

Diagnostic role of Multidetector Computed Tomography in detecting peritoneal adhesions: A cross sectional study

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Abstract

Background: Peritoneal adhesions are becoming increasingly common, with increased tendency to present with complications like acute and chronic pain, infertility, bowel obstruction. The most important causes of adhesions are prior surgical procedures, or any other peritoneal insult like tuberculosis. Peritoneal adhesions though not always possible to be accurately identified on computed tomography, imaging do provide a clue on adhesions being the cause.

Aim: To assess the diagnostic role of multi detector computed tomography in identifying peritoneal adhesions by using subtle imaging clues.

Materials and Methods: This was a cross-sectional study of 35 patients suspected to have adhesions, evaluated between June 2021 to June 2022 using multi detector Computed tomography, with both plain and contrast enhanced studies obtained using nonionic low osmolar contrast media. The imaging findings studied were acute angulation of bowel loop, matted & fixed location of bowel loops, bowel obstruction, loss of properitoneal fat line, focal mesenteric haziness, fat notch sign and beak sign. Data collected were analyzed using IBM SPSS Statistics, considering p value of ≤ 0.05 as significant.

Results: The mean age distribution was 51-60 years and majority were females (60%). Direct visualization of adhesions was not possible in any of the cases. On comparing the imaging features of adhesion with intraoperative findings, sensitivity was 75%, specificity was 25% and was not statistically significant (p value - 0.970).

Conclusion: Present study concluded that peritoneal adhesions to be detected on imaging, needs a high clinical index of suspicion.

Key words: Computed tomography, peritoneum, bowel, adhesions.

Introduction

Peritoneal adhesion has now become one of the important causes for abdominal pain in patients presenting to the emergency department. It also has the tendency to cause complications like bowel obstruction, chronic abdominopelvic pain and infertility in cases of females. Peritoneal adhesions also impose difficulty in surgical procedures^[1]. Hence, prompt diagnosis is of great importance to help in intervening at an early stage. Peritoneal adhesions are characterized by formation of bands of fibrous tissue which join intra-abdominal organs to parietal peritoneal surfaces (entero-parietal adhesions) or to each other (entero-enteric adhesions)^[2]. These

often result from body's healing process after an insult which is most often a result of surgery or due to underlying inflammation^[3]. In recent times with increase in operative procedures, the incidence of peritoneal adhesions have also increased and has become one of the most frequent causes of bowel obstruction. Adhesions occur in more than 90% of patients following major abdominal surgery and in around 55-100% of women who undergo pelvic surgery^[4]. Peritoneal adhesions though not always possible to be accurately identified on multidetector computed tomographic imaging, the imaging do provide a clue on adhesions being the cause. The imaging findings like presence of acute angulated

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bowel loop, matted bowel loops, beak sign, fat notch sign, bowel obstruction in the absence of any cause detectable on imaging, loss of properitoneal fat line, focal haziness in the mesentery are all some findings predictive of adhesions^[5]. Though none of the findings are specific, the presence of multiple findings add to the increased predictability of adhesions. So the purpose of this study is to evaluate the diagnostic role of multi detector computed tomography in identifying peritoneal adhesion by using subtle imaging clues and comparing it with intraoperative findings.

Materials & Methods:

This was a cross-sectional study conducted over a period of 1 year from June 2021 to June 2022. The study was approved by the institutional ethical committee. Informed and written consent was taken from all the patients enrolled in the study as per the guidance of the institutional ethical committee. Patients presenting with clinical features suggestive of peritoneal adhesions like acute abdominal pain, intestinal obstruction or chronic pelvic pain and referred by clinician for evaluation using computed Tomography were included in the study. While patients who were below the age of 18 years, pregnant women, with renal impairment, those with allergy to contrast media and those who didn't give consent for the study were excluded from the study. The study group consisted of 35 individuals suspected to have adhesions as sample size (based on a previous study by Saini et al, sensitivity of detecting peritoneal adhesions by multidetector computed tomography was 85%)^[6].

Images were acquired using 16 slice multi detector computed tomography Toshiba aquilion lightning machine using both non contrast and contrast enhanced techniques. Contrast study was done using low osmolar non-ionic contrast media - iohexol with 350mg of iodine content/ml, calculating based on the weight of the patient (1 mL/Kg) and injecting at the rate of 4ml/sec provided there are no contraindications for administration of contrast. After acquisition of source images in axial plane, volumetric reconstruction was done in multiplanar formats to help in best delineation of pathology. The imaging features studied were acute angulation of bowel loop, matted and fixed location of bowel loops, presence of bowel obstruction, loss of properitoneal fat line, focal mesenteric haziness and signs like fat notch sign and beak sign and direct visualization of adhesive band.

The collected data was analyzed with International Business Machines (IBM) Statistical Package for the Social Sciences (SPSS) Statistics for Windows, version 23.0. (Armonk, NY: IBM Corp). Frequency analysis

and percentage analysis were used for categorical variables and to find the efficacy of imaging to predict the adhesion in comparison with the gold standard intra operative finding, sensitivity, specificity, positive predictive value, negative predictive value & accuracy were used and the probability value 0.05 was considered as significant level.

Results:

Of the 35 patients involved in the study, most patients were in the age group of 51-60 years [Table 1] and majority of patients were females [Table 2].

Table 1 - Age distribution of the patients

Age distribution		
	Frequency	Percent
Up to 30 yrs.	4	11.4
31 - 40 yrs.	5	14.3
41 - 50 yrs.	7	20.0
51 - 60 yrs.	11	31.4
Above 60 yrs.	8	22.9
Total	35	100.0

Table 2: Gender distribution

Gender distribution		
	Frequency	Percent
Female	21	60.0
Male	14	40.0
Total	35	100.0

Clinical features of chronic abdominal pain, bowel obstruction were present in 21 patients [60%] and 23 patients [65%] respectively. Previous history of abdominal surgery was present in 27 patients [77%] and abdominal tuberculosis in 5 patients [14%]. The imaging findings taken into consideration for predicting adhesion include acute angulation of bowel loop, matted and fixed location of bowel loops, presence of bowel obstruction [Table 3] which was found in 20 [57%], 24 [69%] and 23 [66%] of patients respectively. The predominant pattern of bowel obstruction was small bowel obstruction.

Table 3: Frequency and percentage analysis of acute angulated bowel loop, matted and fixed location of bowel loops and bowel obstruction.

	Acute Angulated Bowel Loop		Matted And Fixed Location Of Bowel Loops		Bowel obstruction	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Absent	15	42.9	11	31.4	12	34.3
Present	20	57.1	24	68.6	23	65.7
Total	35	100.0	35	100.0	35	100.0

The other imaging features like loss of pro peritoneal fat line, focal mesenteric haziness and special signs like fat notch sign and beak sign were seen in 28 [80%], 29 [83%], 2 [6%] and 12 [34%] respectively [Table 4].

Table 4: Frequency and percentage analysis of Loss of Pro-peritoneal Fat Line, Fat Notch Sign and Beak sign.

	Loss of Pro-peritoneal Fat Line		Fat Notch Sign		Beak sign	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Absent	7	20.0	33	94.3	23	65.7
Present	28	80.0	2	5.7	12	34.3
Total	35	100.0	35	100.0	35	100.0

None of the imaging findings were specific for adhesion. However when many of these findings were present, diagnosis of adhesion can be made if there is high clinical suspicion. In our study of 35 patients, in none of the cases we were able to directly visualize the adhesive band. Sensitivity, specificity, Positive predictive value, negative predictive value and accuracy of our study were 74.1%, 25.0%, 76.9%, 22.2% and 62.9% respectively [Table 5]. The results however weren't statistically significant (p value - 0.97) at probability value of 0.05.

Table 5: Statistical analysis with sensitivity, specificity, PPV, NPV and accuracy of imaging in predicting adhesion in comparison with intra operative finding of adhesion.

		Surgical Presence Of Adhesion		Total	Sensitivity	74.1
		Present	Absent			
					Specificity	25.0
Radiological Evidence of Adhesion	Present	20	6	26	PPV	76.9
	Absent	7	2	9	NPV	22.2
Total		27	8	35	Accuracy	62.9

Discussion:

In our study, 35 patients who had past history of abdominal surgery or tuberculosis were mainly included with majority of cases between the age group of 51-60 years. Also majority of patients were females, because of increased incidence of gynecological surgeries in them. The past history of surgery was the most important factor than the age and gender distribution. Based on previous study done on the incidence of Peritoneal adhesions following surgery by Kössi J et al^[4], it was found that, the prevalence of adhesions was 63%-97%. In our study also, history of abdominal surgery was present in 77.1% and history of aabdominal Tb was present in 14.3%.

The clinical presentation of chronic abdominal pain and bowel obstruction were majorly considered. The incidence of chronic abdominal pain owing to adhesions is controversial. In our study, chronic abdominal pain was present in 60% of cases.

However, based on a study by Kresch AJ et al^[7], controversy still exists on the role of adhesions in chronic pelvic pain. Though, adhesions have been

proposed as an important cause of chronic pain, and their surgical lysis, have been alleviating the pain, controversy remains. Based on previous literature, small bowel obstruction following adhesions is the most common complication of peritoneal adhesions. In our study, bowel obstruction was present in about 65% of cases. Based on studies done previously, the adhesions are the most common cause, accounting for 60%–70% of all cases of small bowel obstruction^[8].

The imaging features studied in our study were acute angulation of bowel loop, loss of properitoneal fat plane, matted and fixed location of bowel loops, presence of bowel obstruction, fat notch sign, beak sign, presence of focal mesenteric haziness and direct visualization of adhesive band. Much of these imaging features were based on a review of previous literature^[5].

In our study, in none of the cases, we were able to visualize the adhesive band directly on imaging. This is the major reason for reduction in specificity of study. In a study conducted by Petrovic et al^[9], the extraluminal band had a high positive predictive value

for adhesive SBO (71%), sensitivity and specificity of the extraluminal band for adhesive obstruction was 61% and 63%, respectively. However, even with multiplanar imaging, it may be difficult to demonstrate them and in our study we weren't able to visualize adhesions directly.

The presence of acute angulated bowel loop was seen in 57% of cases [Figure - 1]. Matted and fixed location of bowel loops, most commonly clumped in pelvis was also found in majority (69%) of patients and remains a clue for suspecting adhesion. However, based on literature, matted bowel loops is not only specific for detecting adhesion but can also be encountered with peritoneal Tuberculosis^[10].



Figure 1: Computed tomographic image showing acute angulated bowel loop

Presence of bowel obstruction, which is one of the most common referral for imaging in emergency department was seen in about 60% of cases. The pattern of bowel obstruction was predominantly small bowel obstruction [Figure - 2]. Previous literature also identifies adhesions as the cause of small bowel obstruction in 60-70% of cases^[6].

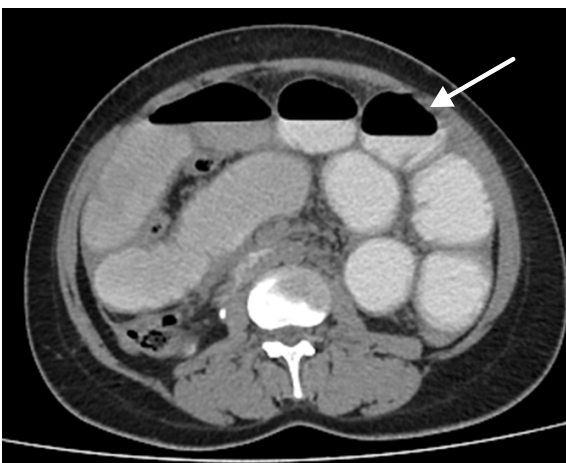


Figure 2: Contrast enhanced tomographic image showing small bowel obstruction.

The presence of special signs like fat notch sign and beak sign were also included in identifying adhesions. Fat notch sign is seen as a result of extrinsic compression of bowel at the transition point because of the presence of adhesive band^[2]. It was present in very less number (6%) of cases and it remained a subtle clue in those cases. Beak sign refers to tapering of bowel loops at the point of obstruction^[11]. In our study beak sign was present in 35% of cases [Figure-3].

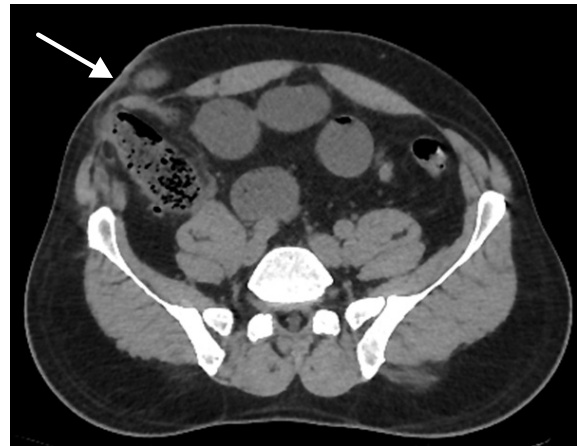


Figure 3: Computed tomographic image showing beak sign

However, based on literature, the specificity of beak sign, limiting only to adhesive small bowel obstruction is poor as this sign was also observed in other causes of bowel obstruction^[5]. Loss of properitoneal fat plane was a good predictor of adhesions [Figure - 4]. Its presence gives a clue that there is past history of surgery and in many cases of our study, small bowel loops were noted adherent to the scar site, which could be inciting factor for adhesive colic or may even point to the transition site of obstruction.



Figure 4: Computed tomographic image showing loss of properitoneal fat plane with entero-parietal adhesions.

Focal mesenteric haziness, results from vascular congestion and focal fluid collection. When there are presence of other associated findings suspicious of adhesion, adhesive etiology can be considered as the cause of focal mesenteric haziness^[12]. In one of our case, imaging features were consistent with presence of small bowel obstruction, with focal mesenteric haziness and there was no evidence of mechanical cause of obstruction and also no past history of surgery or tuberculosis. Intraoperative finding was suggestive of congenital adhesive band causing small bowel obstruction [Figure - 5].

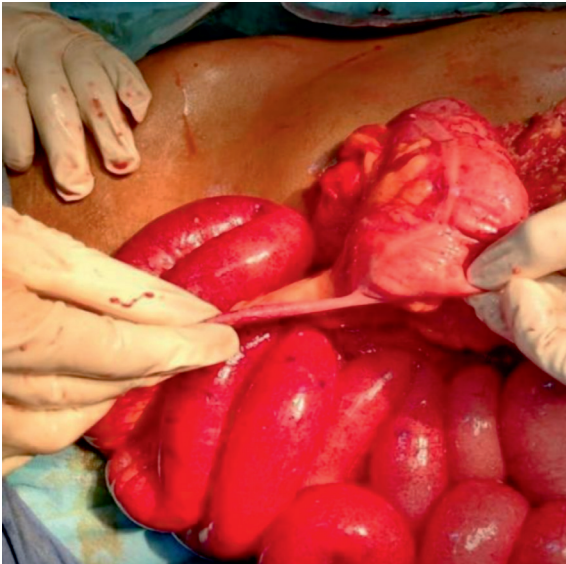


Figure 5: Intraoperative image of a patient showing presence of adhesion.

However, we weren't able to directly demonstrate the adhesive band. Congenital adhesive band, though a rare cause of bowel obstruction should also be considered as a differential for the cause of small bowel obstruction especially in young individuals. The studied imaging findings in 35 patients were ultimately compared with gold standard surgical outcome. Intraoperatively, adhesion was present in 27 patients [77.1%].

In our study, on comparing the radiological presence of adhesion with surgical presence of adhesion, the sensitivity was 75% and specificity was 25% and wasn't statistically significant (p value - 0.97). The low specificity of study is because adhesive band could not be visualized directly in any of our cases. However, the above mentioned radiological features may provide a clue for suspecting adhesion as the cause. So based on our study, Multidetector computed Tomography can be considered the first investigation of choice for evaluating patients suspected to have adhesions. However, the Clues remain subtle, and diagnosis of adhesion needs a high index of suspicion.

The major limitation is that the study did not predict about the nature of adhesive band - either as single or matted adhesion. Also our study, did not predict the nature of obstruction as closed loop or not. Presence of Closed loop obstruction is a poor prognostic indicator and an important predictor for strangulation in bowel loop. The other signs of strangulation like presence of free fluid, decreased bowel wall enhancement, which predict the bowel vascularity were also not included in this study.

Conclusion:

Peritoneal adhesions to be detected on imaging, needs a high index of suspicion based on our study results. There are subtle clues like presence of acute angulation of bowel loop, matted and fixed location, loss of properitoneal line of fat, focal mesenteric haziness, fat notch sign, beak sign and bowel obstruction in the absence of mechanical cause which may point to the presence of adhesion as the etiology but requires high index of suspicion. Presence of multiple findings may increase the predictability of adhesions.

Recommendations:

The study of nature of obstruction (closed loop or not), presence of features of strangulation in adhesive obstruction can further help to predict the prognosis of the patient and can remain a future scope of research.

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