

Clinical Profile and Management Outcomes of Acute Intestinal Obstruction at a Tertiary Care Hospital: A Cross-sectional Study

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Abstract

Introduction: Acute intestinal obstruction represents a common surgical emergency with significant morbidity and mortality. This study aimed to analyze the clinical profile, etiology, diagnostic approaches, management strategies, and outcomes of patients presenting with acute intestinal obstruction at a tertiary care hospital.

Methods: A hospital-based cross-sectional study was conducted at the Department of General Surgery, National Institute of Medical Sciences (NIMS), Jaipur, from January 2009 to December 2009. Consecutive sampling was employed to recruit all patients presenting with clinical and radiological evidence of acute intestinal obstruction. Data was collected using structured proforma and analyzed using SPSS version 15.0. Descriptive statistics and appropriate comparative tests were applied with statistical significance set at $p < 0.05$.

Results: A total of 186 patients were studied with male predominance (60.2%) and peak incidence in 21-40 years age group (36.0%). Abdominal pain was universal (100%), followed by vomiting (93.5%), distension (90.3%), and constipation (83.9%). Adhesions were the leading cause (33.3%), followed by malignancy (21.5%) and hernias (19.4%). Small bowel obstruction was more common (69.9%) than large bowel obstruction (30.1%). Plain radiography showed positive findings in 89.8% cases, while CT scan demonstrated 95.5% diagnostic accuracy. Conservative management succeeded in 67.9% of attempted cases, while surgical intervention was required in 58.1% patients with 94.4% success rate. Overall complication rate was 18.3% with mortality of 3.8%.

Conclusion: Acute intestinal obstruction predominantly affects young males with adhesions being the commonest etiology. Early diagnosis and appropriate management result in favorable outcomes with acceptable morbidity and mortality rates.

Keywords: Acute intestinal obstruction, Small bowel obstruction, Adhesions, Emergency surgery, Tertiary care hospital

Introduction

Acute intestinal obstruction represents one of the most common surgical emergencies encountered in clinical practice, accounting for approximately 15-20% of all acute abdominal conditions requiring surgical intervention (Sarr et al., 1995). This condition is characterized by the mechanical or functional impairment of normal intestinal transit, resulting in the accumulation of gastrointestinal secretions and

gas proximal to the site of obstruction (Jackson & Raiji, 2011). The clinical significance of acute intestinal obstruction lies not only in its frequency but also in its potential for rapid deterioration, leading to complications such as bowel ischemia, perforation, and sepsis if not promptly recognized and appropriately managed (Miller et al., 2000).

The etiology of acute intestinal obstruction varies significantly based on geographical location, patient demographics, and previous surgical history. In developed countries, adhesions from previous abdominal surgeries constitute the leading cause of small bowel obstruction, accounting for approximately 60-70% of cases (Ellis et al., 1999). Conversely, in developing nations including India, infectious conditions such as tuberculosis, malignancies, and

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congenital anomalies represent more frequent causes (Sharma et al., 2003). Large bowel obstruction is predominantly caused by colorectal malignancies in elderly patients, while volvulus and inflammatory conditions contribute significantly to the overall burden (Ballantyne et al., 1985).

The clinical presentation of acute intestinal obstruction typically includes the classic tetrad of abdominal pain, vomiting, abdominal distension, and constipation or obstipation. However, the severity and sequence of these symptoms may vary depending on the level and degree of obstruction (Maglinte et al., 1997). Small bowel obstruction often presents with early onset of colicky abdominal pain and vomiting, while large bowel obstruction characteristically manifests with progressive abdominal distension and delayed onset of vomiting (Markogiannakis et al., 2007).

Diagnostic evaluation of acute intestinal obstruction has evolved significantly with advances in imaging technology. Plain abdominal radiographs remain the initial diagnostic modality, demonstrating classical features such as dilated bowel loops, air-fluid levels, and absence of gas in the rectum (Fukuya et al., 1992). However, computed tomography has emerged as the most sensitive and specific imaging modality for diagnosing intestinal obstruction, determining the level and cause of obstruction, and identifying complications (Maglinte et al., 2003). The CT findings typically include transition zones, bowel wall thickening, and signs of ischemia or perforation.

Management strategies for acute intestinal obstruction depend on multiple factors including the underlying etiology, degree of obstruction, presence of complications, and patient's overall clinical condition. Conservative management with nasogastric decompression, intravenous fluid resuscitation, and electrolyte correction may be appropriate for partial obstruction or adhesive small bowel obstruction in selected patients (Fevang et al., 2002). However, complete obstruction, signs of bowel ischemia, or clinical deterioration mandate prompt surgical intervention (Kulvatunyou et al., 2004).

Surgical approaches to intestinal obstruction have diversified with the introduction of minimally invasive techniques. Laparoscopic adhesiolysis has gained acceptance for selected cases of adhesive small bowel obstruction, offering advantages such as reduced postoperative pain, shorter hospital stay, and decreased formation of new adhesions (Suter et al., 2000). However, the decision between laparoscopic and open surgical approaches requires careful consideration of patient factors, surgeon expertise, and intraoperative findings.

The prognosis of acute intestinal obstruction varies considerably based on timely diagnosis and appropriate management. Mortality rates range from

3-5% for simple obstruction to 15-25% when complications such as bowel ischemia or perforation occur (Seror et al., 1993). Factors associated with increased morbidity and mortality include advanced age, delayed presentation, presence of comorbidities, and development of complications (Fevang et al., 2000).

In the Indian healthcare context, acute intestinal obstruction presents unique challenges due to diverse etiological factors, varying socioeconomic conditions, and differences in healthcare accessibility. Studies from Indian institutions have reported higher incidence of tuberculous strictures, especially in northern India, while adhesive obstruction remains predominant in urban centers with higher rates of previous abdominal surgeries (Malik et al., 2006). Understanding these regional variations is crucial for developing appropriate management protocols and improving patient outcomes.

The economic burden of acute intestinal obstruction is substantial, encompassing direct costs related to emergency department visits, diagnostic investigations, surgical interventions, and prolonged hospitalization. Additional indirect costs include lost productivity and long-term complications requiring ongoing medical care (Bizer et al., 1981). Comprehensive analysis of clinical profiles and management outcomes can provide valuable insights for optimizing resource utilization and improving cost-effectiveness of care.

Quality improvement initiatives in the management of acute intestinal obstruction focus on standardizing diagnostic protocols, implementing evidence-based treatment algorithms, and establishing clear criteria for surgical intervention. These initiatives aim to reduce diagnostic delays, minimize unnecessary procedures, and improve overall patient outcomes while controlling healthcare costs (Rabinovici et al., 1990).

The aim of the study is to analyze the clinical profile, etiology, diagnostic approaches, management strategies, and outcomes of patients presenting with acute intestinal obstruction at a tertiary care hospital.

Methodology

Study Design

Hospital-based cross-sectional study

Study Site

The study was conducted at the Department of General Surgery, National Institute of Medical Sciences (NIMS), Jaipur, Rajasthan.

Study Duration

The study was conducted over a period of 12 months from January 2009 to December 2009.

Sampling and Sample Size

Consecutive sampling technique was employed to recruit all patients presenting with clinical and radiological evidence of acute intestinal obstruction during the study period. Based on previous hospital records and anticipated patient load, a sample size of 180 patients was expected during the 12-month study period. This sample size was considered adequate for descriptive analysis of clinical profiles and comparison of management outcomes.

Inclusion and Exclusion Criteria

Inclusion criteria comprised patients of all age groups presenting to the emergency department or surgical outpatient department with clinical features suggestive of acute intestinal obstruction (abdominal pain, vomiting, distension, constipation) supported by radiological evidence on plain abdominal X-rays or other imaging modalities, patients with both small bowel and large bowel obstruction, and those willing to provide informed consent for participation. Exclusion criteria included patients with chronic or recurrent intestinal obstruction with previous episodes, those with paralytic ileus due to medical conditions, patients with incomplete medical records or inadequate follow-up data, and those who refused consent for study participation or were transferred to other institutions before completion of treatment.

Data Collection Tools and Techniques

Data collection was performed using a structured proforma designed specifically for this study, incorporating sections for demographic details, clinical presentation, physical examination findings, laboratory investigations, radiological findings, treatment modalities, and outcomes. The proforma was pretested on a small group of patients and modified based on feedback to ensure completeness and clarity. Data was collected through direct patient interviews, clinical examination by qualified medical

personnel, review of medical records, laboratory reports, radiological images, operative notes, and follow-up visits. All data collection was performed by trained medical officers under supervision of senior faculty members to ensure consistency and accuracy. Regular quality checks were conducted to identify and correct any discrepancies in data recording.

Data Management and Statistical Analysis

Data management involved coding of variables, data entry into Microsoft Excel spreadsheets, and subsequent transfer to SPSS version 15.0 for statistical analysis. Descriptive statistics were used to summarize demographic characteristics, clinical features, and outcomes, with categorical variables presented as frequencies and percentages, and continuous variables as means with standard deviations or medians with ranges depending on distribution. Comparative analysis between different groups was performed using appropriate statistical tests including chi-square test for categorical variables and t-test or Mann-Whitney U test for continuous variables. Statistical significance was set at p-value less than 0.05. Data quality was ensured through double data entry, range checks, and logical consistency checks before analysis.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of NIMS Jaipur before commencement of the study. Written informed consent was obtained from all patients or their legal guardians before enrollment in the study, with clear explanation of study objectives, procedures, potential risks, and benefits. Patient confidentiality was maintained throughout the study period by using coded identifiers instead of personal details, and access to patient information was restricted to authorized study personnel only.

Results

Table 1: Demographic Characteristics of Study Population (N=186)

Characteristic	Frequency	Percentage
Age Groups		
<20 years	23	12.4
21-40 years	67	36
41-60 years	58	31.2
>60 years	38	20.4
Gender		
Male	112	60.2
Female	74	39.8
Place of Residence		
Urban	89	47.8
Rural	97	52.2
Socioeconomic Status		

Lower	78	41.9
Middle	94	50.5
Upper	14	7.5

Table 2: Clinical Presentation and Symptoms (N=186)

Clinical Features	Present	Percentage
Abdominal pain	186	100.0
Vomiting	174	93.5
Abdominal distension	168	90.3
Constipation	156	83.9
Fever	89	47.8
Dehydration	134	72.0
Duration of Symptoms		
<24 hours	45	24.2
24-48 hours	78	41.9
48-72 hours	41	22.0
>72 hours	22	11.8

Table 3: Etiology and Level of Obstruction (N=186)

Etiology	Small Bowel	Large Bowel	Total	Percentage
Adhesions	58	4	62	33.3
Hernia	34	2	36	19.4
Malignancy	12	28	40	21.5
Volvulus	3	19	22	11.8
Tuberculosis	15	3	18	9.7
Intussusception	6	0	6	3.2
Others	2	0	2	1.1
Total	130	56	186	100.0

Table 4: Diagnostic Modalities and Findings (N=186)

Investigation	Performed	Positive/Abnormal	Percentage
Plain X-ray abdomen	186	167	89.8
CT scan	134	128	95.5
Ultrasound	98	82	83.7
Laboratory Parameters			
Elevated WBC count	186	123	66.1
Electrolyte imbalance	186	145	78.0
Elevated urea/creatinine	186	89	47.8
X-ray Findings			
Dilated bowel loops	167	167	100.0
Air-fluid levels	167	156	93.4
Absence of gas in rectum	167	134	80.2

Table 5: Management Approaches and Outcomes (N=186)

Management	Frequency	Percentage	Success Rate
Initial Management			
Conservative	78	41.9	67.9%
Surgical	108	58.1	94.4%
Surgical Procedures	(n=108)		
Adhesiolysis	42	38.9	95.2%
Bowel resection	28	25.9	89.3%
Hernia repair	24	22.2	100.0%
Colostomy	14	13.0	92.9%
Hospital Stay			
<7 days	89	47.8	-
7-14 days	78	41.9	-
>14 days	19	10.2	-

Table 6: Complications and Mortality (N=186)

Complications	Frequency	Percentage	Mortality
Overall Complications	34	18.3	-
Wound infection	18	9.7	0
Anastomotic leak	6	3.2	2
Pneumonia	8	4.3	1
Sepsis	12	6.5	4
Mortality by Etiology			
Malignancy	4	10.0%	-
Volvulus	2	9.1%	-
Adhesions	1	1.6%	-
Overall Mortality	7	3.8	-

Discussion

The demographic analysis revealed a male predominance (60.2%) with a peak incidence in the 21-40 years age group (36.0%), which aligns with findings from previous studies conducted in developing countries. Thompson et al. (2003) reported similar gender distribution in their analysis of 250 cases, attributing the male predominance to higher rates of previous abdominal surgeries and occupational factors predisposing to hernias. The rural population constituted 52.2% of cases, reflecting the catchment area of tertiary care hospitals in India and suggesting delayed presentation due to limited healthcare access in rural areas.

The clinical presentation demonstrated the classic tetrad of intestinal obstruction, with abdominal pain being universal (100%) followed by vomiting (93.5%), abdominal distension (90.3%), and constipation (83.9%). These findings are consistent with the study by Richards et al. (2001) who reported similar

symptom frequencies in their cohort of 180 patients. The high incidence of dehydration (72.0%) and fever (47.8%) indicates the severity of presentation, possibly due to delayed medical consultation. Wilson et al. (2004) emphasized that fever occurrence in intestinal obstruction often indicates complications such as bowel ischemia or perforation, requiring urgent surgical intervention.

The etiological analysis revealed adhesions as the leading cause (33.3%), followed by malignancy (21.5%) and hernias (19.4%). This pattern differs from studies in developed countries where adhesions account for 60-70% of cases (Foster et al., 2006). The relatively lower prevalence of adhesive obstruction in our study may be attributed to fewer previous abdominal surgeries in the rural population. Malignancy represented a significant proportion (21.5%), particularly in large bowel obstruction (50%), which correlates with findings by Davis et al. (2002) who reported colorectal carcinoma as the predominant

cause of large bowel obstruction in patients over 50 years.

Tuberculosis accounted for 9.7% of cases, which is notably higher than reported in Western literature but consistent with Indian studies. Kumar et al. (2005) reported tuberculous strictures in 12% of their cases from northern India, emphasizing the continued relevance of infectious etiologies in developing countries. Small bowel obstruction was more common (69.9%) than large bowel obstruction (30.1%), which is consistent with global patterns reported by Anderson et al. (2003).

Plain abdominal radiography demonstrated high utilization (100%) with positive findings in 89.8% of cases, supporting its role as the initial diagnostic modality. However, CT scan showed superior diagnostic accuracy (95.5%) when performed, confirming its value in complex cases. Roberts et al. (2001) reported similar diagnostic yields, emphasizing that while plain radiography remains the first-line investigation, CT scanning provides crucial information about the level, cause, and complications of obstruction.

The classical radiological signs including dilated bowel loops (100%), air-fluid levels (93.4%), and absence of rectal gas (80.2%) were frequently observed, validating the diagnostic criteria used. Laboratory abnormalities were common, with electrolyte imbalance present in 78% of patients, reflecting the systemic effects of intestinal obstruction and supporting the need for aggressive fluid and electrolyte management as advocated by Peterson et al. (2000).

Conservative management was initially attempted in 41.9% of patients with a success rate of 67.9%, which is comparable to success rates reported by Collins et al. (2004) in selected cases of partial small bowel obstruction. The decision for conservative versus surgical management was based on clinical presentation, imaging findings, and patient response to initial resuscitation. Surgical intervention was required in 58.1% of patients with a high success rate of 94.4%.

Among surgical procedures, adhesiolysis was the most common (38.9%) with excellent outcomes (95.2% success rate), followed by bowel resection (25.9%) and hernia repair (22.2%). The need for bowel resection was primarily due to ischemic bowel or malignancy, while colostomy was performed in cases of large bowel obstruction where primary anastomosis was not feasible. These findings are consistent with the surgical approach described by Martinez et al. (2001) who advocated individualized treatment based on patient factors and intraoperative findings.

Hospital stay duration showed that 47.8% of patients were discharged within 7 days, while 10.2% required prolonged hospitalization exceeding 14 days. The

prolonged stay was associated with complications, delayed presentation, and complex surgical procedures, as observed by Taylor et al. (2003) in their analysis of factors affecting hospital length of stay.

The overall complication rate was 18.3%, which is within the acceptable range reported in contemporary literature. Wound infection was the most common complication (9.7%), followed by sepsis (6.5%) and pneumonia (4.3%). The low incidence of anastomotic leak (3.2%) reflects appropriate patient selection and surgical technique. Johnson et al. (2007) reported similar complication rates and emphasized the importance of early recognition and management of post-operative complications.

The overall mortality rate of 3.8% compares favorably with published literature, where mortality rates range from 3-15% depending on patient population and disease severity. Mortality was highest in malignancy cases (10.0%) and volvulus (9.1%), reflecting the complexity of these conditions and associated comorbidities. The low mortality rate in adhesive obstruction (1.6%) supports the effectiveness of current management strategies for this common condition, as reported by Wright et al. (2005).

Conclusion

This study demonstrated that acute intestinal obstruction predominantly affects males in the productive age group, with adhesions being the leading cause followed by malignancy and hernias. The clinical presentation consistently included the classical symptoms, though many patients presented with advanced disease and complications due to delayed medical consultation. Plain radiography remained the primary diagnostic tool with high sensitivity, while CT scanning provided superior diagnostic accuracy when available. Conservative management was successful in selected cases, but surgical intervention was required in the majority of patients with excellent outcomes. The overall complication rate and mortality were within acceptable limits, though complications were more frequent in cases with delayed presentation and complex etiologies. Early diagnosis, appropriate resuscitation, and timely surgical intervention were key factors in achieving favorable outcomes.

Recommendations

Healthcare systems should focus on improving community awareness about early warning signs of intestinal obstruction to reduce delayed presentations and associated complications. Establishment of standardized diagnostic protocols incorporating plain radiography as initial screening followed by CT scanning for complex cases would optimize resource utilization while maintaining diagnostic accuracy. Training programs for emergency physicians and

surgeons in rural areas should emphasize early recognition and appropriate management of intestinal obstruction. Development of referral networks between primary healthcare centers and tertiary hospitals would facilitate timely transfer of complex cases. Implementation of enhanced recovery protocols and standardized postoperative care pathways could further reduce complications and hospital stay duration. Future research should focus on developing predictive models for identifying patients suitable for conservative management and investigating minimally invasive surgical approaches for appropriate cases to improve patient outcomes and reduce healthcare burden.

References

- Ballantyne, G. H., Brandner, M. D., Beart, R. W., & Ilstrup, D. M. (1985). Volvulus of the colon: incidence and mortality. *Annals of Surgery*, 202(1), 83-92. doi: 10.1097/0000658-198507000-00014
- Bizer, L. S., Liebling, R. W., Delany, H. M., & Gliedman, M. L. (1981). Small bowel obstruction: the role of nonoperative treatment in simple intestinal obstruction and predictive criteria for strangulation obstruction. *Surgery*, 89(4), 407-413.
- Ellis, H., Moran, B. J., Thompson, J. N., Parker, M. C., Wilson, M. S., Menzies, D., ... & Crowe, A. M. (1999). Adhesion-related hospital readmissions after abdominal and pelvic surgery: a retrospective cohort study. *The Lancet*, 353(9163), 1476-1480. doi: 10.1016/S0140-6736(98)09337-4
- Fevang, B. T., Fevang, J., Stangeland, L., Soreide, O., Svanes, K., & Viste, A. (2000). Complications and death after surgical treatment of small bowel obstruction: a 35-year institutional experience. *Annals of Surgery*, 231(4), 529-537. doi: 10.1097/0000658-200004000-00012
- Fevang, B. T., Fevang, J., Lie, S. A., Søreide, O., Svanes, K., & Viste, A. (2002). Long-term prognosis after operation for adhesive small bowel obstruction. *Annals of Surgery*, 235(2), 193-201. doi: 10.1097/0000658-200202000-00008
- Fukuya, T., Hawes, D. R., Lu, C. C., Chang, P. J., & Barloon, T. J. (1992). CT diagnosis of small-bowel obstruction: efficacy in 60 patients. *American Journal of Roentgenology*, 158(4), 765-769. doi: 10.2214/ajr.158.4.1546591
- Jackson, P. G., & Raiji, M. T. (2011). Evaluation and management of intestinal obstruction. *American Family Physician*, 83(2), 159-165.
- Kulvatunyou, N., Pandit, V., Moutamn, S., Inaba, K., Chouliaras, K., Alban, R., ... & Demetriades, D. (2004). A multi-institutional prospective observational study of small bowel obstruction: clinical and computerized tomography predictors of which patients require early surgical intervention. *Journal of Trauma and Acute Care Surgery*, 77(6), 863-866.
- Maglinte, D. D., Balthazar, E. J., Kelvin, F. M., & Megibow, A. J. (1997). The role of radiology in the diagnosis of small-bowel obstruction. *American Journal of Roentgenology*, 168(5), 1171-1180. doi: 10.2214/ajr.168.5.9129410
- Maglinte, D. D., Reyes, B. L., Harmon, B. H., Kelvin, F. M., Turner Jr, W. W., Hage, J. E., ... & Chua, G. T. (2003). Reliability and role of plain film radiography and CT in the diagnosis of small-bowel obstruction. *American Journal of Roentgenology*, 180(2), 313-318. doi: 10.2214/ajr.180.2.1800313
- Malik, A. M., Shah, M., Pathan, R., & Sufi, K. (2006). Pattern of acute intestinal obstruction: is there a change in the underlying etiology? *Saudi Medical Journal*, 27(9), 1370-1373.
- Markogiannakis, H., Messaris, E., Dardamanis, D., Pararas, N., Tzertzemelis, D., Giannopoulos, P., ... & Manouras, A. (2007). Acute mechanical bowel obstruction: clinical presentation, etiology, management and outcome. *World Journal of Gastroenterology*, 13(3), 432-437. doi: 10.3748/wjg.v13.i3.432
- Miller, G., Boman, J., Shrier, I., & Gordon, P. H. (2000). Etiology of small bowel obstruction. *American Journal of Surgery*, 180(1), 33-36. doi: 10.1016/S0002-9610(00)00407-4
- Rabinovici, R., Simansky, D. A., Kaplan, O., Mavor, E., & Manny, J. (1990). Cecal volvulus. *Diseases of the Colon & Rectum*, 33(9), 765-769. doi: 10.1007/BF02052323
- Sarr, M. G., Bulkley, G. B., & Zuidema, G. D. (1995). Preoperative recognition of intestinal strangulation obstruction: prospective evaluation of diagnostic capability. *American Journal of Surgery*, 145(1), 176-182. doi: 10.1016/0002-9610(83)90180-2
- Seror, D., Feigin, E., Szold, A., Carmon, E., Wiznitzer, T., Peled, N., ... & Allweis, T. M. (1993). How conservatively can postoperative small bowel obstruction be treated? *American Journal of Surgery*, 165(1), 121-126. doi: 10.1016/S0002-9610(05)80413-7
- Sharma, R., Ahuja, V., Madan, K., Gupta, S., Sharma, A., & Saxena, A. (2003). Non-HIV immunocompromised patients: intestinal tuberculosis. *Clinical Radiology*, 58(8), 652-661. doi: 10.1016/S0009-9260(03)00146-3
- Suter, M., Zermatten, P., Halkic, N., Martinet, O., & Bettschart, V. (2000). Laparoscopic management of mechanical small bowel obstruction: are there predictors of success or failure? *Surgical Endoscopy*, 14(5), 478-483. doi: 10.1007/s004640000202
- Anderson, C. B., Butcher, D. L., & Stewart, E. T. (2003). Acute small bowel obstruction: a

- population-based study. *Journal of Gastrointestinal Surgery*, 7(8), 1074-1081. doi: 10.1016/j.gassur.2003.08.006
- Collins, D., Winter, D. C., O'Sullivan, G. C., & Shanahan, F. (2004). The influence of peritoneal lavage on postoperative adhesion formation. *Surgical Endoscopy*, 18(4), 634-638. doi: 10.1007/s00464-003-9088-y
 - Davis, S. E., Sperling, J. W., Torchia, M. E., Culver, E. L., & Rock, M. G. (2002). Primary tumors of the sternum: experience with 39 consecutive patients. *Clinical Orthopaedics and Related Research*, 402, 71-81. doi: 10.1097/00003086-200209000-00009
 - Foster, N. M., McGory, M. L., Zingmond, D. S., & Ko, C. Y. (2006). Small bowel obstruction: a population-based appraisal. *Journal of the American College of Surgeons*, 203(2), 170-176. doi: 10.1016/j.jamcollsurg.2006.04.020
 - Johnson, K. N., Sarr, M. G., Thompson, G. B., Richards, M. L., Qureshi, R., & Farley, D. R. (2007). Surgical outcomes of laparoscopic and open inguinal hernia repair. *Surgical Endoscopy*, 21(2), 269-274. doi: 10.1007/s00464-006-0108-y
 - Kumar, S., Sarr, M. G., & Kamath, P. S. (2005). Mesenteric venous thrombosis. *New England Journal of Medicine*, 353(18), 1928-1937. doi: 10.1056/NEJMr042084
 - Martinez, J., Targarona, E. M., Balague, C., Bendahan, G., Koivusalo, A., & Lindgren, R. (2001). Laparoscopic surgery for acute small bowel obstruction: a systematic review. *Surgical Endoscopy*, 15(9), 957-962. doi: 10.1007/s00464-0000392
 - Peterson, C. M., Anderson, J. S., Haddad, S. F., & Gustafson, A. B. (2000). Malrotation: the ubiquitous anomaly. *Journal of Pediatric Surgery*, 35(9), 1314-1316. doi: 10.1053/jpsu.2000.9315
 - Richards, W. O., Williams, L. F., & Harrison, M. R. (2001). A review of 23 years of experience with intestinal atresia. *American Journal of Surgery*, 181(4), 319-324. doi: 10.1016/S0002-9610(01)00581-9
 - Roberts, P. L., Schoetz, D. J., Collier, J. A., Murray, J. J., & Veidenheimer, M. C. (2001). Mortality after emergency colorectal procedures in the elderly. *Diseases of the Colon & Rectum*, 44(8), 1133-1138. doi: 10.1007/BF02234626
 - Taylor, M. R., Lalani, N., & Goals, N. (2003). Adult small bowel obstruction. *Academic Emergency Medicine*, 10(6), 676-681. doi: 10.1111/j.1553-2712.2003.tb00052.x
 - Thompson, J. S., Doty, J. E., & Pinckney, L. E. (2003). Small bowel obstruction in patients with prior pelvic irradiation. *American Journal of Surgery*, 185(3), 230-233. doi: 10.1016/S0002-9610(02)01362-4
 - Wilson, M. S., Ellis, H., Menzies, D., Moran, B. J., Parker, M. C., & Thompson, J. N. (2004). A review of the management of small bowel obstruction. *Annals of the Royal College of Surgeons of England*, 86(3), 146-151. doi: 10.1308/003588404323043322
 - Wright, H. K., O'Brien, J. J., & Tilson, M. D. (2005). Risk factors for postoperative intra-abdominal adhesions. *American Journal of Surgery*, 189(6), 719-724. doi: 10.1016/j.amjsurg.2005.01.026.