

# Volvulus of the Small Intestine in Adults: A Study of Predisposing Factors

K. VAEZ-ZADEH,\* M.D., W. DUTZ,\*\* M.D., M. NOWROOZ-ZADEH,\*\*\* M.D.

*From the Departments of Surgery and Pathology, Pahlavi University Medical School,  
Shiraz, Iran*

VOLVULUS of the small intestine is rarely encountered in western Europe and the U. S. A., while it is frequently seen in parts of Africa, India and Iran. Much confusion persists regarding classification of the disease. We prefer to recognize three groups of volvulus: 1) Volvulus Neonatorum, due to malrotation of the bowel and defective fixation of the mesentery, 2) Primary Volvulus of the Small Bowel, without any obvious anatomical cause, 3) Secondary Volvulus of the Small Bowel, where the rotation is caused by abnormal fixation due to acquired or congenital lesions such as adhesions, tumors, Meckel's diverticulum, duplications, etc.

No generally accepted explanation for the development of primary volvulus has been offered. The purpose of this study is to review possible etiological factors and describe our experience with primary volvulus in Iran as compared with other parts of the world.

## Materials and Methods

All records of patients with bowel obstruction and volvulus seen at Saadi Hospital, Shiraz, between October 1962 and

October 1967 were reviewed. The incidence is compared with that from other countries.

Symptoms and signs of all cases of volvulus were noted and the dietary history taken. Careful measurements of mesenteric and bowel lengths were made during operation, if the condition of the patient permitted. The topographic anatomy of the bowel in a hundred unselected adult autopsy cases was studied and measurements of the same parameters as in the volvulus cases were taken (Fig. 1).

## Results

### Incidence

The incidence in different areas of the world, as collected from large series, is summarized in Table 1. An analysis of the data shows that the incidence is least in the U. S. A. and western Europe and gradually increases towards the East. It varies in different regions of Africa. The frequency in the West was much greater in the 19th and the first decades of the 20th century and fewer instances have been seen since then. In our series the incidence of volvulus of the small bowel is 19.6% of all bowel obstructions, while in the U. S. A. the percentage has fallen from 6.9% in 1930 to 3.3% in 1958 in the same institution,<sup>47, 53</sup>

Our cases of bowel obstruction are summarized in Table 2. Primary volvulus is a disease of adult men. Thirty-two of our cases were men and only one was a woman. This is also true of other series in which a sex incidence is given.<sup>1, 45, 52</sup> The anatomi-

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\* Assistant Professor, Department of Surgery, Pahlavi University Medical School, Saadi Hospital, Shiraz, Iran.

\*\* Professor and Chairman, Department of Pathology, Pahlavi University Medical School, Shiraz, Iran.

\*\*\* Instructor, Department of Surgery, Pahlavi University Medical School, Shiraz, Iran.

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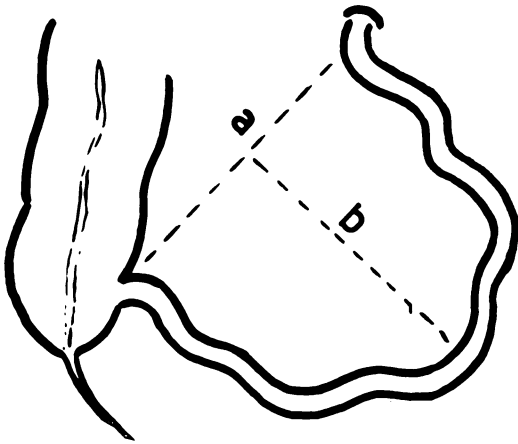


FIG. 1. Measurement of mesentery:  
a-Root; b-Breadth.

cal causes in eight cases of secondary volvulus are summarized in Table 3. Of the eight secondary small bowel volvuli five were in men. The age distribution is summarized in Table 4.

Our patients were mainly villagers and those few who lived in town had recently migrated from villages and maintained the rural pattern of life.

#### Etiological Factors

The causes of primary volvulus of the small bowel and the mechanism of rotation of the entire root of the mesentery have not been explained. Several anatomical and dietary factors have been implicated.

All authors agree that an unusual mobility of the bowel must be present before total rotation may occur in the absence of adhesions or secondary fixation of intestinal loops. Laxity of the abdominal wall, absence of mesenteric fat, physical exercise, abdominal trauma, constipation or diarrhea and pregnancy have all been mentioned. It has been suggested that an unusual length of the bowel, inherited or acquired, might also lead to easy rotation.<sup>22</sup> Comparative anatomy shows that bowel size and length are related to the cellulose content of the food of different animal species. The meat-eating animals have much shorter bowels than the grass and wood

digesting animals.<sup>42</sup> The bowel length/body size ratio for man takes an intermediary position. It is thought, that among people who have maintained a vegetable-cereal diet through generations, the average bowel length considerably exceeds that in the wealthier meat-eating population. Koenig<sup>22</sup> considered volvulus a Russian disease. He attributed its high frequency in Russia of the turn of the century to the supposedly longer length of the bowel in Russians (26 ft.) versus Germans (19 ft.).

Undue breadth or narrowness of the base of the mesentery might equally favor rotation.<sup>12</sup> No measurements in support of these statements have been provided to our knowledge.

#### Anatomical Factors

All our patients were well-developed and muscular. There was no appreciable excessive subcutaneous, mesenteric or retroperitoneal fat. The abdominal wall muscles were described as strong in the operative notes. Only two patients had abdominal wall relaxations.

No obvious anatomical malformations of the root of the mesentery were detected. Some subjects with prolonged torsion showed occasional fibrous thickening of the base of the mesentery, considered by some authors as "mesenteritis."<sup>4</sup>

The measurements (Fig. 1) of the mesenteric root and breadth and the length of the small bowel are summarized in Table 5. We are aware that the *in vivo* and postmortem measurements may vary. Autopsies were made from 1-24 hours after death, and did not show any decomposition. The mesenteric root fixed to the posterior abdominal wall is not affected by postmortem relaxation. In our opinion, a comparison of antemortem and postmortem measurements is permissible in this diameter. Table 5 shows that the six patients with volvulus have, on average, a narrower mesenteric insertion than the general popula-

TABLE 1. *The Reported Incidence of Volvulus of the Small Bowel*

Author	Country	Year	Total Obstruction	Total Small Bowel Volvulus	Percentage of Small Bowel Volvulus	Primary Small Bowel Volvulus	Percentage of Primary Small Bowel Volvulus
1. Agarwal <i>et al.</i> <sup>1</sup>	Agra, India	1966	45	9	20	—	—
2. Braun <i>et al.</i> <sup>4</sup>	Berlin, Germany	1924	750	56	7.45	29	3.8
3. Brooks <i>et al.</i> <sup>5</sup>	Kingston, Jamaica		250	1	0.004	—	—
4. Gibson <sup>14</sup>	New York, U. S. A.	1900	1,000	36	3.6	—	—
5. Hall-Craggs <sup>16</sup>	Mulago, Kampala	1960	1,230	21	1.7	—	—
6. Kerr <i>et al.</i> <sup>19</sup>	Nairobi, Kenya	1946	21	7	33	—	—
7. McKechnie <i>et al.</i> <sup>25</sup>	Mayoclinic, U. S. A.	1936	—	34	—	3	—
8. Nemir <sup>27</sup>	Penn., U. S. A.	1952	430	12	2.79	—	—
9. Obalinski <sup>20</sup>	Russia	1894	110	19	17.2	—	—
10. Perquis <i>et al.</i> <sup>34</sup>	Brazaville, Congo	1965	58	4	6.8	—	—
11. Ripstein <i>et al.</i> <sup>36</sup>	Montreal, Canada	1950	712	23	3.2	—	—
12. Sankaran <sup>39</sup>	India	1962	225	24	16.6	—	—
13. Smith <i>et al.</i> <sup>43</sup>	Min., U. S. A.	1955	1,252	9	0.7	—	—
14. Spasokukozki <sup>44</sup>	Smolensk, Russia	1909	96	28	29.0	28	29
15. Sundell <sup>46</sup>	Helsinki, Finland	1958	640	10	1.5	—	—
16. Sweet <sup>47</sup>	Boston, U. S. A.	1930	520	36	6.9	—	—
17. Vick <sup>49</sup>	London, England	1932	6,892	85	1.2	—	—
18. Waldron <i>et al.</i> <sup>50</sup>	Texas, U. S. A.	1956	493	27	5.4	—	—
19. Wangenstein <sup>51</sup>	Minn., U. S. A.	1953	1,252	64	5.0	42	3.5
20. Welch, C. <sup>53</sup>	Boston, U. S. A.	1958	—	—	3.3	—	1.6
21. Our series	Shiraz, Iran	1967	205	41	19.6	33	16.0

tion of Iran and of Europeans of some 50 years ago as reported in Gray's Anatomy.<sup>15</sup> The breadth of the mesentery is not very

susceptible to postmortem changes. The finding of a longer mesentery in the volvulus subjects is therefore significant. The

TABLE 2. *Two Hundred and Nine Cases of Bowel Obstruction in Shiraz, October 1962 to October 1967*

	No.	%
Small bowel volvulus	41	19.6
Primary	33	
Secondary	8	
Large bowel volvulus	35	16.7
Strangulated hernia	87	41.6
Obstruction due to adhesion	31	14.8
Intussusception	8	3.8
Obstruction due to malignancy	6	2.8
Obstruction due to ascaris	1	0.5
Total obstructions	209	100

TABLE 3. *Anatomical Causes of 8 Cases of Secondary Small Bowel Volvulus*

	Number
Postoperative adhesions	6
Meckel's diverticulum	1
Appendicitis	1
Total	8

greater length of the bowel at autopsy indicates possible postmortem relaxation as compared with the six volvulus subjects. We realize that many more comparative measurements of this type are needed to prove or disprove satisfactorily the question raised.

### Diet and Related Factors

The importance of a high residue diet in the development of small bowel volvulus has been stressed for Indians and Africans.<sup>16, 37</sup> Kallio<sup>8</sup> thinks that the reason for a lower incidence of volvulus amongst Finns in Minnesota than in their own country is the less voluminous and more nutritious food. The meteorism caused by cellulose-rich foods associated with congenital anomalies resulted supposedly in knotting of the gut. Sweet<sup>47</sup> also implicated meteorism. Wangenstein,<sup>51</sup> on the contrary, found no dietary deficiencies in his patients.

TABLE 4. *Age Distribution in 41 Cases of Primary and Secondary Small Bowel Volvulus*

Decades	Primary	Secondary
Mean age	43 years	38.6 years
2nd	3	1
3rd	12	5
4th	7	1
5th	5	1
6th	4	0
7th	2	0

Spasokukozki<sup>44</sup> described a detailed mechanism with particular emphasis on the strong pressure exerted by energetic peristaltic waves in the direction of least resistance: When voluminous masses of poorly digestible food are taken, the first few jejunal loops become distended and heavy, and encountering no resistance from the empty lower small intestine, fall into the pelvis. The empty loops of the lower jejunum and ileum are pushed upwards in a clockwise direction causing a torsion of 180°. When the stomach is emptied, the bowel is then pushed further towards the left upper quadrant, while the bolus is carried forward filling up the distal loops. These becoming heavy fall down leading to a complete clockwise rotation of the mesentery.

Spasokukozki's<sup>44</sup> theory is captivating. The mechanism outlined requires strong peristalsis, tense, firm abdominal muscles, physical activity in upright position and a feeding pattern of very bulky meals taken at long intervals. His cases occurred most frequently during the short Russian summer, amongst the peasants working in the fields.

In our experience, the disease was encountered almost exclusively in middle-aged farmers (Table 4). There were several important features:

1) Not one obese patient was noted. The absence of excessive fat padding of the mesentery, omentum and retro-peritoneum permits increased bowel mobility.

TABLE 5. Results of Measurements of Small Bowel and its Mesentery in Centimeter

	Volvulus (6 cases)			Autopsies (100 cases)			Gray's Anatomy
	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
Root of mesentery	13.4	20	9	14.8	33	4	15
Breadth of mesentery	22	28	14	18.7	25	8	20
Length of jejunum and ileum	499	710	360	622	1300	350	600

2) The general diet of the region per head and per day is as follows<sup>40, 41</sup>: 2,526 calories, 75.6% from legumes and cereals, 2.9% by meat. Cereals provide 85% of total protein intake and animal food 12%. Average daily total consumption of cereals and bread 681 Gm. and meat 6.1 Gm. No obvious malnutrition was seen. Our patients eat only two meals daily. The bowel is practically always empty and contracted except at times of bulky meals. The poorly digestible food produces two to three solid bowel movements daily. Very active peristalsis is mandatory to keep the heavy bolus moving.

3) Thirty-nine of 41 patients showed strong abdominal muscles. This is in contrast to patients with sigmoid volvulus.

4) All our patients were farmers. Volvulus occurred during or immediately after prolonged heavy exercise such as ditch digging or shovelling, necessitating exertion of the abdominal press. The seasonal incidence is shown in Table 6. Twelve cases (29%) were seen during June and July, when irrigation and harvesting are most urgent.

5) Women were very rarely involved. Their abdominal walls are lax due to frequent child-bearing. They work in the house and on the fields in a crouching position harvesting vegetables and do not perform the heavy work of men. They are on average more obese than men.

**Other Factors**

Harer<sup>17</sup> mentions that volvulus is the most common cause of intestinal obstruc-

TABLE 6. Seasonal Incidence in 41 Cases of Small Bowel Volvulus

Season	No.	Percentage
Spring	7	17
Summer	15	36.5
Autumn	11	26.8
Winter	8	19.5
Total	41	100

tion in pregnancy. Only 32 cases were reported in the U. S. A. until 1962, 72% in the sigmoid colon. Small bowel volvulus was usually due to adhesions or other secondary causes. We have seen no cases of primary volvulus in pregnancy.

Physical violence to the abdomen is in our experience not a cause of primary volvulus.

Purgation and habitual constipation were no factors in our series. Foreign bodies, gallstones, and mesenteric cysts were not found.

Ascaris and other parasitic infestations are frequent in southern Iran.<sup>21</sup> Our patients had less than average infestation and no knotting or ascaris ball formation was noted.

**Discussion**

Wilms<sup>4, 54</sup> thought that during fasting or food intake rotation of the root of the mesentery to 180° occurs regularly. He stressed that under the active influence of peristalsis this physiological twist may turn into a volvulus. To support this thesis he passed a loop of dog's intestine through a ring. He then injected fluid into the proximal loop.

As the pressure in the loop increased, more and more of the bowel was pulled inside the ring and twisted. This experiment was repeated by Braun and Wortmann.<sup>4</sup> They could not produce any rotation.

The dietary theory, as described by Spasokukozki,<sup>45</sup> is supported by two findings: Obstruction can raise the intraluminal pressure from 2–4 cm. to 70 cm. H<sub>2</sub>O.<sup>32</sup> Food intake<sup>24</sup> as well as raised intraluminal pressure<sup>32</sup> stimulate peristaltic activity. We believe that primary volvulus is caused by a combination of factors: hypermobility, hypermotility and rapid sudden filling of an empty bowel with large quantities of poorly digestible food favor rotation.

Bulky food is ingested on an empty bowel. The solid bolus is moved rapidly on. The heavy loops sink into the pelvis, displace the empty distal bowel upwards, and pull on the duodeno-jejunal flexure, stretching the mesentery into a more transverse position. This pull and rotation narrows the luminal passage and increases pressure and peristalsis. Tense abdominal muscles permit movement in only one diameter. The bolus reaches the left upper quadrant and rotation is completed when powerful peristalsis, aided by sudden strong diaphragmatic contraction pushes the now filled distal bowel into the pelvis.

The age incidence, dietary habits, seasonal incidence, professional preference and frequency of clockwise rotation in our series (80%) are in keeping with the above theory. The increased mesenteric length as indicated in our measurements could be a supportive factor. More detailed research on the latter point is necessary to reach a firm conclusion.

### Summary

Forty-one cases of small bowel volvulus are reported, accounting for 19.6% of all obstructions in Shiraz, Iran.

Primary small bowel volvulus is a disease of male farmers in the active age

group. It is initiated by bulky, poorly digestible meals taken at long intervals and favored by hypermotility of the gut and hypermobility of the mesentery.

Evidence in support of this theory is presented.

### References

1. Agarwal, S. L. and Singh, R. P.: A Review of Intestinal Obstruction. *Internat. Surg.*, **46**: 113, 1966.
2. Berard, M. L. and Delore, M. X.: De l'occlusion intestinale par torsion du mesentere, volvulus de l'intestin grele. *Ass. Franc. Chir. Proc-verb.*, **13**:410, 1899.
3. Brannen, Ed.: Four Cases of Volvulus of Small Bowel Complicating Early Pregnancy. *Amer. J. Obstet. Gynec.*, **84**:854, 1962.
4. Braun, W. and Wortmann, W.: *Der Darmverschluss und die sonstigen Wegstörungen des Darmes*. Berlin, J. Springer, 1924.
5. Brooks, V. E. H. and Butler, A.: Acute Intestinal Obstruction in Jamaica. *Surg. Gynec. Obstet.*, **122**:261, 1966.
6. Bull, P.: Volvulus de la totalite de l'intestin grele. *Bull. et Mem. Soc. Chir. Par.*, **33**:1111, 1907.
7. Burgess, A. H.: Volvulus of the Small Intestine. *Lancet*, **2**:1690, 1902.
8. Clarence, D.: Current Procedure in Management of Obstruction of Small Intestine. *JAMA*, **54**:463, 1954.
9. Corneliac, M. E.: Occlusions intestinales complexes par volvulus de l'intestin grele avec incarceration du sigmoide. *Mem. Acad. Chir.*, **92**:472, 1966.
10. Delbet, P.: Occlusion intestinale par torsion de la totalite de l'intestin grele et de son mesentere. *Bull. et Mem. Sos. Chir. Par.*, **33**:578, 1907.
11. Dennis, C. and Manor, P.: Current Procedure in Management of Obstruction of Small Intestine. *JAMA*, **54**:463, 1954.
12. Dott, N. M.: Anomalies of Intestinal Rotation. *Brit. J. Surg.*, **11**:251, 1923.
13. Dott, N. M.: Volvulus Neonatorum. *Brit. Med. J.*, **1**:230, 1927.
14. Gibson, C. L.: A Study of One Thousand Operations for Acute Intestinal Obstruction and Gangrenous Hernia. *Ann. Surg.*, **32**:486, 1900.
15. Gray, H.: *Gray's Anatomy, Descriptive and Applied*. London, Longmans Green and Co., Ltd., p. 1173, 1926.
16. Hall-Craggs, E. C. B.: Sigmoid Volvulus in an African Population. *Brit. Med. J.*, **1**:1015, 1960.
17. Harer, W. B., Jr. and Harer, W. B., Sr.: Volvulus Complicating Pregnancy and Puerperium. *Obstet. Gynec.*, **12**:399, 1958.
18. Kallio, K. E.: Die Knotenbildungen des Darmes. *Acta. Chir. Scandin.*, **700**:276 (suppl. 21), 1932.
19. Kerr, W. G. and Kirkaldy-Willis, W. H.: Volvulus of the Small Intestine. *Brit. Med. J.*, **1**:799, 1946.

20. Kohn, S. G., Briele, H. A. and Douglass, L. H.: Volvulus Complicating Pregnancy. *Amer. J. Obstet. Gynec.*, **48**:398, 1944.
21. Kohout, E., Dutz, W. and Petrossian, A.: Laboratory Findings in Iranian Villages and Tribal Communities. *Amer. J. Clin. Nut.*, **20**:410, 1967.
22. Koenig, F.: *Lehrbuch der speciellen Chirurgie fur Aerzte und Studierende*. A. Hirschwald, Berlin, 1904.
23. Lo, A. M., Evans, W. E. and Carey, L. C.: Review of Small Bowel Obstruction at Milwaukee County General Hospital. *Amer. J. Surg.*, **111**:884, 1966.
24. Mann, F. C.: Experimental Studies on Motor Mechanism of Intestine. *Tr. West. S. A.*, **50**:475, 1941.
25. McKechnie, K. E. and Priestley, J. T.: Volvulus of Small Intestine. *Amer. J. Surg.*, **34**:286, 1936.
26. Moretz, W. H. and Morton, J. J.: Acute Volvulus of Small Intestine: Analysis of 36 Cases. *Ann. Surg.*, **132**:899, 1950.
27. Nemir, P., Jr.: Ten-year Statistical Survey at the Hospital of the University of Pennsylvania. *Ann. Surg.*, **135**:367, 1952.
28. Nissen, R. and Maurer, W.: Zur Pathophysiologie und Chirurgie des Ileus. *Zbl. Chir.*, **90**:1533, 1965.
29. North, J. P.: Acute Intestinal Obstruction. *Internat. Clin.*, **3**:206, 1929.
30. Obalinski, A.: Ueber Laparotomie bei innerem Darmverschluss auf Grund eigener 110 Falle. *Arch. Klin. Chir.*, **48**:1, 1894. (Quoted by Wangenstein.)
31. Ostrum, B. J. and Heinz, E. R.: Small Bowel Obstruction—versus Adynamic Ileus. *Amer. J. Roentgen.*, **89**:734, 1963.
32. Owings, J. C., McIntosh, C. A., Stone, H. B. and Weinberg, J. A.: Intraintestinal Pressure in Obstruction. *Arch. Surg.*, **17**:507, 1928. (Quoted by Wangenstein.)
33. Paterson, H. J.: Acute Intestinal Obstruction. *Brit. Med. J.*, **2**:546, 1932.
34. Perquis, P., Montbarbon, J. P., Douzou, J., Romani, J. and Bruneau, H.: Occlusion chez le noir africain. *Med. Trop. (Marseille)*, **25**:749, 1965.
35. Renton, C. J. C.: Primary Volvulus of Small Intestine. *Brit. Med. J.*, **2**:743, 1965.
36. Ripstein, C. B. and Miller, G. G.: Volvulus of the Small Intestine. *Surgery*, **27**:506, 1950.
37. Roles, H. C.: Volvulus of the Intestine during Pregnancy. *E. Afr. Med. J.*, **42**:7, 1965.
38. Rowlands, R. P.: Volvulus of the Intestine. *Brit. Med. J.*, **1**:287, 1929.
39. Sankaran, V.: Volvulus in South India. *Ind. J. Surg.*, **24**:748, 1962.
40. Sen Gupta, P. N. and Hedayat, H.: Report on the Household Food Consumption and Nutrition Survey in Fars. Part II, F.A.O. United Nations. Food and Nutrition Institute, Tehran, 1965.
41. Sen Gupta, P. N. and Hedayat, H.: Report on the Food Consumption and Nutrition Survey and Other Investigations in the Gashgai Tribe of Fars Province. F.A.O. of the United Nations. Food and Nutrition Institute, Tehran, 1966.
42. Sisson, S.: *Anatomy of the Domestic Animals*, p. 482, 4th Ed. W. B. Saunders & Co., Philadelphia, 1953.
43. Smith, G. A., Perry, J. F., Jr. and Yonehira, E. G.: Mechanical Intestinal Obstruction: A Study of 1252 Cases. *Surg. Gynec. Obstet.*, **100**:651, 1955.
44. Spasokukozki, S.: Volvulus intestinorum als Krankheit des hungernden Menschen. *Arch. Klin. Chir.*, **91**:211, 1909.
45. Svane, S.: Volvulus of the Entire Small Intestine in Adults. *Acta. Chir. Scandin.*, **129**:647, 1965.
46. Sundell, B.: Volvulus of the Intestinal Loop. *Ann. Chir. Gynaec. Fenn.*, **50**:388, 1961.
47. Sweet, R. H.: Volvulus of the Coecum. *New Eng. J. Med.*, **213**:287, 1935.
48. Tagart, R. E. B.: Volvulus of Small Intestine; The Position of Relief. *Lancet*, **1**:71, 1950.
49. Vick, R. M.: Statistics of Acute Intestinal Obstruction. *Brit. Med. J.*, **2**:546, 1932.
50. Waldron, G. W. and Hampton, J. M.: Intestinal Obstruction: A Half Century Comparative Analysis. *Ann. Surg.*, **153**:839, 1961.
51. Wangenstein, O. H.: *Intestinal Obstructions*. 3rd Ed. Springfield, Illinois, Charles C Thomas Publishers, 1955, p. 659.
52. Weible, R. E.: Volvulus; Torsion of the Whole Mesentery. *Surg. Gynec. Obstet.*, **19**:644, 1914.
53. Welch, C. E.: *Intestinal Obstruction*. Chicago, The Year Book Publishers Inc., 1958, p. 14.
54. Wilms, M.: *Der Ileus*. Pathologie und Klinik des Darmverschlusses. Stuttgart, Deutsche Chirurgie. F. Enke., Lieferung 46, 1906. (Quoted by Braun & Wortmann.)
55. Wilson, R.: Volvulus of the Coecum. *Canad. J. Surg.*, **8**:363, 1965.