

## Avicenna's View on the Etiologies of Intestinal Obstruction

Zahra Moradi,<sup>1\*</sup> Mehdi Besharat,<sup>2</sup> Bagher Minaiee,<sup>3</sup> Jale Aliasl,<sup>4</sup> Zohreh Parsa Yekta,<sup>5</sup> and Mohsen Nasiri Toosi<sup>6</sup>

<sup>1</sup>Department of Traditional Medicine, School of Traditional Medicine, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran

<sup>2</sup>Infectious Diseases and Tropical Medicine Research Center, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran

<sup>3</sup>Department of Histology, Tehran University of Medical Sciences, Tehran, IR Iran

<sup>4</sup>Department of Traditional Medicine and Clinical Trial Research Center, Shahed University of Medical Sciences, Tehran, IR Iran

<sup>5</sup>School of Nursing and Midwifery, Tehran University of Medical Sciences, Tehran, IR Iran

<sup>6</sup>Department of Gastroenterology, Tehran University of Medical Sciences, Tehran, IR Iran

\*Corresponding Author: Zahra Moradi, Department of Traditional Medicine, School of Traditional Medicine, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran. Tel: +98-2188773521, Fax: +98-2188795008, E-mail: zahramoradi2011@gmail.com

Received 2014 May 6; Revised 2014 September 6; Accepted 2014 November 25.

### Abstract

**Context:** Bowel obstruction is one of the most common causes of acute abdomen. Because of heterogeneity of patients' population and variety of causes, therapeutic strategies are not standardized, so treatment of intestinal obstruction is a surgical challenge in many cases. A traditional medicine approach could help detect some issues that were ignored by modern medicine. One of the major schools of medicine, with a history of several thousand years, is Iranian traditional medicine. In this regard, Avicenna, who lived in the medieval period, has had a great influence on the medical knowledge of the world by writing an encyclopedia of medicine entitled "Qanun of Medicine."

**Evidence Acquisition:** The aim of this study was to investigate Avicenna's views on the causes of intestinal obstruction and comparing them to modern medicine views. This is a review study on an Iranian traditional textbook of medicine by Avicenna, entitled "Qanun of Medicine" (in short "Qanun"). We used Qanun in its original language (Arabic) along with its Persian translation. It consists of 5 books. Part 16 of the third book talks about intestinal anatomy and introduces some intestinal diseases such as "qoolinj" and "ilavos." Intestinal obstruction can be a kind of "qoolinj" or "ilavos" disease. All intestinal obstruction etiologies in Qanun are searched in international and Iranian databases (Scopus, ISI, SID, and Iranmedex) and similar causes in modern medicine will be discussed in this article.

**Results:** According to Qanun, 16 causes are involved in intestinal etiologies of bowel obstruction such as "reeh," mucoid phlegm, abdominal hot and dry distemperament, decreased bile secretion, job, and so on while modern medicine considers some of them, for instance, volvulus, intestinal herniation, worm, intestinal pseudo-obstruction, and opiate.

**Conclusions:** Attention to the similar causes of intestinal obstruction in modern medicine and traditional medicine is the starting point for investigation of noninvasive diagnostic and therapeutic methods that have been mentioned in Qanun. In addition, etiologies which are missed in modern medicine can open new doors to the researchers and gastroenterologists for the study, diagnosis, and prevention of the disease.

**Keywords:** Intestinal Obstruction, Etiology, Traditional Medicine

### 1. Context

Bowel obstruction is one of the most common causes of acute abdomen (1) and also a common surgical emergency (2). Acute bowel obstruction occurs when a partial or complete blockage happens in the forward flow of the small or large intestinal contents (3, 4).

Obstruction can occur anywhere in the intestinal lumen and its cause can be mechanical or nonmechanical. Mechanical causes physically block the movement of material through the intestines (4). Mechanical obstruction of the small intestine and colon is moderately common, accounting for several hundred thousand admissions per year in the United States (5). The most common causes of intestinal obstruction are intra-abdominal adhesions, malignancy, or intestinal herniation (1, 3, 4, 6). Patients

generally present with nausea and vomiting, colicky abdominal pain, abdominal distention, and failure to pass flatus or bowel movements (3-6).

Management of uncomplicated obstructions includes fluid with correction of metabolic derangements, intestinal decompression, and bowel rest. Evidence of vascular compromise, perforation, or failure to resolve with adequate bowel decompression is an indication for surgical intervention (3). Owing to heterogeneous population of patients and variety of causes, therapeutic strategies are not standardized, and therefore, treatment of bowel obstruction is a surgical challenge in many cases (1).

Ibn Sina, or as he has been known in the West, Avicenna (980 - 1037 AD) was a foremost Iranian physician and phi-

philosopher (7). He was the author of almost 200 books on science, religion, and philosophy (8). Scholars used his masterpiece, "Qanun of Medicine" (Al-Qanun fi al-Tibb), as a medical encyclopedia and textbook in Islamic territories and Europe, for almost a millennium (9). Avicenna is regarded as the father of modern medicine and clinical pharmacology. Moreover, he is known for a major influence on both medical practice and the development of logic in Medieval Europe (8). Avicenna's role in medicine and his valuable works can be summarized as "Medicine was absent till Hypocrites created it, dead till Galen revived it, dispersed till Rhazes collected it, and deficient till Avicenna completed it" (7).

Avicenna in his famous book, "Qanun" mentioned the types of intestinal diseases and their signs and symptoms. Etiology of bowel obstruction from Avicenna's point of views generally includes the intestinal and non-intestinal causes. The most important intestinal etiologies are intestinal distemperament, enteritis, colitis, intestinal volvulus, dry stool, and "reeh." Some of the nonintestinal etiologies include renal stone or inflammation of some organs such as liver, kidney, spleen, and bladder. The most important bowel obstruction symptoms mentioned in Qanun are nausea, vomiting, severe cramping, absence of passage of flatus and feces, severe dyspepsia, anorexia, and polydipsia (10, 11).

Regarding the mentioned signs, bowel obstruction is a severe constipation. From the Iranian traditional medicine (ITM) viewpoint, constipation is recognized as the origin and mother of other diseases and prevention and treatment of constipation is very important. So treatment of constipation in ITM School is the first priority (12).

## 2. Evidence Acquisition

This study aimed to investigate Avicenna's views on the intestinal etiologies of bowel obstruction and comparing them to modern medicine views. This is a review study on an Iranian traditional textbook of medicine, Qanun of Medicine by Avicenna. We used Qanun in its original language (Arabic) along with its Persian translation. Part 16 of the third book talks about intestinal anatomy and introduces some intestinal diseases such as "qoolinj" and "ilavos". Intestinal obstruction can be a kind of "qoolinj" or "ilavos" disease. All intestinal obstruction etiologies in Qanun were searched in international and Iranian databases (Scopus, ISI, SID, and Iranmedex) and similar causes in modern medicine will be discussed in this article too.

### 2.1. Avicenna and His Book, Qanun of Medicine

The Persian and Muslim scientist and physician, Ibn (Abu Ali) Sina, known as Avicenna in Europe was born in the year 980 AD in a village near Bokhara (which was a city in ancient Persia) and died in the year 1037 AD in Hamadan, Iran (13). George Sarton introduces Avicenna as one of "the most famous scientist of Islam and one of the most famous of all races, places, and times." He is

known as "Galenus of Islamic world" because of his immense medical encyclopedia, the Qanun of Medicine which is one of earliest textbooks in medicine (13).

Qanun of Medicine has been widely used in the West. At that time, medicine, and other sciences were at their zenith in the Middle East and the oriental references were translated to European languages. This made the basis of new experimental science that had somehow the same methodology and dynamic thinking (14). However Avicenna in the Qanun, similar to scientists in the modern era, discussed on human body and its disorders based on experimental methods and his practical experiences in his articles. The subjects of the Qanun, irrespective of being dated in some issues, are similar to subjects of modern medical textbooks such as Harrison's Principles of Internal Medicine.

In recent years, researchers have taken a new look at different medical topics of Qanun; for example, major role of Avicenna in the development of ophthalmology in ancient Persia (15), Avicenna's creative approach to the urologic disorders and modern urology (13), Avicenna's recommended treatment for tuberculosis (16), principles of clinical epidemiology in Avicenna's Qanun (17), atheroprotector role of the spleen based on the teaching of Avicenna (7), head injuries in the Qanun of Medicine (18), a new analysis of contributions to diagnosis and treatment of cataracts from the Qanun (14), and relation between body humors and hypercholesterolemia (19). For better understanding of Avicenna's view, at first it is necessary to have a description of intestinal anatomy and some terms used in this regard in Qanun.

## 2.2. Anatomy and Physiology

### 2.2.1. Anatomy

In Qanun, intestines are excretory organs with 2 layers and include 6 parts. Upper intestines are thin with inner mucoid surface, named as "asna ashari" (duodenum), "saem" (jejunum), and "deghagh" (ileum). Lower intestines need resistance to stools, so they are thick and firm with internal fat and comprise "aevor" (appendix), "colon," and "direct intestine" (rectum) (20).

### 2.2.2. Mizaj

In Qanun of Medicine, "mizaj" (temperament) is described as a quality, which is the outcome of mutual interaction of the 4 opposite primary qualities (hot, cold, wet, and dry) residing within the elements. These elements are so intermixed that develop a very intimate relationship to one another. Their opposite powers alternatively dominate until a state of balance is reached throughout the whole. This state of equilibrium is called temperament (mizaj) (20). In other words, the dominant quality of the compound object means "mizaj." In the ITM system, mizaj is one of the main rules. It has an important role in main-

taining the ideal healthy state of an individual. Imbalanced healthy temperament, which is called distemperament (sui' e mizaj) leads to several diseases (19).

### 2.2.3. Humor

In the ITM texts, "khelt" which is called "humor" too, is a wet and fluid material that results from food changes in the first stage of permutation. Normally, the human body has four humors: blood or "dam," phlegm or "balgham," yellow bile or "safra," and black bile or "sauda." Each of these humors are related with pairs of qualities: hot and wet, cold and wet, hot and dry, and cold and dry, respectively (20). In addition, each humor corresponds to one of the four elements: water, air, fire, and earth, respectively (20).

### 2.2.4. Reeh

Reeh flows in the body like its counterpart "wind" in the nature and acts as an expanding element in pelvic organs' ducts to simplify excretory functions, such as defecation, urination, and erection/ejaculation (21).

## 3. Results

In book 3, part 16, treatise 3, Avicenna has described the "qoolinj" and "ehtebase soft" (stool retention) as follows (10, 11). "Qoolinj" and "ilavos" are painful intestinal diseases, which lead to difficulty in defecation. Causes of "qoolinj" are in colon and around it, while the origin of "ilavos" is in small intestine. Based on symptoms and their causes, "qoolinj" and "ilavos" are included in various types that obstructive type can be considered the equivalent of bowel obstruction in modern medicine. Avicenna said that the cause of "qoolinj" and "ilavos" can be obstruction that prevents passage of feces, humors, and reeh. So it leads to severe bowel stretching and pain. If the cause of obstruction is not inflammation, most often it is caused by filling the appendix that had been expanded to colon.

The followings are the causes of intestinal obstruction in Qanun and if there are similar to causes mentioned in modern medicine books and articles, they will be quoted respectively, too.

### 3.1. Intestinal Obstruction Etiologies

There are 6 main causes of the intestinal obstruction according to Qanun of Medicine which are explained in detail in the following sections.

#### 3.1.1. Enteritis and Colitis

In Qanun book, intestinal inflammation has 2 types (hot and cold). Avicenna believed that inflammation which leads to intestinal obstruction is most often hot.

#### 3.1.2. Mucoïd Phlegm (Balgham Lazij)

Obstruction can occur due to filling bowel by mucoïd phlegm (a kind of abnormal phlegm). Avicenna said that

the most common cause of intestinal obstruction is mucoïd phlegm and fever is a beneficial factor in its recovery.

#### 3.1.3. Aggregation of Bowel Reeh

The second most common cause of intestinal obstruction according to Avicenna is "reeh". He believed that "reeh" scatters from the small intestine wall because it is thin-walled structure. However, "reeh" can accumulate in colon, appendix, and rectum because they are colder than small intestine as well as thick and rigid.

#### 3.1.4. Intestinal Volvulus

Avicenna enumerated causes of intestinal volvulus: tearing of the ligaments that connect the intestines to the posterior abdomen, "reeh," abdominal hernia, inguinal hernia, and scrotal hernia.

According to modern medicine, intestinal volvulus is one of the main causes of large bowel obstruction (22, 23). The most common site of volvulus is the sigmoid colon. Intestinal volvulus is an uncommon cause for small bowel obstruction (6). Intestinal herniation is also a common cause of intestinal obstruction (3, 4, 6, 24). In a study in 2012, the incidence of intestinal obstruction causes in the period 1898 - 1868 (group I) was compared with the period of 2003-2000 (group II) (25). The results of this study showed that abdominal hernia is the commonest cause of small bowel obstruction in both groups. However, isolated small-bowel volvulus as the cause of small intestinal obstruction significantly decreased. The most common cause of large bowel obstruction in group I, was volvulus of the sigmoid colon or of the cecum (72.0%); in group II, bowel obstruction was caused by cancer in 80.4% of patients.

#### 3.1.5. Heavy Worm Infestation

In Qanun, worms are divided into 4 types (based on the appearance) that include large long, round, flat, and small. Age prevalence of intestinal worm infections was mentioned in childhood and adolescence. Intestinal aggregation of worms can result in bowel obstruction.

According to studies, worm infestation is one of the causes of intestinal obstruction, especially in children. Roundworms (ascariasis) are the commonest cause of bowel obstruction (26-31). Therefore, as the first differential diagnosis, round worm obstruction should be considered in any intestinal obstruction in an endemic area (32).

#### 3.1.6. Dry Stool

According to Qanun, dry stool has several causes which are explained in the following sections: 1) Dry temperament foods consumption. 2) Intestinal function disturbance to expel the stool: Intestinal pseudo-obstruction (IPO) is a syndrome characterized by derangement of bowel propulsive motility without mechanical obstruction of the intestine. Although chronic intestinal pseudo-

obstruction (CIPO) is uncommon in clinical practice, this syndrome is one of the main causes of intestinal failure and characterized by high morbidity and mortality. It may be idiopathic or secondary to a variety of diseases. CIPO is classified into 3 main categories of neuropathies, mesenchymopathies, and myopathies. The long-term outcome of IPO is generally poor in the majority of cases (33-36). 3) Avicenna believed that intestinal obstruction in many cases is caused by opiate. Patients receiving opioid medication for postoperative or chronic pain often have opioid-induced bowel dysfunction (OBD). The most common symptoms of OBD are intestinal motility disorder and constipation (37-41). 4) Abdominal muscles contraction is one of the factors in defecation. According to Avicenna, weakness of abdominal muscles contraction can lead to intestinal obstruction. High sexual activity is a cause of this weakness. 5) Intestinal neuropathy. 6) Decreased bile secretion: Avicenna believed that bile secretion is necessary to defecation. So decreased bile secretion can lead to retention of feces in the colon. 7) According to the Qanun, narrow blood vessels called "masarigha" absorb intestinal digested food and pass them into the liver. Large volume of fluid absorption by "masarigha" for several reasons, can lead to dry stool. Some of these reasons are excessive sweating, exercise, and hot weather. 8) Work-related heat stress such as glass blowing and forging. 9) Severe abdominal hot distemperament leads to dry stool and so intestinal obstruction. This distemperament has two reasons: (I) release of excessive hot bile into the intestine that burns small amounts stool or dry stool. (II) severe cold weather that has several effects, including congestion of heat inside the body, increases urination, closing anal sphincter, and moving the stool upward. 10) Abdominal and intestinal dry distemperament can lead to dry stool and intestinal obstruction. 11) Inflammation of rectum (zahir): Avicenna described "zahir" as a severe rectum pain that can result in retention of stool and followed by secretion of mucosa and bloody diarrhea. It has several causes such as proctitis, "reeh," and release of very hot bile or blood into the intestine.

### 3.2. Intestinal Obstruction in Qanun: Treatment

Avicenna believed that treatment of intestinal obstruction should be started in early stage of this disease. Eradication of the major causes of the disease needs a complete treatment. The overall treatment includes laxative or emetic foods, enema, and herbal medicines. First step of the treatment is to change the diet and second stage is to eliminate undigested food and abnormal humor that cause disease in gastrointestinal tract. Numerous herbal drugs were mentioned in Qanun based on the types and causes of disease (10, 11).

## 4. Conclusions

We compared "qoolinj" in ITM with intestinal obstruction for the first time in this study. However, we have not done any clinical study for it yet. Our findings show that

Avicenna despite the lack of access to modern technology has mentioned some etiologies of intestinal obstruction that modern medicine confirms them. Although, nowadays most causes of intestinal obstruction is adhesion band, due to increased operations, there are some causes mentioned by Avicenna, which are ignored in modern medicine, and they can open new doors to researchers and gastroenterologists regarding the study, diagnosis, and prevention of the disease. On the other hand, attention to the similar causes of intestinal obstruction in modern medicine and traditional medicine is the first step towards evaluation of the noninvasive diagnostic and therapeutic methods that have been mentioned in Qanun. Although pathogenesis theories of intestinal obstruction in Qanun had been expressed with its own language, this study is indicative of the comprehensiveness of Avicenna's knowledge and his great deal of experience, which can still be of great importance for better diagnosis and treatment of patients and resolving some modern medicine deficiencies. It should be mentioned that many therapeutic strategies of intestinal obstruction were noted in Qanun of Avicenna that reviewing and researching on them, can hopefully open doors towards new and noninvasive treatments.

## Acknowledgments

This study was part of a PhD thesis for the first author entitled "Explanation of Etiologies and Clinical Manifestations of Intestinal Diseases According to Iranian Traditional Medicine, Based on the Clinical Evidence," which was supported by the School of Traditional Medicine, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran. Also we would like to thank Mandana Tavakkoli Kakhki and Marzieh Gharraati for their valuable comments.

## Footnotes

**Author's Contribution:** Development of the main idea and writing the article: Zahra Moradi. Revision of the study: Mehdi Besharat, Bagher minaee, Jale Aliasl, Zohreh Parsa Yekta, and Mohsen Nasiri-Toosi.

**Funding/Support:** We received no funding from any organization for this research.

## References

1. Bruch HP, Schwander O, Markert U. Intestinal obstruction as cause of acute abdomen. *Chir Gastroenterol.* 2002;**18**(3):244-51. doi: 10.1159/000066557.
2. Stephenson JA, Singh B. Intestinal obstruction. *Surgery (Oxford).* 2011;**29**(1):33-8. doi: 10.1016/j.mpsur.2010.10.005.
3. Jackson PG, Raiji MT. Evaluation and management of intestinal obstruction. *Am Fam Physician.* 2011;**83**(2):159-65. [PubMed: 21243991]
4. Longo D, Fauci A, Kasper D, Hauser S, Jameson J, Loscalzo J. *Harrison's principles of internal medicine.* New York: McGraw-Hill; 2010.
5. Cappell MS, Batke M. Mechanical obstruction of the small bowel and colon. *Med Clin North Am.* 2008;**92**(3):575-97. doi: 10.1016/j.mcna.2008.01.003. [PubMed: 18387377]
6. Markogiannakis H, Messaris E, Dardamanis D, Pararas N, Tertzemelis D, Giannopoulos P, et al. Acute mechanical bowel obstruction: clinical presentation, etiology, management and outcome. *World J Gastroenterol.* 2007;**13**(3):432-7. [PubMed: 17230614]



7. Emtiazy M, Choopani R, Khodadoost M, Tansaz M, Nazem E. Atheroprotector role of the spleen based on the teaching of Avicenna (Ibn Sina). *Int J Cardiol.* 2013;**167**(1):26-8. doi: 10.1016/j.ijcard.2012.06.020. [PubMed: 22726399]
8. Tabei S, Riazi A. Medical sciences in the third millennium: An Avicennian approach. *Iran Red Crescent Med J.* 2009;**11**:4-9.
9. Fallahi F, Namdar H, Emaratkar E, Nazem E, Nikbakht Nasrabadi A, Choopani R, et al. Avicenna's view of reperfusion in myocardial infarction. *Int J Cardiol.* 2013;**165**(2):393-4. doi: 10.1016/j.ijcard.2012.08.051. [PubMed: 23017817]
10. Guillhon de Araujo Sant'Anna AM, Dubois J, Miron MC, Seidman EG. Wireless capsule endoscopy for obscure small-bowel disorders: final results of the first pediatric controlled trial. *Clin Gastroenterol Hepatol.* 2005;**3**(3):264-70. [PubMed: 15765446]
11. Sina AA. *Qanun.* Teharn: Soroush; 2004.
12. Choopani R, Tansaz M, Movahhed M, Mokaberinejad M, Khodadoost M. Constipation due to Liver Disorder in Iranian Traditional Medicines Viewpoint. *Int J Pediatr.* 2014;**2**(2.1):30.
13. Madineh SM. Avicenna's Canon of Medicine and Modern Urology: part I: bladder and its diseases. *Urol J.* 2008;**5**(4):284-93. [PubMed: 19101908]
14. Nejabat M, Maleki B, Nimrouzi M, Mahbodi A, Salehi A. Avicenna and cataracts: a new analysis of contributions to diagnosis and treatment from the canon. *Iran Red Crescent Med J.* 2012;**14**(5):265-70. [PubMed: 22829984]
15. Khodadoust AA. Ophthalmology from ancient Persia to the modern era. *Arch Ophthalmol.* 2006;**124**(10):1481-3. doi: 10.1001/archophth.124.10.1481. [PubMed: 17030718]
16. Asadi-Pooya AA, Pnjehshahin MR, Beheshti S. The antimycobacterial effect of honey: an in vitro study. *Riv Biol.* 2003;**96**(3):491-5. [PubMed: 15055885]
17. Sajadi MM, Mansouri D, Sajadi MR. Ibn Sina and the clinical trial. *Ann Intern Med.* 2009;**150**(9):640-3. [PubMed: 19414844]
18. Aciduman A, Arda B, Ozakturk FG, Telatar UF. What does Al-Qanun Fi Al-Tibb (the Canon of Medicine) say on head injuries? *Neurosurg Rev.* 2009;**32**(3):255-63. doi: 10.1007/s10143-009-0205-5. [PubMed: 19437052]
19. Emtiazy M, Keshavarz M, Khodadoost M, Kamalinejad M, Gooshahgir SA, Shahradsajestani H, et al. Relation between Body Humors and Hypercholesterolemia: An Iranian Traditional Medicine Perspective Based on the Teaching of Avicenna. *Iran Red Crescent Med J.* 2012;**14**(3):133-8. [PubMed: 22737569]
20. Avicenna. *Canon on medicine.* 19 ed. Beirut, Lebanon: Alaalami Library Publication; 2005.
21. Latifi SA, Minaiee B, Kamalinejad M, Nazem E, Gooran S. Complementary treatment in chronic pelvic pain syndrome: a case report study. *Iran Red Crescent Med J.* 2014;**16**(4):e13681. doi: 10.5812/ircmj.13681. [PubMed: 24910801]
22. Taourel P, Kessler N, Lesnik A, Pujol J, Morcos L, Bruel JM. Helical CT of large bowel obstruction. *Abdom Imaging.* 2003;**28**(2):267-75. doi: 10.1007/s00261-002-0038-y. [PubMed: 12592477]
23. Hayakawa K, Tanikake M, Yoshida S, Urata Y, Inada Y, Narumi Y, et al. Radiological diagnosis of large-bowel obstruction: nonneoplastic etiology. *Jpn J Radiol.* 2012;**30**(7):541-52. doi: 10.1007/s11604-012-0092-5. [PubMed: 22744438]
24. Uranues S, Tomasch G, Nagele-Moser D. Laparoscopic treatment of acute small bowel obstruction\*. *Eur Surg.* 2012;**44**(1):19-22. doi: 10.1007/s10353-012-0075-x.
25. Drozd W, Budzynski P. Change in mechanical bowel obstruction demographic and etiological patterns during the past century: observations from one health care institution. *Arch Surg.* 2012;**147**(2):175-80. doi: 10.1001/archsurg.2011.970. [PubMed: 22351915]
26. Wasadikar PP, Kulkarni AB. Intestinal obstruction due to ascariasis. *Br J Surg.* 1997;**84**(3):410-2. [PubMed: 9117326]
27. Archibong AE, Ndoma-Egba R, Asindi AA. Intestinal obstruction in southeastern Nigerian children. *East Afr Med J.* 1994;**71**(5):286-9. [PubMed: 7925057]
28. Villamizar E, Mendez M, Bonilla E, Varon H, de Onatra S. Ascaris lumbricoides infestation as a cause of intestinal obstruction in children: experience with 87 cases. *J Pediatr Surg.* 1996;**31**(1):201-4. [PubMed: 8632280]
29. Das CJ, Kumar J, Debnath J, Chaudhry A. Imaging of ascariasis. *Australas Radiol.* 2007;**51**(6):500-6. doi: 10.1111/j.1440-1673.2007.01887.x. [PubMed: 17958683]
30. Nagotkar L, Shanbag P, Shenoy P. Hypokalemic paralysis following severe vomiting in a child with intestinal obstruction due to round worms. *J Trop Pediatr.* 2010;**56**(1):63-4. doi: 10.1093/tropej/fmp044. [PubMed: 19502600]
31. Stojanovic M, Slavkovic A, Stojanovic M, Marjanovic Z, Bojanovic M. A rare case of intestinal obstruction due to ascariasis in Niš, south Serbia. *Open Med.* 2011;**6**(4):390-4. doi: 10.2478/s11536-011-0028-y.
32. Baba AA, Ahmad SM, Sheikh KA. Intestinal ascariasis: the commonest cause of bowel obstruction in children at a tertiary care center in Kashmir. *Pediatr Surg Int.* 2009;**25**(12):1099-102. doi: 10.1007/s00383-009-2486-8. [PubMed: 19760197]
33. Gabbard SL, Lacy BE. Chronic intestinal pseudo-obstruction. *Nutr Clin Pract.* 2013;**28**(3):307-16. doi: 10.1177/0884533613485904. [PubMed: 23612903]
34. Ohkubo H, Kessoku T, Fuyuki A, Iida H, Inamori M, Fujii T, et al. Assessment of small bowel motility in patients with chronic intestinal pseudo-obstruction using cine-MRI. *Am J Gastroenterol.* 2013;**108**(7):1130-9. doi: 10.1038/ajg.2013.57. [PubMed: 23511458]
35. Iida H, Inamori M, Sekino Y, Sakamoto Y, Yamato S, Nakajima A. A review of the reported cases of chronic intestinal pseudo-obstruction in Japan and an investigation of proposed new diagnostic criteria. *Clin J Gastroenterol.* 2011;**4**(3):141-6. doi: 10.1007/s12328-011-0219-8. [PubMed: 26189344]
36. Antonucci A, Fronzoni L, Cogliandro L, Cogliandro RF, Caputo C, De Giorgio R, et al. Chronic intestinal pseudo-obstruction. *World J Gastroenterol.* 2008;**14**(19):2953-61. [PubMed: 18494042]
37. Panchal SJ, Muller-Schwefe P, Wurzelmann JI. Opioid-induced bowel dysfunction: prevalence, pathophysiology and burden. *Int J Clin Pract.* 2007;**61**(7):1181-7. doi: 10.1111/j.1742-1241.2007.01415.x. [PubMed: 17488292]
38. Kurz A, Sessler DI. Opioid-induced bowel dysfunction: pathophysiology and potential new therapies. *Drugs.* 2003;**63**(7):649-71. [PubMed: 12656645]
39. Pappagallo M. Incidence, prevalence, and management of opioid bowel dysfunction. *Am J Surg.* 2001;**182**(5A Suppl):11S-8S. [PubMed: 11755892]
40. Greenwood-Van Meerveld B, Gardner CJ, Little PJ, Hicks GA, Dehaven-Hudkins DL. Preclinical studies of opioids and opioid antagonists on gastrointestinal function. *Neurogastroenterol Motil.* 2004;**16** Suppl 2:46-53. doi: 10.1111/j.1743-3150.2004.00555.x. [PubMed: 15357851]
41. Chang HY, Lembo AJ. Opioid-induced bowel dysfunction. *Curr Treat Options Gastroenterol.* 2008;**11**(1):11-8. doi: 10.1007/s11938-008-0002-1. [PubMed: 21063859]