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Original Research Article

Role of multi-slice computed tomography in evaluation and management of intestinal obstruction

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ABSTRACT

Background: The purpose of this study is to evaluate the role of multi-slice computed tomography (CT) with reference to presence or absence of intestinal obstruction, level of obstruction, the cause of obstruction, and correlating with their clinical diagnosis.
Methods: Patients were admitted directly from Out Patient Department or emergency department with complaints suggestive of intestinal obstruction. Computed tomography scan interpretations performed by experienced radiologists were compared with the final diagnosis that was made on the basis of information obtained clinically, by investigations, and by surgical findings.
Results: Majority of patients were males 62%. Mean age 51.62±17.46 years. Majority presents with abdominal pain 94% and constipation 72%.The most common cause of obstruction was adhesion bands 18%.The pre CT diagnosis was changed because of CT findings in 28 patients. Only in 50 (89.28%) patients CT findings matched with intra-operative and cause of obstruction was also found, and in 6 (10.71%) patients intra-operative findings are different from CT findings. In bowel obstruction, the CT sensitivity was 89.28%, specificity 90.90%, positive predictive value 92.59%, negative predictive value 86.95% and accuracy 92.59%.
Conclusions: We concluded that multi-slice CT is highly sensitive and specific in determining the presence, the cause and site of bowel obstruction, the site of obstruction and cause of obstruction. We recommended the use of CT scan when diagnosis between ileus and obstruction on the basis of clinical and plain radiographic are difficult or in patients in whome small bowel obstruction is diagnosed when conservative management is contemplated.

Keywords: Intestinal obstruction, Clinical examination, CT scan, Conservative/ surgical management

INTRODUCTION

Bowel obstruction was recognized, described and treated by Hippocrates. The earliest recorded operation as treatment was performed by Praxagoras circa 350 BC, when he created an enterocutaneous fistula to relieve the obstruction of a segment of bowel.[1] Acute intestinal obstruction occurs when there is interruption of forward flow of intestinal contents or impaired by a mechanical cause, which can be either acute or chronic.[2,3] The most common cause of intestinal of obstruction is intra-abdominal adhesions, herniation, and malignancy. The patients usually presents with vomiting, abdominal pain, and cessation of passage of flatus and stool, although the severity of presenting symptoms depends on the site and level of intestinal obstruction. Distension of abdomen, tympanic note percussion, and high-pitched bowel sounds are classic signs. The different causes of small intestinal obstruction are adhesions bands, closed loop, hernia, carcinoid tumors, lymphoma, peritoneal carcinomatosis,

appendicitis, adeno-carcinoma, radiation enteropathy, intussusceptions and causes of large bowel include carcinoma, fecal impaction, diverticulitis, cecal volvulus and sigmoid volvulous.[4] When small bowel obstruction is suspected to the patient, diagnosed clinically and by physical examination, diagnostic Imaging play very important role in verifying the presence of obstruction, the site of obstruction, severity of obstruction, and cause of the obstruction. By providing this information, imaging impacts directly on patient management, whether a trial of conservative therapy should be instituted rather than resorting to immediate surgery because of the possibility of strangulation. Radiology is playing a vital tool in the clinical decision making of patients with known or suspected bowel obstruction since it provides important information about anatomy and function of bowel.[5] Imaging including abdominal radiography, computed tomography are used to confirm the diagnosis and also helps in decision making for therapeutic planning.

Acute, mechanical small bowel obstruction is a common surgical emergency. It is estimated that over 300,000 laparotomies per year are performed in the United States for adhesion causing obstructions.[6,7] On plain radiographs of abdomen in standing and supine position, the cardinal findings that suggest the diagnosis of small bowel obstruction are air-fluid levels proximal to the point of obstruction and clearance or absence of air-fluid level distal to the obstruction. On ultrasonography, intestinal obstruction is considered to be present when length of segment is >10 cm and dilated loop measures >2.5 cm. Sometimes etiology of intestinal obstruction can be determined by ultrasonography, but accuracy is less than computed tomography (CT). The barium luminal contrast is useful for localizing the obstructing segment and also characterized it as complete or incomplete obstruction, just as with oral contrast radiography.[8] But CT scan also provides imaging of lumen and also the abdominal contents outside the lumen unlike oral contrast radiography which provides imaging of luminal surface only. Due to this advantage, the nature of the obstruction, especially when occur due to an extra-luminal or intramural malignant process, can be established.[9] CT scan being more accurate and more rapid, it replaces, abdominal ultrasound, small bowel follow through, and enteroclysis for diagnosis of intestinal obstruction. On CT, when there occurs non –visualization of oral contrast in the colon, even after 12 hours of administration is a reliable indicator of complete obstruction, whereas visualization of oral contrast in the colon indicates incomplete small bowel obstruction. In a meta-analysis, conventional CT had a sensitivity of 92% (range 81-100%) and specificity of 93% (range 68-100%) in detecting complete obstruction.[10] Multi-slice CT scanner enables better spatial resolution through thinner collimation. Axial, sagittal, coronal, and curved multiplanar. The new technology that is of increasing interest in the diagnosis of small bowel obstruction is multiplanar reformatted imaging at a workstation. Multiplanar views is useful in identify the site of obstruction, level of obstruction, and cause of obstruction when axial findings are indeterminate.[11]

Objective

The object of this study is to evaluate the role of multi-slice computed tomography (CT) with reference to presence or absence of intestinal obstruction, level of obstruction, the cause of obstruction, and correlating with their clinical diagnosis.

METHODS

The present study was conducted from November 2012 to April 2015 and included 100 patients. Written, informed consent was obtained from all participants and ethical clearance was granted by our college ethical committee (68/ETH/OSMU/ICMR). The study was prospective, observational. Patients presented with intestinal obstruction in emergency department and (Out Patient Department) OPD were included in the study. Patients that are, severely decompensated, pregnant females, and patients with deranged kidney function test were excluded from the study group. All the patients of study group were evaluated by detailed history, general physical examination, and systemic examination was done along with baseline investigations i.e. complete blood count, blood sugar, kidney function test, serum electrolytes, X-ray chest and abdomen, ultrasound abdomen) were done. Patients were then subjected to multi-slice CT scan. The CT scan was reported by two experienced radiologist of the same department. The initial reporting was done independently. They were unaware about the patients' clinical characteristics and time sequence.

Technique of CT scan

Using a 64 multi-detector CT machine, CT scan of the chest, abdomen and pelvis was done for all patients that are including in the study group. All the exams were interpreted in axial scans in addition to coronal and sagittal reconstruction. The patients were given water soluble oral contrast and as well as the different phases of IV contrast (arterial, venous and delayed phases) were tailored according to the presentation of the patients. Then CT scan of chest, abdomen and pelvis was done. In over distension of abdomen and vomiting oral contrast was not given, because of chances of bowel perforation and aspiration increases.

Statistical analysis

Statistical Software SPSS (Version 20.0) and Microsoft Excel were used to carry out the statistical analysis of data, in terms of mean, SD, Range, sensitivity, specificity and appropriate test of significance wherever required.

RESULTS

The present study was conducted from November 2012 to April 2015 and included 100 patients. Majority were males (62%) in the age group of 51- 60 years, mean age 51.62±17.46 years. In our study majority of patients presents with abdominal pain 94%, constipation 72%, abdominal distention 68% and vomiting 62% and guarding 68% (Table 1).

Table 1: Demographic profile of patients in study group.

	Number of patients	Percentage (%)
Age in years		
<20	2	2
21-30	15	15
31-40	12	12
41-50	23	23
51-60	26	26
>60	22	22
Total	100	100
Sex distribution		
Males	62	62
Females	38	38
Total	100	100
Clinical presentation of patients		
Pain abdomen	94	94
Vomiting	62	62
Abdominal distension	68	68
Constipation	72	72
Tachycardia	36	36
Abdominal tenderness	68	68
Guarding	60	60
Obstipation	14	14

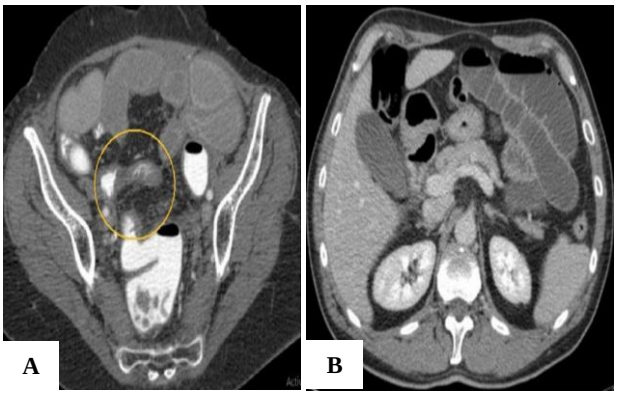

Figure 1: (A) CT scan of 57 year male showing adhesion band (circle) as a cause of obstruction, (B) Adhesion bands resulting in closed loop obstruction of small bowel.

In this study group, the CT finding shows most common cause of obstruction was adhesion bands 18% (Figure 1 A and B), followed by dilated gut loops 17%, gut perforation 8%, intussusceptions 8% (Figure 2 A and B) tumors 7%, mesenteric infarction 5% (Figure 3), sigmoid volvulus 5%, internal hernia 4%, external hernia 3%, pancreatitis 3%, sigmoiditis 3%, intra-peritoneal abscess 3%, radiation enteritis 3%, appendicitis 2%,post-traumatic ileus 2%, Jujenal haematoma 2%, caeccal volvolus 1% (Figure 4), extra-peritoneal haematoma 1%, gall stone ileus 1%, carcinomatosis 1%, faecal impaction 1%, and unknown cause 2%. The pre CT diagnosis was changed because of CT findings in 28 patients. In all these patients differential diagnosis was between obstruction and ileus. In 26 patients CT results correctly cause the surgeon to change the pre-CT diagnosis. In 9 patients small bowel obstruction was excluded by CT scan and in 17 patients CT showed obstruction that has been clinically presumed to be ileus. In two cases the pre-CT was incorrectly changed on the basis of the CT finding, the surgeon thought that these patients have ileus, with dilated gut loops, because of taking neuroleptic drugs; however CT showed obstruction, surgery performed after CT scan, showed no mechanical obstruction.

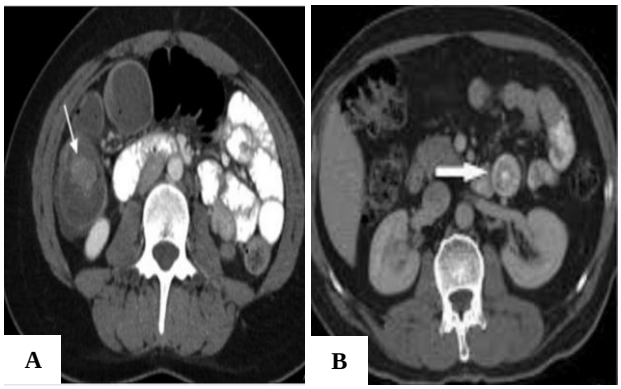

Figure 2: (A) CT scan of 13 year male showing ileo-colic intussusception (arrow) as causing obstruction and (B) CT scan of 40 male showing 40 year target sign (arrow) in ileo-ileal intussusception.

Figure 3: CT scan of 52 female showing transmesentric internal hernia with dilated jejunal loops, engorgement with swirling of the mesenteric vessels.

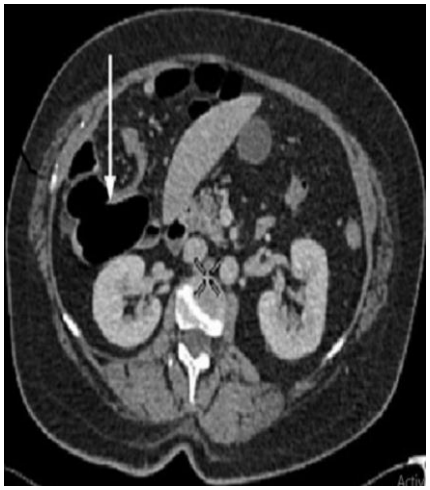

Figure 4: CT scan of 45 year female, demonstrating-whirl sign at the point of caecal volvulus (arrow).

CT correctly shows cause of obstruction in 90 of the 100 cases (Table 2) and failed shows cause of obstruction 10 case (adhesion band in 2, primary tumor in 1, internal hernia in 2, radiation enteritis in 2, dilated gut loops in 1, and two cases of unknown case). The diagnosis for cause of obstruction in Pre-CT was correctly changed after CT finding in 41 patients and accurate pre-CT diagnosis was in 49 patients. After CT scan the management was also modified in 28 patients. Before CT scan the type of management decided was conservative in 52 cases and operative in 48 cases. Conservative management was correctly changed to operative in 18 cases because CT showed surgical cause of ileus and in 10 cases the pre CT plan was correctly changed from operative to conservative, because CT allowed correct differentiation of ileus from obstruction. In this study, after CT scan, 44% of patients managed conservatively and 56% of patients managed surgically. Out of 56 patients who have undergone laparotomy, only in 50 (89.28%) patients CT findings matched with intra-operative and cause of obstruction was also found, (Table 3) and in 6 (10.71%) patients intra-operative findings are different from CT findings (radiation enteritis in 2 patients, internal hernia in 2, adhesion bands in one and primary tumor in one).In Bowel obstruction, the CT sensitivity was 89.28%, specificity 90.90%, positive predictive value 92.59%, negative predictive value 86.95% and accuracy 92.59% (Table 4) shows that how accurate CT findings were helpful in guiding patient management (operative/ Conservative). Also, the difference between the two management lines was also found to be statistically significant ($p<0.05$).

Table 2: Role of CT scan in intestinal obstruction.

Final diagnosis	Number	CT diagnosis		Change in management	
		Accurate Pre-CT diagnosis	Accurate post-CT diagnosis	Surgical to conservative	Conservative to surgical
Pancreatitis	3	1	3	1	0
Sigmoiditis	3	3	3	0	0
Extraperitoneal haematoma	1	1	1	0	0
Appendicitis	2	1	2	0	0
Mesenteric infarction	5	3	5	0	2
Adhesion bands	18	13	16	1	3
Tumour	7	1	6	0	2
Ext. hernia	3	0	3	0	3
Internal hernia	4	0	2	0	3
Radition enteritis	3	1	1	2	0
Jujenal hematoma	2	1	2	1	0
Gall stone ileus	1	0	1	0	0
Carcinomatosis	1	0	1	1	0
Intraperitoneal abscess	3	0	3	0	2
Dilated bowel loops	17	9	16	1	0
Intussusception	8	6	8	0	1
Perforation gut	8	5	8	0	1
Post traumatic ileus	2	1	2	1	0
Faecal impaction	1	0	1	1	0
Sigmoid volvulus	5	3	5	0	0
Caecal volvulus	1	0	1	0	0
Unknown cause	2	0	0	1	1
Total patients	100	49	90	10	18

Table 3: Distribution according to whether CT findings matched or not with intra operative findings.

CT matched	Number	Percentage (%)
Yes	50	89.28
No	6	10.71
Total	56	100

Table 4: Evaluation of sensitivity and specificity of CT as diagnostic tool.

CT	Operative management	Conservative management	Total
Positive	50	4	54
Negative	6	40	46
Total	56	44	100

DISCUSSION

Intestinal obstruction is a common clinical condition, with clinical manifestation similar to those seen in other acute abdominal conditions. In spite of recent advance in abdominal imaging, sub-acute intestinal obstruction remains a challenge to diagnose and treat it accurately.[5] In the intestinal obstruction, the history and clinical examination of patient plays, vital role for diagnosis. For proper management of intestinal obstruction, it is an essential to determine the site, level, and cause of intestinal obstruction and before surgery try to establish a prognosis. Multiple diagnostic modalities are available in radiology, ranging from conventional radiography through barium studies to computed tomography (CT). In diagnosis of intestinal obstruction, the accuracy of Multi-slice CT scan has shown by several studies. Most of these studies were retrospective. However for diagnosis and management of small bowel obstruction, the role Multi-slice CT, still remains to be explored further. For detection of high grade or complete obstruction, CT has a sensitivity of 78-100%. CT can also give valuable information about the presence of closed-loop obstruction or strangulation; both these conditions require emergency surgery. In general, in emergency department, CT scan allows appropriate diagnosis and timely management.[11]

In present study, 26% in the age group of 51-60 years, followed by 23% in the age of 41-50 years and 22% in >60 years. <20 years age group had minimum number of participants 2%. In our study 62% were males and 38% study participants were females.[12,13] The common presenting symptom was abdominal pain 94% followed by constipation 72%, abdominal distention 68%,vomiting 62%, abdominal tenderness 68%, guarding 60% and obstipation 14% only.[14,15] The most frequent reason for requesting CT scan was to differentiate between adynamic ileus from obstruction, the second reason was find out the cause of obstruction and third reason for requesting CT pertained to patients in whom obstruction was definitely present, but cause could not be ascertained i.e. they had no history of surgery, hernia etc. In distinguishing between ileus and bowel obstruction, CT enabled us to correctly change the Pre-CT diagnosis in 28% of cases. The accurate pre CT diagnosis was only in 49% of patients and accurate post CT was in 90% of patients. In this study 44% of patients managed conservatively and 56% of patients managed surgically. In 56 patients who have undergone laparotomy, only in 50 (89.28%) patients CT findings matched with intra-operative and cause of obstruction was also found, and in 6 (10.71%) patients intra-operative findings are different from CT findings (radiation enteritis in 2 patients, internal hernia in 2, adhesion bands in one and primary tumor in one).[16] The most common cause of obstruction was found adhesion obstruction 18%,mostly these patients have history of surgery for primary malignancy or laparotomy. The adhesion obstruction diagnosis is based on the visualization of a transition from dilated bowel to non-dilated bowel without an associated mass. This method enabled us to differentiate adhesions from other causes apart from internal hernias and radiation enteritis. The second most common cause of obstruction found was dilated gut loops 17%, followed by intussusception 8%, gut perforation 8%, mesenteric infarction 5%, pancreatitis 5%, sigmoiditis 5%, sigmoid volvulus 4%, internal hernia 4%, radiation enteritis 3%,intr-peritoneal abscess 3%, and appendicitis 2% etc. To know the cause of bowel obstruction before surgery is controversial; it is unimportant if surgeons embrace the philosophy "never let the sun set or rise on bowel obstruction", but it is important if concerned surgeons recommend non operative treatment according to the cause and the severity of the intestinal obstruction.[1] The management was also changed after performing CT scan from surgical to conservative in 10 patients and conservative to surgical in 18 patients. CT scan use in diagnosis of sub- acute intestinal obstruction and radiation enteritis is limited because they have no specific CT signs. Strangulation is most common complication associated with adhesions, hernias (internal or external). Sometimes, it may develop with small bowel volvulus without associated intra-peritoneal abnormality.

Major problem in bowel obstruction is recognition of bowel strangulation. Among the patients with strangulating obstruction, ischemia was correctly diagnosed. When we suspect strangulation or when clinical examination and initial investigational findings remain indeterminate for diagnosis of intestinal obstruction, CT scan is recommended to rule out diagnosis doubt.[17] The signs of strangulation like those of intestinal ischemia on the Multi-slice CT include: inflammation or intramural hemorrhage, a thickened bowel wall due to edema; mural thumb printing from intramural hemorrhage or edema. The most clinically useful information obtained from CT pertaining to patients in whom (1) differention of ileus and bowel obstruction was difficult and (2) bowel obstruction was diagnosed and conservative management was contemplated. Accurate CT findings were helpful in guiding patient management (operative versus

conservative). In present study, CT scan sensitivity for bowel obstruction was 89.28%, specificity 90.90%, positive predictive value 92.59%, negative predictive value 86.95% and accuracy 92.59%.Similar results were obtained by Mallo et al who conducted a systemic review.[18] This review was designed in assessing intestinal ischemia and complete small bowel obstruction by performing CT scan. However other authors have reported for diagnosis of bowel obstruction the sensitivity of Multi-slice CT scan is as high as 94% and specificity 96%.[19,20] This discrepancy could be due to patient selection in these studies favoring patients with complete bowel obstruction. These results were similar to our study results. Now a day's most of patients with bowel obstruction were managed by conservative than surgical, because of modern techniques in abdominal imaging allow us confident diagnosis or exclusion of bowel ischemia. In addition, the role of the radiologist as a consultant to the surgeon is a crucial one. Therefore, a full understanding of which imaging modalities to use, when to use them, were to use and what imaging findings to look for to allow an individualized treatment approach to each patient is of great importance.

CONCLUSION

We concluded that multi-slice CT is highly sensitive and specific in determining the presence, the site and cause of bowel obstruction. We recommended the use of CT scan when clinical examination and plain radiograph is unable to differentiate between ileus and obstruction or in patients in whome small bowel obstruction is diagnosed when conservative management is contemplated. Multi-slice CT has high sensitivity in diagnosing complete obstruction but has relatively low sensitivity in diagnosing sub-acute bowel obstruction and patients with sub-acute bowel obstruction can be treated conservatively initially unless an associated surgical lesion is detected on Multi-slice CT. When Multi-slice CT is used with comprehensive approach it not only helps in making correct diagnosis of intestinal obstruction but also affects on patients outcome.

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