

REVIEW

Auscultation for bowel sounds in patients with ileus: an outdated practice in the ICU?

S.H.W. van Bree^{1,2}, M.M.C. Prins³, N.P. Juffermans⁴

¹Department of Intensive Care Medicine, Gelderse Vallei Hospital, Ede, the Netherlands

²Department of Internal Medicine, Amsterdam UMC location AMC, University of Amsterdam, Amsterdam, the Netherlands

³Tytgat Institute for Liver and Intestinal Research, Amsterdam Gastroenterology and Metabolism, Amsterdam UMC location AMC, University of Amsterdam, Amsterdam, the Netherlands

⁴Department of Intensive Care Medicine, Amsterdam UMC location AMC, Amsterdam, the Netherlands

Correspondence

S. van Bree - breees@zgv.nl

Keywords - auscultation; bowel sounds; intestinal motility; ileus; bowel obstruction

Abstract

Background: Ileus can be the consequence of multiple factors, including an operation, a side effect of drugs or the result of an obstruction requiring direct operative correction. Although auscultation for bowel sounds is routinely performed in the ICU and a well-established part of the physical examination in patients, its clinical value remains largely unstudied.

Methods: To determine whether auscultation for bowel sounds helps in clinical decision-making in ICU patients with ileus, a literature search of PubMed, Embase and Cochrane was performed to study the diagnostic value of auscultation for bowel sounds.

Results: The inter-observer variability for the assessment of the quantity, volume and pitch of bowel sounds was high, with a moderate inter-observer agreement for discerning postoperative ileus, bowel obstruction and normal bowel sounds (kappa value 0.57). The intra-observer reliability of duplicated recordings for distinguishing between patients with normal bowels, obstructed bowels or postoperative ileus was 54%. No clear relation between bowel sounds and intestinal transit was found. Sensitivity and positive predictive value were low: 32% and 23% respectively in healthy volunteers, 22% and 28% in obstructive ileus, and 22% and 44% in postoperative ileus.

Conclusions: Auscultation with the aim to differentiate normal from pathological bowel sounds is not useful in clinical practice. The low sensitivity and low positive predictive value together with a poor inter- and intra-observer agreement demonstrate the inaccuracy of utilising bowel sounds for clinical decision-making. Given the lack of evidence and standardisation of auscultation, the critically ill patient is more likely to benefit from abdominal imaging.

Introduction

Ileus can be the consequence of multiple factors, including an operation, or medications such as opiates, but can also result from an obstruction that may require direct operative correction. As the pathogenesis of ileus is complex, there are more causes of ileus in intensive care patients such as critical illness itself,^[1] ischaemia, diverticulitis and peritonitis, contributing at various times during the development of this entity.^[2] Therefore, the decreased propulsive ability in patients with ileus may be broadly classified as caused either by bowel obstruction or intestinal atony/paralysis.

Reported clinical symptoms of ileus include nausea, vomiting, bloating, abnormal or loss of peristaltic bowel sounds, delayed passage of flatus and stool, and inability to progress to an oral diet.^[3,4] Gastrointestinal problems occur frequently and are associated with adverse outcomes in intensive care patients.^[5-8] Different gastrointestinal symptoms and complications [e.g. decreased bowel sounds and delayed gastric emptying] may occur in up to 50% of mechanically ventilated patients.^[5,9] Despite this, there is no consensual means for obtaining a precise assessment of gastrointestinal function,^[8] and it remains unclear which symptoms most reliably reflect recovery of the gastrointestinal tract in the intensive care unit (ICU).^[3,10-12] Clinical parameters to diagnose ileus, such as return of bowel sounds and time to first flatus, may lack accuracy, while other clinical parameters such as nausea, vomiting and tolerance of solid food strongly depend on patient reporting.^[13] Thus, it is questionable to what extent these parameters reflect recovery of intestinal motility. Thereby, it may not be surprising that studies assessing ileus have used various clinical parameters as primary outcome measure.^[13,14]

In the ICU, diminished bowel peristalsis and the absence of bowel sounds are common in mechanically ventilated patients receiving sedatives, opiates and/or catecholamines. Data suggest that bowel sounds may be decreased or absent in half of the patients in the intensive care.^[4-6,15] There are contradictory data in the literature about what constitutes normal bowel sounds; however, what is consistent throughout is the reported abnormality of a complete lack of bowel sounds.

Auscultation for bowel sounds is routinely performed in the ICU and a well-established part of the physical examination in patients with suspected ileus,^[16-18] while its clinical value remains largely unstudied.^[19-23] In this review, the following clinical question is addressed: Does auscultation for bowel sounds help in clinical decision-making in critically ill patients with ileus?

Methods

To identify studies and case series that report on the utility of bowel sounds in clinical decision-making in intensive care patients with ileus, we searched MEDLINE (1950 to September 2017), EMBASE (1980 to Sept 2017, ISI Web of Science (1964 to September 2017), and the Cochrane Library (2005 to September 2017). The following subheadings were used: (“intestinal obstruction” OR “bowel obstruction” OR “ileus”) AND (“auscultation” OR “bowel sounds” OR “gastrointestinal motility” OR “peristalsis” OR “diagnosis” OR “ICU” OR “critically ill”).

Two authors independently reviewed the titles and abstracts yielded by this comprehensive search. All titles and abstracts were screened to identify manuscripts for eligibility. Based on the initial screening, selected full-text articles were obtained for second stage screening of the whole article. Randomised controlled trials, prospective and retrospective cohorts and case series were all eligible for inclusion, irrespective of publication status, date of publication and blinding status. Language was limited to English. Quality assessment was done with the methodological index for non-randomised studies (MINORS) checklist.^[24]

Results

The search yielded 947 articles. After elimination of irrelevant titles and duplicates, 172 abstracts were evaluated. A total of 21 publications were retrieved for further assessment and finally seven full-text articles were included in the results section of this review. There were no systematic reviews or meta-analyses of randomised controlled trials on this topic.

Accuracy and variability in assessment of bowel sounds in bowel obstruction, healthy controls and in postoperative ileus

Only two studies have determined whether an accurate diagnosis of mechanical small bowel obstruction, postoperative ileus and normal intestinal motility can be made based on bowel sound characteristics (*table 1*).^[25,26] Bowel sounds were recorded for 30 seconds using an electronic stethoscope and were randomly replayed to clinicians of the departments of internal medicine and surgery without providing any clinical information. The clinicians were instructed to categorise the patient recordings as small bowel obstruction, ileus or normal. The study by Gu et al. determined the accuracy of bowel sounds in 9 patients with small bowel obstruction, 7 patients with ileus and 10 healthy volunteers.^[25] Recordings of patients with obstructive ileus were correctly labelled in only 42%. However, recordings of healthy volunteers and those of patients with ileus yielded a sensitivity of 78% and 84% respectively. If the physician believed she or he was hearing a bowel obstruction, this had a positive predictive value (PPV) of 72%, while for ileus and normal intestinal motility the PPV was 93% and 54% respectively. The inter-observer agreement was moderate (kappa value 0.57). The subsequent study by Felder et al. was a more elaborate reproduction of the earlier published study by Gu et al. with similar results, but also included the level of training of the clinicians.^[26] The study cohort consisted of recordings of bowel sounds of 19 patients with mechanical small bowel obstruction, 156 patients with postoperative ileus and 177 healthy volunteers. A total of 45 recordings were played consecutively to physicians, with 15 of the recordings duplicated. Over 78% of the recordings of

Table 1. Accuracy and inter/intra-observer variability in bowel obstruction, ileus and healthy volunteers

Author	Design & MINORS score	Patients	Outcome	Results (%)	Limitations
Gu, 2010 ^[25]	Prospective 13	A: Healthy volunteers B: Intestinal obstruction C: Postoperative ileus	Correct classification of bowel sounds: Sensitivity/PPV	A: 78/54 B: 42/72 C: 84/93	- Electronic recordings - Patient characteristics unknown - Small selection of bowel recordings
Felder, 2014 ^[26]	Prospective 20	A: Healthy volunteers B: Intestinal obstruction C: Postoperative ileus	Correct classification of bowel sounds & reliability: Sensitivity/PPV /intra-observer reliability	A: 32/23/59 B: 22/28/52 C: 22/44/53	- Electronic recordings
Breum, 2015 ^[28]	Prospective 19	Patients with clinically suspected bowel obstruction: A: Intestinal obstruction (n=37) B: Without obstruction (n=61)	Sensitivity, specificity, PPV and NPV of pathological bowel sounds with respect to intestinal obstruction & Inter-observer agreement (median kappa (κ)-value)	- Sens.: 42 - Spec.: 78 - PPV: 48 - NPV: 76 - κ-value: 0.29 (low)	- Shorter duration of electronic recordings (25 seconds)

PPV = positive predictive value, NPV = negative predictive value; MINORS = methodological index for non-randomised studies score. The global ideal score is 24: 12 items are scored 0 (not reported), 1 (reported but inadequate) or 2 (reported and adequate)^[24]

obstructive ileus were incorrectly labelled and not recognised as obstructive ileus, yielding a sensitivity of less than 22%. Recordings of healthy volunteers and those of patients with postoperative ileus yielded a sensitivity of just 32% and 22%, respectively. The PPV of bowel obstruction recordings was 28% and for normal and postoperative ileus recordings 23% and 44% respectively. This indicates that when a clinician judged the recording to match obstructive ileus, this was actually true in only 28% of cases. Auditory characteristics (tinkling, high pitched and rushes) in each bowel sound category were highly variable. Of all physicians, 58% reported tinkling as normal bowel sounds. However, high-pitched sounds and rushes, characteristics often associated with small bowel obstruction, were reported in 23% to 73% of normal bowel sounds recordings. High-pitched sounds and rushes were reported to be heard less frequently in the obstructed recordings, 28% and 23%, respectively, than in the normal recordings, 60% and 46%, respectively. For the postoperative ileus recordings, clinicians reported hearing tinkling, high-pitched sounds or rushes approximately one-third of the time. The intra-observer reliability for normal bowel sounds was 59%, for obstructive ileus recordings 51% and for postoperative ileus 56%. The overall intra-observer reliability of duplicated recordings was only 54%.

The question remains whether physicians are able to determine by stethoscope whether bowel sounds are normal in their patients suspected of bowel obstruction. Durup-Dickenson et al. assessed inter- and intra-observer agreement in physicians' evaluation of quantity, volume and pitch of bowel sounds. A total of 100 physicians were presented with 20 bowel sound recordings in a blinded set-up. The recordings had been made in healthy volunteers and patients in the emergency department presenting with peritonitis or bowel obstruction. Inter-observer agreement regarding pitch, intensity and quantity yielded κ -values of 0.19, 0.30 and 0.24 ($p < 0.0001$), respectively, corresponding to slight, fair and fair agreement. With regard to the intra-observer agreement, the probability of agreement was only 0.55, 0.45 and 0.41 for pitch, intensity and quantity respectively, which approximates flipping a coin.^[20]

Hyperactive bowel sounds were thought to be useful in diagnosing obstructive ileus, as suggested by a cohort study performed by Bohner et al. in patients presenting with abdominal pain lasting less than seven days, and with no history of abdominal injury including surgery.^[27] Investigating which data from history and physical examination may help to exclude bowel obstruction and thereby avoid the additional request of abdominal radiographs, they found that 'increased' bowel sounds was one of the six variables with the highest sensitivity to exclude bowel obstruction. However, a more recent study investigating the accuracy of bowel sounds to diagnose obstructive ileus was performed by Breum et al., in which 53 physicians listened to electronically recorded bowel sounds from 98 patients admitted with clinically suspected

intestinal obstruction. A low accuracy and low inter-observer-agreement for bowel obstruction was found.^[28] Moreover, using a simulation model, Mehmood et al. found that healthcare professionals of the internal medicine department and the ICU had a correct detection rate of hyperdynamic bowel sounds of 50%.^[29]

Relationship between bowel sounds and intestinal transit

The presence of audible peristalsis as a sign of intestinal contraction is routinely used in postoperative patients. However, until recently it was not known whether this actually correlates with effective intestinal transit.^[30,31] Intestinal transit was analysed by scintigraphy in 60 patients to determine which clinical symptoms best reflect postoperative intestinal motility.^[13] Postoperative defecation together with tolerance of solid food proved to be the best clinical composite endpoint of postoperative ileus. This was in accordance with a recent systematic review determining the best clinical endpoint for postoperative ileus.^[32] Strikingly, seven patients had developed a major postoperative complication, with paralytic ileus requiring a nasogastric tube. In these patients, the indium-111 tracer had not reached the colon at day 2, demonstrating no significant intestinal propulsive activity. Interestingly, in six out of these seven patients with a paralytic ileus, there was still presence of audible peristalsis (*table 2*).^[33] These data indicate that the reported absence of audible peristalsis poorly reflects postoperative dysmotility.

Table 2. Auscultation for the presence of bowel sounds audible peristalsis in relation with intestinal transit

Postoperative day 2	Auscultation of bowel sounds		n =
	No	Yes	
GC = 0 (paralytic ileus)	1	6	7
GC < 2 (no recovery of colonic transit)	0	41	41
GC ≥ 2 (recovery of colonic transit)	1	11	12

In the patients without ileus, the recovery of colonic transit (defined as geometrical centre (GC) of radioactivity ≥ 2) was significantly correlated with clinical recovery^[33]

Discussion

There are practical difficulties in determining whether bowel sounds are hyperactive, hypoactive or truly absent, considering that normal bowel sounds occur intermittently between 5 and 35 times a minute in an irregular pattern.^[34-37] The minimum amount of time to auscultate before concluding that no bowel sounds are present varied from 30 seconds to 7 minutes, with most authors advising practitioners to auscultate for at least 5 minutes if no sounds are heard initially.^[35,38-41] In addition, bowel sounds demonstrate a large variation in sound distribution and

intensity in healthy subjects. Along with this, the terminology commonly used for normal and pathological bowel sounds is variable and the labelling of bowel sounds is often subjective.^[17] Thereby, the diagnostic ability of bowel sounds to discern normal and pathological conditions is not well characterised, and aberrant bowel sounds may be of limited value for the diagnosis of small bowel obstruction.^[42] Despite these issues, bowel sounds are claimed to help us develop our differential diagnosis.^[16,35,36,39-41,43] However, for a diagnostic test to be of value, it not only has to be well interpretable and accurate but, most importantly, also reproducible.^[23] In the study by Felder et al. the intra-observer reliability for normal bowel sounds, obstructive ileus recordings and postoperative ileus was low at 50-60%.^[26] This makes it unlikely that the diagnostic value of auscultation increases with the addition of patient history and physical findings. Furthermore, several studies have reported no differences between junior and senior doctors, contradicting the assumption that the diagnostic value of auscultation may be further improved by increasing systematic training.^[26,28]

Previous studies have demonstrated low to moderate inter-observer agreement for bowel sounds assessment in various motility disorders.^[19,20,22,25,28,44] Variation in the intensity of the volume and pitch of the sound further challenges the clinician trying to determine whether bowel sounds are overly loud or soft. A partial obstruction may provoke a hollow, very high-pitched tinkling sound as a result of liquid and gas accumulating under pressure in the dilated bowel.^[41] However, there is no clear evidence that very high-pitched bowel sounds have clinical pertinence.^[45]

Besides a lack of accuracy, there are specific conditions in the ICU that may further hamper the utility of auscultating bowel sounds in critical care. Contact precautions are part of the standard care in the ICU to prevent the spread of multidrug resistant bacteria from infected or colonised patients. These precautions include the use of disposable or patient-dedicated simple stethoscopes. As previously demonstrated by Mehmood et al., these low-end stethoscopes perform poorly, hampering reliable auscultation in the ICU. Physicians differ in how long they listen for bowel sounds, and they listen for a shorter time compared with nurses in the ICU. As a result, different conclusions about the presence of normal bowel sounds can be made within the same patient in the same department.^[21,29] Had abdominal auscultation not been such a cheap commonly practised investigation, it would probably not have survived in clinical practice for more than 150 years, given the very limited documentation of its clinical value.^[28,46] The practice of auscultation therefore appears to be more a reflection of tradition and anecdotal evidence, and begs the question whether it may be better to abandon this routine procedure in order to avoid delayed diagnosis or even misjudgement of patients with suspected bowel obstruction.^[28] We are strong

supporters of the history and physical exam and advocate for the use of hands, ears, nose and eyes to interpret the patient's condition. However, intensivists must be progressive, embracing new modalities and letting go of less reliable methods. For example, the bedside ultrasound for the diagnosis of small bowel obstruction might be a more suitable alternative. In line with this, a recent systematic review of the diagnostic modalities used to identify bowel obstruction found ultrasound to be superior to all other modalities.^[47] The lack of consensus, standardisation and evidence may encourage educators and physicians in the ICU to discuss the efficacy and utility of this manoeuvre during clinical training. Especially, in an era of expanding diagnostic possibilities,^[48] the intensive care patient is more likely to benefit from abdominal imaging than auscultation if the suspicion of an ileus requiring operative intervention arises.^[49]

For many years, the dogma was not to give patients any oral or enteral feeds unless bowel sounds were present. However, a number of studies have shown that ileus is not equated with intestinal failure and that bowel function and nutrient-absorbing capacity may be suppressed in patients with ileus, but are not absent.^[50] Moreover, the sounds made by the bowel are evidence of contractility, not absorptive capacity or mucosal integrity. Thus, the intestine can still produce loud bowel sounds while its mucosa is eroded and denuded of villi.^[51,52] In fact, the use of bowel sounds to drive any clinical decision has never been validated and nowadays guidelines support the use of early enteral nutrition, stating there is no need to wait for bowel sounds.^[52,53] Moreover, the presence of bowel sounds poorly reflects postoperative dysmotility as bowel sounds are still audible in the majority of patients with a paralytic ileus. These findings are in line with a recently published prospective study in 124 adult patients undergoing major abdominal surgery. In this blinded observational study, Read et al. found no association between bowel sounds and flatus, bowel movement, or tolerance of oral intake.^[54] This further underlines that clinical decisions in intensive care patients with ileus should not be based on auscultatory assessment of bowel sounds.^[3,33,45]

Conclusion

The low sensitivity and positive predictive value, together with a poor inter- and intra-observer agreement, demonstrate low accuracy of utilising bowel sounds for clinical decision-making. Thereby, the diagnostic utility of auscultation in differentiating normal from pathological bowel sounds in ICU patients is useless and should be abandoned.

Disclosures

All authors declare no conflicts of interest. No funding or financial support was received.

References

- Bauer AJ, Schwarz NT, Moore BA, Türler A, Kalff JC. Ileus in critical illness: mechanisms and management. *Curr Opin Crit Care*. 2002;8:152–7.
- Adike A, Quigley EMM. Gastrointestinal motility problems in critical care: a clinical perspective. *J Dig Dis*. 2014;15:335–44.
- van Bree SHW, Nemethova A, Cailotto C, Gomez-Pinilla PJ, Matteoli G, Boeckxstaens GE. New therapeutic strategies for postoperative ileus. *Nat Rev Gastroenterol Hepatol*. 2012;9:675–83.
- Reintam A, Parm P, Kitus R, Kern H, Starkopf J. Gastrointestinal symptoms in intensive care patients. *Acta Anaesthesiol Scand*. Blackwell Publishing Ltd; 2009;53:318–24.
- Mutlu GM, Mutlu EA, Factor P. GI complications in patients receiving mechanical ventilation. *Chest*. 2001;119:1222–41.
- Mentec H, Dupont H, Bocchetti M, Cani P, Ponche F, Bleichner G. Upper digestive intolerance during enteral nutrition in critically ill patients: frequency, risk factors, and complications. *Crit Care Med*. 2001;29:1955–61.
- Montejo JC, Grau T, Acosta J, et al. Multicenter, prospective, randomized, single-blind study comparing the efficacy and gastrointestinal complications of early jejunal feeding with early gastric feeding in critically ill patients. *Crit Care Med*. 2002;30:796–800.
- Reintam A, Parm P, Kitus R, Starkopf J, Kern H. Gastrointestinal failure score in critically ill patients: a prospective observational study. *Crit Care*. 2008;12:R90.
- Montejo JC. Enteral nutrition-related gastrointestinal complications in critically ill patients: a multicenter study. The Nutritional and Metabolic Working Group of the Spanish Society of Intensive Care Medicine and Coronary Units. *Crit Care Med*. 1999;27:1447–53.
- Collins TC, Daley J, Henderson WH, Khuri SF. Risk factors for prolonged length of stay after major elective surgery. *Ann Surg*. 1999;230:251–9.
- Hiranyakas A, Bashankaev B, Seo CJ, Khaikin M, Wexner SD. Epidemiology, pathophysiology and medical management of postoperative ileus in the elderly. *Drugs Aging*. 2011;28:107–18.
- Reintam Blaser A, Malbrain MLNG, Starkopf J, et al. Gastrointestinal function in intensive care patients: terminology, definitions and management. Recommendations of the ESICM Working Group on Abdominal Problems. *Intensive Care Med*. 2012;38:384–94.
- van Bree SHW, Bemelman WA, Hollmann MW, et al. Identification of clinical outcome measures for recovery of gastrointestinal motility in postoperative ileus. *Ann Surg*. 2014;259:708–14.
- Reintam A, Kern H, Starkopf J. Defining gastrointestinal failure. *Acta Clin Belg*. 2007;62 Suppl 1:168–72.
- Dark DS, Pingleton SK. Nonhemorrhagic gastrointestinal complications in acute respiratory failure. *Crit Care Med*. 1989;17:755–8.
- Li B, Tang S, Ma Y-L, Tang J, Wang B, Wang J-R. Analysis of bowel sounds application status for gastrointestinal function monitoring in the intensive care unit. *Crit Care Nurs Q*. 2014;37:199–206.
- De Dombal F. The physical examination revisited. Diagnosis of acute abdominal pain. 2nd ed. Churchill Livingstone; 1991. p. 47–62.
- Reintam Blaser A, Starkopf J, Malbrain MLNG. Abdominal signs and symptoms in intensive care patients. *Anaesthesiol Intensive Ther*. 2015;47:379–87.
- Bjerregaard B, Bryntz S, Holst-Christensen J, et al. The reliability of medical history and physical examination in patients with acute abdominal pain. *Methods Arch*. 1983;22:15–8.
- Durup-Dickenson M, Christensen MK, Gade J. Abdominal auscultation does not provide clear clinical diagnoses. *Dan Med J*. 2013;60:A4620.
- Baid H. A critical review of auscultating bowel sounds. *Br J Nurs*. 2009;18:1125–9.
- Gade J, Kruse P, Andersen OT, Pedersen SB, Boesby S. Physicians' abdominal auscultation. A multi-rater agreement study. *Scand J Gastroenterol*. 1998;33:773–7.
- Sackett D. Clinical epidemiology. A basic science for clinical medicine. 2nd ed. Lippincott Williams and Wilkins; 1991. p. 52–8.
- Slim K, Nini E, Forestier D, Kwiatkowski F, Panis Y, Chipponi J. Methodological index for non-randomized studies (MINORS): development and validation of a new instrument. *ANZ J Surg*. 2003;73:712–6.
- Gu Y, Lim HJ, Moser MAJ. How useful are bowel sounds in assessing the abdomen? *Dig Surg*. 2010;27:422–6.
- Felder S, Margel D, Murrell Z, Fleshner P. Utility of bowel sound auscultation: a prospective evaluation. *J Surg Educ*. 2014;71:768–73.
- Böhner H, Yang Q, Franke C, Verreet PR, Ohmann C. Simple data from history and physical examination help to exclude bowel obstruction and to avoid radiographic studies in patients with acute abdominal pain. *Eur J Surg*. 1998;164:777–84.
- Breum BM, Rud B, Kirkegaard T, Nordentoft T. Accuracy of abdominal auscultation for bowel obstruction. *World J Gastroenterol*. 2015;21:10018–24.
- Mehmood M, Abu Grara HL, Stewart JS, Khasawneh FA. Comparing the auscultatory accuracy of health care professionals using three different brands of stethoscopes on a simulator. *Med Devices (Auckl)*. 2014;7:273–81.
- Maffezzini M, Campodonico F, Canepa G, Gerbi G, Parodi D. Current perioperative management of radical cystectomy with intestinal urinary reconstruction for muscle-invasive bladder cancer and reduction of the incidence of postoperative ileus. *Surg Oncol*. 2008;17:41–8.
- Bungard TJ, Kale-Pradhan PB. Prokinetic agents for the treatment of postoperative ileus in adults: a review of the literature. *Pharmacotherapy*. 1999;19:416–23.
- Wu Z, Boersema GSA, Dereci A, Menon AG, Jeekel J, Lange JF. Clinical endpoint, early detection, and differential diagnosis of postoperative ileus: a systematic review of the literature. *Eur Surg Res*. 2015;54:127–38.
- van Bree, Sjoerd HW, Bemelman W, et al. Auscultation of bowel sounds to assess intestinal motility? In: Poster 0198. 2015. p. Neurogastro 2015, European Society of NeuroGastroenterology.
- Rhoads J. *Advanced Health Assessment and Diagnostic Reasoning*. Philadelphia: Lippincott Williams & Wilkins; 2006.
- Seidel, HM, Ball JW, Dains JE, Benedict G. *Mosby's Guide to Physical Examination*. 6th edn. St Louis: Mosby Elsevier; 2006.
- Bickley, LS, Szilagyi P. *Bates' Guide to Physical Examination and History Taking*. 10th edn. Philadelphia: Lippincott Williams & Wilkins; 2009.
- Kahan S, Miller R, Smith E. In a Page: Signs and Symptoms. 2nd edn. Philadelphia: Lippincott Williams & Wilkins; 2009.
- Smith C. Assessing bowel sounds - more than just listening. *Nursing (Lond)*. 1988;18:42–3.
- Estes M. *Health Assessment and Physical Examination*. 3rd edn. Clifton Park, New York: Thomson Delmar Learning; 2006.
- Jarvis C. *Physical Examination and Health Assessment*. 5th edn. St Louis: Saunders Elsevier; 2008.
- Epstein O, Perkin, GD. *Cookson J. Clinical Examination. The abdomen*. 4th edn. Edinburgh: Mosby Elsevier; 2008. p.186–225.
- Ching SS, Tan YK. Spectral analysis of bowel sounds in intestinal obstruction using an electronic stethoscope. *World J Gastroenterol*. 2012;18:4585–92.
- Khan KS, Bachmann LM, ter Riet G. Systematic reviews with individual patient data meta-analysis to evaluate diagnostic tests. *Eur J Obstet Gynecol Reprod Biol*. 2003;108:121–5.
- Yen K, Karpas A, Pinkerton HJ, Gorelick MH. Interexaminer reliability in physical examination of pediatric patients with abdominal pain. *Arch Pediatr Adolesc Med*. 2005;159:373–6.
- Moll van Charante EP, de Jongh TOH. [Physical examination of patients with acute abdominal pain]. *Ned Tijdschr Geneesk*. 2011;155:A2658.
- Hooker C. *An Essay on Intestinal Auscultation*. *Bost Med Surg J*. 1849;1439–40.
- Taylor MR, Lalani N. *Adult Small Bowel Obstruction*. Carpenter CR, editor. *Acad Emerg Med*. 2013;20:527–44.
- Godfrey A. Listening to Bowel Sounds: An Outdated Practice? <https://blogs.jwatch.org/frontlines-clinical-medicine/2017/03/01/listening-bowel-sounds-outdated-practice>
- Rami Reddy SR, Cappell MS. A Systematic Review of the Clinical Presentation, Diagnosis, and Treatment of Small Bowel Obstruction. *Curr Gastroenterol Rep*. 2017;24:19:28.
- McCarter MD, Gomez ME, Daly JM. Early postoperative enteral feeding following major upper gastrointestinal surgery. *J Gastrointest Surg*. 1:278–85; discussion 285.
- Deranged Physiology [Internet]. http://www.derangedphysiology.com/main/required-reading/endocrinology-metabolism-and-nutrition/Chapter_5.1.1.3/when-and-how-start-enteral-nutrition
- Heighes PT, Doig GS, Simpson F. "Timing and Indications for Enteral Nutrition in the Critically Ill." *Nutrition*. Springer International Publishing, 2016; p.55–62.
- Farkas J. *PulmCrit- New guidelines simplify ICU nutrition* [Internet]. Available from: <https://emcrit.org/pulmcrit/enteral-nutrition-intubated/>
- Read TE, Brozovich M, Andujar JE, Ricciardi R, Caushaj PF. Bowel Sounds Are Not Associated With Flatus, Bowel Movement, or Tolerance of Oral Intake in Patients After Major Abdominal Surgery. *Dis Colon Rectum*. 2017;60:608–13.