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Accuracy of Computed Tomography in Small Bowel Obstruction

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Small bowel obstruction is a common clinical occurrence, primarily caused by adhesions. The diagnosis is usually made on the clinical findings and the presence of dilated bowel loops on plain abdominal radiograph. Computed tomography (CT) is increasingly used to diagnose the cause and location of the obstruction to aid in the timing of surgical intervention. We used a retrospective chart review to identify patients with a diagnosis of small bowel obstruction between 2009 and 2012. We compared the findings on CT with the findings at operative intervention. Sixty patients had abdominal CT and subsequent surgical intervention. Eighty-three per cent of CTs were correct for small intestine involvement and 80 per cent for colon involvement. The presence of adhesions or perforation was correctly identified in 21 and 50 per cent, respectively. Sixty-four per cent correctly identified a transition point. The presence of a mass was correctly identified in 69 per cent. Twenty per cent of the patients who had ischemic small bowel at surgery were identified on CT. CT has a role in the clinical assessment of patients with small bowel obstruction, identifying with reasonable accuracy the extent of bowel involvement and the presence of masses and transition points. It is less reliable at identifying adhesions, perforations, or ischemic bowel.

Small bowel obstruction (SBO) is a common surgical problem with 300,000 annual hospital admissions in North America.[1] The leading cause for SBO is adhesions resulting from previous abdominal surgery, which has been reported as up to 80 per cent.[2–4] Hernias are the second most common cause of obstruction followed by other causes including masses and narrowings of the intestinal lumen, which may be either inflammatory or neoplastic. In patients without previous surgery, and the developing world, the most common cause of SBO is hernias.[4]

Computed tomography (CT) scans have been increasingly used for the evaluation of SBO. Improvements in image quality and availability over recent years has increased the accuracy of information about the etiology and stage of disease that can be determined from CT evaluations. This is much more than can be gleaned from plain abdominal radiographs alone.

Small bowel obstruction can be classified in many different ways, high-grade *versus* low-grade, high *versus* low, but one of the most important is complete *versus* partial. A partial obstruction may spontaneously resolve with time, but most complete obstructions require urgent operative intervention. CT scans are increasingly used for risk stratification, to determine which patients require early intervention, and to identify those than can be safely managed conservatively. Patients with clear clinical signs of peritonitis or ischemia, with pain, guarding, raised white cell count, or evidence of a complete obstruction will need emergent surgery. CT has a major role in patients who do not have clear signs and symptoms at presentation or equivocal findings on plain film, and their need for early intervention may only be detected on CT; a delay in surgery may result in increased morbidity or mortality.[5] There is a fourfold risk of mortality associated with nonviable bowel found on abdominal exploration.[6]

The site and cause of obstruction is valuable information for surgeons making the decision to operate. Identification of the transition point on CT is important for the evaluation of the etiology, because it can often be identified at this point. Colon et al.[7] found a 63 per cent positive predictive value for correlation between the radiographically identified transition zone and operative findings. The importance of the information that CT can give clinicians, over and above that which can be determined on plain abdominal films, to guide operational planning has led to its inclusion

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in the recent guidelines for the management of SBO.[8, 9] The availability of CT scans with reporting at all times of day, we predict, will soon lead to CT scans in all patients requiring operations. However, how accurate is the information that we get from these scans? Our objective was to assess the accuracy of CT reporting in patients with SBO in our institutions.

Methods

We obtained permission from the Institutional Review Boards and performed a retrospective chart review on 223 patients discharged with a diagnosis of SBO from January 2009 until September 2012 at University Hospital and Robley Rex Veterans Affairs Medical Center, Louisville, Kentucky.

We collected data on patient characteristics, imaging performed, and surgical intervention. In particular we looked for the correlation between the CT report and operation note for important factors in the evaluation of SBO. The presence of a small or large bowel involvement, transition point, adhesions, perforation, masses, incarcerated and strangulated hernias, ischemic colitis, small bowel infarct, carcinomatosis, and irritable bowel disease was reviewed from the CT and operation report. Statistical analysis on the data was performed using SigmaPlot 11.0 (Systat Software Inc., Chicago, IL).

Results

We identified 223 patients who were discharged with a diagnosis of SBO during the time period. One hundred seventy-six patients were evaluated with CT scans and 60 of these went on to have operations. Two patients had laparoscopic operations; the remainder was performed open. The average age of the patients was 66 years (range, 17 to 90 years), and 58 (97%) were male, which is expected given the large veteran population in our study.

Twenty-five CT scans accurately predicted small bowel involvement with a successful diagnosis rate of 83 per cent. Eighteen CT scans predicted large bowel involvement, which were correct in 12 cases (80%). Adhesions were seen on eight CT scans but were present in 29 operations with a diagnostic accuracy in only six (21%). Perforations were correctly identified in two cases, although they were reported on a further two scans, which had no mention of perforation in the operation report.

A transition point was identified on 24 CT scans, but only noted in 11 operations, with a correlation between the CT and operative findings in seven cases (64%). Masses were seen in 12 CT scans, although only nine (69%) of these were commented on in the accompanying operation note, missing a further four masses. Five incarcerated hernias were correctly identified on CT, 56 per cent of those seen at operation. Strangulated hernia was incorrectly noted on two CT scans and missed on a further three.

There was one report of ischemic colitis on CT, which was not noted at operation, and the CT reports did not identify the other three cases found at surgery. Three cases of small bowel infarction were identified on CT images, although only one of these was noted to be accurate at operation, missing the other four cases that had small bowel infarction present at operation. Carcinomatosis was correctly identified on 66 per cent (two of three) of CT scans in patients with carcinomatosis and inflammatory bowel disease was correctly identified on CT in all cases where it was present.[1]

Discussion

There are approximately 600 per 100,000 population annual hospital discharges with a diagnosis of SBO in the United States.[10] Adhesions are the most common cause of obstruction in the Western world and rates of adhesions have remained stable over time.[10, 11] In our study, adhesions were reported on only eight CT scans but were noted to be present in 29 operations with a diagnostic accuracy of only 21 per cent[6] (Table 1). Adhesive bands are typically not visible on CT, so this is often a diagnosis of exclusion on CT images.[12] Kinking or tethering of the bowel at an identifiable transition point is often a good indication of adhesions, especially with a history of previous surgery. The difficulty of identification of adhesions justifies the lack of accuracy seen in our cases. Recent articles have shown a decreased risk of admission for SBO after laparoscopic rather than open surgery for cholecystectomy, hysterectomy, and bowel resection and a decreased need for operative intervention during admission. This is despite similar rates of SBO, which may be the result of a less severe adhesion profile.[11, 13] Two of our patients were able to be treated laparoscopically, which might signify a less severe phenotype.

We found 64 per cent[7] of our patients who had transition points identified on CT scan had the transition point commented on in the operation note. This fits with the previously reported 63 per cent positive predictive value[7] but seems low based on the improvements in CT image quality. This may be the result of underreporting of identification of the transition point in the operation note or an error in CT evaluation.

Overall 80 per cent were accurate for small or large bowel involvement and greater than 66 per cent for masses, carcinomatosis, and inflammatory bowel disease. Hernias were more likely to be misdiagnosed as

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TABLE 1. *Comparison of Preoperative CT Scanning and Operative Findings*

Factor	Number Seen on CT	Number Seen at Operation	Number Seen in Both CT and Operation	Accuracy (%)
Small bowel involvement	40	30	25	83
Colon involvement	18	15	12	80
Adhesion	8	29	6	21
Perforation	4	2	2	100
Transition point	24	11	7	64
Masses	12	13	9	69
Strangulated hernia	2	3	0	0
Incarcerated hernia	7	9	5	56
Ischemic colitis	1	3	0	0
Small bowel infarct	3	5	1	20
Carcinomatosis	2	3	2	67
Irritable bowel disease	1	1	1	100

CT, computed tomography.

were signs of ischemia. There were several false-positives in the reporting of some factors: 50 per cent[2] of perforations and multiple cases involving ischemia of the small or large bowel, which may have led to unnecessarily early intervention.

Currently, evidence is emerging regarding early CT identification of patients who may fail conservative management. This group may exhibit signs of small bowel feces, mesenteric edema, mesenteric fluid, and free fluid and could benefit from earlier intervention.[12] Few diagnostic procedures in medicine are accurate at identifying all pertinent information consistently, and human error in interpretation plays a role as well. Overall, CT scans and expert radiologic interpretation in patients with suspected intestinal obstruction are often helpful; however, our data indicate room for improvement in this imaging study and caution in overdependence on such studies in making important clinical decisions. Future use of CT scans will likely increase, to hopefully allow earlier identification and intervention in these patients who will benefit from an early operation and decrease the morbidity and mortality associated with SBO. However, their usefulness is currently limited by lack of correlation with operative findings. Such discrepancies should be discussed between the surgeon and radiologist and should continue to be the subject of discussion at teaching conferences.

Limitations

As a retrospective chart review, the accuracy of our results is dependent on the documentation of others in the reporting of CT images and operative findings. A more accurate result could be obtained by a prospective study with collaboration from radiology to assess CT images and an active participant looking for the assessed findings in the operating room.

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