

Predicting Factors for Mortality in Sigmoid Volvulus

Bilsel Baç*, Mustafa Aldemir*, İbrahim Taçyıldız*, Celalettin Keleş*

SUMMARY

Sigmoid colon is the most frequent site for a volvulus and volvulus of the sigmoid colon (SV) is characterized by a high morbidity and mortality. The objective of this study was to evaluate predicting factors for mortality in the SV cases. Between January 1994 and December 2001, the records of patients operated on due to SV at Dicle University Hospital (DUH) were retrospectively reviewed. The epidemiological, clinical, and laboratory features were evaluated as probable risk factors for mortality. Variables associated with SV were determined using logistic regression models. Of 90 patients, 80 (88.9%) were male, and 10 (11.1%) were female. The mean age was 58.8±12.9 (19-85) and 63.6±16.1 (23-83) for the patients with uneventful outcome (Group 1) and for the patients with fatal outcome (Group 2), respectively (p=0.000). The period of symptoms before admission (PSBA) were 2.2±0.73 (1-4) days and 5.6±1.7 (2-10) days in Group 1 and Group 2 respectively (p=0.000). While the 73.8 % of patients in the Group 1 were operated on an emergency state, 100 % of patients in the Group 2 were operated on an emergency state (p=0.002). In the univariate analysis, other significant risk factors were significantly fluid-electrolyte imbalance, elevated abdominal pressure (EAP), cardiovascular disease, respiratory disease, leukocytosis, hypotension, presence of necrosis, and presence of major contamination (p=0.000). These variables were entered into the logistic regression model for revealing the risk factors for mortality. In multivariate analysis, long PSBA [Odds Ratio (OR) =17.17, 95% Confidence Interval (CI) =2.86-103.07, P=0.002], presence of cardiovascular disease at the admission (OR=0.19, CI=0.001-0.52, P=0.019) and age (OR=0.87, CI=0.77-0.99, P=0.046) were found significantly predictive for mortality. EAP, fluid-electrolyte imbalance, respiratory disease, and presence of major contamination were not statistically significant factors for mortality after sigmoid volvulus. In our study, we determined that conditions, such as a long PSBA, presence of cardiovascular disease and age were predicting factors for mortality.

Key Words: Sigmoid volvulus, mortality, predicting factors.

Sigmoid Volvulusta Mortalite İçin Ön Belirleyici Faktörler

ÖZET

Sigmoid kolon, volvulusun en sık görüldüğü yerdir ve sigmoid volvulus (SV), yüksek mortalite ve morbiditeye sebep olur. Bu çalışmanın amacı, SV vakalarında mortaliteyi önceden belirleyen faktörleri değerlendirmek idi. Ocak 1994 ve Aralık 2001 tarihleri arasında, Dicle Üniversitesi Hastanesinde, SV nedeniyle ameliyat edilen hastaların kayıtları geriye dönük incelendi. Epidemiyolojik, klinik ve laboratuvar özellikleri, mortalite için olası risk faktörleri olarak değerlendirildi. SV ile ilişkili değişkenler, logistik regresyon modelleri kullanılarak belirlendi. Toplam 90 hastanın, 80 (%88.9)'i erkek, 10 (11.1%)'i kadın idi. Yaş ortalaması, sorunsuz hastalar için (Grup 1) 58.8±12.9 (19-85) ve ölen hastalar için (Grup 2) 63.6±16.1 (23-83) idi (p=0.000). Başvuru öncesi semptomların süresi, Grup 1'de 2.2±0.73 (1-4) gün ve Grup 2'de 5.6±1.7 (2-10) gün (p=0.000) idi. Grup 1'deki hastaların %73.8'i, grup 2'deki hastaların %100'ü acil olarak operasyona alınmışlardı (p=0.002). Tek yönlü analizlerde, diğer önemli risk faktörleri; sıvı-elektrolit dengesizliği, artmış abdominal basınç, kardiyovasküler hastalık, solunum yolu hastalığı, lökositoz, hipotansiyon, nekroz varlığı ve major kontaminasyon varlığı idi (p=0.000). Bu değişkenler, mortalite için risk faktörlerini ortaya çıkarmak için, logistik regresyon modeline girildi. Çok değişkenli analizlerde, uzun başvuru öncesi semptomların süresi [Odds Ratio (OR) =17.17, 95% Confidence Interval (CI) =2.86-103.07, P=0.002], başvuruda kardiyovasküler hastalığın varlığı (OR=0.19, CI=0.001-0.52, P=0.019) ve yaş (OR=0.87, CI=0.77-0.99, P=0.046) mortalite için önemli ön belirleyici faktör olarak bulundu. Artmış intraabdominal basınç, sıvı-elektrolit dengesizliği, solunum yolu hastalığı ve major kontaminasyon SV sonrası mortalitede istatistiksel olarak önemli faktörler değildi. Çalışmamızda, başvuru öncesi semptomların süresinin uzamış olması, başvuruda kardiyovasküler hastalığın varlığı ve yaşın, mortaliteyi önceden tahmin etmede etkili faktörler olduğunu tespit ettik.

Anahtar Kelimeler: Sigmoid volvulus, mortalite, ön belirleyici faktörler.

* Dicle Üniversitesi Tıp Fakültesi Genel Cerrahi A.D.

INTRODUCTION

The incidence and demographic features of volvulus of the sigmoid colon (SV) varies around the world. In the developed world, SV is responsible for 5% of large bowel obstructions and occurs in elderly and frail patients (1). In the developing world, SV constitutes 50% of large bowel obstructions (1). A higher incidence of SV is reported in the inhabitants of rural areas compared with those from urban areas (2). The condition may also be more common in those with poorer socioeconomic status (3,4). In developed countries, residents of long-term care institutions are at particular risk of developing SV (5-7).

A previous review documented an over-all mortality rate of 19.7 per cent in association with SV, with a 52.8 per cent mortality rate when gangrenous intestine is present and 12.4 per cent when the colon remained (8). Most deaths were the result of coexisting disease, rather than a direct result of the procedure itself or complications related to the procedure (7). Little is known about the predicting factors for mortality in SV cases. In this study, we intended to evaluate predicting factors for mortality in a series with SV.

PATIENTS and METHODS

Using a standardized data collection instrument, case records of all patients with SV diagnosed between January 1994 and December 2001 at the University Hospital of Dicle were reviewed. The diagnosis of SV was made from the history of a large bowel obstruction (constipation, abdominal distension, abdominal pain, nausea and fecaloid vomiting), which was often recurrent, and from the plain abdominal radiographs. In the latter, the cardinal features were 'omega' sign of the distended, twisted, sigmoid colon. The other features were metallic sound or hyperactive bowel sound.

Non-operative detorsion (percutaneous deflation, sigmoidoscopic and tube detorsion) was attempted as the initial treatment of SV. The patients who recovered with detorsion were operated on electively after bowel preparation, but the others were operated on

urgently. Laparotomy was performed on all patients after active fluid resuscitation, correction of any electrolyte and acid base disturbances, and establishment of satisfactory urine output (catheter monitoring). Nasogastric tube decompression was inserted in all cases. Gentamycin 80 mg, ampicillin/sulbactam 1gr and metronidazole 500mg were administered intravenously at the time of induction of anaesthesia. Four more doses were given every 8 h in those patients with viable bowel and for 7-10 days in those with infarcted bowel and major contamination.

At laparotomy, viability of the bowel was assessed through a lower mid line incision. Gaseous distention of the large bowel was relieved either by antegrade decompression or any catheter aspiration. Emergency operative procedures were as following; a) appendectomy plus on-table colonic irrigation plus resection and primary anastomosis, b) resection plus end colostomy (Hartmann's procedure), c) Mesosigmoidoplasty orocolopexy. Elective operative procedures were as following: a) bowel preparation plus primary resection and colocolic anastomosis b) bowel preparation plus mesosigmoidoplasty. Volvulus of the sigmoid colon was diagnosed in 90 patients. Patients were divided into two groups: uneventful outcome (Group 1, n=65) and fatal outcome (Group 2, n=25). During admission, all abnormal findings related to epidemiological, clinical and laboratory features, and additional diseases were evaluated as possible- predictive risk factors for operative mortality. Analysed for risk factors included: age, gender, the PSBA, EAP (The measurement of transurethral bladder pressure > 25 mm Hg) fluid-electrolyte imbalance (hypo/hyperpotassemia hypocalcaemia, hypo/hypermnatremia, elevated level of serum urea nitrogen, metabolic acidosis), cardiovascular disease (ischemic heart disease and/or heart failure), respiratory disease, leukocytosis (>15000/ μ L), hypotension (symptomatic, or systolic blood pressure <70 mm Hg), emergency operation, presence of necrosis, and presence of major contamination (purulent or fecaloid peritoneal fluid).



Biostatistical evaluation was done on an IBM-compatible personal computer using SPSS 10.0 software. Student-t test for continuing variables and chi-square test for categorical variables were used. To identify factors independently related to the development of mortality, we also performed backward stepwise (Wald) logistic regression. A *P* value of <0.05 was considered to be statistically significant.

RESULTS

Volvulus of the sigmoid colon was diagnosed in 90 patients. Of 90 patients, 80 (88.9%) were male, 10 (11.1%) were female, Sixty-five (72.2%) had an uneventful postoperative outcome (Group 1), while 25 (27.8%) died postoperatively (Group 2). There was no statistical difference related to gender between both groups (*p*=0.720). The mean age was 58.8±12.9 in group 1, and 63.6±16 in group 2 (*p*<0.001). PSBA was 2.2±0.73 (1-4) days and 5.6±1.7 (2-10) days in group 1 and group 2, respectively (*p*=0.000). While the 73.8 % of patients in the group 1 were operated on an emergency state, all the patients in the group 2 were operated on an emergency state (*p*=0.002). The Length of Stay in Hospital (LSH) was 10.92±4.67 (4-37) days and 5.75±4.29 (1-13) days in group 1 and group 2 respectively (Table 1).

Table 1: Univariate analysis of potential predictors for mortality in patients with SV

Parameters	Group 1 n (%)	Group 2 n (%)	P value
Gender			
Female	8(12.3)	2(8)	=0.720
Male	57(87.7)	23(92)	
Respiratory disease	7(10.8)	18(72)	=0.000
Cardiovascular disease	3(4.6)	25(100)	=0.000
Hypotension	4(6.2)	25(100)	=0.000
Leukocytosis	29(65)	24(96)	=0.000
Fluid-electrolyte imbalance	4(6.2)	25(100)	=0.000
Elevated abdominal pressure	9(13.8)	21(84)	=0.000
Operation time			
Emergency	48(73.8)	25(100)	=0.002
Elective	17(26.2)	0(0)	
Presence of necrosis	30(46.2)	24(96)	=0.000
Major contamination	3(4.6)	21(84)	=0.000
Age†	58.8± 12.9(19-85)	63.6± 16.1(23-83)	<i>p</i> <0.001
PSBA (day)†	2.2±0.73(1-4)	5.6±1.7(2-10)	=0.000

† Data: mean value ± standard deviation (min-max).

Detorsion with tube in 12 patients and operative detorsion in one patient had been performed before admission. Metallic or hyperactive bowel sound was found in 60(66.7%) and 4 (4.4%) patients in the group 1 and group 2 respectively. The rate of fecaloid vomiting was 8.9%) and 26.7% in the group 1 and group 2 respectively. Almost all patients in the both groups had some degree of abdominal distention. Fifty-four (60%) patients had generalized abdominal tenderness. Typical “Omega shaped” image was shown in plain abdominal graph of all patients. In addition, free air was detected in sub-diaphragmatic region of 15 patients (16.7%). The patients were operated on electively or emergently (Table 2). During hospitalisation period; the postoperative complications were wound infection in ten patients, intraabdominal abscess in seven, evisceration and wound dehiscence in five, colostomy leakage in five, enterocutaneous fistula in five, arrhythmia in three, intestinal bleeding (amebiasis) in two, pneumonia in two.

Table 2: Operative procedures

	Group 1 (n)	Group 2 (n)	Total n(%)
<i>Emergency</i>			
Resection+ anastomosis	15	5	20(22.2)
Hartmann's procedure	30	17	47(52.2)
Mesosigmoidoplasty	3	3	6(6.7)
<i>Elective</i>			
Resection+ anastomosis	16	-	16(17.8)
Mesosigmoidoplasty	1	-	1(1.1)

The probable risk factors for mortality were analysed using univariate and multivariable analysis. Age, gender, PSBA, EAP, fluid-electrolyte imbalance, cardiovascular disease, respiratory disease, leukocytosis, hypotension, emergency operation, presence of necrosis, and presence of major contamination were entered into the univariate model. In univariate analysis, age, PSBA, EAP, fluid-electrolyte imbalance, cardiovascular disease, respiratory disease, leukocytosis, hypotension, emergency operation, presence of necrosis, and presence of major contamination were found significantly associated with mortality risk (Table 1).

These variables were entered into the logistic regression model for revealing the independent risk factors for mortality. In

multivariate analysis, long PSBA [Odds Ratio (OR) =17.17, 95% Confidence Interval (CI) =2.86-103.07, P=0.002], presence of cardiovascular disease at admission (OR=0.19, CI=0.001-0.52, P=0.019) and age (OR=0.87, CI=0.77-0.99, P=0.046) were found significantly important for mortality. EAP, fluid-electrolyte imbalance, respiratory disease, and presence of major contamination were not a statistically significant for mortality (Table 3).

Table 3: Predicting factors for mortality of SV

Factors	Pvalue	Odds ratio*	95%confidence interval (Lower-Upper)*
Age	0.046	0.87	0.77-0.99
Delayed admission	0.002	17.17	2.86-103.07
Cardiovascular disease	0.019	0.19	0.001-0.52
Respiratory disease	0.98	0.18	0.00-1.15
Elevated abdominal pressure	0.98	48.76	0.00-1.27
Fluid-electrolyte imbalance	0.91	0.00	0.00-3.96
Major contamination	0.93	0.00	0.00-3.48

*Backward stepwise (Wald) logistic regression.

DISCUSSION

Genetic or congenital factors may be important in predisposing to the development of SV. At necroscopic examination, there is wide variation in the length of the sigmoid loop. Those who possess a sigmoid colon with a long loop and narrow base of mesenteric attachment would be more prone to volvulus. True congenital SV has not been referred, but there are many reports of infants and children who have suffered SV. Many had abnormal bowel habits and several had primary intestinal pathology, such as imperforate anus (9,10) or Hirschsprung's disease (11).

Multiple factors are likely to predispose these groups to SV: advanced age, associated neurological disease with altered intestinal motility, high-fiber diet, medications altering intestinal motility and constipation (12). In the Western hemisphere, there is a high incidence of significant medical diseases in patients who had SV, such as Parkinson's disease (13,14), renal and cardiovascular disorders (7,15) and malignant disease (15).

Volvulus of the sigmoid colon has been reported to occur in all age groups, from neonates (10) to elderly. Most often this condition is observed in adults, but the age at which it is most common also varies geographically. In developing countries, a men age between 40 and 60 years is usually reported (2,3,16-18), whereas in developed countries, the mean age is between 60 and 70 years (15,19-21). In this series, mean age 63.6±16.1(23-83) in the group 2, with fatal outcome. The mean age of group 2 was significantly higher than that of group 1.

There is a marked over-all preponderance of male patients with SV (5). In many series from developing countries, males comprise approximately 90 per cent of reported patients, whereas in other series from developed countries, there is usually a less marked male preponderance or an equal male to female ratio (5,9,18,20,22,23). It was suggested (9) that the more spacious female pelvic area allowed a greater possibility of spontaneous reduction of a beginning volvulus.

The triad of abdominal pain, distension and constipation are the predominant signs and symptoms of SV (19,24). The primary physical finding is tympanic abdominal distension, particularly when compared with the short duration of the symptoms (9). In the absence of gangrene, many have remarked on the good general condition of the patient (15) and the finding of gross abdominal distension in a patient whose general state remains good should alert the clinician to the possibility of SV. The patterns of intestinal sounds are generally nondiagnostic and may be increased or decreased. Clinical features that suggest the presence of gangrene include severe pain, deterioration in the general condition of the patient with tachycardia and hypotension, and marked abdominal tenderness with absent intestinal sounds (19,21). In this study, in the group 1 hyperactive bowel sound was higher, whereas in the group 2 hypoactive bowel sound and fecaloid vomiting were higher. The cause of all of these may be delayed admission.

In volvulus of the sigmoid colon, gas and fluid continue to be forced into the loop and are unable to escape. The loop distends, often



to a remarkable degree, to which bacterial fermentation in the loop may contribute. The twisted segment of intestine forms a closed-loop obstruction. As obstruction persists, fluid and electrolyte loss may lead to significant deficits (9,25). Several authors have remarked on the incidence of hypokalemia at presentation in these patients (26,27). Although rate (100%) of fluid-electrolyte imbalance in the group 2 was significantly higher than that of group 1 (6.2%), fluid-electrolyte imbalance revealed not to be a factor for mortality in our study.

Emergent resection carries a high mortality rate partly because of the poor general condition of the patient and toxemia from necrosis (28). Mortality following emergent surgery for acute SV is higher (36-80%) (1,14,23,29) in the developed than in the developing world (16-33%) (25,30,31). This is probably due to patients in the developed world being elderly and frail with poor cardiovascular reserve (23,29). This makes them less able to withstand the disorder and its surgical treatment than those of the developing world, who, despite debilitation resulting from delayed presentation, are usually relatively young and healthy (30,32,33). Most deaths were the result of coexisting disease, rather than a direct result of the procedure itself or complications related to the procedure (7). The distension may be of such a degree as to embarrass respiration (34). Effects of increased intra-abdominal pressure are renal and respiratory dysfunction. The increased intra-abdominal pressure elevates the diaphragms, increases intra-thoracic pressure, and thereby compresses the lungs. Ventilation can still be achieved but only at the expense of increased airway pressures. As the intra-thoracic pressure continues to rise, the ventilation-perfusion ratio worsens. Other effects of increased intra-abdominal pressure involve a decrease in perfusion of abdominal viscera (35,36). Although factors such as, delayed admission, presence of cardiovascular disease and respiratory disease, EAP and emergent operation were significantly higher in group 2, delayed admission and presence of cardiovascular disease revealed to be the predicting factors for mortality (in the logistic

regression test) in our study. The mean age was 58.8 ± 12.9 (19-85) and 63.6 ± 16.1 (23-83) in the group 1 and group 2 consecutively.

A previous review documented an over-all mortality rate of 19.7 per cent in association with SV, with a 52.8 per cent mortality rate when gangrenous intestine were present and 12.4 per cent when the intestine remained viable (8). When gangrenous intestines are present, resection is mandatory. Gangrene may be patchy and difficult to recognize. In volvulus of the sigmoid colon with gangrene of the loop, resection should be performed without detorsion. Otherwise, endotoxin and bacteria may be released into the general circulation (9). Diaz-Plasencia et al (37) reported that hypotension and presence of purulent or fecaloid peritoneal fluid or evidence of macroscopic bowel perforation were predictive factors for postoperative mortality in the patients with gangrenous SV. In our study, during admission, we determined that presence of hypotension, presence of necrosis and major contamination and leukocytosis were significant factors predictive for the mortality in univariate analysis, but not in the logistic regression test.

The initial management should be by nonoperative decompression. In patients who are otherwise fit, elective resection of the sigmoid colon should be fulfilled after successful deflation with sigmoidoscopic or tube, because of the high risk of recurrence. When gangrene is detected in the intestines at laparotomy, resection is mandatory. If viable intestines are encountered at laparotomy, the operative strategy is highly controversial. Primary resection and anastomosis can be performed or these procedures can be postponed and simple detorsion can be performed. One wonders if there is a place for attempts to "fix" the sigmoid colon and, thus, avoid recurrence without the hazards of resection. The roles of newer techniques, such as colonoscopy and colonic intraoperative antegrade irrigation (on-table lavage) in the management of SV have been referred (9). We preferred Hartmann's procedure (52.2%) in majority of patients due to the poor general condition of elderly and presence necrosis (60%).



We determined that conditions, such as a long period of symptoms before admission, presence of cardiovascular disease at the admission and age were predicting factors for mortality. The conditions, such as early admission, aggressive preoperative resuscitation, appropriate antibiotherapy and surgery and postoperative metabolic support help minimize morbidity and mortality rates.

REFERENCES

1. Baker DM, Wardrop PJC, Burell H, Hardcastle JD. The management of acute sigmoid volvulus in Nottingham. *J R Coll Surg Edinb* 1994; 39: 304-6.
2. Sinha RS. A clinical appraisal of volvulus of the pelvic colon with special reference to aetiology and treatment. *Br J Surg*, 1969; 56:838-40.
3. Mishra SB, Sahoo KP: Primary resection and anastomosis for volvulus of sigmoid colon. *J Indian Med Assoc*, 1986; 84:265-8.
4. Wilson H, Dunavant WD: Volvulus of the sigmoid colon. *Surg Clin North Am* 1965; 45:1245-51.
5. Ballantyne GH Review of sigmoid volvulus. Clinical patterns and pathogenesis. *Dis Colon Rectum* 1982 ; 25:823-30.
6. Friedman JD, Odland MD, Bubrick MP: Experience with colonic volvulus. *Dis Colon Rectum* 1989 ; 32:409-16.
7. Mangiante EC, Croce MA, Fabian TC, Moore OF, Britt LG: Sigmoid volvulus. A four-decade experience. *Am Surg* 1989; 55:41-4.
8. Ballantyne GH: Review of sigmoid volvulus: history and results of treatment. *Dis Colon Rectum* 1982 ; 25:494-501.
9. Gibney EJ: Volvulus of the sigmoid colon. *Surg Gynecol Obstet*, 1991; 173:243-55.
10. Janik JS, Humphrey R, Nagaraj HS: Sigmoid volvulus in a neonate with imperforate anus. *J Pediatr Surg*, 1983; 18:636-8.
11. Venugopal KS, Wilcox DT, Bruce J: Hirschsprung's disease presenting as sigmoid volvulus in a newborn. *Eur J Pediatr Surg*, 1997; 7:172-3.
12. Avots-Avotins KV, Waugh DE: Colon volvulus and the geriatric patient. *Surg Clin North Am*, 1982; 62:249-60.
13. Rosenthal MJ, Marshall CE: Sigmoid volvulus in association with parkinsonism. Report of four cases. *J Am Geriatr Soc*, 1987; 35:683-4.
14. Bak MP, Boley SJ: Sigmoid volvulus in elderly patients. *Am J Surg*, 1986; 151:71-5.
15. Siroospour D, Berardi RS: Volvulus of the sigmoid colon: a ten-year study. *Dis Colon Rectum*, 1976, 19:535-41.
16. Arigbabu AO, Badejo OA, Akinola DO: Colonoscopy in the emergency treatment of colonic volvulus in Nigeria. *Dis Colon Rectum* 1985; 28:795-8.
17. Gibney EJ: Sigmoid volvulus in rural Ghana. *Br J Surg* 1989; 76:737.
18. Osime U: Volvulus of the sigmoid colon. *J R Coll Surg Edinb* 1980; 25:32-7.
19. Anderson JR, Lee D: The management of acute sigmoid volvulus. *Br J Surg* 1981; 68:117-20.
20. Ryan P: Sigmoid volvulus with and without megacolon. *Dis Colon Rectum* 1982; 25:673-9.
21. Khoury GA, Pickard R, Knight M: Volvulus of the sigmoid colon. *Br J Surg* 1977; 64:587-9.
22. Pahlman L, Enblad P, Rudberg C, Krog M: Volvulus of the colon. A review of 93 cases and current aspects of treatment. *Acta Chir Scand* 1989; 155:53-6.
23. Welch GH, Anderson JR: Acute volvulus of the sigmoid colon. *World J Surg* 1987; 11:258-62.
24. Arnold GJ, Nance FC: Volvulus of the sigmoid colon. *Ann Surg* 1973; 177:527-37.
25. Taha SE, Suleiman SI: Volvulus of the sigmoid colon in the Gezira. *Br J Surg*, 1980; 67:433-5.
26. Ballantyne GH: Sigmoid volvulus: high mortality in county hospital patients. *Dis Colon Rectum* 1981, 24:515-20.
27. Forward AD: Hypokalemia associated with sigmoid volvulus. *Surg Gynecol Obstet*, 1966; 123:35-42.
28. Madiba TE, Thomson SR: The management of sigmoid volvulus. *J R Coll Surg Edinb*, 2000; 45:74-80.
29. Theuer C, Cheadle WG. Volvulus of the colon. *Am Surg*, 1991; 57:145-50.



30. Sroujeh AS, Farah GR, Jabaiti SK, el-Muhtaseb HH, Qudah MS, Abu-Khalaf MM: Volvulus of the sigmoid colon in Jordan. *Dis Colon Rectum*, 1992; 35:64-8.
31. Udezue NO: Sigmoid volvulus in Kaduna, Nigeria. *Dis Colon Rectum*, 1990; 33:647-9.
32. Tiwary RN, Prasad S: Mesocoloplasty for sigmoid volvulus: a preliminary report. *Br J Surg*, 1976; 63:961-2.
33. Khanna AK, Misra MK, Kumar K: Extraperitonealization for sigmoid volvulus: a reappraisal. *Aust N Z J Surg*, 1995; 65:496-8.
34. Schagen van Leeuwen JH: Sigmoid volvulus in a West African population. *Dis Colon Rectum*, 1985; 28:712-6.
35. Diebel LN, Dulchavsky SA, Brown WJ: Splanchnic ischemia and bacterial translocation in the abdominal compartment syndrome. *J Trauma* 1997, 43:852-5.
36. Richardson JD, Trinkle JK: Hemodynamic and respiratory alterations with increased intra-abdominal pressure. *J Surg Res* 1976; 20:401-4.
37. Diaz-Plasencia J, Rebaza-Iparraguirre H. An index of the severity of intestinal gangrene due to colonic volvulus. *Rev Gastroenterol Peru* 1993; 3:96-104.

