# Accuracy of 64 Sliced Multi-detector Computed Tomography in Diagnosis of Small Bowel Obstruction

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***Objective:*** *The purpose of the present study was to determine the accuracy of 64 sliced multi-detector computed tomography (MDCT) in the diagnosis of patients with suspected small bowel obstruction (SBO) and identify the definite cause of SBO for further investigation or treatment.*
***Material and Method:*** *A retrospective study was performed on 35 patients with suspected SBO who underwent 64 sliced MDCT to establish the diagnosis and cause of SBO. The patients were enrolled from January 1, 2005 to June 30, 2007. The MDCT scan of whole abdomen from patients with suspected SBO were retrospectively evaluated by two gastrointestinal radiologists without knowledge of the patients history determined the presence or absence of SBO, cause, location, small-bowel feces sign, complication (sign of associated bowel strangulation), and confident on a five-point scale. Sensitivity and specificity estimates with confidence intervals were calculated. Weighted-kappa statistics were used to estimate agreement between readers.*
***Results:*** *Twenty-five patients ultimately proved to have SBO, and ten patients had no evidence of SBO. The overall sensitivity, specificity, and accuracy of 64 sliced MDCT to establish the diagnosis of SBO were 96%, 100%, and 97%, respectively. The final diagnosis was established either by surgery (13 patients) or by the clinical evolution (12 patients). Causes of SBO included adhesions (n = 10), metastases (n = 4), post-radiative enteropathy (n = 1), internal hernia (n = 3), ileitis (n = 2), inguinal hernia (n = 1), submucosal hemorrhage (n = 1), benign stricture secondary to chronic pancreatitis (n = 1), midgut volvulus (n = 1), and SMA syndrome (n = 1). When obstructions were classified into low and high grade obstruction, CT results could be used to identify correctly 100% (13 of 13) of high grade SBO and 58% (7 of 12) of low grade SBO. The 64 sliced MDCT yielded one false-negative for patients with partial SBO due to adhesion band. Small-bowel feces sign was detected in 4 of 25 patients, who were diagnosed as SBO.*
***Conclusion:*** *The 64 sliced MDCT is a highly sensitivity and specificity method to diagnose SBO and cause of obstruction. The ability of MDCT to show the cause of SBO makes CT an important additional diagnostic tool when specific management issues must be addressed.*

***Keyword:*** *Small bowel obstruction, Multi-detector computed tomography, Small bowel sign*

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The need to confirm or exclude suspected SBO is a frequent indication for the performance of abdominal radiologic examinations in hospital-based practices. In the past, plain abdominal radiography and barium examinations have been the standard methods of abdominal imaging. The usefulness of abdominal computed tomography (CT) in establishing the diagnosis and cause of SBO has been described and a diagnostic accuracy of 90-95% has been shown[1,2]. It has been proposed as a useful adjunct diagnosis procedure in detecting the presence of small bowel obstruction, its level, and its cause and complication. Recently, multidetector computed tomography (MDCT), a newly advanced technique that acquires isotropic data, multiplanar and 3D evaluation which improved detection and characterization of small bowel pathology has been introduced[3]. The diagnosis of SBO on CT involves identifying dilated

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loops of bowel proximally with normal-caliber or collapsed loops distally. A small bowel caliber of greater than 2.5 cm is considered dilated[4].

Accordingly, the authors performed a retrospective study to establish accuracy of 64 sliced MDCT in the diagnosis of SBO, cause, and its location in Siriraj Hospital.

## Material and Method

This retrospective review was performed on a database containing the records of patients at Siriraj Hospital which were approved by a local institutional review board. The board determined that this retrospective study could be conducted without acquiring a signed informed consent from the patients. Patients' symptoms, admission records, surgical records, follow-up records and pathological findings were evaluated. The patients were enrolled from January 1, 2005 to June 30, 2007. Clinical suspicion was based on the known symptoms and signs of obstruction, including abdominal pain, nausea and vomiting, abdominal distension, abdominal tenderness, abnormality of bowel sounds, and abdominal mass.

The present study population comprised 45 patients in whom obstruction of the small bowel was suspected clinically and underwent 64 sliced MDCT (LightSpeed 64 scanner, GE Healthcare or Somatom Sensation 64, Siemens Medical Solutions) to establish the diagnosis of SBO. Thirty-five MDCT scans were available for review by two gastrointestinal radiologists without knowledge of the patients' history and final diagnosis. The readers were asked to evaluate whether obstruction was present and if present, the level, cause of the obstruction and small-bowel feces sign were assessed. Additional in the case of SBO being present on MDCT, the authors tried to identify signs of associated bowel strangulation, indicating the need of rapid surgical treatment. The following signs were studied: bowel wall edema, ascites, target sign, mesenteric fluid, congestion of mesenteric vessels, pneumatosis intestinalis, portal vein gas, absent bowel enhancement, mesenteric hemorrhage, and increased density of bowel wall in non-contrast enhanced CT.

The presence or absence of obstruction was determined by means of consensus of the two readers with a five-point confidence scale (0 = none, 1 = probably no obstruction, 2 = indeterminate, 3 = probable obstruction, 4 = definite obstruction). Only the consensus readings were used for analysis. A rating of "Probable obstruction" or "definite obstruction" was considered a positive finding for small bowel obstruction. A rating of "none" or "probably no obstruction" was considered a negative finding for small bowel obstruction.

Sensitivity and specificity for the diagnosis of SBO were calculated and reported with 95% exact binomial confidence intervals. An interobserver agreement was assessed with weighted-kappa statistic was interpreted by using the following scale: fair agreement, 0.21-0.40; moderate agreement, 0.41-0.60; substantial agreement, 0.61-0.80; and almost perfect agreement, 0.81-1.0[7].

### *Patient characteristics*

There were 25 men and 10 women (age range, 14-92 years, mean age 55.9 years). A history of previous abdominal surgery was present in 14 patients (40%). Sixteen patients (46%) had a history of malignancy including 9 patients who had undergone abdominal radiotherapy. Three patients (9%) had a history of hematologic disorders, including Hemophilia A, anaplastic anemia, and idiopathic thrombocytopenic purpura. One patient (3%) had a history of genitourinary problem as acute ureteric obstruction with perinephric collection, who presented with clinical to be ruled out SBO. One patient (3%) had a history of systemic lupus erythematosus (SLE) with lupus nephritis.

### *Examination technique*

All the examinations were performed on 64 sliced MDCT in Siriraj Hospital institution (LightSpeed 64 scanner, GE Healthcare or Somatom Sensation 64, Siemens Medical Solutions).

MDCT scans were obtained with a 64 sliced MDCT (LightSpeed VCT, GE Healthcare) using the following scanning parameters: collimation, 16 x 0.75 mm; table feed/rotation, 9 mm; slice width, 0.75 mm; volume pitch, 16; 120 kVp; and 500 mAs.

MDCT scans were obtained with a 64 sliced MDCT (Somatom Definition, Siemens) using the following scanning parameters: collimation, 16 x 0.75 mm; table feed/rotation, 9 mm; slice width, 0.75 mm; volume pitch, 16; 120 kVp; and 250 mAs.

All 10 control scans were obtained using IV contrast medium and 3% iodinated water-soluble oral contrast agent. Of the 25 patients with small bowel obstruction, 24 patients received IV contrast medium, and 15 patients received oral contrast medium. Water in dilated small bowel loops were used as negative contrast agent in the rest of this group. At the beginning of the contrast-enhanced CT scan, 100 ml of

nonionic iodinated contrast material was injected IV through a 20-gauge cannula at 3 ml/sec using an automated power injector. The delay between the start of contrast administration and the start of helical scanning was approximately 70 seconds to achieve the venous phase (using the CARE bolus-triggering program). Images were obtained from the dome of the liver to the lower margin of the symphysis pubis during a single breath-hold. Images were reconstructed at 1.25-mm intervals with soft-tissue algorithm. Coronal and sagittal reformation of original axial images were performed for evaluation in each case.

*Image analysis*

***Presence of a change in caliber of a small bowel loop:*** This finding was based on the presence of a change in caliber of a loop of the small bowel from a distended segment proximal to the point of obstruction to a collapsed segment distal to the obstruction. A loop of the small bowel wider than 2.5 cm was considered to be distended[4]. If the transition zone could not be defined, obstruction was considered indeterminate or absent.

***Cause of SBO:*** When a point of transitional from dilated bowel to normal caliber without apparent cause was identified, adhesions were presumed to be the cause of obstruction[1,2].

***Degree of obstruction:*** Classified as low grade and high grade obstruction which were defined as more than 50% and 80% change of caliber respectively.

***Location:*** 2 sites; proximal (duodenum, jejunum) and distal (distal jejunum and ileum )

***Small-bowel feces sign:*** It is defined by the presence of particulate (colon-liked) feculent matter mingled with gas bubbles in the lumen of dilated loops of the small intestine. The small-bowel feces sign has been described as a finding indicative of SBO or another severe small-bowel abnormality[4-6]. If there was presence of small-bowel feces sign, the involved length was measured.

***Bowel wall edema:*** A bowel wall thickness of 2 mm or less was considered normal. Bowel wall thickness was considered abnormal if it appeared to be thicker than 2 mm in a non-collapsed segment[8]. Owing to the difficulty of accurately measuring the thickness of the small bowel wall, this wall, this evaluation was partly subjective, and the values were therefore not recorded.

***Ascites:*** This was defined as presence of fluid in the peritoneal cavity as opposed to fluid in the mesentery[8]. The amount and attenuation value of ascites were not measured.

***Target sign:*** The target sign is seen on contrast material-enhanced CT. With this sign, the thickened bowel wall demonstrates three layers that comprise a contrast-enhanced inner (mucosal) and outer (muscularis) layer of high attenuation between which is a layer of decreased attenuation (submucosal edema)[9].

***Mesenteric fluid:*** The presence of localized fluid in the small bowel mesentery attached to abnormal (dilated, thicked) small bowel loops was considered abnormal[8]. The amount of fluid was not evaluated and the attenuation was not measured.

***Congestion of mesenteric vessels:*** Enlargement of the small mesenteric vessels around the site of the obstruction compared with mesenteric vessels distant from this site was considered a positive finding[8].

***Absent bowel enhancement***: This finding was based on visual comparison of the attenuation of the bowel wall at the site of the obstruction with the attenuation of bowel loops distant from this site, after contrast material injection[8].

***Pneumatosis intestinalis:*** This condition in which gas is found in a linear or cystic form in the submucosa or subserosa of the bowel wall[10,11].

***Portal vein gas:*** At CT, portal vein gas appears as tubular areas of decreased attenuation in the liver which is caused by the accumulation of gas in the intrahepatic portal veins, from where it is carried by centrifugal blood to the hepatic periphery. The radiographic criterion for portal vein gas is a branching area of low attenuation extending to within 2 cm of the liver capsule[11].

***Increased density of the bowel wall in non-contrast enhanced CT:*** High attenuation of the wall is caused by intramural hemorrhage and hemorrhagic infarction[12].

**Results**

A total of 45 patients were considered in the original sample. In the cases of 10 of the patients were excluded due to lost follow-up (n = 5) and incomplete records (n = 5), finally 35 of the patients were included in the present study; 25 men, 10 women; mean age 55.9 years.

Of the 35 patients examined to rule out SBO, twenty-five patients ultimately proved to have SBO, and ten patients had no evidence of SBO. Of the 25 patients with SBO, there were 24 (96%) true-positive

interpretations for obstructions and one (4%) false-negative interpretations. Of the 10 patients without SBO or control group, there were all (100%) true-positive interpretations with no SBO (Table 1).

The overall sensitivity, specificity, and accuracy of MDCT to establish the diagnosis of SBO were 96% (84-99%), 100% (72-100%), and 97%, respectively. Positive predictive value (PPV) and negative predictive value (NPV) were 1.00 (0.86-1.00) and 0.90 (0.62-0.98).

The final diagnosis was established either by surgery (13 patients) or by the clinical evolution (12 patients). When obstructions were classified into low and high grade obstruction, CT findings were identified of high grade SBO in 13 patients and low grade SBO in 12 patients. In addition, CT results could be used to identify correctly 100% (13 of 13) of high grade SBO and 58% (7 of 12) low grade SBO (Table 2).

Causes of SBO included adhesions (n = 10), metastases (n = 4), post radiative enteropathy (n = 1), internal hernia (n = 3), ileitis (n = 2), inguinal hernia (n = 1), submucosal hemorrhage (n = 1), benign stricture secondary to chronic pancreatitis (n = 1), midgut volvulus (n = 1), and SMA syndrome (n = 1). The cause of obstruction was correctly predicted in 92% (23 of 25) (Table 3).

Nine of ten patients who had SBO from adhesions were depicted on CT scan (Fig. 1); history of previous surgery (n = 8) and no previous surgery (n = 2). One patient who recently underwent abdominal surgery with development of abdominal distension had a surgically proven diagnosis of adhesion. Both reviewers interpreted as post operative ileus in this patient.

Four patients who had SBO from metastases were depicted on CT scan (Fig. 2) which included primary malignancy such as rectal cancer (n = 2), cervical cancer (n = 1) and bladder cancer (n = 1). In the one case of bladder cancer, CT revealed recurrent tumor at anastomotic site (ileal conduit), who received surgical intervention; partial ileal resection with ileocolic anastomosis.

One of one patient who had SBO from post-radiation enteropathy was detected on CT scan (Fig. 3). The patients who had a history of uterine cancer, status post operative hysterectomy, received external beam irradiation at the pelvic region.

Two of three patients who had SBO from internal hernia were depicted on the CT scan, one had a sign of associated bowel strangulation; bowel wall edema with increased density of bowel wall in non-contrast enhance CT, target sign, mesenteric fluid but limited in evaluating congestion of mesenteric vessels or absent of bowel wall enhancement because contrast-enhanced CT was not obtained (Fig. 4). However, intra-operative finding found gangrene of the small bowel, so partial small bowel resection with end-to-end anastomosis was performed in this case.

One patient, who was diagnosed with indirect inguinal hernia (IIH), CT scan could identify its (Fig. 5) and the patient was managed by repair IIH.

**Table 1.** Summary of CT scan interpretations in establish diagnosis of small bowel obstruction

| Interpretations | Patient with SBO | Patient without SBO |
|---|---|---|
| Positive CT finding | 24 | 0 |
| Negative CT finding | 1 | 10 |
| Total | 25 | 10 |

**Table 2.** Summary of CT scan interpretations in establish grading of small bowel obstruction

| Grading | CT present | |
|---|---|---|
| | No. | % |
| High grade | 13/13 | 100 |
| Low grade | 7/12 | 58 |
| Total | 20/25 | 80 |

**Table 3.** Summary causes of small bowel obstruction

| Cause of SBO | Correct CT diagnosis | |
|---|---|---|
| | No. | % |
| Adhesions (n = 10) | 9/25 | 36 |
| Metastases (n = 4) | 4/25 | 16 |
| Post-radiation enteropathy (n = 1) | 1/25 | 4 |
| Internal hernia (n = 3) | 2/25 | 8 |
| Ileitis (n = 2) | 2/25 | 8 |
| Inguinal hernia (n = 1) | 1/25 | 4 |
| Submucosal hemorrhage (n = 1) | 1/25 | 4 |
| Benign stricture secondary to chronic pancretitis (n =1) | 1/25 | 4 |
| Midgut volvulus (n = 1) | 1/25 | 4 |
| SMA syndrome (n =1) | 1/25 | 4 |
| Total | 23/25 | 92 |

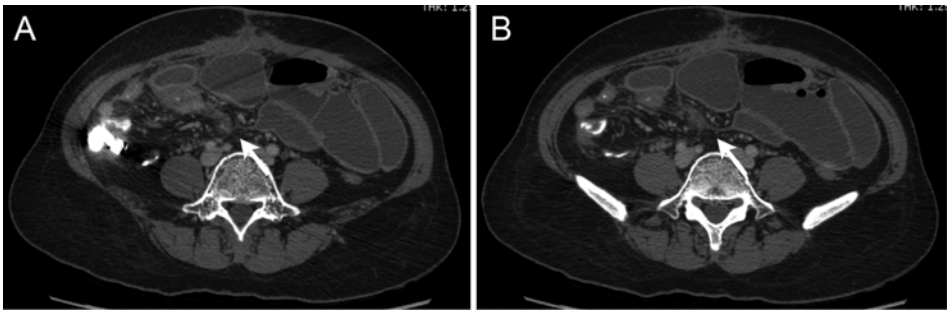


**Fig. 1** Axial CECT scans of abdomen in 51-year-old female patient who presented with clinical suspected acute small bowel obstruction and undergone previous abdominal surgery. (A, B) CT scan shows abrupt diameter change between the dilated jejunum and the collapsed ileum loops or bird-beak appearance (transitional zone; white arrow). These findings are findings are represent distal small bowel obstruction secondary to the adhesion band

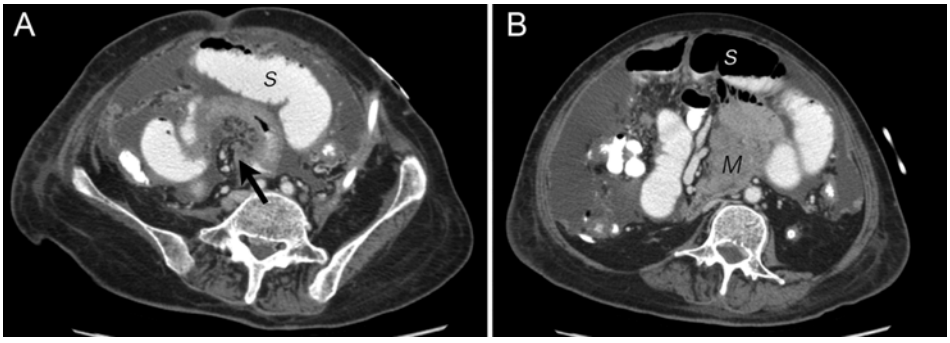


**Fig. 2** Small bowel obstruction secondary to carcinomatosis peritoneii; axial CECT scans of abdomen in 63-year-old female patient underlying cervical cancer, underwent hysterectomy with bilateral salphingectomy and external beam irradiation at pelvis. (A, B) CT scan show serosal metastasis at distal small bowel loop (black arrow), causing proximal small bowel loops dilatation (s). Heterogeneous enhancing soft tissue mass is also noted at aortocaval (M), suggestive of lymph node metastasis

One patient with idiopathic thrombocytopenic purpura (ITP) who was diagnosed with submucosal hemorrhage at distal jejunum, CT scan identified it (Fig. 6). He received platelet and coagulation factors transfusion to improve his condition.

One patient who was diagnosed with midgut volvulus, CT scan could identify it and demonstrated the whirl sign appearance (Fig. 7).

One patient who was diagnosed with benign stricture secondary to chronic pancretitis, CT scan identified it, and underwent choledocoduodenostomy 5 years ago. Later, the diagnosis was proven by surgical interventention and found to be benign stricture at duodenal bulb and the second part of the duodenum (Fig. 8).

The last patient who was diagnosed with SMA syndrome had typical CT findings as vertical linear transition site from extraluminal vessels compression at the third portion of the duodenum, causing proximal duodenum dilatation.

Four of twenty-five patients who had SBO, MDCT scans were depicted with small-bowel feces sign (Fig. 6C); mean 7.3 cm in length involved. Small-bowel feces sign was not detected in patients without SBO.

Interobserver agreement was assessed with weighted-kappa statistic that as 0.918 at 95% CI (almost perfect agreement).

## Discussion

Due to clinical and abdominal plain film differentiation of simple obstruction, closed loop obstruction and strangulation of the bowel are unreliable but critical for patient management. CT now plays a primary role in evaluation of small

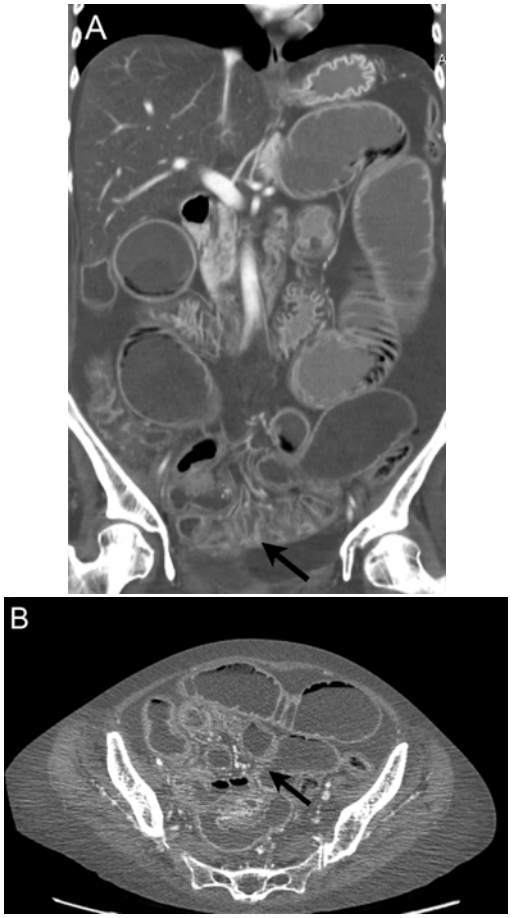


**Fig. 3** Coronal CECT (A) and axial CECT (B) scans of abdomen in 53-year-old female patient with history of uterine carcinoma, status post hysterectomy and external beam irradiation at pelvic region. (A, B)CT scan demonstrates small bowel wall thickening with an increased amount of soft tissue within mesentery (black arrow), findings there are consistent with radiation-induced fibrosis and cause to distal small bowel obstruction

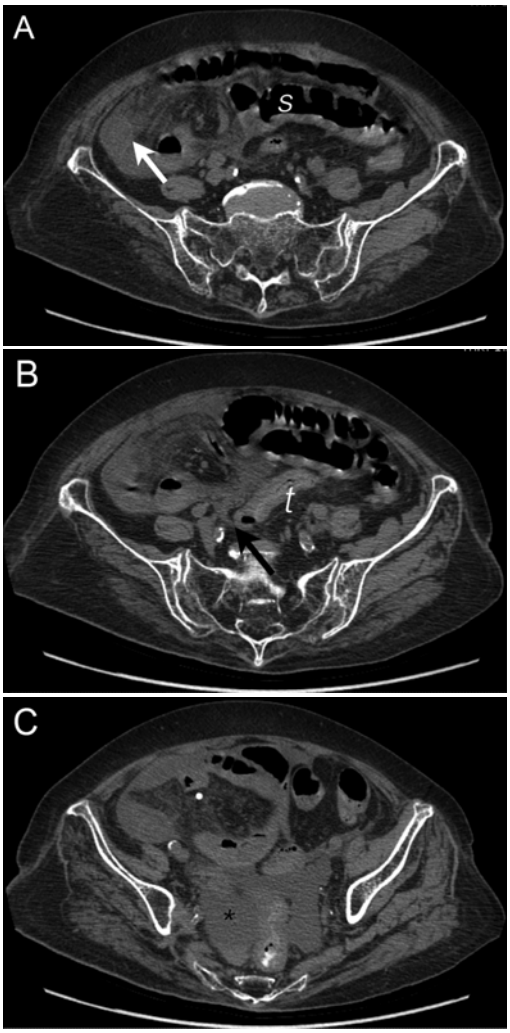


**Fig. 4** Axial NECT scans of abdomen in 86-year-old female patient with clinical peritonitis. (A-C) CT scan show generalized small bowel dilatation (s). Abrupt change in caliber at terminal ileum (t), represents transitional point (black arrow). Marked bowel thickening with increased density of bowel wall is noted at area of volvulus (white arrow). Layering of high-density fluid is also noted in pelvic cavity (*). All these findings are suggestive of distal small bowel obstruction secondary to volvulus and detectable sign of associated bowel ischemia. In later, she had underwent explore laparotomy that found internal hernia with small bowel gangrene

bowel obstruction for localized obstructive site, determine degree of obstruction, diagnose closed loop obstruction, and identify ischemia or perforation of involved bowel. The recent multi-detector CT (MDCT) technique and multiplanar reformation, which optimize the visualization of bowel and adjacent anatomic structures, are helpful in delineating anatomy and identifying an obstructive transition point with greater reliability and confidence. Furthermore, the fast speed of scanning optimizes the evaluation of a patient who has closed loop obstruction or bowel ischemia because artifacts caused by bowel motility, respiratory and patient motion are minimized[13].

A recent MDCT study[14] using multiplanar reformation did not demonstrate significantly improved

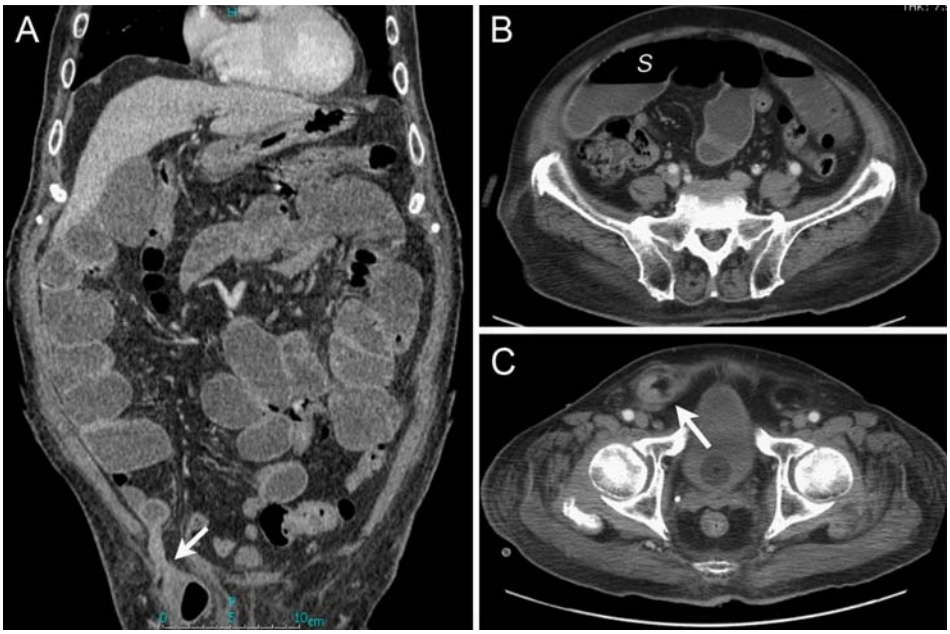


**Fig. 5** Axial CT scans of abdomen in 77-year-old male patient with history of lump at right groin for 2 years and had acute abdominal pain for 1 day. Coronal (A) and axial (B, C) CECT show herniated ileal loop to the right groin region (white arrow) and dilatation of small bowel loops (*S*), The mass represents right indirect inguinal hernia, causing distal small bowel obstruction

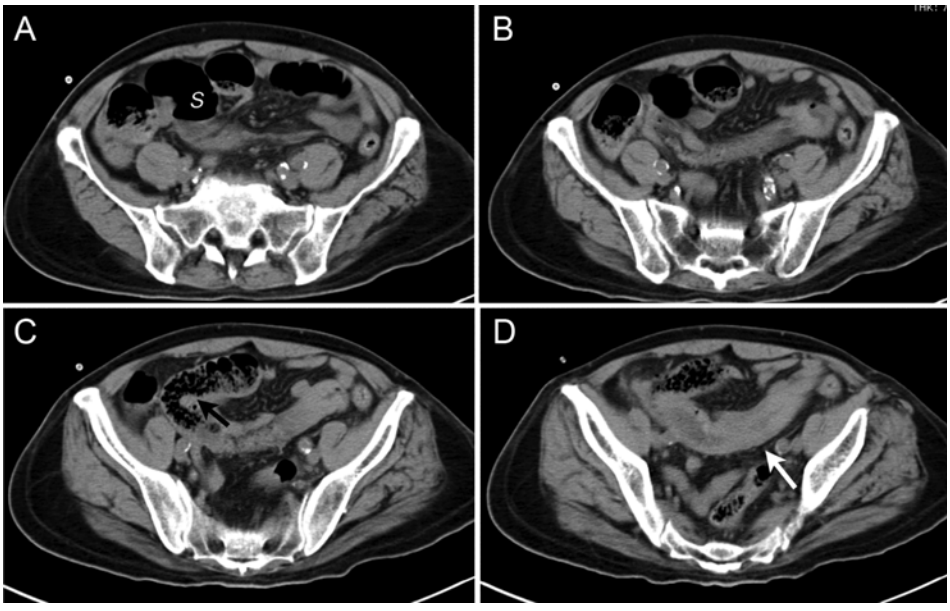


**Fig. 6** Small bowel obstruction secondary to submucosal hemorrhage; axial NECT scans of abdomen in 73-year-old male patient who was idiopathic thrombocytopenic purpura and presented with symptoms indicating sudden onset of small bowel obstruction. NECT scan shows focal high-attenuation small bowel wall thickening at ileum (white arrow), compatible with submucosal hemorrhage. Dilatation of the small bowel is seen (s), Small bowel feces sign is also noted proximal to obstructive point (black arrow)

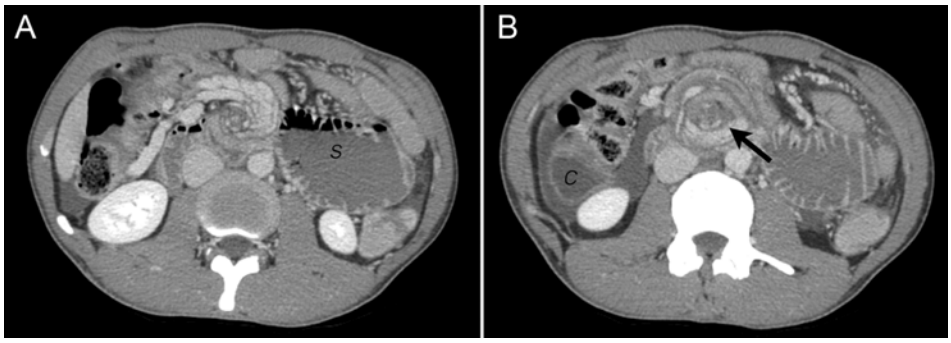


**Fig. 7** Axial CECT scans of abdomen in 25-year-old male patient who presented with clinical suspected acute small bowel obstruction. (A, B) CT scan shows severe dilatation of proximal jejunum (*s*). The whirl sign of mesenteric vessels along mesenteric root is seen at mid abdomen (black arrow). All these findings are compatible with midgut volvulus and no evidence of bowel ischemia is noted. High position of cecum is also observed (*c*)

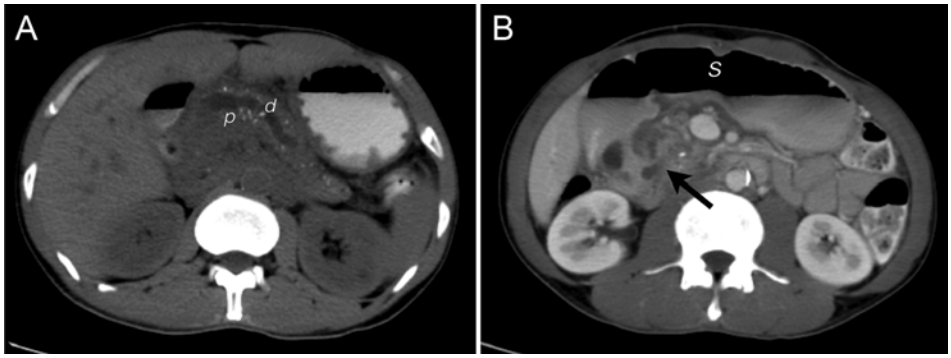


**Fig. 8** Axial NECT (A) and CECT (B) scans of abdomen in 36-year-old male, who underwent choledocoduodenostomy for 5 years. (A) NECT scan shows discrete calcification within pancreatic parenchyma (*p*) with diffuse dilatation of main pancreatic duct (*d*), consistent with chronic pancreatitis. (B) CECT scan shows heterogeneous soft tissue enhancing lesion at pancreatic head with pressure effect to the second part of duodenum (black arrow), causing proximal duodenum and stomach dilatation (*s*)

sensitivity and specificity of diagnosis SBO relative to evaluation of transverse images alone. However, the use of coronal reformation images has been shown to increase confidence of radiologist. Furthermore, clinicians are appreciative of more familiar anatomy demonstrated with multiplanar reformation.

CT findings of SBO included dilated proximal and collapsed or normal-appearing distal small-bowel loops. If a diameter of 2.5 cm is used to indicate small-bowel dilatation, 25 of our 35 patients with obstruction were diagnosed correctly by CT as having SBO. In most of these patients, the transition from dilated to collapsed or normal-appearing loops was abrupt, so that the CT diagnosis was obvious. The CT diagnosis of SBO is more difficult or missed in patients with a gradual transition or low grade obstruction. This pitfall was a similar finding that was mentioned by previous studies in which the CT is less precise (reported accuracy, 48%-67%) for depicting low-grade SBO because changes in bowel caliber are more subtle with low-grade SBO[15-17].

In adhesion, subsequent surgery in patients who have undergone laparotomy at least once reveals adhesions in over 90% of cases[18]. These adhesions occupy either the area of surgical intervention or the undersurface of the abdomen. However, adhesions produce symptoms in only a minority of cases. Adhesions are responsible for at least 60% of cases of SBO; more than 80% of these lesions occur after surgery, 15% are due to inflammation, and the

remaining few are due to congenital or unexplained causes[20]. The diagnosis of SBO due to adhesions is made when all other causes of obstruction have been ruled out at CT. Bowel obstruction is considered to be present at CT when distended bowel loops are seen proximal to collapsed loops. When a point of transition from dilated small bowel to normal-caliber bowel without apparent cause is identified, adhesions are the presumed cause.

About peritoneal carcinomatosis, ovarian carcinoma is the most frequent cause of metastatic disease of the omentum[21,22]. Other tumors that frequently spread to the omentum include carcinoma of the colon, stomach, pancreas, breast, and endometrium. CT findings in SBO secondary to peritoneal carcinomatosis include an omental mass in the transition zone causing obstruction[18].

One patient in the SBO groups caused by radiation enteropathy from, uterine cancer, localized to the irradiated area in pelvic cavity. In marked radiation-induces changes causing small bowel obstruction, CT shows diffuse wall thickening and mesenteric fibrosis[18]. Predisposing factors in the progression of radiation injury include excessive radiation, underlying cardiovascular disease, fixation of the bowel, and an asthenic habitus[19].

Internal hernia is a rare cause of SBO, with a reported incidence of 0.2%-0.9%[23,24]. These hernias may be either congenital or acquired. This condition involves herniation of a viscus, usually the small bowel, through a normal or abnormal aperture within the peritoneal cavity. This herniation may be persistent or intermittent. Because of the risk of strangulation of the hernia contents, even small intestinal hernias are dangerous and may be lethal[25].

Indirect inguinal hernias are the most common abdominal wall hernias. In cases of strangulated hernia, compromise of the blood supply is present, resulting in thickening of bowel loops. Adjacent inflammatory changes can be seen at CT in association with SBO[18].

Intramural intestinal hemorrhage, in adults may involve any portion of the small bowel and is usually a complication of anticoagulant therapy. However, it may also be secondary to any condition that predisposes to bleeding or result from trauma or biopsy[26]. Intraluminal intestinal hemorrhage most often involves the duodenum and jejunum, and its CT appearance depends on the age of the hematoma[18].

Small bowel volvulus is a rare but life-threatening surgical emergency. On the basis of its cause, volvulus of the small intestine can be divided into 2 types: primary volvulus, in which there are no predisposing anatomic abnormalities (idiopathic), and secondary volvulus, in which a congenital or acquired abnormality causes rotation of the bowel[27]. The most frequent causes of secondary volvulus are post-operative adhesions, in which the intestine is fixed to a point that acts as a pivot, and hernia[28]. The key feature that indicates a bowel volvulus is the presence of the whirl sign as described by Fisher, where the center of the whirl was the superior mesenteric artery (SMA) and the whirled appearance was created by the encircling loops of bowel. In conclusion, the whirl sign is highly suggestive of intestinal volvulus and should raise suspicion for complicated closed-bowel obstruction[29].

SMA syndrome is a rare condition in which the third portion of the duodenum is intermittently compressed between the aorta and the SMA. The basic diagnostic technique is a conventional barium study of the upper gastrointestinal tract, but findings are not specific and often are nondiagnostic. CT angiography (CTA) combined with 3D reconstructions is a non-invasive technique that may have a complementary diagnostic role similar to that of angiography in patients with a classic clinical presentation suggestive of SMA syndrome[29].

The small-bowel feces sign is a finding that can be observed on CT scans of the abdomen. It is the result of delayed intestinal transit and is believed to be caused by incompletely digested food, bacterial overgrowth, or increased water absorption of the distal small-bowel contents due to obstruction[4-6]. One study reported the presence of this sign in predominantly low grade, subacute obstruction[5]. Another study found that this sign is more often present in moderate and high grade obstruction[30]. The possible reason may be that it does not depend on the degree of obstruction, but the chronicity of the process is the possible cause. However, incidence of this sign varies from 7.4-82%[5,6,30]. The Recognition is important to prevent a delay in medical intervention. Since the sign is usually seen immediately proximal to the level of obstruction, it may be helpful in recognition of the exact site, cause and saves time for evaluated CT study.

The recommendation for evaluating a patient with clinically suspected small bowel obstruction with CT scan were acute symptoms especially an emergency patient, suspected bowel strangulation, inconclusive enteroclysis, planned for treatment as nonsurgical management, failed to conservative treatment in post

surgical patient, possibly colonic obstruction especially in an elderly patient and postoperative patients or patients with signs of intrabdominal inflammation[16].

Limitation of the present study is mainly the small number of subjects that are affected to evaluate additional signs such as small-bowel feces sign or sign of associated bowel strangulation. Then sensitivity, specificity and accuracy of these associated findings cannot be evaluated. Second, this retrospective study may be caused to bias in selective cases. Third, only 50% of the presented patients population with SBO surgically proven. Because the current treatment of SBO due to adhesions without clinical or imaging signs of closed loop or ischemia is nonsurgical. Fourth, the sensitivity and specificity may be decreased if comparison between bowel ileus and small bowel obstruction which must differentiate these 2 entities in daily clinical practice.

## Conclusion

MDCT is highly sensitive and specific in determining the presence of SBO and clearly demonstrates the site and cause of obstruction. The possibility of associated strangulation can be assessed with MDCT findings of bowel ischemia, particularly with contrast material administration or by pointing out the specific type of bowel obstruction (*i.e.*, closed-loop obstruction). MDCT is recommended for the evaluation of patients with suspected SBO, particularly when clinical and initial conventional radiographic findings remain indeterminate or strangulation is suspected.

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## *ความแม่นยำในการวินิจฉัยลำไส้เล็กอุดตันโดยใช้การตรวจเอกซเรย์คอมพิวเตอร์ 64 สไลด์*

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***วัตถุประสงค์****: เพื่อศึกษาความแม่นยำในการวินิจฉัย และสาเหตุของการเกิดภาวะลำไส้เล็กอุดตันโดยใช้การตรวจเอกซเรย์คอมพิวเตอร์ 64 สไลด์*

***วัสดุและวิธีการ****: ศึกษาย้อนหลังจากผู้ป่วยที่ได้รับการตรวจเอกซเรย์คอมพิวเตอร์ 64 สไลด์ในผู้ป่วยจำนวน 35 คน ที่สงสัยภาวะลำไส้เล็กอุดตันในโรงพยาบาลศิริราชตั้งแต่เดือนมกราคม พ.ศ. 2548 ถึงมิถุนายน พ.ศ. 2550 โดยรังสีแพทย์ 2 ท่าน ที่ไม่ทราบประวัติ, สาเหตุ, ความรุนแรง, ภาวะแทรกซ้อน (เช่นภาวะลำไส้ขาดเลือด) เพื่อศึกษาความไว ความจำเพาะ ความแม่นยำของการตรวจ*

***ผลการศึกษา****: ผู้ป่วย 25 คน ได้รับการวินิจฉัยว่าเป็นภาวะลำไส้เล็กอุดตัน และผู้ป่วย 10 คน ได้รับการวินิจฉัยว่าไม่มีภาวะลำไส้เล็กอุดตัน ค่าความไว ความจำเพาะ และความถูกต้องของการตรวจ โดยเครื่องเอกซเรย์คอมพิวเตอร์อยู่ที่ 96%, 100% และ 97% โดยผู้ป่วยจำนวน 13 คนได้รับการผ่าตัดและ ผู้ป่วย 12 คน ได้รับการรักษาแบบประคับประคอง สาเหตุของภาวะลำไส้เล็กอุดตัน ได้แก่ พังผืด (n = 10), มะเร็งกระจายมาที่ลำไส้ (n = 5), internal hernia (n = 3), การอักเสบของลำไส้เล็กส่วนปลาย (n = 2), inguinal hernia (n = 1), เลือดออกที่ผนังลำไส้ (n = 1), ลำไส้ตีบจากภาวะอักเสบของตับอ่อนเรื้อรัง (n = 1), midgut volvulus (n = 1), and SMA syndrome (n = 1)*

***สรุป****: การตรวจวินิจฉัยและหาสาเหตุภาวะลำไส้เล็กอุดตันโดยใช้การตรวจเอกซเรย์คอมพิวเตอร์ 64 สไลด์ ให้ความไว ความจำเพาะ ความแม่นยำของการตรวจสูง ช่วยให้ผู้ป่วยได้รับการรักษาที่ถูกต้องและรวดเร็วมากขึ้น*