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ORIGINAL ARTICLE

SIGMOID VOLVULUS: WHAT HAS CHANGED IN THE LAST 50 YEARS?

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ABSTRACT

Background: *Sigmoid volvulus (SV) is the wrapping of the sigmoid colon around itself. The aim of this study is to evaluate the changes in SV from past to present.*

Methods: *The clinical records of 993 patients treated over a 50-year period between June 1966 and June 2016 were analyzed, retrospectively until June 1986 (612 patients), and prospectively thereafter (381 patients).*

Results: *The incidence decreased over the last 25 years ($p<0.001$). Although the patients' age, gender, history, and comorbidity rate were similar, the symptom duration shortened ($p<0.001$), and the rate of shock decreased ($p<0.005$). The clinical presentation did not change. Non-operative therapeutic procedures were most commonly used ($p<0.001$), and flexible endoscopy took the place of barium enema and rigid endoscopy ($p<0.001$). Although the success rate of the non-operative procedures increased ($p<0.001$) and the hospitalization period shortened ($p<0.001$), rates of morbidity, mortality, and recurrence did not change. The pre-operative diagnostic accuracy rate increased ($p<0.001$). The need for surgical treatment, as well as volvulus direction and over rotation rate were similar, while bowel gangrene was seen less often ($p<0.05$). Non-resectional surgical methods were used less frequently ($p<0.001$), and resection with primary anastomosis generally took the place of the resection with stoma ($p<0.005$). The morbidity and mortality rates of the surgery decreased ($p<0.05$, for each) and the hospitalization period shortened ($p<0.001$), while the recurrence rate did not change.*

Conclusions: *We observed a decrease in the incidence of SV as well as changes in the diagnostic and therapeutic strategies, and an improvement in the prognosis, while the clinical features did not change.*

Key words: *Sigmoid colon, Volvulus, Intestinal obstruction, Diagnosis, Treatment*

INTRODUCTION

Sigmoid volvulus (SV) is a rare form of intestinal obstruction in which the sigmoid colon wraps around itself and its own base (1). The incidence of SV is relatively high in Turkey, particularly in Eastern Anatolia (2,3), where this study was based. The clinic which carried out the study has over 50 years of experience with SV, which included 993 cases, and the investigators proposed to evaluate the differences in incidence, general characteristics, clinical presentation, diagnosis, treatment, and prognosis over the 50-year period.

PATIENTS AND METHODS

We reviewed the clinical records of 993 patients with SV who were treated over a 50-year period from June of 1966 to June of 2016. All patients underwent resuscitation and clinical examination and then received abdominal X-rays, while selected stable patients underwent computed tomography (CT) and/or magnetic resonance imaging (MRI) in the more recent years of the study period. Patients with no complications received emergency non-operative detorsion treatments including barium enema, rigid endoscopy, or flexible endoscopy for both diagnostic and therapeutic purposes. For patients with acute abdominal findings and bowel gangrene or whose non-operative detorsion treatments had been unsuccessful, emergency surgery was performed, which included resectional or non-resectional techniques.

The following data were noted: age, gender, previous volvulus attacks, associated diseases, symptom periods, symptoms and signs, radiological and endoscopic findings, non-operative and operative treatments, morbidity, mortality, recurrence, and hospitalization period. Data from the first 25-year period (from June 1966 to June 1991) were compared with those from the second (from June 1991 to June 2016) using Student's t, Chi-Square, or Fisher's exact tests in statistical analyses. Statistical significance was set at $p<0.05$.

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RESULTS

A total of 993 patients with SV received emergency treatment. Table 1 shows the findings over the total 50 years and for each 25-year period, as well as the statistical analysis between the first and second 25-year periods. As seen, there was a statistically significant decrease in the incidence of SV (cases per year from 26.9 to 12.8, cases per 100 000 persons per year from 9.6 to 2.3; $p<0.001$, for each). Conversely, the statistical analysis did not demonstrate any difference between the age, gender, history of volvulus, and associated diseases ($p>0.05$, for each).

Although the symptom duration (42.9 hours vs. 29.4 hours, respectively; $p<0.001$) and the proportion of patients with shock (14.9% vs. 8.1%, respectively; $p<0.005$) decreased significantly, the clinical findings were similar between the first 25-year period and the second ($p>0.05$, for each).

In the latter 25 years, we used non-operative detorsion in more cases (68.6% vs. 80.0%, respectively; $p<0.001$). We used barium enema from 1966 to 1968 together with rigid endoscopy. We began using flexible endoscopy in 1988, which took the place of rigid endoscopy by 2003. Thus, our usage of flexible endoscopy statistically significantly increased (26.6% vs. 90.2%, respectively; $p<0.001$) in the last compared with the first 25-year time period. The success, morbidity, mortality and early recurrence rates of the rigid and flexible endoscopies were 81.8% vs 83.2%, 2.6% vs 1.4%, 0.9% vs 0.3%, and 3.3% vs 6.3%, respectively. When we discontinued the use of barium enema and began using flexible endoscopy, the success rate of the non-operative procedures increased significantly (80.2% vs. 86.0%, respectively; $p<0.001$) and the hospitalization period decreased statistically significantly (40.5 hours vs. 25.2 hours, respectively; $p<0.001$), while no difference was demonstrated between the time periods for the morbidity, mortality, and early recurrence rates ($p>0.05$, for each). On the other hand, the diagnostic accuracy rate, which was confirmed by endoscopy or, in some patients, by surgery, improved significantly in the latter period (78.0% vs. 90.9%, respectively; $p<0.001$), particularly due to CT and/or MRI coming into play.

The rate of need for surgical treatment did not change ($p>0.05$). The rate of surgical findings, the direction of volvulus and over rotation were statistically similar ($p>0.05$, for each), while there was a statistically significant decrease in the rate of bowel gangrene (63.7% vs. 53.6%, respectively; $p<0.05$). Non-resectional surgical methods, including detorsion and sigmoidopexy, were used less often (28.0% vs. 9.3%, respectively; $p<0.001$), and we performed resection with primary anastomosis more often compared with the resection with stoma (30.5% vs. 45.7%, respectively; $p<0.005$) in the latter 25 years, while we did not use exteriorization.

Finally, although we found statistically significant decreases in the morbidity (37.5% vs. 27.1%, respectively; $p<0.05$) and mortality rates (18.5% vs. 10.7%, respectively; $p<0.05$), and a statistically significant decrease in the hospitalization period (14.8 days vs. 8.1 days, respectively; $p<0.001$), the early and late recurrence rates did not differ ($p>0.05$, for each).

Table 1. The results and the statistical analyses

Parameter	June 1966-June 2016 (50 years total)	June 1966-June 1991 (first 25 years)	June 1991-June 2016 (second 25 years)	Statistical analysis and comment (first 25 vs second 25 years)
Case	993	673	320	-
Incidence (case per year)	19.9	26.9	12.8	Student's t test, t=40.3, p<0.001
Incidence (case per 100.000 person per year)	4.8	9.6	2.3	Student's t test, t=33.9, p<0.001
Age (mean year)	58.9	58.2	60.0	Student's t test, t=1.0, p>0.05
Gender (male/female)	82.0%/18.0%	82.5%/17.5%	81.3%/18.7%	Chi-Square test, x^2=0.3, p>0.05
History of volvulus	225/892 (25.2%)	146/572 (25.5%)	79/320 (24.7%)	Chi-Square test , x^2=0.1, p>0.05
Associated disease	235/892 (26.3%)	152/572 (26.6%)	83/320 (25.9%)	Chi-Square test, x^2=0.1, p>0.05
Symptom period (mean hour)	38.1	42.9	29.4	Student's t test, t=7.2, p<0.001
Shock	111/892 (12.4%)	85/572 (14.9%)	26/320 (8.1%)	Chi-Square test, x^2=8.3, p<0.005
Abdominal pain-tenderness	882/892 (98.9%)	565/572 (98.8%)	317/320 (99.1%)	Fisher's exact test, p>0.05
Distention	860/892 (96.4%)	554/572 (96.9%)	306/320 (95.6%)	Chi-Square test, x^2=0.9, p>0.05
Obstipation	821/892 (92.0%)	531/572 (92.8%)	290/320 (90.6%)	Chi-Square test, x^2=1.5, p>0.05
Non-operative detorsion	718/993 (72.3%)	462/673 (68.6%)	256/320 (80.0%)	Chi-Square test, x^2=13.4, p<0.001
Barium enema	13/718 (1.8%)	13/462 (2.8%)	0/256 (0.0%)	Fisher's exact test, p<0.01
Rigid endoscopy	351/718 (48.9%)	326/462 (70.6%)	25/256 (9.8%)	Chi-Square test, x^2=240.9, p<0.001
Flexible endoscopy	354/718 (49.3%)	123/462 (26.6%)	231/256 (90.2%)	Chi-Square test, x^2=263.7, p<0.001
Success of non-operative detorsion	555/675 (82.2%)	352/439 (80.2%)	203/236 (86.0%)	Chi-Square test, x^2=12.4, p<0.001
Morbidity of non-operative detorsion	17/718 (2.4%)	13/462 (2.8%)	4/256 (1.6%)	Chi-Square test, x^2=1.1, p>0.05
Mortality of non-operative detorsion	5/718 (0.7%)	4/462 (0.9%)	1/256 (0.4%)	Fisher's exact test, p>0.05
Early recurrence of non-operative detorsion	27/555 (4.9%)	14/352 (4.0%)	13/203 (6.4%)	Chi-Square test, x^2=1.7, p>0.05
Hospitalization period of non-operative detorsion (mean hour)	35.2	40.5	25.2	Student's t test, t=16.0, p<0.001
Diagnostic accuracy	816/993 (82.2%)	525/673 (78.0%)	291/320 (90.9%)	Chi-Square test, x^2=24.2, p<0.001
Surgery	465/993 (46.8%)	325/673 (48.3%)	140/320 (43.8%)	Chi-Square test, x^2=1.5, p>0.05
Direction of volvulus (counter clock wise)	189/370 (51.1%)	118/230 (51.3%)	71/140 (50.7%)	Chi-Square test, x^2=0.0, p>0.05
Over rotation (>360^o)	81/370 (21.9%)	51/230 (22.2%)	30/140 (21.4%)	Chi-Square test, x^2=0.0, p>0.05
Bowel gangrene	282/465 (60.6%)	207/325 (63.7%)	75/140 (53.6%)	Chi-Square test, x^2=4.2, p<0.05
Nonresectional surgery	104/465 (22.4%)	91/325 (28.0%)	13/140 (9.3%)	Chi-Square test, x^2=19.9, p<0.001
Exteriorization	4/465 (0.9%)	4/325 (1.2%)	0/140 (0.0%)	Fisher's exact test, p>0.05
Resection and stoma	193/465 (41.5%)	130/325 (40.0%)	63/140 (45.0%)	Chi-Square test, x^2=1.0, p>0.05
Resection and primary anastomosis	163/465 (35.1%)	99/325 (30.5%)	64/140 (45.7%)	Chi-Square test, x^2=9.9, p<0.005
Morbidity of surgery	160/465 (34.4%)	122/325 (37.5%)	38/140 (27.1%)	Chi-Square test, x^2=4.7, p<0.05
Mortality of surgery	75/465 (16.1%)	60/325 (18.5%)	15/140 (10.7%)	Chi-Square test, x^2=4.3, p<0.05
Early recurrence of surgery	3/465 (0.6%)	2/325 (0.6%)	1/140 (0.7%)	Fisher's exact test, p>0.05
Hospitalization period of surgery (mean day)	12.7	14.8	8.1	Student's t test, t=12.1, p<0.001
Late recurrence of surgery	9/179 (5.0%)	7/101 (6.9%)	2/78 (2.6%)	Fisher's exact test, p>0.05

DISCUSSION

Although SV has been known as a rare form of intestinal obstruction since its description by von Rokitansky in 1836 (1, 4), it is important today due to its grave prognosis (3, 5).

The incidence of SV differs across regions of the world, and is endemic in certain regions including certain African, Asian, Middle Eastern, Eastern and Northern European, and South American countries as well as Turkey (1, 2, 4, 6-8). The presence of a redundant sigmoid colon with a narrow mesentery (dolichosigmoid) is the most important factor in the development of SV, and some factors including advanced age, male gender, high altitude, high fiber-vegetable diet, and constipation habits, some of which are present in Turkey, are known risk factors for the anatomic prerequisite described above and SV (1, 2, 9-11). According to our data, based on our hospital statistics and community-based parameters, the SV incidence in Eastern Anatolia is 4.8 per 100,000 persons per year, which is very high when compared with that of the United States, which is 1.67 per 100,000 persons per year (4). Similarly, our SV incidence, which is 19.9 cases per year per hospital, is also very high when compared to that of Europe, which is below 4 patients per year per hospital (1). However, our results clearly indicated a decreasing incidence, from previously 9.6 per 100,000 persons per year, similar to that of certain endemic areas such as the Middle East and Africa (1, 7, 12) but different from the United States (8), to just 2.3 per 100,000 persons per year. This may be ascribed to westernization of dietary habits (1). Another probable cause of this decrease in Turkey may be the improvement of living conditions; in some rural areas the use of outdoor toilets was more common in the past compared with the situation now and this could have led to delays in defecation habits resulting in constipation. A positive correlation has been observed between advanced age with sigmoid dolichocolon: SV was seen more commonly in the 4^{th} to 8^{th} decades of life (1,2,9,10,13). Similarly, dolichosigmoid, as well as SV were more common in males, in a ratio of 2:1 to 10:1 (1, 2, 9, 10, 14). In the present series, we found similar results, and the SV distribution by age and gender did not show any change during the study period. On the other hand, the recurrence rate of SV ranged between 13%-85%, as we observed in our study population (1,2,4,5). Additionally, similar to our results, comorbidities often occur together with SV, at a reported rate ranging between 25%-63% (1, 2,5,7,8,13). In our series, the history of volvulus and associated diseases were seen at similar rates during the first and second 25-year study periods.

Although the clinical features of SV depend on the degree and the rate of development of the colonic torsion, patients usually present with a mean delay of 1-4 days, and due to this latency, 7.2%-12.5% of the patients are in a state of shock (1,2,5,6,13), as was also observed in our study population. The shortened presentation time for patients to seek medical care for their condition in this study, as well as the decrease in the shock rate in our series, may be due to improvement in socioeconomic conditions. In the past, transport facilities and health services were inadequate in some rural areas. In addition, the triad of abdominal pain, distention, and constipation as classical manifestations of SV has been seen in 33%-88% of patients, similar to our study population (1, 2,4,7,8,13). In our series, the clinical presentation of the disease did not change during the observed period.

Non-surgical detorsion is advocated as the initial treatment to follow an early and effective resuscitation in uncomplicated SV patients (1,3,8,15-24). Although reduction of SV by barium or saline enema was used in the past, it is no longer generally recommended because of the risk of missing the possibility of bowel gangrene, perforation, and peritonitis (3,15,17,18,22). Instead, endoscopic reduction has become the preferred approach, with a 48.1%-100% success rate, 0%-26.4% morbidity rate, and 0%-19.0% mortality rate (1, 3, 8, 15-24), as we found in our study. In addition, the use of flexible instead of rigid endoscopes may increase the success rate and decrease the morbidity and mortality rates. Overall, flexible endoscopes are better tolerated by patients, and endoscopists find them easier to use (1,3, 17,24). In our series, non-operative procedures were used mostly in the latter 25-year period, probably due to the decrease in the shock and bowel gangrene rates, which can be explained by the shortening of the period in which patients present for medical assistance (25). While barium enema together with rigid endoscopy was used from 1966 to 1968, the practice of using barium enema was halted in 1968 due to its high morbidity and mortality rates. Also since 1988 there was an option to use flexible endoscopy which replaced rigid endoscopy in 2003. After starting to use flexible endoscopy and ceasing to perform barium enemas, there was an increased success rate of non-operative procedures and the hospitalization period was also reduced in the second 25-year period. However the morbidity, mortality, and early recurrence rates did not demonstrate any difference in our series.

Accurate diagnosis of SV is not possible in 10-15% of patients even with thorough clinical and X-ray imaging and requires the use of CT and/or MRI. The presence of a whirl sign, defined as twisted bowel loops encircling mesenteric vessels in addition to distended sigmoid loops and intestinal air-fluid levels as on abdominal CT and/or MRI, is highly diagnostic for SV and may improve pre-operative diagnostic confi-

dence (1,2,26-28). Our diagnostic accuracy rate increased in the latter 25-year period, probably due to CT and/or MRI coming into play.

In patients with SV, surgical treatment is an important choice. If bowel gangrene, perforation, or peritonitis are present and if non-surgical detorsion is unsuccessful, emergency surgery is needed, which includes different non-resectional or resectional techniques (1,3,17-24,29-32). Hence, in our series, the rate of the need for surgical treatment did not change in the latter 25-year period. As an operative finding, volvulus is generally seen in a counter-clockwise direction and is not thought to be involved with clinical presentation and prognosis (17). Similarly, over rotation, which is defined as the presence of a rotation greater than 360^{o}, generally occurs in about 25% of patients, causing a fulminant clinical presentation owing to ischemic pain and negatively affects the prognosis (1, 17). In addition, bowel gangrene, which is associated with comorbidity, shock, symptom duration, and over rotation, is generally seen in 6.1%-30.2% of SV cases and worsens the prognosis (1,3,17,25). In our series, the operative findings mentioned above were similar to those reported in the literature, and while neither volvulus direction nor over rotation findings differed over the study period, the bowel gangrene rate was lower in the second half period, which can be explained by the reduction in the time that patients would present to a health facility seeking assistance for their medical condition. In the second 25-year-period, non-resectional methods were used less often, probably due to the recurrence risk associated with operative detorsion and sigmoidopexy procedures (1,3,17), which were used in the first period. A possible reason for performing the resection in the same session is to reduce the need for elective sigmoid resection, which has become popular recently (1,3,4,17,33,34). Although stoma is a lifesaving procedure in complicated patients (1,3,4,17), primary anastomosis has generally been the preferred treatment after resection in selected patients, particularly in recent years (1,3,5,17-22,29-32). In our series, similar to the literature findings, resection with primary anastomosis often replaced resection with stoma in the latter 25 years, while exteriorization was discontinued due to its associated high mortality rate.

SV has a grave prognosis, and a mean of 11.1%-34.8% morbidity, 5.3%-16.7% mortality, and 6.4%-55.5% recurrence rates (1-8,17,18-24,29-33), similar to our results. Although we found decreases in the morbidity and mortality rates, as well as in the duration of the hospitalization period, which may be explained by the development of peri operative health services and operative techniques, similar to published results (1,3,5,8,17, 29), we found no changes in the early and late recurrence rates.

In the present study, in which we compared certain parameters of SV by evaluating the results over 50 years from past to present, we found a decrease in the incidence, symptom duration, shock rate, barium enema and rigid endoscopy usage, hospitalization period of the non-operative detorsion, bowel gangrene rate, non-resectional surgery usage, morbidity and mortality rates, and hospitalization period following surgery. In contrast, we demonstrated an increase in the non-operative detorsion and flexible endoscopy usage, success of the non-operative detorsion, diagnostic accuracy rate, and resection with primary anastomosis usage. Finally, the age, gender, previous recurrence and comorbidity rates, clinical presentation, morbidity, mortality and early recurrence rates following non-operative detorsion, need for surgery, operative findings including the rotation direction and degree, and recurrence of surgery did not change during the study period.

CONFLICT OF INTEREST:
None

REFERENCES

1. Raveenthiran V, Madiba TE, Atamanalp SS, De U. Volvulus of the sigmoid colon. *Colorectal Dis*. 2010; 12 (7): e1-e17.
2. Atamanalp SS. Sigmoid volvulus: Diagnosis in 938 patients over 45.5 years. *Tech Coloproctol.* 2013; 17(4): 419-24.
3. Atamanalp SS. Treatment of sigmoid volvulus: A single-center experience of 952 patients over 46.5 years. *Tech Coloproctol.* 2013; 17(5): 561-9.
4. Ballantyne GH, Brandner MD, Beart RW, Ilstrup DM. Volvulus of the colon. Incidence and mortality. *Ann Surg*. 1985; 202(1); 83-92.
5. Onder A, Kapan M, Arikanoglu Z et al. Sigmoid colon torsion: mortality and relevant risk factors. *Eur Rev Med Pharmacol.* Sci 2013; 17(s1): 127-32.
6. Grossmann EM, Longo WE, Stratton MD, Virgo KS, Johnson FE. Sigmoid volvulus in Department of Veterans Affairs Medical Centers. *Dis Colon Rectum* 2000; 43(3): 414-8.
7. Heis HA, Bani-Hani KE, Rabadi DK et al. Sigmoid volvulus in the Middle East. *World J Surg*. 2008; 32(3): 459-64.

8. Halabi WJ, Jafari MD, Kang CY, et al. Colonic volvulus in the United States. Trends, outcomes, and predictors of mortality. *Ann Surg. 2014*; 259(2): 293-301.
9. Atamanalp SS, Ozturk G, Aydinli B, Oren D. The relationship of the anatomical dimensions of the sigmoid colon with sigmoid volvulus. *Turk J Med Sci.* 2011; 41(3): 377-82.
10. Alatise OI, Ojo O, Nwoha P, Omoniyi-Esan G, Omonisi A. The role of the anatomy of the sigmoid colon in developing sigmoid volvulus: a cross-sectional study. *Surg Radiol Anat.* 2013; 35(3): 249-57.
11. Madiba TE, Aldous C, Haffajee MR. The morphology of the foetal sigmoid colon in the African population: a possible predisposition to sigmoid volvulus. *Colorectal Dis*. 2015; 17(12): 1114-20.
12. Segal I. Decreasing incidence of sigmoid volvulus at Baragwanath Hospital Johannesburg. *S Afr Med J.* 1985; 67(12): 443.
13. Atamanalp SS, Ozturk G. Sigmoid volvulus in the elderly: Outcomes of a 43-year, 453-patient experience. *Surg Today* 2011; 41(4): 514-9.
14. Atamanalp SS, Ozturk G. Sigmoid volvulus in pregnancy. *Turk J Med Sci.* 2012; 42(1): 9-15.
15. Starling JR. Initial treatment of sigmoid volvulus by colonoscopy. *Ann Surg.* 1979; 190(1): 36-9.
16. Brothers TE, Strodel WE, Eckhauser FE. Endoscopy in colonic volvulus. *Ann Surg.* 1987; 206(1): 1-4.
17. Oren D, Atamanalp SS, Aydinli B, et al. An algorithm for the management of sigmoid colon volvulus and the safety of primary resection: experience with 827 cases. *Dis Colon Rectum* 2007; 50(4): 489-97.
18. Jangjoo A, Soltani E, Fazelifar S, Saremi E, Aghaei MA. Proper management of sigmoid colon volvulus: our experience with 75 cases. *Int J Colorectal Dis.* 2010; 25(3): 407-9.
19. Mulas C, Bruna M, Garcia-Armengol J, Roig JV. Management of colonic volvulus: Experience in 75 patients. *Rev Esp Enferm Dig.* 2010; 102(4): 239-48.
20. Tan KK, Chong CS, Sim R. Management of acute sigmoid volvulus: an institution's experience over 9 years. *World J Surg*. 2010; 34(8): 1943-8.
21. Lou Z, Yu ED, Zhang W, Meng RG, Hao LQ, Fu CG. Appropriate treatment of acute sigmoid volvulus in the emergency setting. *World J Surg*. 2013; 19(30): 4979-83.
22. Swenson BR, Kwaan MR, Burkart NE, et al. Colonic volvulus: presentation and management in metropolitan Minnesota, United States. *Dis Colon Rectum* 2012; 55(4): 444-9.
23. Maddah G, Kazemzadeh GH, Abdollahi A, Bahar MM, Tavassoli A, Shabahang H. Management of sigmoid volvulus: options and prognosis. *J Coll Physicians Surg Pak*. 2014; 24(1): 13-7.
24. Atamanalp SS, Atamanalp RS. The role of sigmoidoscopy in the diagnosis and treatment of sigmoid volvulus. *Pak J Med Sci*. 2016; 32(1): 244-8.
25. Atamanalp SS, Kisaoglu A, Ozogul B. Factors affecting bowel gangrene development in patients with sigmoid volvulus. *Ann Saudi Med*. 2013; 33(2): 144-8.
26. Atamanalp SS, Kantarci M, Ozogul B, Kisaoglu A, Atamanalp RS. The role of CT and MRI in the diagnosis of sigmoid volvulus. *Turk J Med Sci.* 2014; 44: 352.
27. Levsky JM, Den EI, DuBrow RA, Wolf EL, Rozenblit AM. CT findings of sigmoid volvulus. *Am J Roentgenol.* 2010; 194(1): 136-43.
28. Jaffe T, Thompson WM. Large-bowel obstruction in the adult: Classic radiographic and CT findings, etiology, and mimics. *Radiology* 2015; 275(3): 651-63.
29. Suleyman O, Kessaf AA, Ayhan KM. Sigmoid volvulus: Long-term clinical outcome and review of the literature. *S Afr J Surg*. 2012; 50(1): 9-15.
30. Katsikogiannis N, Machairiotis N, Zarogoulidis P, et al. Management of sigmoid volvulus avoiding sigmoid resection. *Care Rep Gastroenterol.* 2012; 6(2): 293-9.
31. Yassaie O, Thompson-Fawcett M, Rossaak J. Management of sigmoid volvulus: is early surgery justifiable? *ANZ J Surg*. 2013; 83(1-2): 74-8.
32. Bruzzi M, Lefevre JH, Desaint B, et al. Management of acute sigmoid volvulus: short- and long-term results. *Colorectal Dis*. 2015; 17(10): 922-8.
33. Atamanalp SS, Oren D, Aydinli B, et al. Elective treatment of detorsioned sigmoid volvulus. *Turk J Med Sci*. 2008; 38(3): 227-34.
34. Ifversen AKW, Kjaer DW. More patients should undergo surgery after sigmoid volvulus. *World J Gastroenterol*. 2014; 20(48): 18384-9.