Intestinal Obstruction Caused by Adhesions

A Review of 388 Cases*

John F. Perry, Jr., M.D., Grafton A. Smith, M.D., and Earl G. Yonehiro, M.D.,

Minneapolis, Minn.

ADHESIONS HAVE PROBABLY replaced external hernia as the most common cause of intestinal obstruction. Souttar (1925)[13] and Vick (1932),[15] for example, when reviewing the combined statistics from British Hospitals, found external hernia responsible for 46 and 47.9 per cent of obstructions, respectively, while adhesions accounted for only 11.1 and 7.3 per cent. In this country, in 1932, McIver[11] found external hernia the most frequent cause of bowel obstructions (44 per cent), and adhesions the basis of occlusion less frequently (30 per cent). However, recent reports list adhesions as the prime cause of intestinal obstruction, and our experience had confirmed this. Probably responsible for this change is the ever increasing number of abdominal operations that are being done, and possibly the fact that more external hernias are repaired while still in a relatively early stage.

In a survey of intestinal obstruction at the University of Minnesota Hospitals for the period between January 1, 1942, and September 1, 1953, 388 of the total of 1252 cases, or 31 per cent of obstructions, were found to be caused by postoperative adhesions, or by adhesions of an inflammatory or congenital nature. External hernia was responsible for only 10.2 per cent.

Our purpose in this paper is to present a review of our experience in management of these obstructions caused by adhesions, and to discuss this problem briefly. All cases of adhesive obstruction are included, whether intestinal obstruction was the illness that necessitated hospital admission or whether it developed secondarily in the course of another disease.

The diagnosis was confirmed by operation or autopsy in 274 cases (70.6 per cent). In 114 cases (29.4 per cent), treated by conservative decompression, it was the clinical impression at the time plus a current review of available records and roentgenograms that established the diagnosis.

Etiology. Obstructions were caused by adhesions of three types: postoperative adhesions, inflammatory adhesions (without antecedent surgery), and congenital bands. Most frequent were occlusions due to postoperative adhesions; 79.4 per cent of the cases were of this type. Operations on the large bowel, appendectomies, and operations for intestinal obstruction were the most common preceding surgical procedures. Inflammatory adhesions were responsible for 17.8 per cent of obstructions. Here, appendicitis and diverticulitis were the most often encountered inflammatory diseases, as they initiated the adhesive process in 42 and 14.5 per cent of these cases, respectively. Less common causes, in the order of importance, were pelvic inflammatory disease, regional enteritis, cholecystitis, and ulcerative colitis. Congenital bands accounted for only 2.8 per cent of all adhesive obstructions.

Intraperitoneal abscesses were associated lesions in these obstructions, and deserve mention. Such abscesses accompanied or initiated the adhesive process that caused obstruction in 17.8 per cent of all cases. As would be expected, intraperitoneal infection of this character was present most commonly in those patients with adhesive obstructions caused by inflammatory diseases. Forty

---

seven and eight tenths per cent of these had abscesses. Thirteen per cent of postoperative obstructions were likewise associated with abscesses in the peritoneal cavity. Thus, intraperitoneal infection was a significant consideration in the formation of adhesions that led to obstruction.

Strangulation obstruction was a second concern, occurring in 11.8 per cent of all cases. It was common among those obstructions caused by congenital bands, 45.9 per cent were strangulation obstructions. It occurred less often in postoperative obstructions (12 per cent), and strangulation was rare when obstruction was caused by inflammatory adhesions (2.9 per cent).

Location. The small bowel is considerably more susceptible to obstruction by adhesions than is the colon, as is evident from the distribution of cases. The majority, 88.4 per cent, were small bowel obstructions. Only 8.0 per cent were colic occlusions, and 3.6 per cent of cases were of the mixed variety, with obstruction simultaneously of both colon and small bowel.

The type of adhesions causing obstruction also influenced the location of the obstruction. Thus, large bowel and mixed obstructions were common in the groups due to inflammatory adhesions (30.5 per cent) or congenital bands (22.3 per cent) but were uncommon (6.8 per cent) in the group of obstructions caused by postoperative adhesions.

Age Distribution. The average age of patients was 45.9 years, and 68.6 per cent were 60 years of age or younger. That patients in extremes of life were not exempt is evident, for 14 patients were less than one year old, and eight were over 80 years old.

Mortality Rates. There were 37 deaths, or an overall case fatality rate of 9.5 per cent. Twelve patients who died had developed obstruction as a complication of another illness for which the patient had been hospitalized. In each the bout of obstruction was survived, but the patient succumbed to his

TABLE I. *Types of Adhesions Causing Obstructions.*

Obstructing Mechanism	Total Cases	Simple Adhesions	Adhesions with Abscess or Localized Inflammatory Perforation	Adhesions with Strangulation
Postoperative adhesions....	308	231	40	37
Inflammatory adhesions....	69	34	33	2
Congenital bands	11	6	0	5
Total.........	388	271	73	44

original disease. Three additional patients were moribund on arrival and they died within six hours after admission. This leaves 22 deaths for which intestinal obstruction or the treatment thereof was responsible. If just these 22 deaths are considered, then the mortality rate falls to 5.9 per cent.

As would be expected, the occurrence of abscesses in the peritoneal cavity in the presence of intestinal obstruction increased the risk for the patient. Whereas simple obstruction was treated 263 times with a mortality rate of 3.8 per cent, among 69 patients with obstruction complicated by intraperitoneal abscesses, 7.3 per cent of the group succumbed.

Strangulation obstruction was attended by a mortality rate of 17.1 per cent in 41 cases. Gangrene adversely influenced survival even more as 36.8 per cent of the 19 patients with non-viable bowel succumbed. In fact, all the deaths in the group with strangulation obstruction were among those patients with gangrene.

Very young and very old patients tolerate obstruction poorly, as had been shown by others.[4, 6] In this group of cases, two of the 12 patients under one year of age died (16.7 per cent), and 14 of the 22 deaths due to obstruction occurred in the group of 109 patients 61 to 80 years of age, a mortality rate of 12.8 per cent. Eight patients over age 80 were treated without fataliy, but the group is too small to permit any conclusions.

TABLE II. *Death Due to Adhesive Obstruction by Age.*

Age Group	Number of Cases	Deaths	Mortality Percent
0– 1 yr..............	12	2	16.7%
1–20 yr.............	52	2	3.8%
21–40 yr............	73	2	2.7%
41–60 yr............	119	2	1.7%
61–80 yr............	109	14	12.8%
Over 80............	8	0	0
Total..............	373*	22	5.9%

* Three patients moribund on arrival and 12 patients dying of diseases other than obstruction are excluded.

TABLE III. *Deaths and Duration of Obstruction Prior to Institution of Treatment.*
(291 Cases)

Duration	Cases	Deaths Number	Mortality Percent
12 hours or less........	24	0	0.0%
12–24 hours............	44	2	4.5%
24–48 hours............	40	3	7.5%
48 hours to one week. ..	98	9	9.2%
Over one week..........	85	8	9.4%
Total..................	291	22	7.5%

Distension of the intestine and the train of events which is initiated thereby has been shown experimentally to be an important cause of death in simple intestinal obstruction. Reduced venous pressure and reduced venous outflow in the mesenteric veins follow distension, and finally, sustained intraluminal pressures lead to loss of viability in areas of the intestine and an increased permeability of the bowel wall. This permeation of the bowel wall with impaired viability and subsequent peritoneal contamination is the chief lethal issue in simple obstruction.[16, 17]

To evaluate this effect in patients, simple postoperative adhesive obstructions of the small bowel were considered separately, and the complicated obstructions excluded. Therefore, obstructions resulting from primary inflammatory processes or congenital bands, and all postoperative adhesive obstructions with strangulation or intra-abdominal infection, were removed from consideration. The remaining simple small bowel obstructions were divided into three groups, based on the degree of intestinal distension that had existed at the time of obstruction. Roentgenographic and surgical findings were utilized to classify obstruction into severe, moderate and slight degrees of intestinal distension. In 89 cases the degree of intestinal distension was classified as severe. Moderate and slight distension was present in 84 and 36 cases, respectively. That

distension and its effects in the absence of other complications was a lethal factor in obstruction was confirmed, as seven deaths occurred among the patients with severe intestinal distension (7.9 per cent), whereas the mortality rates were 1.2 per cent (one death) in those with moderate distension, and 2.8 per cent (one death) when distension was slight.

The duration of obstruction prior to treatment influences survival.[8, 12] In this series, in 291 cases the duration of symptoms prior to treatment was known. Of 24 cases treated within 12 hours after onset of the obstruction, none died. When the disease had existed for 48 hours or longer untreated, death occurred in 9.3 per cent of cases.

Treatment. Cases were divided into three categories to assess the merits of early operation versus intestinal intubation. The first group included those patients treated only by inlying gastric tube or long intestinal tube; the second was comprised of those treated for a period greater than 24 hours by intestinal intubation or inlying gastric tube, who then had an operation; the third consisted of those patients who had an operation within 24 hours of admission. As can be seen from Table IV, the best results were achieved in the group who were treated without operation. Here, only 1.7 per cent of patients died. In the group treated by early operation (surgery within 24 hours of admission) 9.2 per cent succumbed, and a 7.2 per cent mor-

tality rate was encountered in the group operated upon after 24 or more hours of suction treatment. It is noteworthy that in this last group the mortality rate was higher when decompression was not achieved, and distension remained uncorrected for periods greater than 24 hours (six deaths in 44 cases, 13.6 per cent).

Strangulation obstructions were recognized before death in all except one patient. Twenty-two patients were correctly diagnosed and operated upon without delay. Five of these died (22.7 per cent). Eighteen were operated upon after a period of delay with one death, and in one patient, conservatively treated, strangulation obstruction was discovered at autopsy. Thus, delayed recognition of 19 strangulation obstructions resulted in death of 10.4 per cent patients.

Among these 41 strangulation obstructions, gangrene had developed in 19 instances. Thirteen patients were recognized to have strangulation obstructions and were operated upon without delay, with five deaths (38.4 per cent). Five patients were operated upon after a period of delay with one death, and one patient, mentioned above, died during conservative treatment and was found to have gangrene at autopsy. Thus, in this group of six patients with gangrene, treated by suction, two died (33.3 per cent).

Causes of Death. In the 22 cases where death was due to obstruction or at least related to its treatment, the following causes were found: (a) Eleven patients succumbed to what is best described as the effects of obstruction. Six of these deaths were the direct result of uncontrolled distension. Another two patients had well defined peritonitis at the time of operation and death resulted from this. The remaining three patients had gangrenous bowel at post-mortem examination. One of these was never operated upon, and in the other two, the viability of the bowel was misjudged at operation. (b) Seven patients (31.8 per cent) succumbed to complications which were di-

rectly related to the operative treatment of obstruction. Six of these deaths were due to anastomotic breakdown or spillage at operation, which resulted in peritonitis. The other death was attributable to anesthesia. (c) Four patients (18.2 per cent) died of complications not so clearly related to the type of treatment. Postoperative intussusception occurred in one patient, and was not recognized. Aspiration pneumonia caused one death, and a third patient succumbed to a cerebro-vascular-accident. Finally, one death resulted from accidental air embolism.

COMMENTS

Postsurgical adhesions accounted for 79 per cent of all adhesive obstructions here. It is likewise the experience of others, that surgery is the most common cause of adhesions that lead to obstruction. Becker (1952)[2] found that 90 per cent of adhesive obstruction in his material followed abdominal surgery, and Bollinger and Fowler (1953)[3] reported that 41 per cent of all small bowel obstructions in their series was due to postoperative adhesions.

Although the prevention of adhesions following operations has not been achieved, certain valid contributions have been made in this direction. Deaver[7] long ago stressed the importance of avoiding trauma to the peritoneum, and he recommended that careful operative technic, strict asepsis and minimal handling and exposure of the viscera be practiced. Antopol[1] first described the granulomatous lesions that might occur following the introduction of talc into the peritoneal cavity. Dennis[9] recently re-emphasized the rôle of glove powder in adhesion formation, and suggested that hydrolyzed starch which has replaced talc for this purpose may not be free of this complication. He advised the use of wet pads to wipe all traces of powder from the surgeons' gloves. In addition, he recommended that unnecessary trauma to the abdominal viscera be avoided, and that careful hemostasis be practiced. The

TABLE IV. *Treatment of Intestinal Obstruction Due to Adhesions.*

	All cases	All Deaths		Cases Excluding Deaths from Causes other than Obstruction	Deaths Due to Obstruction*	
		Number	Percent		Number	Percent
Decompression with Tube, without operation..	120	6	5.0	116	2	1.7
Gastric suction.........................	59	6	10.2	55	2	3.6
Long Intestinal Tube..................	61	0	0	61	0	0
Preliminary Trial of Suction followed by Surgery...............................	188	20	10.6	181	13	7.2
Gastric Suction.......................	71	4	5.6	70	3	4.3
Long Intestinal Tube..................	117	16	13.7	111	10	9.0
Successful Decompression.............	69	6	8.7	67	4	6.0
Failure of Decompression.............	48	10	20.8	44	6	13.6
Immediate Surgery after Intubation.........	80	11	13.7	76	7	9.2
Gastric Suction.......................	63	8	12.7	59	4	6.8
Long Tube...........................	17	3	17.7	17	3	17.7
	388	37	9.5	373	22	5.9

* Three patients moribund on arrival are excluded.

introduction of agents into the peritoneal cavity for the prevention of postsurgical adhesions has not been successful.[16, 17]

Although the magnitude of the insult in part explains the greater risk attending obstruction in infants, specific aspects of the problem can be incriminated as contributory to a greater death rate in these young patients. Delayed diagnosis is attended with fluid and electrolyte derangements, and aspiration pneumonia from vomiting may be well established. Technical difficulties at operation, and problems of anesthesia are greater. Responsibility for care is often divided between surgeon and medical staff. The dividends in terms of survival when the operating surgeon has charge of preoperative and postoperative care has recently been emphasized by Gross. Both Browne[4] and Gross[10] expressed the opinion that better results will be achieved consistently when those with special interest and training have the responsibility for management of infants with intestinal obstruction.

Our results are in keeping with the trend of higher mortality rates in the aged. From his experience, Cutler[6] concluded that the obstruction itself rather than the patient's age and co-existing ailments had been re-sponsible for the larger number of deaths encountered in older patients. Cole,[5] however, expressed the opinion that complicating diseases do add a greater risk in the aged than in the young patient. He likewise found that although an elderly patient free of concurrent disease and complications will tolerate a major operation almost as well as a young adult, the former will tolerate emergency operations poorly. Here, the management of the intestinal obstruction in older patients follows the plan subsequently described, but some details of preoperative and postoperative management deserve comment. The necessity of replacing the blood volume to adequate levels is of prime importance.[5] Preoperative and daily postoperative weighing of patients, coupled with carefully recorded intake and output data, will serve to prevent overhydration or inadequate fluid replacement. As infections are tolerated poorly by the older patient, aspiration pneumonia is to be avoided. Continuous gastroduodenal suction is utilized until normal intestinal function is resumed. If a long intestinal tube is placed into the small bowel, a second shorter tube is passed into the stomach and both are maintained on continuous suction, and thereby gastric regurgitation is

prevented. Thrombophlebitis and phlebo-thrombosis are treated currently with anti-coagulant drugs.

The reports of McKittrick[12] and Dennis,[8] as well as our results, indicate the necessity for early diagnosis and institution of appropriate treatment promptly in intestinal obstruction. The utilization of routine abdominal roentgenograms early in the course of all unexplained abdominal conditions may be helpful in this regard, as intestinal distension may be detected thereby when clinical abdominal distension is absent. Diagnosis and institution of treatment of obstruction before the disease is over 24 hours old offers the best prognosis. If this advantage is to be gained, the diagnosis must usually be made or suspected by the first physician in attendance.

The type of treatment to be employed in adhesive obstructions is a final consideration. Most of the recent efforts to further improve results in the treatment of intestinal obstruction have been directed toward early operation. McKittrick in 1941,[12] and more recently Becker (1952),[2] and Bollinger and Fowler (1953),[3] have recommended immediate surgical treatment in the majority of cases.

Most proponents of early operations base their recommendations principally on the thesis that strangulating obstructions cannot be diagnosed in 100 per cent of cases, and that delay in those that are misdiagnosed carries a risk that outweighs the advantages gained by conservative decompression. We do not agree. We feel that non-operative decompression has a definite place in the management of simple intestinal obstructions, and should not be abandoned. Those patients who can be successfully treated by this modality are managed at a negligible risk. Moreover, a significant number of adhesive obstructions respond to intestinal decompression. Almost one-third (114 cases, 30.5 per cent) of adhesive obstructions in this group were relieved by non-operative means, and the mortality rate encountered was low. Among those patients initially treated by suction who subsequently required operation, the mortality has not been higher than for those managed by early operation unless decompression had failed and distension remained uncontrolled.

It is recognized that utilization of conservative decompression for treatment of obstruction assumes the risk of unrecognized strangulation obstruction. Strangulation obstructions in the group treated by early operation were in many instances advanced (13 of 22 were gangrenous), and the risk was accordingly high (22.7 per cent died). In those patients who initially manifested no signs of strangulation and were treated by tube, and in whom strangulation was subsequently suspected and operation carried out, the diagnosis was usually made before advanced vascular impairment had occurred (five of 18 were gangrenous), and the risk of treatment was consequently lower (one death). In only one instance (one of 41 strangulation obstructions) was the diagnosis not made until autopsy. Thus, in 19 patients with delayed recognition, the risk was 10.5 per cent (two deaths). It is concluded, therefore, that the advantages in nonoperative relief of adhesive obstructions achieved at a low death rate outweigh the risk of delayed recognition in strangulation in adhesive obstructions.

Control of intestinal distension is a primary consideration in management of intestinal obstruction. The lethal character of the sequence of events which distension initiates makes decompression imperative; therefore, failure to relieve intestinal distension by suction after 12 hours is an indication for operative intervention.

Based on the above conclusions, the following plan for the management of adhesive obstructions has been adopted in this clinic:

1. All patients with findings suggestive or indicative of strangulation obstruction or wherein coexisting abdominal conditions are compelling factors for immediate surgery are operated upon as soon as they can

be prepared. With few exceptions patients who have large bowel obstructions with distension are operated upon without delay. Transverse colostomy is performed if the obstruction is not relieved by division of adhesive bands. Primary resection and anastomosis in the face of large bowel distension is not recommended.[17]

2. In remaining patients a trial of intestinal intubation is carried out. Conservative treatment is interrupted at any time if signs suggesting strangulation develop. At the end of a 12 hour period abdominal roentgenograms are repeated and the patient's status is re-evaluated. If no real progress has been made in the relief of distension, conservative treatment is interrupted and operation carried out. Conservative decompression is continued if no signs or symptoms of strangulation obstruction develop and improvement is progressive.

SUMMARY

Adhesions, accounting for 31 per cent of all cases, were the most common cause of intestinal obstruction at the University of Minnesota hospitals during the 11 year eight month period ending September 1, 1953.

The overall mortality rate in these obstructions was 9.5 per cent. Excluding those patients dying of other diseases and those moribund on arrival, the mortality rate was 5.9 per cent.

Age, duration of obstruction prior to treatment, strangulation, intraperitoneal sepsis and degree of intestinal distension influenced survival.

Indications for operative and non-operative treatment of obstructions due to adhesions are given: Simple obstructions are initially treated by intestinal suction; strangulation obstructions by early operation. Suction treatment of simple obstructions is interrupted if distension of the bowel is not relieved in 12 hours, or if signs of stran-

gulation develop. Suction is continued if distension is relieved and improvement is progressive.

BIBLIOGRAPHY

1 Antopol, W.: Lycopodium Granuloma, Its Clinical and Pathological Significance Together with Note on Granuloma Produced by Talc. Arch. Path., 16: 326, 1933.

2 Becker, W. F.: Acute Adhesive Ileus; A Study of 412 Cases with Particular Reference to Abuse of Decompression in Treatment. Surg., Gynec. & Obst., 95: 472, 1952.

3 Bollinger, J. A., and E. F. Fowler: Results of Treatment of Acute Small Bowel Obstruction. Arch. Surg., 66: 888, 1953.

4 Browne, D.: Neonatal Obstruction. Proc. Royal Soc. Med., 44: 623, 1951.

5 Cole, W. H.: Operability in the Young and Aged. Ann. Surg., 138: 145, 1953.

6 Cutler, C. W.: Acute Intestinal Obstruction in Elderly Patients. Surg., Gynec. & Obst., 94: 481, 1952.

7 Deaver, J. B.: Intraabdominal Adhesions. Surg., Gynec. & Obst., 37: 506, 1923.

8 Dennis, C., and S. P. Browne: Treatment of Small Bowel Obstruction. Procedure Used at the University of Minnesota Hospitals. Surgery, 13: 94, 1943.

9 Dennis, C.: Current Procedure in Management of Obstruction of Small Intestine. J. A. M. A., 154: 463, 1954.

10 Gross, R.: The Surgery of Infancy and Childhood. W. B. Saunders Co., Philadelphia, 1953.

11 McIver, M. A.: Acute Intestinal Obstruction: General Considerations. Arch. Surg., 25: 1098, 1932.

12 McKittrick, L. S.: The Diagnosis and Management of Acute Obstruction of the Small Intestine. New England J. Med., 225: 642, 1941.

13 Souttar, H. S.: Acute Intestinal Obstruction. Proc. of Sections at Annual Meeting, Bath, 1925, Section of Surgery. Brit. M. J., 2: 993, 1925.

14 Smith, G. A., J. F. Perry and E. G. Yonehiro: Mechanical Intestinal Obstruction, a Study of 1252 Cases. To be published.

15 Vick, R. M.: Statistics et Acute Intestinal Obstruction. Brit. M. J., 1: 596, 1932.

16 Wangensteen, O. H.: Intestinal Obstruction, 2nd Edition. Charles Thomas Co., Springfield, Illinois, 1942.

17 ————: Intestinal Obstruction, 3rd Edition. Charles Thomas Co., Springfield, Illinois, 1955.