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"Diagnostic Accuracy of MDCT in the Identification of Intestinal Obstruction Keeping Surgical Findings as the Gold Standard

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Abstract

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Introduction: Bowelobstruction is the most common health event amid all surgical admissions for acute abdominal pain. Small intestinal obstruction is responsible for around 12–16% of admissions in surgicalemergencies and around 20% of procedures from emergency surgeries.

Methodology: This was a cross-sectional analyticalstudy. The totalsample size was 142 and the non-probabilitypurposivesamplingtechniquewas used. Factors such as gender, age, and pathologies associated with intestinal obstruction were analyzed using descriptive statistics and a chi-square test. Furthermore, the diagnostic accuracy of MDCT in case of intestinal obstruction was evaluated by a 2 x 2 table.

Results: Adhesions found on CT and surgery accounted for 8.5% and 13.4% respectively. Neoplasms were identified in 13.4% of cases on CT and 11.3% of cases during surgery. Hernias was discovered in 14.8% of cases on CT and 9.2% of cases in laparotomy. Ascites were found in 21.1% of cases on CT and 2.8% during surgery. Impacted stools were present in16.9% ofcases onbothCT and surgery. 2x2 table revealed intestinal obstruction, 52.1% on CT and 45.1% during surgery.

Conclusion:Our findingsrevealedthatMDCTdemonstratedmoderatesensitivity(58.11%)and specificity (69.12%) in the identification of intestinal obstruction compared to surgical findings. The diagnosticaccuracyofMDCTis63.38%.

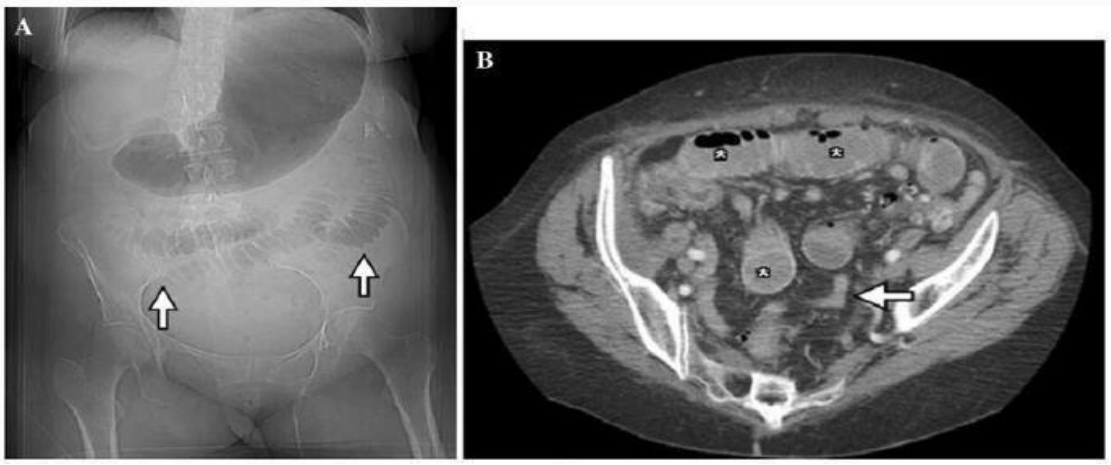
Introduction:

Acute intestine obstruction is the most prevalent reason for emergency laparotomy, with substantial morbidity and death, accounting for 30% of acute abdominal emergencies[(1)].It can happen anywhere along GIT's length, like small intestinal obstruction, large intestinal obstruction or gastroduodenal obstruction. Studies also told us that,the small bowel is responsible for approximately 75% of all intestinal mechanical blockages[(2)]and that small intestinal obstruction accounts for 12-16% of surgical emergency admissions and around 20% of emergency surgery procedures[(3)].

Intestinal obstruction could be classified as mechanical or functional. Mechanical obstruction results from physical blockage, such as kinking or stricture, while functional obstruction was due to issues with intestinal wall movement or nerve dysfunction. There were also distinctions between partial and complete obstruction, with complete obstruction preventing the passage of all intestinal contents. Complex SBO involves the combination of bowel blockage and ischemia leading to necrosis and perforation.

Its causes include intra-abdominal adhesions, neoplasm, herniation, inflammatory bowel disease,intussusception, tuberculosis, inflammatory strictures and volvulus. The commonest causes of thesmall intestinal obstruction are adhesions linked to the prior surgery. Clinically, it may presents asabdominal pain, vomiting, nausea and constipation[(4)].

Besides laboratory and clinical evaluations, diagnostic imaging is also used to evaluate individuals with acute abdominal pain. The first imaging modality used for suspected bowel obstruction was abdominal radiographs because of its widespread availability, low cost, speed of acquisition and low radiation exposure and because abdominal radiography is diagnostic in 50 – 60% of cases[(5)].The diagnostic accuracy of abdominal radiographs for suspected intestinal obstruction was between 50-80%[(6)]. However, there are certain limitations to these radiographs such as; inability to determine the cause of obstruction, incapacity to determine the exact site of obstruction and an incompetence to determine the severity of obstruction[(7)].



AbdominalRadiograph and MDCT SCANwithSuspectedSBO

In addition to plain radiography, contrast imaging/fluoroscopic studies could also provide important information about the presence of an obstruction and its location, but these studies were not recommended in case of complete bowel obstruction.

Abdominal sonography is more competent imaging test than abdominal radiography and its sensitivity for small bowel obstruction is 89%[(8)]. Abdominal sonography is a non-invasive imaging modality, easily accessible and affordable[(9)]. However, its limitations include high dependence on user's expertise, difficulty in assessing problem at the site of obstruction and limited ability to determine the severity of obstruction[(10)].

MRI was established as a practical andfavorable methodto diagnose small bowel obstruction because of very high sensitivity(100%) and specificity(93%)[(11)]. When compared to other imaging modalities,MRI has limited usefulness in diagnosing intestinal obstruction due to its lower spatial and temporal resolution, less widespread availability and higher cost. However, MRI could be used as an alternative where CT imaging was not feasible e.g; pregnant patients, patients allergic to contrast[(3)].

On the other hand, sensitivity and specificity of computed tomography was recorded at 93% and 90% respectively[(5)]. In addition to effects such as ischemia and necrosis, doctors can interpret the kind, level and supply of obstruction from simple CT images[(12)]. Spatial resolution of CT scans was improved by multidetector CT and multiplaner reformation and hence diagnostic accuracy of CT scans was also Improved[(3)]. As a result, ComputedTomography is more commonly used to assess suspected SBO.

It is generally accepted that acute andcomplete or high-grade obstruction requires immediate surgery, whereas partial obstruction caninitially be managed conservatively unless there is an accompanying lesion that requires surgery.CTis beneficial in determining the degree and source of blockage, as well as the consequences thatnecessitate emergency surgery. If we caneffectively diagnose the cause of intestinal obstruction on CT scan, we can help out the surgical team with early detection, better operative and postoperative management andprevention of complications. In conditions where a health practitioner with earlierinformation could select a laparoscopic method, preoperative CT stopping laparotomiesadditionally enables to keep away from headaches and postoperative health center stayed[(13)].

Material and method

This analytical cross sectional study was carried out for a period of four months at Shalimar Hospital, Lahore. A total of 142 patients were included in the study.All Patients with suspicion of intestinal obstruction**,**whose MDCT was performed but they were not treated surgically were excluded.

Patients of any age with clinical suspicion of small bowelobstruction, who subsequently underwent surgery for small bowel obstruction wereincluded. Patients presented symptoms such as inability to pass stools, constipation, vomitingand nausea.

All patients were examined using 64-slice multidetectorcomputed tomography (Aquillion Toshiba Medical System). Data was collected through non probability purposive sampling technique. MDCT examination findings such as intestinal obstruction, adhesions, neoplasms, hernia, ascites, impacted stool, foreign body, free air, free fluid were recorded as well as surgical findings namely intestinal obstruction, adhesions, neoplasms, hernia, ascites, impacted stool were obtained.

Statistical analysis

Data entry and analysis were done by using SPSS version 20. Quantitative variables were presented with mean ± SD. Categorical variables were presented by using frequency and percentages. Pie charts, Bar chart were given. Chi square test was applied. P-value $\leq \alpha = 0.05$ was taken as a level of significance**.**

Results

A total of 142 patients underwent MDCT evaluation for intestinal obstruction. Among the study participants, 69 individuals(48.6%) were male and 73 individuals (51.4%) were females. The minimum age recorded in thestudy population is 5 years, representing the youngest patient included in the research. Themaximum age observed in the study population is 90 years, indicating the oldest patient includedin the study. The mean (average) age of the study population is 52.78 years.

Table 1 presents crosstabulation of the presence and absence of adhesions as identified throughCT scans and surgical findings The table breaks down the cases into four categories. In 106 cases (74.6%), adhesions were not detected on CT scans. In 36 cases (25.3%),adhesions were identified on CT scans. In 123 cases (86.6%), adhesions werenot found during surgery. In 19 cases (13.4%), adhesions were discoveredduring surgery.

Table 1: Crosstabulation of Adhesions Detected on CT vs. Adhesions Found During Surgery

		AdhesionsonSurgery		Total
		absent	Present	
AdhesionsonCT	absent	94	12	106
	present	29	7	36
Total		123	19	142

The chi-square test was performed to assess the statistical significance of the relationship betweenadhesions detected on CT and those found during surgery. The Pearson Chi-Square value is 1.530 with 1 degree of freedom, and the p-value is approximately 0.216. This suggests

that there is nostatistically significant association between adhesions detected on CT and adhesions found duringsurgery at the 0.05 significance level.

Table 2is a crosstabulationofneoplasmsdetectedonCTvs.neoplasmsfoundon surgerysuggesting that neoplasms were not detected onCT scans in 123 cases (86.6%), while in 19 cases (13.4%), neoplasms were identified.In 126 cases (88.7%), no neoplasms were found during surgery while in 16cases (11.3%), neoplasms were discovered during surgery.

Table2:Cross-tabulation ofNeoplasmsDetectedonCTvs.NeoplasmsFoundDuring Surgery

		NeoplasmonSurgery		Total
		Absent	present	
NeoplasmonCT	absent	113	10	123
	present	13	6	19
Total		126	16	142

The chi-square test was conducted to assess the statistical significance of the association between neoplasms detected on CT and those found during surgery. The following results were obtained: The Pearson Chi-Square value was 9.051 with 1 degree of freedom, and the p-valuewas 0.003. This indicates a statistically significant association between the presence ofneoplasms on CT scans and their presence during surgery at the 0.05 significance level (table 3).

Table 3: Chi-SquareTests

	Value	df	Asymptotic Significance (2- sided)	ExactSig. (2- sided)	ExactSig. (1- sided)
PearsonChi-Square	9.051[a]	1	.003		
ContinuityCorrection[b]	6.858	1	.009		
LikelihoodRatio	6.934	1	.008		
Fisher'sExactTest				.009	.009
Linear-by-Linear	8.987	1	.003		

Association					
NofValidCases	142				

The relationship between the detection of hernias through CT scans and thepresence of hernias during surgical examination in a study involving 142 individuals with intestinal obstruction was looked for. In 121 cases (85.2%), no hernias were detected on CT scans. However, in 21 cases(14.8%), hernias were identified on CT scans. In 129 cases (90.8%), no hernias were found duringsurgery while in 13 cases (9.2%), hernias were discovered during surgery.
No statistically significant association was found between the presence of hernias on CT scans andtheir presence during surgery ($p > 0.05$), elaborated in Table 4.

Table 4: Chi-SquareTests

	Value	df	Asymptotic Significance (2- sided)	ExactSig. (2-sided)	ExactSig. (1-sided)
PearsonChi-Square	2.900[a]	1	.089		
ContinuityCorrection[b]	1.672	1	.196		
LikelihoodRatio	2.397	1	.122		
Fisher'sExactTest				.103	.103
Linear-by-LinearAssociation	2.880	1	.090		
NofValidCases	142				

The relationship between the presence of ascites identified on CT scans and theoccurrence of ascites during surgical examination involving 142 individuals withintestinal obstruction was sought. Results showed ascites were detected in 30 cases (21.1%) through CT scans,while during the surgical examination, ascites were found in only 4 cases(2.8%), with 112 cases(78.9%) showing no presence of ascites on CT scans and 138 cases(97.2%) showing no ascites during surgery.
No statistically significant association was observed between the presence of ascites on CT scans and the presence of ascites during surgery ($p > 0.05$).

Table 5 illustrates the relationship between the detection of impacted stools through CT scans and the presence of impacted stools during surgical examination involving 142individuals with intestinal obstruction. In 118 cases (83.1%), no impacted stools were detected onCT scans and in 118 cases (83.1%) no impacted stools were found during surgery. In 24cases (16.9%), impacted stools were identified on CT scans, and in 24 cases (16.9%), impactedstools were discovered during surgery.Pearson chi-square test was applied, and a statistically significant association was observedbetween the presence of impacted stools on CT scans and their presence during surgery ($p < 0.0$).

Table5:Cross-tabulationofIntestinalObstructionDetectedonCTvs. intestinal obstruction Found During Surgery

		IntestinalObstructiononSurgery		
		Present	Absent	Total
IntestinalobstructiononCT	Present	43	31	74
	Absent	21	47	68
Total		64	78	142

We observeda relationship between the detection of intestinal obstruction through CT scans and the presence of intestinal obstruction during surgery. In 74 cases (52.1%), intestinal obstruction was detected on CT scans, and in 64cases (45.1%) intestinal obstruction was found during surgery. In 68 cases (47.9%) no intestinalobstruction was identified on CT scans, and in 78 cases (54.9%) no intestinal obstruction wasdiscovered during surgery.

The Pearson Chi-Square, Likelihood Ratio, and Fisher's Exact Test all confirm the presence of a significant association (Table 6). A statistically significant association was observed between the presenceof intestinal obstruction on CT scans and its presence during surgery ($p < 0.05$).

	Value	df	Asymptotic Significance (2- sided)	ExactSig.(2-sided)	ExactSig.(1-sided)
PearsonChi-Square	10.610[a]	1	.001		
ContinuityCorrection[b]	9.539	1	.002		
LikelihoodRatio	10.771	1	.001		
Fisher'sExactTest				.001	<.001
Linear-by-LinearAssociation	10.535	1	.001		
NofValidCases	142				

Table 6: Chi-SquareTests

The data of frequency distributionof the presence or absence of freefluid and free air as identified through CT scans was observed. In 99 cases (69.7%), nofree fluid was detected on CT scans whereas in 43 cases (30.3%) free fluid was identified on CTscans. Similarly, no free air was detected on CT scans in 128 cases(90.1%) and free air was identified on CTscans in 14 cases (9.9%).

The 2x2 contingency table (Table 7) showed that MDCT correctly identified intestinal obstruction, andsurgical findings also confirmed its presence in 43 cases. MDCT identified obstruction but surgicalfindings did not confirm it in 21 cases. Besides MDCT failed to identify obstruction, but surgicalfindings indicated its presence in 31 cases. MDCT correctly ruled out obstruction, and surgicalfindings also confirmed its absence in 47 cases.

Table7:DiagnosticaccuracyofMDCTfordetectionofintestinalobstruction

		Surgicalfindings		**Total**
		Yes	**No**	
MDCT	**Yes**	43	21	**64**
	No	31	47	**78**

Total	**74**	**68**	

The table also provides statistical measures of the diagnostic accuracy of MDCT for the detectionof intestinal obstruction, including sensitivity, specificity, positive predictive value, negativepredictive value, and overall diagnostic accuracy. Sensitivity and specificity of MDCT were58.11% and 69.12% respectively. Positive predictive value and negative predictive value were67.19% and 60.26% respectively. Calculated diagnostic accuracy of MDCT was 63.38%.

Statistics	**Value**
Sensitivity	58.11%
Specitivity	69.12%
Positive predictive value	67.19%
Negative predictive value	60.26%
Diagnostic accuracy	63.38%

Discussion:

Bowel obstruction is the most common ailment of all surgical admissions for acute abdominalpain[14]. An intestinal blockage results when the forward passage of digestive contents is impeded by a mechanical reason[15].It was critical to evaluate and treat cases of suspected small and large intestinal obstruction, and a proper technique was required to correctly identify the cause of obstruction and to facilitate effective management.As a way out, MDCT examination is now the gold standard for the diagnosis of intestinal blockage enhancing the initial diagnosis, which, in turn, helps the surgeon in surgical planning, thus saving the patient from adverse complications. In our study, we found out that MDCT wasfrequently helpful in the diagnosis of intestinal obstruction and the findings of MDCT werecomparable with surgical findings.

The study was conducted at Shalimar Hospital Lahore. A total of 142 participants showing clinical suspicion for small bowel obstruction were included. Among the study participants, 69 individuals(48.6%) were male and 73 individuals (51.4%) were females. The minimum age recorded was 5 years and themaximum age observed was 90 years, The mean (average) age of the study population was 52.78 years. By statistical analysis of our data, we found that the most

frequent finding was intestinal obstruction comprising of 74 cases (52.1%), detected on MDCT and 64 cases (45.1%) observed during surgery. The second most frequent abnormality was adhesions, found in 36 cases (25.5%) on MDCT and in 19 cases (13.5%) during surgery. Neoplasm was third most frequent abnormality observed in 19 cases on MDCT and 16 cases during surgery.The specificity of the CT scan was59.7% and the sensitivity was 67.2%.

Our study concluded moderate sensitivity and specificity of MDCT for the diagnosis of bowel obstruction whereas, Abdellatef et al.determined results from a total of 50 patients of which 24patients were males and 26 were females. MDCT provided aprovisional diagnosis of intestinal obstruction in 40 individuals. 32/40 were taken for surgery while eight patients were treated conservatively. Out of 32 patients, 31 confirmed intestinal blockage, while one did not, the sensitivity andspecificity of MDCT for the diagnosis of special type of bowel obstruction (closed loop obstruction) was100% and 91.4%, respectively[16]. The reason for this disparity might be patient selection, favoring patients with only high-grade obstruction which was not the case in our study.

Rafiq Suhail, and his co-workers conducted a prospective study to evaluate the accuracy ofmultidetector computerized tomography in the diagnosis of acute abdomen and documented the sensitivity and specificity of MDCT as a diagnostic tool. The study included 64 patients and the resultsshowed that the sensitivity, specificity, positive predictive value, and negative predictive value ofMDCT were 95%, 75%, 98.3%, and 60% respectively. These findings were similar to other studiesconducted globally, but the sample size was small [17]. Our data evaluated the precision of MDCT to diagnose intestinal obstruction keeping surgical findings as the gold standard. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of MDCT was calculated as 58.11%, 69.12%, 67.19%, 60.26% and 63.38% respectively.

A prospective cross-sectional analytical analysis led by Siachami in 2019 investigated the use of MDCT in patients of acute abdomen as a primary imaging modality and identified cases who required surgery. A total of 253 patients were included in the study and their age was atleast 18 years. All of them came with acute abdominal discomfort and had surgery within 48 hours. Careful analysis presented that findings of MDCT were comparable with surgical findings, hence, approving MDCT as the ultimate imaging modality in case of acue abdomen[18].

A similar prospective study was conducted by Dr. Amandeep Singh in 2018. They evaluated the efficacy of MDCT in diagnosing the presence and causes of bowel obstruction. They also determined a correlation between surgical findings and CT findings. The test was comprised of 40 patients who had undertaken CT scans and abdominal laparotomies for suspected intestinal obstruction. There was a strong correlation found between CT findings and surgical findings in determining the source of intestinal obstruction[19]. As a result of CT scan, many causes of intestinal obstruction wereproposed inour study. Among these causes were adhesions (25.3%), ascities (21.1%), impacted stool (16.9%), hernias (14.8%), and neoplasm (13.4%). All of these causes were supported by the results of surgery such as adhesions(13.4%), ascities (2.8%), impacted stool (16.9%), hernias (9.2%) and neoplasm (11.3%) showing a very good agreement between MDCT results and surgical findings.

In our study, the most frequent cause of intestinal obstruction was adhesions followed by neoplasm and hernia.Memon in 2014 determined from 187 patients with suspected small bowelobstruction, 102 underwent surgery. Thecommonest cause of SBO in the study group was adhesions found on laparotomy, followed byhernias[20].

Common causes of intestinal obstruction in our study wereadhesion, neoplasm, hernia and ascites andthese findings were related to Hassan's study in 2019. The study determined from a total of 140patients whose CT findings were compared to surgical findings. One hundred patients were confirmed to have bowel obstruction and the common causesof intestinal obstruction were such as adhesions (35%), followed by mesenteric ischemia (14%),hernia (13%), carcinoma (7%) and tuberculosis (7%)[(21)].

Our study disclosed that MDCT has moderate sensitivity (58.11%) and specificity (69.12%) for identifying intestinal obstruction compared to surgical findings, its positive predictive value (67.19%) suggests a reasonable probability of correctly diagnosing the condition when present. However, the negative predictive value (60.26%) indicates a substantial chance of false negatives.With an overall diagnostic accuracy of 63.38%, MDCT's performance underscores the importanceof cautious interpretation and potential supplementary diagnostic methods.

CONCLUSION:

MDCT is a valuable tool in the diagnosis of various gastrointestinal pathologies causing intestinalobstruction. The findings emphasized that MDCT is effective in identifying causes of intestinal obstruction. MDCT exhibitedmoderate sensitivity and specificity, its positive predictive value was reasonably high, suggestingits potential to accurately diagnose intestinal obstruction when present. MDCT's diagnosticaccuracy emphasizes its role as an essential imaging modality in the evaluation of intestinalobstruction, contributing significantly to efficient surgical planning and patient management.

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