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Original Article

Diagnostic Accuracy of Computed Tomography for Intestinal Obstruction Keeping Laparotomy as Gold Standard

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ABSTRACT

Objective*:* To assess the diagnostic accuracy of computer tomography for intestinal obstruction,keepinglaparotomy findings as a gold standard.

Methods*:* A Cross-sectional Validation study was performed in the Department of Radiology, Combined Military Hospital, Bahawalpur, from June 20th, 2023, to March 19th, 2024. An abdominal CT scan was performed on 130 patients with abdominal pain whowere unable to pass stool. Based on the findings of CT for intestinal obstruction, these patients underwent surgery. The gross and histopathological results of the specimen were obtained to confirm the diagnosis taken as a gold standard examination. Percentage and frequency were used to analyze qualitative variables such as sex, the origin of intestinal obstruction, intestinal obstruction diagnosis by CT and laparotomy, plus histopathological results. Using 2x2 tables, the following metrics were calculated: sensitivity, specificity, and positive and negative predictive value. The laparotomy findings plus histopathological results of the samples collected during surgery were used as a gold standard to calculate the diagnostic accuracy of CT in the diagnosis of intestinal obstruction.

Results*:* Overall sensitivity, diagnostic accuracy, specificity, negative and positive predictive value, and diagnostic accuracy in this study for CT compared to Laparotomy were 94.29%, 92%, 93.84%, 79.31%, and 98.02%, respectively. Post-stratification data based on age and gender showedgreater sensitivity, specificity, and diagnostic accuracy in males and younger age groups.

Conclusion: CT scan was a highly sensitive and specific method for detecting intestinal obstruction when histopathology was used as the gold standard.

Keywords*:* Diagnostic Accuracy, Computed Tomography (Ct), Histopathology, Intestinal Obstruction, Laparotomy.

1. INTRODUCTION

Intestinal obstruction is a common surgical emergency[1]. Dynamic and a-dynamic intestinal obstructions are its two types. The mechanical obstruction is resisted by persistence in the dynamic intestinal obstruction. However, peristaltic movements can be present (non-propulsive state) or absent in adynamic intestinal obstruction2. Commonly, it is accepted that immediate surgery is needed for patients with acute and complete or high levels of intestinal obstruction3. In some regions of Asia, such as Pakistan, India, and Iran, mechanical intestinal obstruction is a significant component of the conditions that call for immediate surgical attention4. In countries like Pakistan and other tropical nations, intestinal obstruction is also a prevalent medical problem, although most instances are not recorded until much later. This delay in its treatment increases the incidence of complications5.

Tuberculosis constitutes the most prevalentcauseof intestinal obstruction, having 38.1% of the total study population, according to the report of Zahid Mahmood et al.[6.] The Second major cause was obstructed/strangulated hernia 26.84%, followed by post-operative adhesions, large gut malignancy, volvulus, and small gut malignancy to be 17.12%, 10.09%, 6.22%, and 0.77%, respectively. According to reports, the sensitivity of computerized tomography (CT) scan is reported to be 63 to 94%, with a specificity value of 78-100% and diagnostic accuracy values of 65-95%,[7-11]. The accuracy was 46-80% in diagnosing intestinal obstruction with conventional radiography, such as an abdominal X-ray, which is the primary technique for investigation and the first imaging treatment[11–15]. Additionally, CT scans can reveal a possibility of strangling or closed-loop blockage, both of which call for an urgent exploratory laparotomy.

Unfortunately, a few studies examined the use of computed tomography (CT) scans to detect intestinal obstruction clearly in our population. A CT scan can determine the cause of the intestinal obstruction before surgery, aiding the surgical team in making an early diagnosis, providing better care during and after the procedure, and reducing the likelihood of complications.

2. METHODOLOGY

After the Ethical Board Review approval (CPSP/REU/RAD-2O22-034-3702; Dated 7th March 2023) from June 20th, 2023, to March 19th, 2024, a cross-sectional validation study was conducted using a purposive non-probability sampling method at the Department of Radiology, Combined Military Hospital, Bahawalpur. The calculated sample size was 130 for the study, using sensitivity and specificity of CT at 95% and 97%, while the prevalence was 73%, using desired precision at 6%.[16]After the informed consent, patients aged 20–60 years of both genders were sent to the radiology unit from the emergency room due to abdominal pain, distention, and flatulence, as well as those who came to the outpatient unit with a clinical diagnosis of intestinal obstruction. The patients who underwent surgery before a CT scan or did not show any clinical signs of intestinal obstruction, were allergic to the contrast media, were pregnant females, and had abnormal renal function tests were excluded from the study.

An abdominal CT scan was done after a history and clinical assessment. A multi-detector CT (128 slices) was used to perform a CT scan with IV contrast material. No oral contrast was used.[17]In every instance, scans with a thickness of10mm slice were collected from the diaphragm to the symphysis pubis. Intestinal dilatation (small intestine ≥3cm, large bowel ≥6cm), mesenteric fat stranding, a transition zone between the dilated and collapsed loops, and an air-fluid level were the criteria for a CT diagnosis. A radiology specialist with five years of post-residency experience or more assessed the

final report. Based on their radiological and clinical exam results, these patients had surgery. The presence of dilated bowel loops, bowel necrosis, and intraperitoneal free fluid, observed during the operation and verified by an operating surgeon with at least five years of experience, confirmed the diagnosis of intestinal obstruction. For the results of the histopathological study, the specimens of the operative parts were obtained at the same time. The final diagnosis was made from laparotomy findings and histopathology results, which were taken as a gold standard. Data was collected on a predesigned Performa.

Data was collected and analyzed using SPSS v.26. Mean ± standard deviation (SD) was used for calculating quantitative variables such as age. Percentage and frequency were used to analyze qualitative variables such as sex, the origin of intestinal obstruction, analysis of intestinal obstruction outcomes by CT scan, and laparotomy plus histopathological outcome. Using 2x2 tables, sensitivity, specificity, and positive and negative predictive value were calculated. Age and gender stratification were carried out to assess the impact of the abovementioned criteria on the results.

3. RESULTS

The demographic data of the study population is shown in Table 1. The Mean age was 39.55±7.761 years, and 53.8% (70)were males. The frequency of intestinal obstruction in the CT-scan group showed positive findings in 101 (77.7%) and negative findings in 29 (22.3%). Similarly, the Frequency of intestinal obstruction in the Laparotomy group showed positive findings in 105 (80.8%) and negative findings in 25 (19.2%) (Table 2).Table 3 shows 2x2 tables for CT and laparotomy-proven intestinal obstruction in all patients and its distribution in terms of age and gender. Overall sensitivity, specificity, diagnostic accuracy, negative predictive value, and positive predictive value in this study for CT compared to Laparotomy were 94.29%, 92%, 93.84%, 79.31%, and 98.02%, respectively. Post-stratification data is shown in Table 4, where age and gender-based distribution of sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy have been shown.

Table 1: Demographic data of the study population

	Frequency	Percentage
Mean Age	39.55±7.761	
20-40	72	55.4
>40	58	44.6
Male	70	53.8
Females	60	46.2
Male: Female	1.1:1	

Table 2: Frequency of Intestinal obstruction between two modalities

Modality	Intestinal Obstruction	Frequency
CT-Scan	Present	101(77.7%)
	Absent	29(22.3%)
Laparotomy and HP	Present	105(80.8%)
	Absent	25(19.2%)

Table 3: 2x2 table for CT and Laparotomy-proven intestinal obstruction (Overall)

		Laparotomy-proven Intestinal Obstruction		
		Present	Absent	
CT proven IO	Present	99 (TP)	02 (FP)	**PPV:** 98.02%
	Absent	06 (FN)	23 (TN)	**NPV:** 79.31%
		Sensitivity: 94.29%	**Specificity:** 92%	**Diagnostic accuracy:** 93.84%

Table 4: Data analysis after stratification (Gender and Age-based)

Variable	Sensitivity	Specificity	PPV	NPV	D.A
Males	93.6%	91.3%	95.7 %	87.5 %	88.6 %
Females	94.8%	100%	100%	40.%	95%
20-40 years	94.4%	100%	100%	20.%	94.5 %
>40 years	94.18%	91.67%	94.18 %	91.67 %	93.10 %
Overall	94.29%	92.00%	98.02 %	79.31 %	93.84 %

4. DISCUSSION

Intestinal obstruction is a prevalent condition, and conventional

radiography is the first step in its diagnosis. This imaging technique has 40 to 80% accuracy in finding the presence of an obstruction, as mentioned earlier[11-15]. Its accuracy is lower in determining the location of the obstruction, the presence of strangulation, and its cause. The use of CT scans has increased in recent years due to technological advancement. It is suggested in cases where the initial radiography is indeterminate, and complications are suspected. Pathologies involving the gut wall, mesenteric vessels, mesentery, and the abdominal cavity can be observed by this method.

Ismail et al.[18],on histological examinations, found that TB (36% of cases), cancer of the large intestine, and postoperative adhesion are the most prevalent causes of intestinal obstruction. According to a different study conducted by Shaikh et al.[4], the most common causes of intestinal obstruction are obstructed or strangulated external hernias (25.83%) and intestinal adhesion (23.33%). Large gut volvulus (13.83%), colonic malignancy (13.83%), and ileocecal tuberculosis (10.83%) follow. Megibow et al.[10]stated that 76.2% of the patients were found to have an intestinal obstruction, and 73% of the time (47 of 64), the cause was predicted correctly. There are several potential causes, such as adhesion (57.8%), primary gut tumor (10.9%), Crohn's disease (6.3%), hernia (4.7%), metastases (3.1%), colonic diverticulitis (3.1%), hematoma (3.1%), and others (4.7%).

Our study calculated the specificity was 96%, sensitivity was 94%, and overall accuracy was 95%. Earlier research confirmed that the accuracy ranged from 65 to 95%, the sensitivity from 63% to 94%, and the specificity from 78% to 100%.[7-11]In one study, ultrasound was compared to CT imaging, had a sensitivity of 92.31% and a specificity of 94.12%, with a PPV of 96% and an NPV of 88.89% in the diagnosis of Small Bowel Obstruction (SBO).[19]Another study reported that CT scans had sensitivity and specificity values of 98.39% and 65.22%, respectively, with an overall diagnostic accuracy of 93.20% compared to operative findings in intestinal obstruction.[20]Regarding the literature at the national level, a study in Faisalabad showed CT scan had 81.1% sensitivity, 90.2% specificity, PPV 84.2%, NPV 92.7%, and 89.4% accuracy in the diagnosis of the transition points of SBO.[21]

Since our study's findings are consistent with those of the research above, CT scans may be used generically to diagnose intestinal obstruction. The stratification of findings showed the study's strength according to patients' ages and sexes. The stratified analysis does not reveal any meaningful difference. The research does not represent the world because its participants only came from a specific area. However, it may be a very accurate detection tool when we add our social and economic aspects and the ratio of patients to doctors.

5. CONCLUSION

According to our findings, a CT scan can detect intestinal obstructions with high sensitivity and specificity and clearly show the obstruction's location and cause.

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