

Appendix (Adapted with permission) (1)

Practice Management Guidelines for Management of Small Bowel 1991 – Present

First Author	Year	Reference Title	Class	Conclusions
Diagnosis – Plain Film/KUB				
Lappas JC(77)	2001	Abdominal radiography findings in small-bowel obstruction: relevance to triage for additional diagnostic imaging. <i>AJR Am J Roentgenol.</i> 2001 Jan;176(1):167-74.	III	(N=81; Retrospective) Plain films help differentiate low grade from high grade but CT gives incremental and needed data if plain radiography was inconclusive
Maglinte DD(78)	1997	Reliability and role of plain film radiography and CT in the diagnosis of small-bowel obstruction. <i>AJR Am J Roentgenol.</i> 1996 Dec;167(6):1451-5.	III	(N=78; Retrospective) Plain radiography and CT have equal sensitivity for grade of obstruction. They recommend initial plain radiographs on all suspected SBO with CT as a follow-up if needed for clinical indication.
Thompson WM(7)	2007	Accuracy of Abdominal Radiography in Acute Small-Bowel Obstruction: Does reviewer Experience Matter. <i>AJR Am J Roentgenol</i> 2007;188:W233-238.	III	(N=90; Retrospective) Comparison of plain radiography to CT by radiologists of various experiences. Sensitivity for SBO ranged from 59 to 93%. Radiologists with a greater degree of experience were more accurate.
Diagnosis –CT				
Bogusevicius A(79)	2002	Prospective randomised trial of computer-aided diagnosis and contrast radiography in acute small bowel obstruction. <i>Eur J Surg.</i> 2002;168(2):7883.	I	(N=90; Prospective) Computer program that differentiates between complete and partial SBO when 36 clinical variables, including the plain radiographic findings, are entered. The time to diagnosis was only 1 hour with the computer program versus 16 hours with contrast radiography.
Zalcman M(13)	2000	Helical CT signs in the diagnosis of intestinal ischemia in small-bowel obstruction. <i>AJR Am J Roentgenol.</i> 2000 Dec;175(6):1601-7.	II	(N=144; Retrospective) They evaluated radiographic signs of bowel ischemia on CT. Strangulation was prospectively diagnosed if reduced wall enhancement or 2 of the other 4 signs were present. The signs were as follows: wall thickening, mesenteric fluid, mesenteric venous congestion, and ascites

Lazarus DE(80)	2004	Frequency and relevance of the "small-bowel feces" sign on CT in patients with small-bowel obstruction. <i>AJR Am J Roentgenol.</i> 2004 Nov;183(5):1361-6.	II	(N=34; Retrospective) The feces sign helped identify the point of obstruction and was more likely in higher degrees of obstruction.
Obuz F(9)	2003	The efficacy of helical CT in the diagnosis of small bowel obstruction. <i>Eur J Radiol.</i> 2003 Dec;48(3):299-304.	II	(N=41; Prospective) CT was 83% accurate in differentiating obstruction vs. non-obstruction, 85% accurate in determining cause, and 100% accurate in determining strangulation/ischemia.
Suri S(6)	1999	Comparative evaluation of plain films, ultrasound and CT in the diagnosis of intestinal obstruction. <i>Acta Radiol.</i> 1999 Jul;40(4):422-8.	II	(N=32; Prospective) Suspected SBO who had plain radiographs, US and CT scan (1990-93). Plain radiography was 75% accurate, US was 84% accurate, and CT was 94% accurate at determining obstruction vs. no obstruction. Level of obstruction 60%, 70%, and 93%. Cause of obstruction 7%, 23%, and 87%.
Taourel PG(81)	1995	Value of CT in the diagnosis and management of patients with suspected acute small-bowel obstruction. <i>AJR Am J Roentgenol.</i> 1995 Nov;165(5):1187-92.	II	(N=57; Prospective) Patients with suspicion of SBO (1991 - 1994). The surgeon was interviewed prior to the CT scan. In 33 pts the clinician wanted to differentiate between SBO and ileus. In 24 pts the clinician wanted to know the cause of SBO. CT correctly changed the differentiation between SBO & ileus in 21% of cases. CT changed the diagnosis (cause) of SBO in 43% and correctly changed presence or absence of strangulation in 23.
Catalano O(82)	1997	The faeces sign. A CT finding in small-bowel obstruction. <i>Radiologe.</i> 1997 May;37(5):417-9.	III	(N=94; Retrospective) Feces sign was only present in 7% of cases, only 1 of which had strangulation.
Chou CK(83)	2000	Differentiation of obstructive from non-obstructive small bowel dilatation on CT. <i>Eur J Radiol.</i> 2000 Sep;35(3):213-20.	III	(N=146; Retrospective) Evaluated 4 CT criteria: 1. continuity of proximal SB, 2. transition zone, 3. intraluminal fluid, and 4. colonic contents. The probability of true obstruction was calculated for each sign. Continuity 69%, Transition zone abrupt 80%, high amount of SB fluid 79%, minimal colonic contents 90%.
Daneshmand	1999	The utility and reliability	III	(N=103 Retrospective) Comparison of plain

S(10)		of computed tomography scan in the diagnosis of small bowel obstruction. <i>Am Surg.</i> 1999 Oct;65(10):922-6.		radiographs with CT in determining partial vs complete SBO and in determining cause. Plain films were 75% sensitive and 53% specific for partial vs. complete. CT was 92% sensitive and 71% specific. Cause was correctly determined or inferred to be adhesions by CT in 91% of cases.
Gollub MJ(84)	2006	Does the CT whirl sign really predict small bowel volvulus?: Experience in an oncologic population. <i>J Comput Assist Tomogr.</i> 2006 Jan-Feb;30(1):25-32.	III	(N=1213; Retrospective) CT scans of patients with suspected SBO at a cancer center were reviewed. Whirl sign was found in 33 pts by a senior radiologist and 14 pts by a senior radiology resident. The whirl sign had a sensitivity of 64% for volvulus by the senior radiologist and much less by the resident. They concluded that the whirl sign is a relatively poor predictor of volvulus in this population.
Ha HK(85)	1997	Differentiation of simple and strangulated small-bowel obstructions: usefulness of known CT criteria. <i>Radiology.</i> 1997 Aug;204(2):507-12.	III	(N=84; Retrospective) Patients with known simple and strangulated SBO were reviewed. (1991-1996). They identified 6 CT findings as best determinants of strangulation: reduced wall enhancement, serrated beak, ascites, and unusual course of mesenteric vasculature, mesenteric haziness, and mesenteric venous engorgement. Using these signs they were able to find 85% of strangulations.
Jaffe TA (86)	2006	Small-bowel obstruction: coronal reformations from isotropic voxels at 16 section multi-detector row CT. <i>Radiology.</i> 2006 Jan;238(1):135-42. Epub 2005 Nov 17.	III	(N=100; Retrospective) Analysis of the added value of coronal reformations (2003-4) in 100 patients with suspected SBO. Coronal images added confidence to the three reader's diagnostic accuracy of obstruction vs. no obstruction.
Kim JH(40)	2004	Usefulness of known computed tomography and clinical criteria for diagnosing strangulation in small-bowel obstruction: analysis of true and false interpretation groups in computed tomography. <i>World J Surg.</i> 2004	III	(N=146; Retrospective) Study of CT scans looking for strangulation (1992-98). Three radiologists were 72% - 82% accurate in determining strangulation. The four clinical criteria, fever, tenderness, tachycardia, leukocytosis, without CT findings were equally accurate, however!

		Jan;28(1):63-8.		
Makita O(11)	1999	CT differentiation between necrotic and nonnecrotic small bowel in closed loop and strangulating obstruction. <i>Abdom Imaging</i> . 1999 Mar-Apr;24(2):120-4.	III	(N=25; Retrospective) This study analyzed CT findings to differentiate necrosis from non-necrosis in patients with proven strangulation. Findings predictive of necrosis were: ascites, vascular dilatation, mesenteric attenuation, and radial distribution, but mesenteric attenuation was most predictive.
Jancelewicz T(87)	2009	Predicting strangulated small bowel obstruction: an old problem revisited <i>J Gastrointest Surg</i> . 2009 Jan;13(1):93-9.	III	(N=192;Retrospective) This chart review of patients operated on for SBO found the CT finding of reduced bowel wall enhancement was the only predictor significant on multivariable analysis. It was 56% sensitive and 94% specific for strangulation.
Hwang JY(2)	2009	Value of multidetector CT in decision making regarding surgery in patients with small-bowel obstruction due to adhesion. <i>Eur Radiol</i> . 2009 Oct;19(10):2425-31.	II	(N=136;Prospective) This observational study of patients who underwent multidetector CT and initial non-operative management. The sensitivity/specificity for predicting need for surgery for high grade obstruction are 100/46.1%; for transition zone are 100/23.1%; for abnormal vascular course are 70/90%.
Hong SS(88)	2010	Three-dimensional CT enterography using oral gastrografin in patients with small bowel obstruction: comparison with axial CT images or fluoroscopic findings <i>Abdom Imaging</i> . 2010 Oct;35(5):556-62	II	(N= 18;Prospective) This study of patients who underwent 3D CT enterography which significantly improved diagnostic confidence for the interpretation of the level, cause of SBO, and the assessment of the interpretability of each image as compared with the use of axial CT images (P < 0.05). 3D CT enterography was superior as compared to fluoroscopic examination (P < 0.05).
Jang KM(89)	2010	Diagnostic performance of CT in the detection of intestinal ischemia associated with small-bowel obstruction using maximal attenuation of region of interest <i>AJR Am J Roentgenol</i> . 2010 Apr;194(4):957-63	II	(N=60;Retrospective) Quantification of bowel wall enhancement using maximal attenuation of a region of interest was a reliable and useful method for the diagnosis of intestinal ischemia.
Hodel J(90)	2009	Location of the transition zone in CT of small-bowel obstruction: added value	III	(N= 89;Retrospective) Multiplanar reformations increased accuracy in localization and confidence in the transition point of SBO

		of multiplanar reformations Abdom Imaging. 2009 Jan-Feb;34(1):35-41		
Delabrousse E(91)	2009	Small-bowel obstruction from adhesive bands and matted adhesions: CT differentiation AJR Am J Roentgenol. 2009 Mar;192(3):693-7	III	(N=67; Retrospective) CT scans of patients with surgically proven SBO were reviewed to differentiate adhesive bands vs. matted adhesions. Patients with adhesive bands were more likely to have a closed loop appearance, beak sign, whirl sign and fat notch sign. Patients with matted adhesions were more likely to have a small bowel feces sign. No patient with matted SBO (n=21) had a whirl sign or a fat notch sign.
Kato K(12)	2010	Interobserver agreement on the diagnosis of bowel ischemia: assessment using dynamic computed tomography of small bowel obstruction Jpn J Radiol. 2010 Dec;28(10):727-32	III	(N= 115;Retrospective) This study evaluating the accuracy and interobserver variability of dynamic CT. Sensitivity, specificity, PPV, NPV for ischemia were 85%, 96-97%, 73-79%, and 97-98% for radiologists
Duda JB(92)	2008	Utility of CT whirl sign in guiding management of small-bowel obstruction AJR Am J Roentgenol. 2008 Sep;191(3):743-7	III	(N=453; Retrospective) A patient with the whirl sign on CT was 25.3 times as likely as a patient without the sign to have SBO necessitating surgery.
Sandhu PS(14)	2007	Bowel transition points: multiplicity and posterior location at CT are associated with small-bowel volvulus Radiology. 2007 Oct;245(1):160-7.	III	(N=100; Retrospective) CT predictors of small bowel volvulus vs small bowel obstruction include multiple transition points (59% vs. 16%), posterior location of transition point, and presence of whirl sign (28% vs. 6%). Presence of all three predictors has 100% specificity for small bowel volvulus.
Atri M(16)	2009	Multi-detector helical CT in the evaluation of acute small bowel obstruction: comparison of non-enhanced (no oral, rectal or IV contrast) and IV enhanced	III	(N=99; Retrospective). Non-enhanced multidetector CT has comparable accuracy to enhanced multidetector CT for diagnosis of SBO and determination of transition point.
Shah ZK(15)	2008	Small bowel obstruction: the value of coronal	II	(N=30; Prospective) Prospective review of retrospective acquired CT scans of patients

		reformatted images from 16-multidetector computed tomography--a clinical radiological perspective J Comput Assist Tomogr. 2008 Jan-Feb;32(1):23-31		with surgically documented SBO. Addition of coronal reformats to CT scans provides small but non-significant improvement in the diagnosis of the transition site, etiology of obstruction as well as detection of complications with only marginal addition to scan evaluation time.
Rocha FG(93)	2009	Nonoperative management of patients with a diagnosis of high-grade small bowel obstruction by computed tomography Arch Surg. 2009 Nov;144(11):1000-4	III	(N=145; Retrospective) Single center review of patients diagnosed with high grade SBO on CT scan. 46% were successfully managed non-operatively. The lengths of stay and complication rates were not different between delayed and immediate operation groups.
Colon MJ (94)	2010	The relevance of transition zones on computed tomography in the management of small bowel obstruction Surgery. 2010 Mar;147(3):373-7	III	(N=200;Retrospective) They reviewed patients that had CT scans for SBO; radiographic transition point had 63% PPV for correlation with intraoperative site of obstruction; presence of transition zone conferred a 38% PPV with 77% sensitivity for operation

Diagnosis –MRI

Beall DP(22)	2002	Imaging bowel obstruction: a comparison between fast magnetic resonance imaging and helical computed tomography. <i>Clin Radiol.</i> 2002 Aug;57(8):719-24.	II	(N=44;Prospective) Authors compared helical CT (oral/IV contrast) with ultrafast HASTE MRI in 44 pts with suspected SBO (1997-1998). Findings: CT (71%, Sensitivity; 71% Specificity) MR (95% sensitivity; 100% Specificity). in differentiating obstruction vs no obstruction. No mention of differentiating high-grade vs low grade obstruction. Limitations of MRI include lack of availability after hours, poor definition of cause of obstruction, and poor visualization of colonic obstructions.
Kim JH(23)	2000	Usefulness of MR imaging for diseases of the small intestine: comparison with CT. <i>Korean J Radiol.</i> 2000 Jan-Mar;1(1):43-50.	III	(N=34;Prospective) Comparison of helical CT (oral/IV contrast) with HASTE MRI pts with a variety of SB diseases (1996 - 1999). Fifteen patients had suspected SBO. MRI and CT were both 100% accurate in diagnosing or excluding SBO. MRI was better at determining the precise cause of obstruction (73% v 60%). MRI was poor at looking at omentum.
Lee JK(25)	1998	MR imaging of the	III	(N=50; Retrospective) MR with HASTE

		small bowel using the HASTE sequence. <i>AJR Am J Roentgenol.</i> 1998 Jun;170(6):1457-63.		sequence distinguished between normal small bowel and abnormal small bowel. Motion did not affect these studies
Regan F (24)	1998	Fast MR imaging and the detection of small-bowel obstruction. <i>AJR Am J Roentgenol.</i> 1998 Jun;170(6):1465-9.	III	(n=43; Retrospective) HASTE MR can be highly accurate in diagnosing SBO and identifying the level of obstruction 26/29 patients with SBO were said to have been correctly identified by HASTE MR (sensitivity 90%, specificity 86%) and 73% had the correct level of obstruction identified. Limitations identified include: absence of dilation in situations where prolonged NG suction has been employed, MRI was poor at identifying masses including malignancies, did not show inflammation as well as CT, and did not show viability.
Takahara T(26)	2011	Peristalsis gap sign at cine magnetic resonance imaging for feasibility study diagnosing strangulated small bowel obstruction: feasibility study. <i>Jpn J Radiol</i> 2011;29:11-18.	III	(N=34; Retrospective) Cine MRI is a potential technique for diagnosing SB strangulation in patients with SBO.
Diagnosis –Ultrasound				
Schmutz GR(17)	1997	Small bowel obstruction: role and contribution of sonography. <i>Eur Radiol.</i> 1997;7(7):1054-8.	II	(N=123; Prospective) Ultrasound was performed to evaluate for small bowel obstruction. Fourteen patients had too much abdominal gas and the study was not diagnostic. Overall accuracy was 81%. Determination of location of obstruction was 80% accurate in the true positives. Determination of cause of obstruction was 63% accurate in the true positives. The studies were performed by an experienced radiologist. Ultrasound was better in identifying the cause of obstruction than plain films.
Czechowski J(18)	1996	Conventional radiography and ultrasonography in the diagnosis of small bowel obstruction and	III	(N=96; Retrospective) (1992-1993) Patients who had acute abdomen and non-diagnostic conventional radiography were reviewed. The study compared plain radiography with ultrasound in patients with suspected small

		strangulation. <i>Acta Radiol.</i> 1996 Mar;37(2):186-9.		bowel obstruction. The authors assert that US added information such as the location of the obstruction and whether strangulation was present (absence of peristalsis, extraluminal fluid).
Grassi R(21)	2004	The relevance of free fluid between intestinal loops detected by sonography in the clinical assessment of small bowel obstruction in adults. <i>Eur J Radiol.</i> 2004 Apr;50(1):5-14.	III	(N=184; Retrospective) All patients (2002) had confirmed SBO. These pts all had both plain films and US. Purpose of the study was to determine if intraperitoneal fluid was helpful in differentiating high-grade vs low-grade obstruction. The authors report that US was 100% accurate in finding free fluid but in 34 pts (20%), the free fluid was explained by medical causes. When these pts were excluded from analysis, surgery confirmed free fluid and either thin walled small bowel or impending necrosis in all pts.
Ko YT(19)	1993	Small bowel obstruction: sonographic evaluation. <i>Radiology.</i> 1993 Sep;188(3):649-53.	III	(N=54; Retrospective) Patients had known or suspected BO (1987 – 1992). Pts had already had plain films except for 2 pregnant pts. SBO was correctly diagnosed in 89%. Level of obstruction was correctly predicted in 76%. Cause of obstruction 20%. Ultrasound is better than plain film but does not show strangulation well.
Unlüer EE(20)	2010	Ultrasonography by emergency medicine and radiology residents for the diagnosis of small bowel obstruction. <i>Eur J Emerg Med.</i> 2010 Oct;17(5):260-4	II	(N=174; Prospective) (2009) EM residents diagnosed SBO using bedside ultrasound with high comparable with that of radiology residents. EM resident sensitivity/specificity were 92.7/93.3 and radiology resident was statistically similar at 88.4/100% respectively. Dilated loops >25 mm jejunum or >15 mm ileum were the most sensitive/specific 94%/94% findings for SBO.
Diagnosis –Enteroclysis				
Boudiaf M(95)	2004	Small-bowel diseases: prospective evaluation of multi-detector row helical CT enteroclysis in 107 consecutive patients. <i>Radiology.</i>	II	(N=107; Prospective) (2000-2002) CT enteroclysis was well tolerated and reliable. It allows for detection of extraluminal disease. Authors advocate for routine use in patients with low grade obstructions in a non-acute settings.

		2004 Nov;233(2):338-44.		
Umschaden HW(96)	2000	Small-bowel disease: comparison of MR enteroclysis images with conventional enteroclysis and surgical findings. <i>Radiology</i> . 2000 Jun;215(3):717-25.	II	(N= 30; Prospective) (1997-1998)MR enteroclysis was performed on 18 patients with inflammatory disease and 12 patients with small bowel obstruction. Findings between conventional and MR enteroclysis had a high concordance rate.
Barloon TJ(97)	1994	Does a normal small-bowel enteroclysis exclude small-bowel disease? A long-term follow-up of consecutive normal studies. <i>Abdom Imaging</i> . 1994 Mar-Apr;19(2):113-5.	III	(N=27; Prospective) Enteroclysis accurately shows closed loop obstruction in 25/27 patients.
Maglinte DD(27)	1991	Preoperative diagnosis by enteroclysis of unsuspected closed loop obstruction in medically managed patients. <i>J Clin Gastroenterol</i> . 1991 Jun;13(3):308-12.	III	(N=27; Retrospective) This study of patients with closed loop obstruction on conventional enteroclysis performed 2-8 after admission for small bowel obstruction. Twenty five patients were taken to the operating room and found to have a non-strangulated closed loop obstruction.
Ohmiya N(98)	2009	Small-bowel obstruction: diagnostic comparison between double-balloon endoscopy and fluoroscopic enteroclysis, and the outcome of enteroscopic treatment. <i>Gastrointest Endosc</i> 2009;69:84-93.	II	(N=66; Retrospective) The diagnostic yield of double-balloon endoscopy for SBO (95%) was higher than that of fluoroscopic enteroclysis (71%). Balloon dilation is considered an alternative to surgery in patients with fibrotic strictures both related and unrelated to Crohn's disease.
Diagnosis – Contrast Studies				
Anderson CA(99)	1997	Contrast radiography in small bowel obstruction: a prospective, randomized trial. <i>Mil Med</i> . 1997 Nov;162(11):749-52.	I	(N=64; Prospective) This randomized study compared early barium UGI versus plain radiography in patients admitted for small bowel obstruction. The results did not show any difference in time to surgery, complications or length of stay between groups. Barium study correctly differentiated between operative and non-operative SBO.

Blackmon S(100)	2000	The use of water-soluble contrast in evaluating clinically equivocal small bowel obstruction. <i>Am Surg.</i> 2000 Mar;66(3):238-42; discussion 242-4.	III	(N=418; Retrospective) This study looked at the use of Gastrografin transit time to help in the diagnosis of patients admitted for with a diagnosis of small bowel obstruction. Patients are given Gastrografin and undergo serial abdominal films. If the contrast does not reach the colon in 6 hours the study is said to be positive. One of the problems with this study is that close to 50% (65) of patients with a positive study did not require surgery. There were two deaths from Gastrografin aspiration.
Brochwicz-Lewinski MJ(101)	2003	Small bowel obstruction--the water-soluble follow-through revisited. <i>Clin Radiol.</i> 2003 May;58(5):393-7.	I	(N= 62; Prospective) This randomized study of patients with suspected small bowel obstruction who were divided in two groups based on if they had an upper gi with small bowel follow through(SBFT) or not. The group with the SBFT had a lower incidence of operation but this difference did not achieve statistical difference. The length of stay was not affected by the SBFT. The patients were randomized and the surgeons changed their clinical management plan based on the results.
Makanjuola D.(102)	1998	Computed tomography compared with small bowel enema in clinically equivocal intestinal obstruction. <i>Clin Radiol.</i> 1998 Mar;53(3):203-8.	III	(N=49; Retrospective) Patients had both CT and 'small bowel enema'. 43/49 pts had definite intestinal obstruction (42 per surgery). SBE was more sensitive in detecting bowel obstruction than CT (100% vs 83%). The 7 missed by CT had short segment stenosis. Conclusion: In clinically suspicious cases of obstruction where CT is neg, use SBE
Sandikcioglu TG(29)	1994	Contrast radiography in small bowel obstruction. A randomized trial of barium sulfate and a nonionic low-osmolar contrast medium. <i>Acta Radiol.</i> 1994 Jan;35(1):62-4.	I	(N= 36; prospective) Nonionic low osmolar weight contrast is an alternative to barium for contrast studies to evaluate for SBO.
Chung CC(32)	1996	A prospective study on the use of water-soluble contrast follow-through radiology in the	II	(N= 51; Prospective) Contrast follow through was a safe procedure. Early operation should occur if patients have "significant obstruction" (contrast does not

		management of small bowel obstruction. <i>Aust N Z J Surg.</i> 1996 Sep;66(9):598-601.		reach cecum in 4 hours). A 4 hour cutoff for contrast reaching the cecum was predictive of outcome for SBO in those with history of surgery.
Joyce WP(34)	1992	The value of water-soluble contrast radiology in the management of acute small bowel obstruction. <i>Ann R Coll Surg Engl.</i> 1992 Nov;74(6):422-5.	II	(N=127; Prospective) Water-soluble contrast study is safe and easy to use and diagnostic study of choice for suspected SBO. Normal contrast study can rule out operative SBO.
Peck JJ(30)	1999	The role of computed tomography with contrast and small bowel follow-through in management of small bowel obstruction. <i>Am J Surg.</i> 1999 May;177(5):375-8.	III	(N= 55; Retrospective) With equivocal findings of SBO first CT and then SBFT should be used. The combined sensitivity and specificity are 95% and 86% respectively, higher than those of each alone.
Enochsson L(103)	2001	Contrast radiography in small intestinal obstruction, a valuable diagnostic tool? <i>Eur J Surg.</i> 2001 Feb;167(2):120-4.	III	(N=2357; Retrospective) The outcome of oral contrast studies can be predicted by plain radiographs. Contrast studies are safe and may be therapeutic.
Dixon PM(28)	1993	The small bowel enema: a ten year review. <i>Clin Radiol.</i> 1993 Jan;47(1):46-8.	III	(N=1465; Retrospective) Routine use of small bowel enema in evaluation of patients with suspected small bowel pathology demonstrates a very high sensitivity (93.1%) and specificity (96.9%) and obstruction had a sensitivity of 98%.
Branco BC(31)	2010	Systematic review and meta-analysis of the diagnostic and therapeutic role of water-soluble contrast agent in adhesive small bowel obstruction. <i>Br J Surg.</i> 2010 Apr;97(4):470-8	III	(Metaanalysis of 14 prospective studies) Evaluated the diagnostic and therapeutic role of water soluble contrast in adhesive SBO. They asserted that contrast progression was accurate in predicting the need for surgery and reduces the need for operation and shortens hospital stay.
Trésallet C(33)	2009	Improving the management of acute adhesive small bowel obstruction with CT-	II	(N= 87; Prospective) Authors concluded transit of Gastrografin into the R colon > 8 hr seemed to predict the need for surgery.

		scan and water-soluble contrast medium: a prospective study Dis Colon Rectum. 2009 Nov;52(11):1869-76		
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Diagnosis – Adjuncts

Bogusevicius A(104)	2007	The role of D-dimer in the diagnosis of strangulated small-bowel obstruction Medicina (Kaunas). 2007;43(11):850-4	II	(N=53; Prospective) This trial concluded that D-dimer is not sensitive or specific for differentiating simple vs. strangulated bowel obstruction.
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Nonoperative Management – General Considerations

Nonoperative Management – Clinical Indicators/Time Period

Miller G(47)	2000	Natural history of patients with adhesive small bowel obstruction. <i>Br J Surg.</i> 2000 Sep;87(9):1240-7.	III	(N=410; Retrospective) (1986-1996) Patients are never free of risk for post-op SBO 2nd to adhesions (14% present >20 yrs post-op). Rate of recurrence was 33% overall (32% for operation, 34% (NS) for cons. Mgmt), each recurrence raised risk of future recurrence. Colorectal procedures were more likely to result in matted adhesions v. single bands and result in more readmits. Recurrence rates b/w op and non-op were similar.
Nauta RJ(41)	2005	Advanced abdominal imaging is not required to exclude strangulation if complete small bowel obstructions undergo prompt laparotomy. <i>J Am Coll Surg.</i> 2005 Jun;200(6):904-11.	III	(N=413; Retrospective) Paper asserts complete SBO warrants no additional imaging other than plain films. 71% of PSBO by plain film without peritonitis resolved with conservative management. In patients with complete SBO, there was a very high rate of bowel resection (31%). This suggests that a complete SBO is a surgical disease.
Seror D(42)	1993	How conservatively can postoperative small bowel obstruction be treated? <i>Am J Surg.</i> 1993 Jan;165(1):121-5; discussion 125-6.	III	(N= 227; Retrospective) 73% response to conservative tx in all SBO (Complete and Partial). No difference in WBC, fever, pulse in those who required surgery. No worse outcome in those watched over 5 days BUT no one that hadn't gotten better by 5 days got better w/o surgery. Weak support of conclusions.
Williams SB(48)	2005	Small bowel obstruction:	III	(N=329; Retrospective) The incidence of recurrent SBO is higher in conservatively

		conservative vs. surgical management. <i>Dis Colon Rectum</i> . 2005 Jun;48(6):1140-6.		managed pts than in operatively managed pts (40.5% v. 26.8%). Time to recurrence in conservative managed patients was shorter (153 v. 411 days)
Miller G(105)	2002	Readmission for small-bowel obstruction in the early postoperative period: etiology and outcome. <i>Can J Surg</i> . 2002 Aug;45(4):255-8.	III	(N= 552;Retrospective) Defined early post-op bowel obstruction as within 50 days because had big group who presented b/w 35-50 days. Most frequent procedure was a small bowel operation for SBO. 23% required operation. 3.3% strangulation. Suggests non-operative management of post-op obstruction.
Shih SC (106)	2003	Adhesive small bowel obstruction: how long can patients tolerate conservative treatment? <i>World J Gastroenterol</i> . 2003 Mar;9(3):603-5.	III	(N= 155;Retrospective) (1999-2001)Paper really suggests if you wait too long, you will have complications.
Fevang BT(35)	2002	Early operation or conservative management of patients with small bowel obstruction? <i>Eur J Surg</i> . 2002;168(8-9):475-81.	II	(N=154; Prospective) (1994-1995)Significant difference in strangulation between early and late operation; suggests surgeons can choose which patients need immediate surgery based on clinical evaluation. Operate for continuous pain, fever, tachycardia, peritonitis, leukocytosis, met acidosis
Ryan MD(107)	2004	Adhesional small bowel obstruction after colorectal surgery. <i>ANZ J Surg</i> . 2004 Nov;74(11):1010-2.	III	(N=21; Retrospective) The 3 year rate for SBO following a colorectal procedure is 3.6%. 48% required OR on first admission for SBO, only 1 for strangulation.
Jeong WK(49)	2008	Conservative management of adhesive small bowel obstructions in patients previously operated on for primary colorectal cancer J Gastrointest Surg. 2008 May;12(5):926-32	II	(N=2586; Retrospective) Analysis of prospective data on theadhesive SBO rate 5.0% at 38 mos after colorectal surgery. 80 % resolve spontaneously. Recommended initial decompression with NGT.
Nonoperative Management – Adjuncts				
Assalia A(54)	1994	Therapeutic effect of oral Gastrografin in adhesive, partial small-bowel obstruction: a	I	(N= 99: Prospective) 100 cc of GG sped return of bowel function (time to first stool) from 23.4h to 6.2 hrs. GG decreased LOS from 4.4d to 2.2d. Trend to improvement in

		prospective randomized trial. Surgery. 1994 Apr;115(4):433-7.		conservative mgmt but not stat sig (21% control v. 10% GG P=0.52). No GG complications
Biondo S(108)	2003	Randomized clinical study of Gastrografin administration in patients with adhesive small bowel obstruction. <i>Br J Surg.</i> 2003 May;90(5):542-6.	I	(N=83; Prospective)(2000-2001)All patients who passed Gastrografin to the colon within 24 hours tolerated early feeding and did not require operation. They operated on every patient who did not pass GG to the colon in 24 hrs – CANNOT say that failure to pass GG predicts non-op failure (they did not try) but they report every patient who failed had a closed loop at surgery (not strangulation).
Burge J(55)	2005	Randomized controlled trial of Gastrografin in adhesive small bowel obstruction. <i>ANZ J Surg.</i> 2005 Aug;75(8):672-4.	I	(N= 45; Prospective) 100 cc of GG reduced time to resolution of SBO from 21 to 12 hrs. LOS decreased by 1 day.GG did not change the number of people who failed non-op mgmt
Chen SC(109)	2006	Specific oral medications decrease the need for surgery in adhesive partial small-bowel obstruction. <i>Surgery.</i> 2006 Mar;139(3):312-6.	I	(N=266; Prospective) Patients treated with Magnesium Oxide, Lactobacillus, and Simethicone for PSBO (by GG study) had a higher incidence of successful non-operative mgmt (77 V 90% p<0.01). This combination of meds may reduce need for operation in PSBO
Choi HK(52)	2002	Therapeutic value of gastrografin in adhesive small bowel obstruction after unsuccessful conservative treatment: a prospective randomized trial. <i>Ann Surg.</i> 2002 Jul;236(1):1-6.	I	(N=124; Prospective) They randomized GG v. surgery after 48hrs of nonoperative management and showed that most of the GG patients did not require surgery.
Fevang BT(44)	2000	Upper gastrointestinal contrast study in the management of small bowel obstruction--a prospective randomized study. <i>Eur J Surg.</i> 2000 Jan;166(1):39-43.	I	(N= 98; Prospective) In this non-blinded study GG mixed with barium had no effect on resolution of SBO, need for operation, rate of strangulation. Resolution was not different from the literature (PSBO 76%; Complete 41%).
Yagci G(56)	2005	Comparison of Urografin versus	II	(N=317; Prospective) Time to first stool was shorter in the Urografin group. UG

		standard therapy in postoperative small bowel obstruction. J Invest Surg. 2005 Nov-Dec;18(6):315-20.		group had better non-op mgmt rate (89.4 to 75.4% p<0.05). UG group had shorter LOS (2.73d v. 6.1d).
Gowen GF(110)	2003	Long tube decompression is successful in 90% of patients with adhesive small bowel obstruction. <i>Am J Surg.</i> 2003 Jun;185(6):512-5.	III	(N=37; Prospective) In patients w/o signs of strangulation a nasally placed long tube (using endoscopy to pass into the jejunum) had a 90% resolution rate for SBO
Roadley G(111)	2004	Role of Gastrografin in assigning patients to a non-operative course in adhesive small bowel obstruction. <i>ANZ J Surg.</i> 2004 Oct;74(10):830-2.	III	(N=25; Prospective) Finding GG in the colon 4 hours post administration reliably predicts successful non-op mgmt.
Atahan K(112)	2010	Hyperosmolar water-soluble contrast medium in the management of adhesive small-intestine obstruction. <i>J Int Med Res.</i> 2010;38(6):2126-34.	III	(N= 37; Prospective study) Patient with adhesional SBOs were given Urografin.. Nonoperative treatment was recommended for patients in whom contrast medium passed observed into the right colon within 8 h following administration regardless of the presence of obstruction signs. Absence of contrast medium in the right colon within 8 h cannot, however, be considered an indication for surgery.
Kumar P(57)	2009	Therapeutic role of oral water soluble iodinated contrast agent in postoperative small bowel obstruction <i>Singapore Med J.</i> 2009 Apr;50(4):360-4	I	(N=41;Prospective)A randomized study of an oral water soluble contrast agent in postoperative small bowel obstruction helped in the earlier resolution of the obstruction (7.5 vs. 35.2 hours) and decreases the length of hospital stay (3.4 vs. 5.3 days).
Di Saverio S(58)	2008	Water-soluble contrast medium (Gastrografin) value in adhesive small intestine obstruction (ASIO): a prospective, randomized, controlled, clinical trial <i>World J Surg.</i> 2008 Oct;32(10):2293-304	I	(N=76;Prospective) This multicenter randomized trial examined traditional treatment ± Gastrografin. The Gastrografin group had higher resolution of SBO (81.5 vs 55%) and reduced time to resolution of obstruction and hospital stay.

Oyasiji T(76)	2010	Small bowel obstruction: outcome and cost implications of admitting service Am Surg. 2010 Jul;76(7):687-91	III	(N=482;Retrospective) Patients admitted to a surgical service have shorter LOS, less hospital charges, shorter time to surgery and less mortality than patients admitted to a medical service.
Ji ZL(113)	2010	Therapeutic value of sesame oil in the treatment of adhesive small bowel obstruction	III	(N=64; Retrospective). Addition of 150ml of sesame oil via NG tube to standard management of partial SBO results in significantly quicker resolution of SBO, shorter hospital LOS, and reduced re-laparotomy rate
Srinivasa S(114)	2010	Use of statins in adhesive small bowel obstruction. J Surg Res. 2010 Jul;162(1):17-21.	III	(N=419;Retrospective)). Preoperative use of statins is associated with decreased operative rates in patients with small bowel obstruction. Relative risk 0.46. However, details on the use statins were unknown. Study showed only association not necessarily causality.

Nonoperative Management – Antibiotics

Sagar PM(68)	1995	Intestinal obstruction promotes gut translocation of bacteria. <i>Dis Colon Rectum</i> . 1995 Jun;38(6):640-4.	II	(N=254; Prospective) This cohort study of both large and small bowel obstructions found bacteria in mesenteric lymph nodes at a 5-fold frequency in obstructed compared to non-obstructed patients (39.9% v. 7.3% p, 0.001). Post-op septic complications were more likely in patients with + mesenteric lymph nodes (36.1 v. 11.1% P<0.05)
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Nonoperative Management – Nutrition

Operative Intervention – General Considerations

Fevang BT(45)	2004	Long-term prognosis after operation for adhesive small bowel obstruction. Ann Surg. 2004 Aug;240(2):193-201.	III	(N=500: retrospective) (1961-1995) Study suggesting lower risk of recurrence if treated surgically. However risk of needing surgery if future episode is the same. The highest risk is after 5 years, but can occur even decades later. Multiple matted adhesions have more recurrence than single bands (at least those rx'd surgically)
Landercasper J(46)	1993	Long-term outcome after hospitalization for small-bowel obstruction. Arch Surg. 1993 Jul;128(7):765-70; discussion 770-1.	III	(N=309; Retrospective) (Rate of recurrence is higher with non-op mgmt (38% v. 21% p<0.001). Complete SBO v. Partial – no difference in recurrence either op or non-op. Op v. non-op no diff in mortality
Butt	2009	Adhesional small bowel	III	(N= 34; Retrospective)Patients with de

MU(115)		obstruction in the absence of previous operations: management and outcomes World J Surg. 2009 Nov;33(11):2368-71		novo adhesions (3.3% of all patients) presented in a similar fashion and had similar outcomes as patients with SBO from postoperative adhesions.
Tingstedt B(116)	2007	Long-term follow-up and cost analysis following surgery for small bowel obstruction caused by intra-abdominal adhesions. Br J Surg. 2007 Jun;94(6):743-8	III	(N=102; Retrospective) Analysis of patients who underwent surgery for SBO. In median follow up of 14 years, there were 273 episodes of intestinal obstruction after the index operation, of which 237 involved inpatient readmissions; 47.3 per cent of the episodes resulted in further surgery. Single band adhesions were more common in patients with no previous abdominal surgery ($P < 0.001$). Some 52.0 per cent of the patients had undergone only one operation for SBO. A mean of 2.7 episodes per patient occurred after the index operation.
Duron JJ(117)	2008	Prevalence and risk factors of mortality and morbidity after operation for adhesive postoperative small bowel obstruction Am J Surg. 2008 Jun;195(6):726-34	II	(N=286; Prospective) A multicenter prospective cohort evaluation of risk factors linked early postoperative mortality with the age and ASA class. Long-term mortality was associated with postoperative complications.
Early Operative – Clinical Indications/Subgroups				
Tortella BJ(118)	1995	Incidence and risk factors for early small bowel obstruction after celiotomy for penetrating abdominal trauma. Am Surg. 1995 Nov;61(11):956-8.	II	(N=341; Prospective) Patients who had a laparotomy for penetrating trauma. The hypothesis is that they would have a higher incidence of post-operative SBO, defined as SBO in 6 months post-exploration. The incidence was higher, 7.4% as compared to a reported 0.69% for post-operative SBO
Meagher AP(119)	1993	Non-operative treatment of small bowel obstruction following appendicectomy or operation on the ovary or tube. Br J Surg. 1993 Oct;80(10):1310-1.	III	(N=330; Retrospective) Patients with Appendectomy/tubo-ovarian procedures are more likely to require operative intervention (95% vs. 53%)
Potts FE 4th(120)	1999	Utility of fever and leukocytosis in acute	III	(N=117; Retrospective) Patients with fever and leukocytosis that are in their 80's most

		surgical abdomens in octogenarians and beyond. <i>J Gerontol A Biol Sci Med Sci.</i> 1999 Feb;54(2):M55-8.		likely have Acute cholecystitis and viscous perforation..
Velasco JM(121)	1998	Post laparoscopic small bowel obstruction. Rethinking its management. <i>Surg Endosc.</i> 1998 Aug;12(8):1043-5.	III	(N=5; Retrospective) Post laparoscopic SBOs will need surgical resolution and will not resolve spontaneously as up to 73% will do after laparotomy
Huang JC(122)	2005	Small bowel volvulus among adults. <i>J Gastroenterol Hepatol.</i> 2005 Dec;20(12):1906-12.	III	(N=19; Retrospective) Volvulus although rare in adults can occur, and will always need surgical therapy.
Takeuchi K(36)	2004	Clinical studies of strangulating small bowel obstruction. <i>Am Surg.</i> 2004 Jan;70(1):40-4.	III	(N=280; retrospective) Purpose was to identify aspects of clinical or laboratory exam that would identify patients with gangrenous bowel. Only 92 (24%) of the 280 patients required surgery and 37 of these had strangulation or intestinal gangrene (13) with small bowel resection. Only factors that were significant for gangrenous small bowel were SIRS (12/13) versus (1/24), elevated or low WBC, and base deficit or acidosis.
Tsumura H(37)	2004	Systemic inflammatory response syndrome (SIRS) as a predictor of strangulated small bowel obstruction. <i>Hepatogastroenterology.</i> 2004 Sep-Oct;51(59):1393-6.	III	(N=95; Retrospective) SIRS and abdominal guarding are predictive of strangulation in SBO.
Ellis CN(123)	1991	Small bowel obstruction after colon resection for benign and malignant diseases. <i>Dis Colon Rectum.</i> 1991 May;34(5):367-71.	III	(N=118; Retrospective) Patients with surgical correction of SBO after history of colon surgery. Patients often get SBO from reoccurrence and it carries higher morbidity and mortality
Matter I(124)	1997	Does the index operation influence the course and outcome of adhesive	III	(N=248; Retrospective) Purpose to look for what types of operations would lead to future SBO. . The previous surgeries were

		intestinal obstruction? <i>Eur J Surg.</i> 1997 Oct;163(10):767-72.		divided into 4 groups: Upper abdominal, small bowel resection, appendectomy /gynecology, and colon resection. The procedure that led to most SBO/yr was appendectomy - 3.1. SBO occurred earliest after resection of small bowel and then colon, with in the first year. Complete obstruction was highest after small bowel resection, 20/26, though only 3 required surgery.
Montz FJ(125)	1994	Small bowel obstruction following radical hysterectomy: risk factors, incidence, and operative findings. <i>Gynecol Oncol.</i> 1994 Apr;53(1):114-20.	III	(N=98; Retrospective) A review of women after radical hysterectomy for non-adnexal gynecologic cancer. Radiation greatly increases incidence of SBO.
Zielinski MD(39)	2010	Small bowel obstruction - who needs an operation? A multivariate prediction model <i>World J Surg.</i> 2010 May;34(5):910-9	III	(N=100; Retrospective). Four clinical features-intraperitoneal free fluid, mesenteric edema, lack of "small bowel feces sign," and a history of nausea and vomiting had a sensitivity of 96%, PPV of 90% for requiring exploration.
Schwenter F(126)	2010	Clinicoradiological score for predicting the risk of strangulated small bowel obstruction. <i>Br J Surg.</i> 2010 Jul;97(7):1119-25	II	(N=233; Prospective) Multivariable analysis in this observational study correlated six variables with small bowel resection in SBO: history of pain lasting 4 days or more, guarding, C-reactive protein level at least 75 mg/l, leucocyte count $10 \times 10^9/l$ or greater, free intraperitoneal fluid volume at least 500 ml on computed tomography (CT) and reduction of CT small bowel wall contrast enhancement.
O'Daly BJ(127)	2009	Detected peritoneal fluid in small bowel obstruction is associated with the need for surgical intervention <i>Can J Surg.</i> 2009 Jun;52(3):201-6	III	Retrospective study (n=100) that demonstrated the presence of free peritoneal fluid on CT scan is an independent predictor of need for surgical intervention (OR 3, 95% CI 1.15-7.84).
Tanaka S(43)	2008	Predictive factors for surgical indication in adhesive small bowel obstruction <i>Am J Surg.</i> 2008 Jul;196(1):23-7	III	(N=53; Retrospective) review of efficacy of treatment with long nasointestinal tube. No comparison arm. Successfully treated in 74% (85% incomplete, 50% complete SBO).

Early Operative – Radiographic Indications

Chen SC(128)	2005	Progressive increase of bowel wall thickness is a reliable indicator for surgery in patients with adhesive small bowel obstruction. <i>Dis Colon Rectum</i> . 2005 Sep;48(9):1764-71.	II	(N=121; Prospective) US demonstrating increase in bowel wall thickness > 3mm are indicator for surgery. Divided into 2 groups: Group 1 – initial SB wall thickness > 3mm, group 2 – SB wall < 3mm. 9(18.4%) of group 1 patients needed surgery and only 4 (5.6%) of group 2.
Chen SC(129)	1999	Oral urografin in postoperative small bowel obstruction. <i>World J Surg</i> . 1999 Oct;23(10):1051-4.	II	(N=116; Prospective) Urografin in the colon at 8 hours predicts successful non-operative treatment. Oral Gastrografin is a good diagnostic tool for prediction of the success of non-operative management of SBO
Perea Garcia J(130)	2004	Adhesive small bowel obstruction: predictive value of oral contrast administration on the need for surgery. <i>Rev Esp Enferm Dig</i> . 2004 Mar;96(3):191-200.	II	(N=100; Prospective) Concluded that earlier use of contrast can lead to earlier decision as to need of surgery or progression of non-operative management of SBO.
Zielinski MD(38)	2011	Prospective, observational validation of a multivariate small-bowel obstruction model to predict the need for operative intervention <i>J Am Coll Surg</i> . 2011 Jun;212(6):1068-76	II	(N=100; Prospective) This observational study recommends early operative intervention if 3 features are present: history of obstipation, mesenteric edema, and lack of small bowel feces sign.

Early Operative – Time Period

Sosa J(131)	1993	Management of patients diagnosed as acute intestinal obstruction secondary to adhesions. <i>Am Surg</i> . 1993 Feb;59(2):125-8.	III	(N=97; Retrospective) Three groups were compared: early operation (< 24 hours) n = 21, successful non-operative management (n = 62) and failed non-operative management (n = 33)Primary reason for early operation was tenderness or surgeon's choice. 4 bowel resections secondary to strangulation in this group. The group with deaths (n=2) and the highest complication rate(36%), and highest strangulation rate was group failed non-operative managements.
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Late Operative – Clinical Indications/Subgroups

Ellozy	2002	Early postoperative	II	(N=225; Prospective) Surveillance of 242
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SH(132)		small-bowel obstruction: a prospective evaluation in 242 consecutive abdominal operations. <i>Dis Colon Rectum</i> . 2002 Sep;45(9):1214-7.		operations performed of 225 patients and monitoring for early post-operative SBO (EPSBO). The majority of the procedure involved the colon, and 45 patients had previous SBO. There were 23 incidents of EPSBO. 20 resolved by day 6 with just NG suction. The other 3 had surgery on day 2, day 16 and day 29 with the latter with SB necrosis and resection. There were no factors identified with this small group of patients predictive of EPSBO
Andersson RE(133)	2001	Small bowel obstruction after appendectomy. <i>Br J Surg</i> . 2001 Oct;88(10):1387-91.	III	(N=245,400; Retrospective) Interesting study of the Swedish national registry of all Swedish hospitals and the appendectomies done over the past 30+ years. Over that time period and there were 2659 SBO operations since on post-appendectomy patients. There were 245400 matched controls with 245 operations for SBO. Cumulated risk of surgery for SBO after appendectomy after 4 weeks is 0.41, at 1 year, 0.63, at 10 years 0.97, and at 30 years 1.30. This is lower then previously thought. The cumulative risk increases with the operative diagnosis with mesenteric adenitis at 1.42 at 30 years, perforated appendicitis at 2.76, and other at 3.24. Acute appendicitis carries the lowest risk of SBO at 0.75
Edna TH(134)	1998	Small bowel obstruction in patients previously operated on for colorectal cancer. <i>Eur J Surg</i> . 1998 Aug;164(8):587-92.	III	(N=472; Retrospective) This study followed patients after resection for colorectal CA for 5.5 years to establish the incidence of SBO. 351 had a curative procedure, the other 121 palliative. In the curative cohort 36/351 developed an SBO that needed surgery, while 5/121 of the palliative procedures developed SBO post operation. Etiology of SBO was cancer in half of all obstructions. and these patients had a much higher post-op mortality. blood loss > 1000 cc at initial operation was associated with a higher rate of SBO, as does the greater dissection of a curative procedure
Fraser SA(135)	2002	Immediate post laparotomy small bowel obstruction: a 16-year	III	(N=52; Retrospective) This review of 15 years of experience with immediate post-operative SBO. Surgical intervention was

		retrospective analysis. <i>Am Surg.</i> 2002 Sep;68(9):780-2.		needed in 22 of these Timing of SBO was about 8 days post-op. Average time to onset of symptoms to surgery was 5 days. Rate of non-operative treatment was 60%, and these patients had less complications and shorter LOS
Siporin K(136)	1993	Small bowel obstruction after abdominal aortic surgery. <i>Am Surg.</i> 1993 Dec;59(12):846-9.	III	(N=44; Retrospective) Examination of patients with either AAA repair or Graft replacement of the Aorta for occlusive disease to identify the incidence of SBO. with Immediate post-operative(<30days) SBO was indentified in 44 patients . Only 18 required operation-- lysis of adhesions and 2 resections.
Butler JA(137)	1991	Small bowel obstruction in patients with a prior history of cancer. <i>Am J Surg.</i> 1991 Dec;162(6):624-8.	III	(N=54; Retrospective) Patients with complete or partial SBO after surgery at some time for cancer. 37 (69%) of these patients had operative therapy. 67% of the group had chemo/radiation therapy. 50% had known recurrence. 25/37 with surgery had recurrent cancer as the cause of the CA. Only 11 patients cleared non-operatively. 49% of the operative patients had major complications, and the operative mortality was 16%, in hospital mortality of 22%.
Komatsu I(138)	2010	Development of a simple model for predicting need for surgery in patients who initially undergo conservative management for adhesive small bowel obstruction <i>Am J Surg.</i> 2010 Aug;200(2):215-23	III	(N=154; Retrospective) Authors identified critical factors for predicting need for subsequent surgical management: Age > 65, presence of ascites, and NGT or LT drainage volume > 500 on day 3
Late Operative – Radiographic Indications				
Choi HK(51)	2005	Value of gastrografin in adhesive small bowel obstruction after unsuccessful conservative treatment: a prospective evaluation. <i>World J Gastroenterol.</i> 2005 Jun 28;11(24):3742-5.	II	(N=212; Prospective) Gastrografin (100cc) was given 48h after non-operative management of SBO (n=44) and was predictive of the need for an operations (contrast not in colon at 24h) and those who did not (contrast in colon at 24h). The need for OR reduced by 74% with a strangulation rate of 0.8%.

Onoue S(53)	2002	The value of contrast radiology for postoperative adhesive small bowel obstruction. <i>Hepatogastroenterology</i> . 2002 Nov-Dec;49(48):1576-8. <i>Related Articles, Links</i>	II	(N=107; Prospective) Gastrografin was administered within 24h of SBO admission after NGT decompression and IVF. Gastrografin was useful in identifying and treating SBO non-operatively, though the incidence of strangulation was not affected..
Deshmukh SD(139)	2011	Non-emergency small bowel obstruction: assessment of CT findings that predict need for surgery <i>Eur Radiol</i> . 2011 May;21(5):982-6	III	(N=129; Retrospective) Chart analysis of non-emergent SBO patients who had CTs only identified the grade of obstruction as predictive of the need for surgery. A small bowel feces sign was inversely related to the need for surgery.
Late Operative – Time Period				
Cox MR(50)	1993	The safety and duration of non-operative treatment for adhesive small bowel obstruction. <i>Aust N Z J Surg</i> . 1993 May;63(5):367-71.	III	(N=123; Retrospective) 2 or more indicators (fever, tachycardia, constant pain, WBC>16) of SB strangulation on admission demonstrates by OR 76% non-viable SB. Without indicators, 69% managed non-op with resolution of SB. Evidence does not support author's statement to abandon non-op at 48h.
Operative Approach – Laparoscopic vs. Open				
Borzellino G(140)	2004	Laparoscopic approach to postoperative adhesive obstruction. <i>Surg Endosc</i> . 2004 Apr;18(4):686-90.	III	(N=65; Retrospective) Using laparoscopy, 6.5% intraop complication, 20% conversion rate and 15.4% recurrence. US guide to enter abdomen without any injury on entrance. Relative contraindications such as massive distention, no free quadrant, and suspected strangulation discussed. Author emphasizes success with numbers above.
Chopra R(141)	2003	Laparoscopic lysis of adhesions. <i>Am Surg</i> . 2003 Nov;69(11):966-8.	III	(N=75; Retrospective) Using laparoscopy, 4.3% SB resection, 32% conversion rate, and overall lower OR time, infectious complications, post-op ileus, and LOS. Author states "viable option."
Duepree HJ(142)	2003	Does means of access affect the incidence of small bowel obstruction and ventral hernia after bowel resection?	III	(N=716; Retrospective) Use of laparoscopy for bowel resection decreases ventral hernia and SBO requiring hospital readmission. SB requiring operative intervention was similar between laparoscopy and open..

		Laparoscopy versus laparotomy. <i>J Am Coll Surg.</i> 2003 Aug;197(2):177-81.		
Wullstein C(143)	2003	Laparoscopic compared with conventional treatment of acute adhesive small bowel obstruction. <i>Br J Surg.</i> 2003 Sep;90 (9):1147-51.	III	(N=104; Retrospective) Using laparoscopy, 17.3% perforation, 51.9% conversion, and longer operative times. Post-operative complications, return of bowel function, and LOS less for laparoscopy.
Leon EL(144)	1999	Laparoscopic management of small bowel obstruction: indications and outcome. <i>J Gastrointest Surg.</i> 1998 Mar-Apr;2(2):132-40.	III	(N=40; Retrospective) Laparoscopy successful 35% assisted 30%, and 35% conversion. Reasons for conversion included dense adhesions, need for bowel resection, Crohns, 2 cancers and large lymph nodes. Those converted had longer LOS.
Levard H(145)	2001	Laparoscopic treatment of acute small bowel obstruction: a multicentre retrospective study. <i>ANZ J Surg.</i> 2001 Nov;71(11):641-6.	III	(N=308; Retrospective) Laparoscopy conversion rate 45.4%. Factors that favor laparoscopic success are SBO post appendectomy, with bands as cause, with less than 2 previous surgeries, and shorter time of symptoms. Those not converted had shorter LOS, fewer complications, and earlier bowel function.
Liau JJ(146)	2005	Laparoscopic management of acute small bowel obstruction. <i>Asian J Surg.</i> 2005 Jul;28(3):185-8.	III	(N=9; Retrospective) Conversion rate of 22%.
Suter M(147)	2000	Laparoscopic management of mechanical small bowel obstruction: are there predictors of success or failure? <i>Surg Endosc.</i> 2000 May;14(5):478-83.	III	(N=15; Retrospective) Enteroclysis guided laparoscopy conversion rate of 6.7%.
Suzuki K(148)	2003	Elective laparoscopy for small bowel obstruction. <i>Surg Laparosc Endosc Percutan Tech.</i> 2003 Aug;13(4):254-6.	III	(N=40; Retrospective) Laparoscopy conversion rate of 40%. Intraop enterotomies 10%. Late recurrence 2.5%
Tsumura	2004	Laparoscopic	III	(N=83; Retrospective) 57% initial success

H(149)		adhesiolysis for recurrent postoperative small bowel obstruction. Hepatogastroenterology. 2004 Jul-Aug;51(58):1058-61.		rate with duration of surgery (>120min) and bowel diameter (>4cm) predictive of conversion. Reoperation rate of 9%. Bowel perforation and need for conversion increased post-op complications.
Pekmezci S(65)	2002	Enteroclysis-guided laparoscopic adhesiolysis in recurrent adhesive small bowel obstructions. Surg Laparosc Endosc Percutan Tech. 2002 Jun;12(3):165-70.	III	(N=21; Retrospective) 57% laparoscopy only, 24% assisted, 19% conversion rate. Utilizing laparoscopy (+/- assisted) diminished time for bowel function and LOS.
Strickland P(66)	1999	Is laparoscopy safe and effective for treatment of acute small-bowel obstruction? Surg Endosc. 1999 Jul;13(7):695-8.	III	(N=25; Retrospective) Complete adhesiolysis 72%. Lap assisted 24%. Open 4%. Utilizing laparoscopy (+/- assisted) diminished time for bowel function and LOS.
O'Connor DB(61)	2011	The role of laparoscopy in the management of acute small-bowel obstruction: a review of over 2,000 cases Surg Endosc. 2011 Sep 5	III	Meta-analysis of English language case series of laparoscopic treatment of adults with SBO 1990 – 2010, totaling 2005 patients from 29 articles. 85% of the obstructions were adhesive, 47% of evaluable adhesive obstructions were single adhesive band. 64% were completed laparoscopically. 29% were converted to open, mainly due to dense adhesions or ischemia requiring resection. Among those with single band adhesive obstruction, 73% were successfully treated laparoscopically. 7% resulted in enterotomy, 7% were lap-assisted. Overall mortality rate was 1.5% and morbidity 15%. 2% had early recurrence of SBO.
Pearl JP (59)	2008	Laparoscopic treatment of complex small bowel obstruction: is it safe? Surg Innov. 2008 Jun;15(2):110-3	III	(N=19; Retrospective) A case series of 19 patients who underwent laparoscopic exploration for acute SBO. 16 cases were able to be completed successfully.
Khaikin M(150)	2007	Laparoscopic vs. open surgery for acute adhesive small-bowel obstruction: patients'	III	(N=31; Retrospective) This case controlled series of patients who underwent laparoscopy and open explorations. Laparoscopy was associated with reduced

		outcome and cost-effectiveness. Surg Endosc. 2007 May;21(5):742-6		hospital stay, early recovery and decreased morbidity but similar operative and hospital charges.
Lee IK(62)	2009	Selective laparoscopic management of adhesive small bowel obstruction using CT guidance. Am Surg. 2009 Mar;75(3):227-31	III	(N=29; Retrospective) Laparoscopic operations were successful in 16 patients and laparotomy in 13. Laparoscopic pts had a shorter operative times, shorter time to PO intake and shorter LOS.
Zerey M(67)	2007	Laparoscopic management of adhesive small bowel obstruction Am Surg. 2007 Aug;73(8):773-8; discussion 778-9	III	(N=46; Retrospective) Laparoscopy is safe and feasible in the management of acute SBO in selected pts. Excellent diagnostic tool and is therapeutic in most cases.
Grafen FC(63)	2010	Management of acute small bowel obstruction from intestinal adhesions: indications for laparoscopic surgery in a community teaching hospital Langenbecks Arch Surg. 2010 Jan;395(1):57-63	III	(N=93; Retrospective) Patients with successful laparoscopy (73%) had more simple adhesions, fewer prior operations and lower ASA.
Ghosheh B(64)	2007	Laparoscopic approach to acute small bowel obstruction: review of 1061 cases. Surg Endosc. 2007 Nov;21(11):1945-9	III	(N=1061; Meta-analysis of 19 studies) Laparoscopic approach was characterized by a 33.5% conversion rate, 6.5% enterotomy rate, and a <1% rate of unrecognized enterotomy.
Wang Q(60)	2009	Laparoscopic management of recurrent adhesive small-bowel obstruction: Long-term follow-up Surg Today. 2009;39(6):493-9	III	(N = 109; Retrospective) Patients undergoing laparoscopic adhesiolysis (N=46) among SBO patients overall. Only patients with 3 or more episodes of SBO in the past were selected. All patients had 1 or 2 prior abdominal operations. Laparoscopic approach was successful in this group 91% of the time. Follow up times 46 months -- 94% of pts were asymptomatic.
Operative Approach – Adjuncts				
Fazio VW(69)	2006	Reduction in adhesive small-bowel obstruction	I	(N=1791; Prospective) This blinded randomized multicenter trial evaluated

		by Seprafilm adhesion barrier after intestinal resection. <i>Dis Colon Rectum</i> . 2006 Jan;49(1):1-11.		Seprafilm. The overall rate of post-operative SBO was not effected However, Seprafilm did have lower (1.8 vs 3.4%) of SBO requiring reoperation (N=90).
Kieffer RW(151)	1993	Indications for internal stenting in intestinal obstruction. <i>Mil Med</i> . 1993 Jul;158(7):478-9.	III	(N=16; Retrospective) Using internal stenting with Baker jejunal tube, recurrent rate of obstruction was 25%. Non-obstructive intra-abdominal complication rate 18.7%.
Meissner K(152)	2000	Effectiveness of intestinal tube splinting: a prospective observational study. <i>Dig Surg</i> . 2000;17(1):49-56.	II	(N=186; Prospective) With internal splinting, 9% complications, 2% procedural complications, 3% reoperation. No early SBO. Lower late SBO compared to historical outcome data.
Kudo FA(74)	2004	Use of bioresorbable membrane to prevent postoperative small bowel obstruction in transabdominal aortic aneurysm surgery. <i>Surg Today</i> . 2004;34(8):648-51.	III	(N=51; Retrospective) Early SBO was lower with Seprafilm evident by earlier diet intake and less abdominal complaints. No reoperations were required in either group
Meissner K(153)	2001	Small bowel obstruction following extended right hemicolectomy and subtotal colectomy: assessing the benefit of prophylactic tube splinting. <i>Dig Surg</i> . 2001;18(5):388-92.	III	(N=34; Retrospective) Intestinal tube splinting showed non-statistical fewer early and late SBO
Mohri Y(73)	2005	Hyaluronic acid-carboxycellulose membrane (Seprafilm) reduces early postoperative small bowel obstruction in gastrointestinal surgery. <i>Am Surg</i> . 2005 Oct;71(10):861-3.	III	(N=184; Retrospective) Incidence of early SBO lower with Seprafilm. No difference in surgical site infection.
Sprouse LR 2nd(154)	2001	Twelve-year experience with the Thow long intestinal tube: a means of preventing postoperative bowel	III	(N=34; Retrospective) Transgastric Thow tube had no long term (>4y) with pts who had operative intervention for adhesion SBO. Follow-up recorded via phone calls to patients (25 of 34). Complications all

		obstruction. <i>Am Surg.</i> 2001 Apr;67(4):357-60.		related to gastrostomy (25%)
Rodriguez-Ruesga R(155)	1995	Twelve-year experience with the long intestinal tube. <i>World J Surg.</i> 1995 Jul-Aug;19(4):627-30; discussion 630-1.	III	(N=47; Retrospective) Complex surgical patients with median 4 previous laparotomies. 23.4% recurrent SBO, only 2 required reoperation.
Korenaga D(156)	2001	Factors influencing the development of small intestinal obstruction following total gastrectomy for gastric cancer: the impact of reconstructive route in the Roux-en-Y procedure. <i>Hepatogastroenterology.</i> 2001 Sep-Oct;48(41):1389-92.	III	(N=48; Retrospective) 22.9% presented with mechanical obstruction and antecolic anastomosis found to be predictive factor. 45% required reoperation.
Poon JT(157)	2004	Small bowel obstruction following low anterior resection: the impact of diversion ileostomy. <i>Langenbecks Arch Surg.</i> 2004 Aug;389(4):250-5.	II	(N=214; Retrospective) SBO following LAR is 10.3%, the majority benign and not malignant recurrence. Diverting ileostomy increases incidence of early SBO.
Holmdahl L(158)	1997	Adhesions: prevention and complications in general surgery. <i>Eur J Surg.</i> 1997 Mar;163(3):169-74.	III	Survey sent out to surgical department heads in Sweden. 84% (87units) response rate. >4700 admissions for adhesion SBO, 47% operative rate. Over 1500 operations/y complicated by previously formed adhesions. Author suggests washing gloves and suturing peritoneum could help but no evidence provided.
Kawamura H(71)	2010	A sodium hyaluronate carboxymethylcellulose bioresorbable membrane prevents postoperative small-bowel adhesive obstruction after distal gastrectomy <i>Surg Today.</i> 2010 Mar;40(3):223-7	III	(N=282; Retrospective) Decreased incidence of SBO 2 years after distal gastrectomy for cancer with seprafilm, (0.9% vs. 6.5%).
Tabata T(72)	2010	Efficacy of a sodium hyaluronate-	III	(N=144; Retrospective) Historical cohort study of of Seprafilm. It reduced early

		carboxycellulose membrane (seprafilm) for reducing the risk of early postoperative small bowel obstruction in patients with gynecologic malignancies. <i>Int J Gynecol Cancer</i> . 2010 Jan;20(1):188-93		SBO(<30 days) from 13.9 to 3.1%. No differences in wound infections or abscesses. All SBO resolved without operation.
Hayashi S(70)	2008	Bioresorbable membrane to reduce postoperative small bowel obstruction in patients with gastric cancer: a randomized clinical trial. <i>Ann Surg</i> . 2008 May;247(5):766-70	I	(N=144; Prospective) This randomized trial of patients undergoing gastrectomy found no significant difference in the occurrence of SBO after gastrectomy with(N=70) or without Seprafilm (N=74).
Bristow RE(159)	2007	Prevention of adhesion formation after radical hysterectomy using a sodium hyaluronate-carboxymethylcellulose (HA-CMC) barrier: a cost-effectiveness analysis. <i>Gynecol Oncol</i> . 2007 Mar;104(3):739-46	III	(N=0; Mathematical model)Decision analysis model that concluded that under a conservative set of clinical and economic assumptions, an adhesion prevention strategy utilizing a HA–CMC barrier in patients undergoing radical hysterectomy for Stage IB cervical cancer is cost-effective from both the perspective of society as a whole and that of a third party payer.
<i>SBO in Pregnancy</i>				
Meyerson S(160)	1995	Small bowel obstruction in pregnancy. <i>Am J Gastroenterol</i> . 1995 Feb;90(2):299-302.	III	(N=9; Retrospective) Review of cases over 15 years and 150,386 deliveries. Previous surgery 8 of 9 cases. Operation required in 8 of 9 patients. No maternal deaths. 3 of 9 fetal deaths (22-30 wks)

