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### Recommended Citation

Haleopota, H. F., Khan, M. A., Shahzad, N. (2018). Sensitivity and specificity of CT scan in small bowel obstruction among children. *Journal of the Pakistan Medical Association*, 68(5), 744-746.  
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## Sensitivity and specificity of CT scan in small bowel obstruction among children

Huma Faiz Halepota,<sup>1</sup> Muhammad Arif Mateen Khan,<sup>2</sup> Noman Shahzad<sup>3</sup>

### Abstract

**Objective:** To determine the sensitivity and specificity of computed tomography scan for diagnosing small bowel obstruction among children.

**Methods:** The retrospective diagnostic test accuracy study was carried out at the Aga Khan University Hospital, Karachi, and comprised data of all patients aged 2-16 years who presented with clinical features of small bowel obstruction and underwent computed tomography scan of abdomen from January 2001 to December 2015. Data was analyzed using SPSS19.

**Results:** Of the 98 subjects, 65(66.0%) were males and 33(34.0%) were females. Overall mean age of the patients was  $7.67 \pm 4.33$  years and mean duration of symptoms was  $2.84 \pm 1.17$  days. Sensitivity, specificity, positive and negative predictive values as well as accuracy of computed tomography scan was 97.4%, 81.8%, 94.9%, 90.0% and 93.9% respectively.

**Conclusion:** CT scan was found to have a high sensitivity, fairly good specificity and accuracy in revealing small bowel obstruction. However, the scan is known to have its limitations in sub-acute intestinal obstruction and primary peritonitis.

**Keywords:** Small bowel obstruction, CT scan, Children, Laparotomy. (JPMA 68: 744; 2018)

### Introduction

Intestinal obstruction is a condition in which intestine is obstructed because of any mechanical or non-mechanical reasons. It accounts for 20% of all surgical admissions for acute abdomen.<sup>1</sup> Small bowel is specifically involved in 60-85% of intestinal obstruction cases.<sup>2</sup> The causes of bowel obstruction are variable and often require urgent management. Delay in diagnosis and management can result in bowel ischaemia and death.<sup>3</sup>

Diagnostic approaches include history, physical examination and radiological investigations in combination. Routinely X-ray abdomen in addition to history and physical examination is done for diagnosis of intestinal obstruction. Its diagnostic accuracy is about 40-80%.<sup>4</sup> This wide range in accuracy clearly reflects the limitation of plain film in diagnosing small bowel obstruction (SBO). To further enhance the diagnostic accuracy the clinicians had to resort various contrast studies in order to establish the diagnosis and ascertain the site of obstruction. This whole process may involve several hours before patient could be taken to emergency operating room for definitive procedure. Thus, the need for a more refined imaging study for immediate diagnosis of SBO is obvious.<sup>5</sup>

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Most of these patients require urgent laparotomy to establish accurate diagnosis and prevent intestinal ischaemia. Recent technological advances in imaging modalities, especially multi-planner computed tomography (CT) scan, have not only improved the ability to identify cases of bowel obstruction that require urgent surgery, but also those that can be managed conservatively. In adults this role of CT scan is well established.<sup>6</sup> However, literature regarding the role of CT scan in paediatric SBO is very limited. The current study was planned to determine the sensitivity and specificity of CT scan in the diagnosis of bowel obstruction in children while taking surgical diagnosis as the gold standard.

### Patients and Methods

The retrospective diagnostic test accuracy study was carried out at the Aga Khan University Hospital (AKUH), Karachi after approval from the institutional ethics committee, and comprised all patients aged 2-16 years who presented with suspected SBO and underwent CT scan of abdomen from January 2001 to December 2015. Medical records were retrieved using international classification of diseases (ICD) codes 54.11 for emergency exploratory laparotomy and 560.9, 751.1, 751.2 for SBO in children.

All patients had undergone CT scan of abdomen without oral contrast prior to specific management (CT scanner 64 slicer; Toshiba Aquillion, Japan).

The clinical criteria for SBO was abdominal pain with distension, bilious vomiting and constipation for 2-5 days. Data of children aged below 2 years and those managed without CT scan was excluded.

CT diagnosis of the obstruction was based on small bowel calibre between the dilated proximal and distal small bowel loops, small bowel dilatation >2.5 cm in the presence of collapsed colon with or without thickened small bowel wall >3mm compromising the lumen. Radiologists who reported on the CT scans had more than 5 years of experience in radiology.

Data was collected and analysed using SPSS19. Mean and standard deviation were calculated for continuous variables, including age and duration of symptoms, and frequency and percentages for categorical variables including gender. A 2x2 table was employed to determine sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy.

## Results

Of the 180 children who had presented with signs and symptoms suggestive of SBO, 98(54.4%) had undergone CT scan and were included in the study. The mean age of these 98 patients was  $7.67 \pm 4.33$  years, and mean duration of symptoms was  $2.84 \pm 1.17$  days. Overall, 65(66.0%) patients were males and 33(34.0%) were females. In terms of obstruction, 59(77.0%) children had it at the level of ileum and 17(22.0%) were at the level of jejunum. The causes of obstruction identified were adhesions in 26(34.0%), case tuberculosis (TB) in 25(33.0%), typhoid 9(12.0%), Meckel's diverticulum 6 (7.9%), trauma in 4(5.3%) and 2(2.04%) cases each of volvulus, tumour and intussusception.

Of the total, 78(94.9%) patients were identified as positive for SBO on the CT scan and underwent laparotomy. Of them, 74(95%) patients had true obstruction confirmed on laparotomy, while 4(5%) patients didn't have SBO on laparotomy (Table).

Sensitivity, specificity, PPV, NPV and accuracy of CT in the detection of small bowel obstruction was 97.4%, 81.8%, 94.9%, 90.0% and 93.9% respectively.

## Discussion

SBO is not uncommon in children. Early diagnosis and treatment is necessary to prevent bowel ischaemia and the resultant need for bowel resection. Plain radiographs are usually the initial imaging tools for diagnosis. CT scan of the abdomen is often used when there is ambiguity in terms of diagnosis, site and cause of obstruction. In adults, CT scan has emerged as a valuable diagnostic tool in the assessment of SBO. Several studies have assessed its utility in detection of SBO with sensitivity and specificity of 94%.<sup>7</sup> CT scan abdomen has been shown to be useful in identifying the site and to some extent the cause of obstruction as well.<sup>8</sup> However, literature regarding the role of CT scan in paediatric SBO is very limited. The first paper was published in 1996 by Jabra et al. and the purpose was to increase awareness of CT as potential problem solving tool for SBO in children.<sup>9</sup> In 2001, the same authors published results with sensitivity of 87% and specificity of 86% of CT scan in the paediatric population of North America.<sup>10</sup> These two studies were published more than a decade ago when multi-detector CT and multi-planar reformats were not universal standard.<sup>9,10</sup>

Over the last 15 years, significant improvements have occurred in scanning technology with resultant gain in image quality and speed. This has further improved the sensitivity in diagnosing SBO in children.<sup>10</sup> In our study, CT correctly diagnosed obstruction in 74 out of 78 (97.37%) patients. The other 4 cases that were CT-positive for SBO turned out to be primary peritonitis with no mechanical obstruction on laparotomy. In all these 4 cases CT showed dilated small bowel loops >2.5cm with moderate free peritoneal fluid but without enhancements or thickening of peritoneal lining. Out of 20 cases where CT findings were negative for SBO, 2 patients required laparotomy for early postoperative bowel adhesions because of persistent clinical features of obstruction (specificity 81.81%). The possible explanation in these 2 cases reported false negative is the early scanning during the course of the disease i.e. within 48 hours of regaining bowel function after abdominal surgery (average duration of symptoms in this series was  $2.84 \pm 1.17$  days). The other 18 cases, although presented clinically with

**Table:** Distribution of Small Bowel Obstruction on C.T Scan and Laparotomy.

C.T scan	Small bowel obstruction present on Laparotomy	Small bowel obstruction absent on Laparotomy	Total
Small bowel obstruction present	74	4	78
Small bowel obstruction absent	2	18	20
	76	22	98

CT: Computed tomography.

features of obstruction, were correctly reported negative on CT as they had no mechanical obstruction and settled with conservative management. They turned out to be 13 cases of abdominal tuberculosis, 3 cases of salmonella enteritis and 2 cases of post-diarrhoeal ileus. All these cases had infective aetiology with functional ileus.

Those who underwent laparotomy, 77.0% had obstruction in ileum and 22.0% in jejunum. Majority of cases had obstruction secondary to post-operative adhesions (35.0%). Tuberculosis is endemic in this region, 26 cases had abdominal tuberculosis presenting with small bowel obstruction confirmed on laparotomy. This is followed by typhoid perforation with 9(12.0%) cases. Others were complicated Meckel's diverticulum 6(7.9%), trauma 4(5.3%) and 2(2.04%) cases each of volvulus, small bowel tumour and intussusception. These findings were similar to those in the paediatric literature reported by Wang et al. with respect to site and cause of obstruction.<sup>11</sup>

In the present study sensitivity, specificity, PPV, NPV and accuracy of CT in SBO detection was 97.4%, 81.8%, 94.9%, 90.0% and 93.9% respectively.

In adults studies have reported variable figures of sensitivity, specificity, and accuracy values, which can be explained by their early presentation with sub-acute bowel obstruction.<sup>12</sup> The sensitivity of CT in studies with partial SBO ranged from 48-100%.<sup>13</sup>

In a study, 28 of 37 adult patients had simple adhesive SBO picked up on CT and successfully managed conservatively.<sup>14</sup> In older children, like adults, sub-acute SBO tends to resolves with nasogastric drainage and intravenous fluids, and surgical intervention is usually reserved for those who have persistent obstruction or evidence of intestinal ischaemia. Over the years, oral contrast studies have severed an important imaging modality in the assessment of sub-acute SBO.<sup>15</sup> Children find it very distressing and tedious, and it is also a time-consuming procedure.

Therefore, use of CT is paramount for surgical decision-making, its easily available, can be performed quickly and safely without oral contrast. The main limitation of the current study is its retrospective nature and multiple radiologists reporting on CT scans.

## Conclusion

CT has a high sensitivity, specificity, and accuracy in revealing SBOs in children. Familiarity with the appearance of obstructive lesions on CT images and the use of helical

and multi-detector scanners will likely yield better scans and improved results. CT scan can be considered a modality of choice in cases where detailed images are required to establish management plan for suspected SBO.

**Disclaimer:** Oral Presentation at WOFAPS 2016 Washington D.C., United States; World Federation of Associations of Paediatric Surgeons.

**Conflict of Interest:** None.

**Source of Funding:** None.

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