent episode of SBO three years later, which has again resolved with brief non-operative management.

Patients with malignancies

Overall, eight patients were diagnosed with malignancy associated with SBO; six patients at the time of initial exploration and two patients with a subsequent diagnosis during follow up. Of these eight patients, three had right-sided colon cancer, two had small bowel neuroendocrine tumors, two had small bowel lymphoma and carcinomatosis peritonei was found in one patient. As previously described, one patient who underwent resection for SB NET had an initial negative laparoscopic exploration at our institution, and one patient with transverse colon cancer was initially treated non-operatively. Upon Prospective Study, SB NETs were visible on initial imaging in both patients (Figures 1 and 2). Findings strongly suggestive of malignancy were noted preoperatively in one of two patients with SB lymphoma (Figure 3). Second patient with small bowel lymphoma had prior lung transplant and was diagnosed with posttransplant lymphoproliferative disorder (PTLD). Demographic data, pathology, history and imaging findings are further described in Table 5.

DISCUSSION

The primary argument for routine abdominal exploration of patients with SBO and VA is the perceived risk of underlying occult malignancy [5]. In our cohort, the overall malignancy rate was 13% with 12% of patients diagnosed with malignancy at the time of the initial surgery despite a lack of a malignant diagnosis on pre-operative CT imaging. The malignancy rate in our study appears to be greater than in the majority of prior reports (4-8%) [6]. One study reported a combined rate of small bowel and mesenteric mass and carcinomatosis as the etiology of SBO in 13% of patients with virgin abdomen, though no specific pathologic data regarding “masses” were provided [7].

The main argument against mandatory exploration is a high rate of negative exploration, and our cohort has a greater proportion of negative explorations compared to prior reports. Potential mimickers of small bowel obstruction described in the literature include ACE-inhibitor related bowel angioedema, eosinophilic enteritis, and different infectious etiologies [8]. Underlying condition for majority of patients with negative exploration and subsequent diagnoses in our cohort included an SB NET, a motility disorder, and ACE-inhibitor related angioedema.

Fig 2: Abdominal CT demonstrating a 1 cm hyperenhancing nodule within a distended loop of small bowel (arrow)

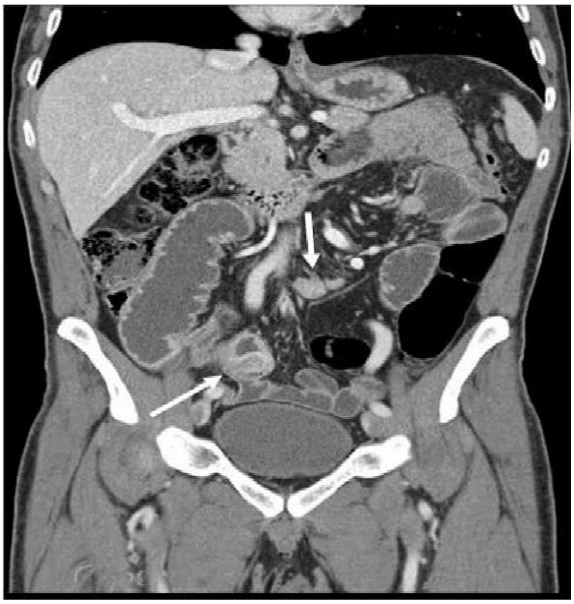

Fig 3: Abdominal CT demonstrating a hyperenhancing mass along with enhancing mesenteric lymph nodes (arrows)

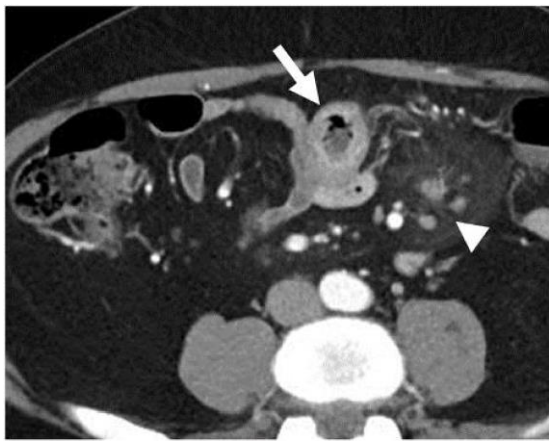

Fig 4: Abdominal CT demonstrating circumferential thickening of small bowel (arrow) and mesenteric lymphadenopathy (arrowhead)

Fig 5: Abdominal CT demonstrated thickening and surrounding edema of the right colon concerning for malignancy

There does not appear to be a distinctive pattern in either presentation or imaging findings in these patients, other than weight loss being more common in patients with therapeutic exploration and leukocyte count being higher in patients with negative exploration. While this may not be a useful parameter in clinical decision making, it may suggest underlying inflammatory or infectious etiology [9]. In spite of relatively low morbidity in the group of patients with negative exploration, this still calls for consideration of an alternative management strategy which can potentially include an attempt of nonoperative management with clear risks and benefits conversation between the patient and the surgeon. Two recent studies suggest that water soluble contrast is safe in patients without prior abdominal surgery and may help in deciding which patients might be treated nonoperatively [10]. Collom *et al*., showed a significant decrease in operative intervention from 50% to 17% when water soluble contrast was used, even in patients with SBO and no prior surgical history [11]. Successful non-operative management of the SBO is reported in 19%-86% of patients with VA [12]. However, follow-up of non-operatively managed patients is invariably poor across studies and no safe conclusion regarding long term outcomes can be made from currently available literature. Even though a malignant SBO may be unlikely to resolve with non-operative management, certain malignant obstructions may be partial, intermittent or temporarily relieved by non-operative management. For example, an early-stage tumor may act as a lead point, which may explain transient resolution of SBO in one of patients with SB NET.

Fig 6: Non-contrast abdominal CT with possible transition point in transverse colon and thickening of both cecum and transverse colon measuring 5 cm in diameter and decompressed left colon (arrows)

Patients who may benefit from non-selective exploration have early-stage malignancy, SBO that would resolve with non-operative management and a malignancy that could be missed by less invasive diagnostic modalities. There were two such patients in our cohort and both of them had early-stage SB NET, prior documented history of SBO that has resolved without operative intervention and both tumors were identified on imaging only retrospectively. While relatively rare, these cases are particularly problematic when non-operative management is considered, and similar rates of such cases (4-7%) were reported in prior studies [13].

The uncertain reliability of CT enterorrhaphy in diagnosing early-stage small bowel maligancy should be kept in mind if conservative management is discussed as a potential treatment strategy. One metaanalysis found the sensitivity of CT-enterorrhaphy in detecting small bowel neuroendocrine tumors to be 92%. However, subgroup analysis was not performed, and the sensitivity applies to different stages and sizes of the primary tumor. Another study suggested lower sensitivity (76% on per-lesion basis and 86% on per-patient basis), particularly for sub centimeter primaries [14].

Table 4: Patients diagnosed with malignancy: demographic data, pathology, history and imaging findings
***American Joint Committee on Cancer Staging Manual, 7th edition**

Demographics	Pathology	History	Imaging findings
49 M	Well differentiated neuroendocrine tumor, 1cm, single nodal metastasis (T2N1)*	None	Hyperenhancing nodule in the wall of distended ileum (1cm, Prospective Study **Figure 1**)
69 M	Well differentiated neuroendocrine tumor,2.3 cm with nodal metastases (T4N1)*	Weight loss, prior episode of obstruction	Hyperenhancing small bowel mass with hyperenhancing mesenteric lymph nodes (**Figure 2**)
66 M	Follicular lymphoma, grade 1	Recurrent obstructions	Circumferential thickening of the small bowel, mesenteric lymphadenopathy (**Figure 3**)
69 M	Obstructing 3 cm annular adenocarcinoma of the ascending colon (T3N1)*	History of anemia, no prior colonoscopy	Thickening and surrounding edema of the right colon (Prospective Study, **Figure 4**)
71 F	Adenocarcinoma of the transverse colon, 2.2 cm (T3N0)*	Weight loss	Possible transition point in transverse colon, thickening of right colon (Prospective Study, **Figure 5**)
55 M	Post-transplant lymphoproliferative disorder (PTLD) involving ileum	Lung transplant	Right colon thickening (likely unrelated)
60 F	Carcinomatosis peritonei, consistent with breast primary	Mastectomy and axillary dissection 20 months prior	Multiple bony sclerotic lesions within pelvis and lumbar spine
66 M	Right colon adenocarcinoma, 3.3 cm (T2N0)*	None	None

The benefit of mandatory exploration in other patients with malignant SBO is less clear. Colon cancer could have been diagnosed colonoscopically, and no therapeutic benefit was provided to the patient with carcinomatosis. Benefits of routine exploration for the immunosuppressed transplant patient are also unclear, and a trial of non-operative management did not appear to be harmful. Certainly, possibility of PTLD causing SBO in a transplant recipient should be considered. Colon cancer was relatively common in patients in our cohort, and all affected patients underwent right hemicolectomy. While there might have been CT findings suggestive of colon lesions in 2 of 3 patients, these were subtle and nonspecific. It is unclear if a transverse colon lesion was an incidental finding in a patient whose SBO resolved with nonoperative management. Therefore, colonoscopy should be strongly considered if SBO is managed non- operatively in a patient with no prior abdomen al operations.

All patients with malignant SBO had either: 1) clinical or imaging findings either diagnostic or strongly suggestive of the underlying malignancy as the cause of SBO; 2) upon Prospective Study , did not benefit from the routine exploration; 3) could have had malignancy diagnosed by less invasive means. Meticulous review of imaging is of crucial importance, since clues to malignancy may be subtle and easily missed, as demonstrated in both patients with small bowel neuroendocrine tumors in our series. Finally, laparoscopy as the sole diagnostic tool in this patient subgroup may not be optimal, as detection of small tumors may require careful palpation [15].

While our method of free text search might not have identified certain patients with virgin abdomen and small bowel obstruction, it is expected to have a high yield for patients in whom the lack of prior abdominal operations was of clinical relevance and was documented as such in the medical record. Our goal was to focus on patients who would pose a diagnostic dilemma, rather than on all patients with small bowel obstruction in a virgin abdomen, since the etiology of bowel obstruction can be obvious (e.g. prior diagnosis of Crohn's disease, imaging findings of advanced intra-abdominal malignancy). Patients who would have been explored regardless of prior surgical history were also excluded. However, retrospective determination of primary reason for operative intervention can be problematic, and strict criteria to identify these patients were applied. Finally, malignancy rate is still about 12% even among excluded patients with virgin abdomen and SBO (Table 1).

Our study has multiple limitations, including its single- institution, retrospective nature with inherent bias, as well as low patient numbers. Additionally, overall follow up was poor although 65% of our

patients were assessed at least 12 months after their initial presentation. Short follow-up and high dropout rate is of particular importance in the group of patients who underwent a non-therapeutic exploration or did not have an operation, since missed neoplastic and IBD are of particular concern.

CONCLUSION

Small bowel obstruction in patients without prior history of abdominal operations has a benign etiology in the majority of patients. The patients with malignant SBO had either imaging or clinical clues which should have led to their malignancy diagnosis. This emphasizes the importance of careful imaging review directed at potential subtle signs of an underlying malignancy. If non- operative management is chosen, close follow up is essential and it should include a careful personal and family history as well as updated colonoscopy in follow up. Further prospective studies are needed to determine the safety of omitting mandatory exploration in this group of patients without prior abdominal operation as long-term outcomes of such strategy remain uncertain.

Conflicts of Interest: None

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