Diagnostic Accuracy of CT Scan in Detecting Intestinal Obstruction Keeping the Histopathology Findings as Gold Standard

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Abstract

Objective: To determine diagnostic accuracy of CT scan to diagnose intestinal obstruction on the basis of histopathological analysis as gold standard.
Methods: Total of one hundred and eleven (n=111) patients with age ranging 20-60 years having profound clinical features of intestinal obstruction were enrolled in the study. CT scan was performed with intravenous contrast medium. Following parameter were assessed on CT scanning: dilatation of bowel loops, presence of abrupt or gradual change of luminal caliber in bowel, and presence of any wall thickening of bowel or focal mass lesion at or around the level of obstruction. Sensitivity, specificity and accuracy was assessed among the two procedures.
Results: Mean age of subjects was 39.6 ± 11.4 years. The female to male ratio in this study was 1:1. Intestinal obstruction was detected in 70% cases using CT scan while 73% cases were identified positive using the histopathological analysis. Overall sensitivity was found to be 95.1%, specificity 96.7%, and accuracy of 69.4% in this study. Among patients with age $\leq$ 40 years, sensitivity was 91.1%, specificity 100%, and cases with ages >40 years exhibited sensitivity of 100% and specificity of 94.7%. Whereas, among male patients sensitivity was 100% and specificity was 93.3% and in female patients the sensitivity was 90.2% and specificity was 100%.
Conclusion: CT is highly sensitive and specific in determining presence of bowel obstruction and it also clearly demonstrates the site and cause of obstruction.
Keywords: Diagnostic Accuracy, CT Scan, intestinal Obstruction, histopathology
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Introduction

Intestinal obstruction is one of the common surgical emergencies[1]. It is of two type i.e. dynamic and adynamic obstruction. In dynamic obstruction peristalsis work against the mechanical obstruction, while in adynamic obstruction peristalsis may be absent or it may be present in non-propulsive form[2]. It is generally accepted that acute and complete or high-grade obstruction requires immediate surgery, whereas partial obstruction can initially be managed conservatively unless there is an accompanying lesion that requires surgery[3]. Mechanical intestinal obstructions, forms important part of pathologies that necessitates emergency surgical intervention in part of Asia, including India, Iran and Pakistan[4].

Intestinal obstruction is also a common medical condition in Pakistan and other tropical countries but majority of cases are reported at later time period. This leads to delay in its management and hence increases complication rate[5]. A study by Zahid Mahmood et al[6] found that the most common cause of intestinal obstruction was tuberculosis (38.13%) followed by the obstructed/strangulated hernia (26.84%), post-operative adhesions (17.12%),

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large gut malignancy (10.09%), volvulus (6.22%) and small gut malignancy (0.77%). Computerized tomography (CT) scan is reported to have the sensitivity, specificity, and accuracy values 63-94%, 78-100% and 65-95%, respectively[7-11]. Conventional radiography like X-ray abdomen, which is first imaging procedure and traditionally main investigation is used for diagnosis of intestinal obstruction, showed accuracy of only 46-80%[11-15]. CT can also demonstrate findings that indicate the presence of closed-loop obstruction or strangulation, both of which necessitate emergency exploratory laparotomy. Unfortunately, these pathologic conditions may be missed, and patients with suspected severe obstruction or bowel ischaemia in whom CT and clinical findings are widely disparate must also undergo laparotomy. In general, however, CT allows appropriate and timely management of these emergency cases.

Intestinal obstruction is a life threatening condition. Few studies have been done to evaluate the role of CT in diagnosis and management of intestinal obstruction. If we can effectively diagnose the cause of intestinal obstruction on CT scan before surgery, we can help out our surgical team for early detection, better operative and postoperative management and prevention of complications.

Patients and Methods

The study was conducted at Radiology department, Liaquat National Postgraduate Medical Centre, Karachi from 20th June 2011 to 19th December 2011. The study design was cross sectional study and sample technique was non probability (purposive). The calculated sample size for this study was (n) 111, taking the confidence interval (CI) of 95%, population proportion (P) of sensitivity of Computed Tomography (CT) in detecting intestinal obstruction keeping histopathological findings in 94%, specificity of 96%, margin of error (d) of 10%. The informed consent was taken.

Total 111 patients of both genders having age ranging between 20 to 60 years exhibiting clinical features of intestinal obstruction were included in this study. Patients referred from emergency room (ER) and Out Patient Department (OPD) with clinical suspicion of bowel obstruction. After brief history and clinical examination, CT scan abdomen was done. These patients underwent surgery on basis of clinical and radiological examination. Later on, histopathological findings of operative specimen were obtained. CT was performed on multidetector CT (MDCT, 16 slice) with intravenous contrast material, unless clinically contraindicated. Contrast material was administered orally 2 hours and immediately before scanning. Per rectal contrast was also given just before scanning, in some cases. Scans were obtained with 8 or 10 mm slice thickness from the dome of the diaphragm to the symphysis pubis in all cases.

Patient who did not give consent or operated before CT scan or do not exhibit clinical feature of intestinal obstruction were excluded from study. Patients having allergy to contrast medium were not included in this study.

Findings assessed on CT included; dilatation of bowel loops, presence of abrupt or gradual change of luminal caliber in bowel, and presence of any wall thickening of bowel or focal mass lesion at or around the level of the obstruction. CT diagnosis of intestinal obstruction was based on the presence of disproportionate dilatation of bowel loops (dilated proximal bowel and collapsed or normal bowel loops distally). Bowel loops were considered collapsed (lumen barely identified), normal, or dilated (small bowel 2.5 cm or more in diameter). The maximum diameter of proximal bowel was measured from outer wall to outer wall. The wall of the bowel was considered thickened if it was more than 3 mm thick in a distended loop of bowel Fig. 1 and 2.

Data compilation and analysis was performed on SPSS version 21. Descriptive statistics were calculated. Quantitative variable i.e. age was expressed as mean ± SD and qualitative variables i.e. gender, diagnosis of intestinal obstruction findings by CT and by histopathological finding, cause of intestinal obstruction were presented in terms of frequency and percentages. Sensitivity, specificity,

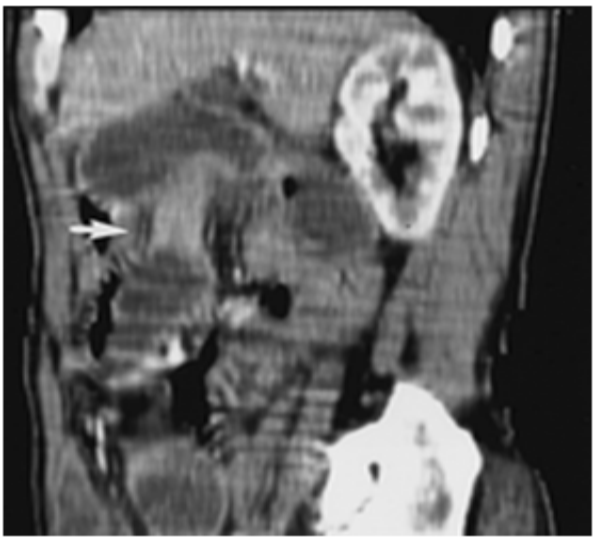

Fig 1. Contrast enhanced CT, reformatted sagittal image, showing stricture causing small bowel obstruction

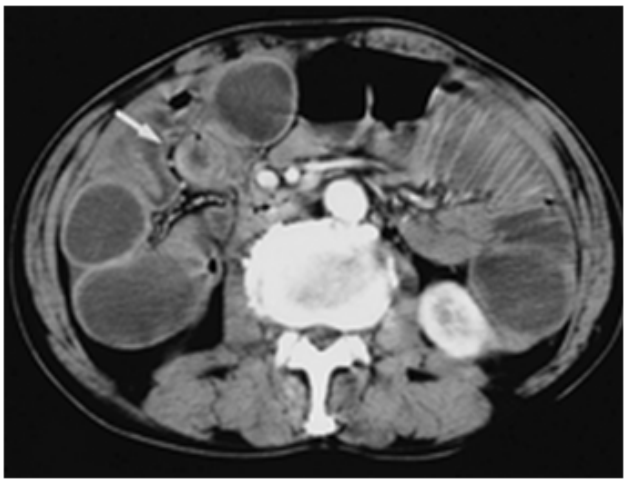

Fig 2. Contrast enhanced CT, axial section, showing adhesive small bowel obstruction.

Table 1. Frequency distribution of intestinal obstruction among two procedures

(n=111)	Frequency		%
CT Scan Findings	Obstruction	78	70.3
	No Obstruction	33	29.7
Histopathology Findings	Obstruction	81	73.0
	No Obstruction	30	27.0

Table 2. Diagnostic accuracy of CT scan for detection of intestinal obstruction.

(n=111)		Histopathological Findings		Total
		Obstruction	No-Obstruction	
CT Scan Findings	Obstruction	77 (95.1%)*	1	78
	No Obstruction	4	29 (96.7%)**	33
Total		81	30	111

*Sensitivity PPV= 98.7%
**Specificity NPP=87.9%
Diagnostic accuracy=69.4%

Table 3. Diagnostic accuracy of CT Scan for detection of intestinal obstruction according to age and gender.

(n=111)	≤ 40 yrs	> 40 yrs	Male	Female
Sensitivity	91.1%	100.0%	100.0%	90.2%
Specificity	100.0%	94.7%	93.3%	100.0%
Positive Predictive Value	100.0%	97.3%	97.6%	100.0%
Negative Predictive Value	73.3%	100.0%	100.0%	78.9%
Diagnostic Accuracy	73.2%	65.4%	72.7%	66.1%

positive predictive value and negative predictive values were calculated using 2 by 2 tables. Diagnostic accuracy of CT scan in detection of intestinal obstruction, keeping in view the histopathological findings of the biopsies taken peroperatively as gold standard were calculated. Stratification was done with regards to age and gender to evaluate effect of mentioned parameters on outcomes.

Results

In 111 patients, male were 55 (49.5%) and female were 56 (50.5%). Male to female ratio was 1.01:1.00. Mean age was ≤ 39.6 ± 11.4 years. Age of 56 (50.5%) patients was 40 years and rest of the 55 (49.5%) patients were aged >40 year.

On CT scan intestinal obstruction was observed in 78 patients and no obstruction was observed in rest of the 33 patients. On histopathological findings the obstruction was observed in 81 patients while not observed in 30 patients (Table 1). The causes of obstruction included; tuberculous stricture and adhesions in 29 (35.8%), postoperative adhesions in 21 (26.0%), obstructed or strangulated hernia in 15 (18.5%), carcinoma of colon and rectum in 7 (8.7%), small bowel tumor or metastasis in 3 (3.7%), post appendicitis in 3 (3.7%), peritonitis (due to bladder rupture and haematoma) in 2 (2.4%) and Meckle's diverticulum in one patient (1.2%). Out of these 81 patients, two patients with peritonitis and one patient with colonic carcinoma at splenic flexure were not diagnosed as bowel obstruction on CT scan.

The overall sensitivity of CT scan was 95.1%, specificity was 96.7% (Table 2).

In both procedures intestinal obstruction was observed in 77 patients (True positive, correctly diagnosed) and no obstruction was found in 29 patients (True negative, correctly diagnosed) in both procedures. The overall sensitivity of CT scan was 95.1%, specificity was 96.7% and diagnostic accuracy was 69.4% (Table 2).

Post stratification analysis based on age showed that those patients who were of age ?40 years had 91.1% sensitivity, 100.0% specificity, and 73.2% diagnostic accuracy. Whereas, those patients who were of age >40 years had 100.0% sensitivity, 94.7% specificity, and 65.4% accuracy of CT scan in diagnosis of intestinal obstruction (Table 3).

Stratified analysis according to gender showed that male patients had 100.0% sensitivity, 93.3% specificity, and 72.7% diagnostic accuracy and among female patients sensitivity was 90.2%, specificity was 100.0%, and diagnostic accuracy was 66.15 of CT scan in diagnosis of intestinal obstruction (Table 3).

Discussion

Bowel obstruction is a relatively common condition. Typically, conventional radiography is the first imaging procedure used in patients with bowel obstruction. As mentioned earlier, the accuracy of this modality in determining the presence of obstruction is still only 46-80%[11-15]. Its accuracy in diagnosing the site and cause of obstruction and the presence of strangulation is even lower.

With recent technologic developments, the role of computed tomography (CT) in the diagnosis of bowel obstruction has expanded. CT is recommended when clinical and initial radiographic findings remain indeterminate or strangulation is suspected. This modality clearly demonstrates pathologic processes involving the bowel wall as well as the mesentery, mesenteric vessels, and peritoneal cavity. Study by Ismail et al[16] on analysis of histopathological examination reported that tuberculosis (36%) was the leading cause of dynamic intestinal obstruction followed by carcinoma of the large gut and postoperative adhesion.

In another study by Shaikh et al[4], it is reported that the cause of intestinal obstruction were obstructed/ strangulated external hernias (25.83%) and intestinal adhesion (23.33%), followed by the ileocaecal tuberculosis (10.83%), colonic malignancy (13.83%) and large gut volvulus (13.83%). Megibow et al.[10] In their study it was reported that 76.2% patients ultimately proved to have intestinal

obstruction while 23.8% did not. The cause of obstruction was correctly predicted in 47 of 64 cases (73%). Causes of obstruction included adhesion (57.8%), metastases (3.1%), primary bowel tumor (10.9%), Crohn's disease (6.3%), hernia (4.7%), haematoma (3.1%), colonic diverticulitis (3.1%) and other (4.7%). Overall sensitivity was 94%, specificity was 96%, and accuracy was 95%. In our study major causes of obstruction were tuberculous stricture/ adhesions (35.8%) postoperative adhesions (26.0%) and hernia obstructed/ strangulated (18.5%). Other causes included colonic/rectal carcinoma (8.6%), small bowel tumor/metastasis (3.7%), post appendicitis (3.7%), peritonitis (2.4%) and Meckle's diverticulum (1.2%). However, CT scan missed diagnosis of bowel obstruction in cases of peritonitis (due to hematoma, urinary bladder rupture) and one case of colonic carcinoma at splenic flexure.

As mentioned earlier, in many studies the sensitivity, specificity, and accuracy values were 63-94%, 78-100% and 65-95%, respectively[7-11]. In our study the overall sensitivity, specificity and diagnostic accuracy was 95.1%, 96.7% and 69.4% respectively. The results of above mentioned studies are comparable to the current study and it is suggesting that application of CT scan for the diagnosis of intestinal obstruction can be generalized.

The strength of this study showed that the results were stratified based on age and sex. There is no statistically significant difference in the stratified analysis. However, there are few limitations of our study such as it is short-sampled study, patients with specific geographical regions were examined that restricts its global or general implications. But keeping our social, economical factors and per patient doctors ratio it maybe a good tool for detection with higher accuracy.

Conclusion

Our results revealed that CT scan is highly sensitive and specific in determining the presence of bowel obstruction and clearly demonstrates the site and cause of obstruction. The possibility of associated strangulation can be assessed with CT findings of bowel ischaemia, particularly with contrast material administration or by pointing out the specific type of bowel obstruction.

Conflict of interest

Authors have no conflict of interests and no grant/ funding/ spport from any organization for this study.

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