

# Intestinal Obstruction: \*

## A Half Century Comparative Analysis

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### Introduction

SURGICAL thinking and practice have gone through several evolutions in an effort to reduce the death rate from intestinal obstruction. Reginald Fitz<sup>8</sup> advocated medical treatment and delayed operation in the late nineteenth century. Early diagnosis and operation were recommended by men like Deaver<sup>5</sup> and Richardson<sup>17</sup> in the first quarter of the twentieth century. Primary intestinal decompression was in favor during an intermediate era. Today, most surgeons are again advocating earlier diagnosis and earlier operation. This paper is a comparative analysis of the intestinal obstruction problem during these periods of evolution of the past fifty years. The Hermann Hospital cases from 1944 to 1956 are also analyzed.

### Clinical Material

Between 1932 and 1943 many surgeons were using intestinal decompression as the primary treatment of intestinal obstruction wherever this was feasible. This era forms a natural dividing line and the collected series have been separated into three groups for comparison (Table 1).

The first group (Table 1) comprises five of the largest series with sufficient data between the years 1905–1931.<sup>4, 11, 15, 21, 22</sup> In this era, fluid and electrolyte replacement was in the experimental state and when used for therapy, saline was usually given subcutaneously in hypertonic solution. Blood and plasma replacement did not constitute a part of the therapeutic regimen. Without antibacterial agents, even minor infections were sometimes

agents of death. In this period, the only attempt at intestinal decompression in general use was intermittent gastric lavage. In fact, the chief means available for controlling mortality in intestinal obstruction were early diagnosis and operation using the best aseptic technics devised.

The second group (Table 1) comprises five of the largest series with sufficient data in which cases occurring between the years 1932–1943 are reported.<sup>6, 7, 13, 18, 24</sup> Four of the series are from large hospitals in which intestinal decompression was the primary means of treatment wherever this mode of therapy could be used. In this period, fluid and electrolyte replacement were in general use as well as blood and plasma replacement on a limited basis. The sulfa drugs also gained a place in the therapeutic armamentarium during this era, and contributed significantly to the reduction in postoperative deaths from infection.

The third group (Table 1) is made up of five collected series covering the years 1940 to 1953.<sup>2, 12, 14, 19, 20</sup> All of these series manifest a decided return to the doctrine of early diagnosis and operation. Little need be said about the ancillary means available for treating intestinal obstruction in this group.

The fourth group (Table 2) is a study of cases of intestinal obstruction occurring between the years 1944 to 1956 at Hermann Hospital. These years were chosen for study because a sufficient number of cases were available during these years to allow a comparison with Group III and also to allow an extended statistical analysis. All of the cases in Hermann Hospital group had radiographic and surgical evi-

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TABLE 1. *Mortality in Intestinal Obstruction.  
From Collected Series in the Literature*

Name	Date Reported	Cases	Deaths	Mortality %	Gangrenous Cases	Gangrenous Deaths	Mortality %
Tuttle	1925	150	75	50.0	19	13	68.4
Miller	1929	343	209	60.9	98	74	75.5
North	1929	200	62	30.5	28	21	75.0
Brill	1929	124	45	36.3	47	28	59.6
Vick	1932	6,892	1,809	26.2	566	344	60.8
Totals		7,709	2,200	28.5	758	480	63.3
Wangensteen	1939	156	28	17.9	39	15	38.5
McKittrick	1940	136	27	19.9	45	16	35.6
Schlicke	1940	166	37	21.8	10	6	24.2
Dennis & Brown	1943	110	17	15.5	23	9	39.1
Eliason & Walty	1947	292	32	11.0	53	10	18.9
Totals		860	139	16.8	170	56	35.6
Moses	1946	118	10	8.5	16	5	31.3
Nemir	1952	430	42	9.8	29	9	31.0
Smith, <i>et al.</i>	1955	1,252	157	12.5	96	27	28.1
Becker	1955	1,007	188	18.7	109	51	46.8
Tendler & Cartwright	1956	684	58	8.5	56	16	28.6
Totals		3,491	455	13.0	306	108	35.3

TABLE 2. *Etiology and Mortality Intestinal Obstruction.  
Hermann Hospital 1944-1956*

Etiology	Cases	Deaths	Mortality %	Gangrenous Cases	Gangrenous Deaths	Mortality %
Adhesions	200	9	1.8	24	3	3.8
Carcinoma	69	22	4.5	3	2	2.5
Hernia	58	6	1.2	19	5	6.3
Inflammatory stricture	32	1	0.2	0	0	0
Intussusception	17	4	2.0	3	0	0
Volvulus	27	7	1.4	17	7	8.8
Mesenteric thrombosis	9	4	0.8	9	4	5.0
Congenital bands	15	1	0.2	2	0	0
Atresia	16	10	10.8	3	2	2.5
Imperforate anus	12	2	0.4	0	0	0
Malrotation	7	1	0.2	0	0	0
Congenital diaphragm	4	2	0.4	0	0	0
Meconium ileus	3	0	0	0	0	0
Megacolon	1	0	0	0	0	0
Endometriosis	2	0	0	0	0	0
Regional ileitis	2	0	0	0	0	0
Foreign body	4	0	0	0	0	0
Diverticulitis	4	0	0	0	0	0
Stricture anastomosis	4	0	0	0	0	0
Compression tumor	5	1	0.2	0	0	0
Gallstone ileus	2	0	0	0	0	0
Totals	493	70	14.1	80	23	28.8

dence of obstruction. The exceptions to these criteria are those patients who died before operation was performed and autopsy showed intestinal obstruction to be present. The above requirements were met in 493 cases and comprise Group IV.

**Etiology**

The etiology of intestinal obstruction has undergone a marked change in the past 50 years. Although primary causes remain the same, frequency of occurrence is very different today as compared with three decades ago.

**Adhesions.** Adhesions are the most common cause of intestinal obstruction, accounting for 38.2 per cent of cases in the collected series from 1940 to 1953 (Table 3, 4). There has been a precipitous increase in the incidence of adhesions causing intestinal obstruction. This increase amounts to 31.3 per cent (Table 4). The reason for this—in part—is an increase in the number of patients undergoing abdominal operations, but probably a substantial percentage can be accounted for if consideration is given to the number of patients surviving abdominal operations and peritoneal infections during the different periods. Also the longevity of the population may contribute to this percentage difference. Cases due to adhesions in the Hermann Hospital group account for 40.7 per cent, and parallel the collected series of the same period (Table 4).

**Hernia.** Whereas adhesions have shown a striking increase, hernia has undergone a concomitant decrease as a cause of intestinal obstruction. The decrease amounts

TABLE 3. *Percentage Intestinal Obstruction*

Etiology	Hermann Hospital (1944-56)	Collected Series (1940-53)
Adhesions	40.7	38.2
Carcinoma	14.1	16.6
Miscellaneous	13.4	11.8
Hernia	11.8	24.1
Inflammatory		
stricture	6.7	—
Volvulus	5.5	4.4
Intussusception	3.5	4.3
Congenital		
bands	2.6	—
Mesenteric		
thrombosis	1.8	0.4

to 34.1 per cent (Table 5). This change must be due to the greater number of elective hernia repairs now being performed.

**Carcinoma.** There has been an increase in the incidence of carcinoma causing intestinal obstruction (Table 6). This increase is not large (4.1%) but is very significant in view of the poor prognosis of a patient with the combination of these two diseases. Increase of carcinoma as a cause of obstruction may be accounted for by increase in surgical resections with local recurrence being more frequent, thus allowing one tumor two opportunities to obstruct bowel before the patient succumbs. The increased longevity of the population would tend to produce a relative increase in the incidence of carcinoma. The Hermann Hospital series shows an incidence of 14.1 per cent. This is in agreement with the average from the literature during the same period of 16.6 per cent (Table 6).

TABLE 4. *Percentage Adhesions Causing Intestinal Obstruction. (Cases Adhesions/Total Cases)*

*From Collected Cases in the Literature and from Hermann Hospital*

Group I	(1905-1931)	7.5%
Group II	(1932-1943)	37.7%
Group III	(1940-1953)	38.2%
Group IV	(Hermann Hospital 1944-1956)	40.7%

TABLE 5. *Percentage Hernia Causing Intestinal Obstruction. (Cases Hernia/Total Cases)*

*From Collected Series in the Literature and from Hermann Hospital*

Group I	(1905-1931)	58.2%
Group II	(1932-1943)	20.0%
Group III	(1940-1953)	24.1%
Group IV	(Hermann Hospital 1944-1956)	11.8%

TABLE 6. *Percentage Carcinoma Causing Intestinal Obstruction. (Cases Carcinoma/Total Cases)**From Collected Series in the Literature and from Hermann Hospital*

Group I	(1905-1931)	12.5%
Group II	(1932-1943)	12.7%
Group III	(1940-1953)	16.6%
Group IV	(Hermann Hospital 1944-1956)	14.1%

**Volvulus.** This cause of intestinal obstruction has become slightly more common. Table 7 shows an increase of 1.3 per cent. Perhaps this small difference requires no explanation; however, it is in accord with the findings of Michel<sup>10</sup> who shows a definite increase in incidence. A contributing factor may be the large number of intra-abdominal adhesions at present. (Table 4). Partial twisting of a segment of bowel may be produced upon contraction of the adhesion. Predisposition to complete twisting of a segment of bowel and strangulation of its blood supply may thereby be produced. The incidence of volvulus in the Hermann Hospital series is in accord with Group III of the collected series—there being a difference of only 1.1 per cent (Table 7).

**Intussusception.** A comparison of the different periods in Table 8 reveals a surprising decrease of 10.4 per cent in the incidence of intussusception causing intestinal obstruction. Intussusception primarily is a disease of infants and children, in whom an underlying cause can rarely be demonstrated. The theories of etiology include hypertrophy of ileal lymphoid tissue supported by O'Sullivan and Child.<sup>16</sup> Matti<sup>9</sup> suggests that dietary change produces vigorous peristalsis countered by

TABLE 7. *Percentage Volvulus Causing Intestinal Obstruction. (Cases Volvulus/Total Cases)**From Collected Series in the Literature and from Hermann Hospital*

Group I	(1905-1931)	3.0%
Group II	(1932-1943)	2.1%
Group III	(1940-1953)	4.4%
Group IV	(Hermann Hospital 1944-1956)	5.5%

antiperistalsis in the cecum. He supports this position by citing experimental evidence of production of intussusception by electrical stimulation and by physostigmine administration. It seems improbable that the decline in incidence of intussusception can be accounted for until there is more evidence regarding etiology. The Hermann Hospital series shows an incidence of 3.5%. This is in accord with the 4.3 per cent incidence from the recent literature (Table 8).

**Mesenteric Thrombosis.** The frequency of mesenteric thrombosis causing intestinal obstruction cannot be accurately determined from collected reports because many of the authors exclude this cause. This accounts for the low percentage (0.4%) of the total cases in Group III (Table 3). The incidence of mesenteric thrombosis in

TABLE 8. *Percentage Intussusception Causing Intestinal Obstruction. (Cases Intussusception/Total Cases)**From Collected Series in the Literature and from Hermann Hospital*

Group I	(1905-1931)	14.7%
Group II	(1932-1943)	5.0%
Group III	(1940-1953)	4.3%
Group IV	(Hermann Hospital 1944-1956)	3.5%

the Hermann Hospital series is 1.8 per cent (Table 3). This small percentage, however, accounted for 17.4 per cent of the deaths among cases with devitalized bowel. If this cause of intestinal obstruction be excluded from the Hermann Hospital series, the overall mortality rate would be reduced to 12.7 per cent.

**Congenital Bands.** This category was designated in those cases where no previous abdominal operation had been performed and where there was a single band causing the obstruction with no evidence of peritoneal infection. Congenital bands represented 2.6 per cent of the cases in the Hermann Hospital series (Table 3).

**Miscellaneous.** In this category are included infrequent causes of intestinal obstruction as well as the congenital malformations (Table 2). This group accounted

for 13.4 per cent of the cases in the Hermann Hospital series and for 11.8 per cent of the collected reports from the literature during the same period (Table 3).

**Mortality**

The mortality in intestinal obstruction has progressively decreased over the past 50 years (Table 9), despite the large increase in obstruction with gangrene which occurred between 1932 and 1943 (Table 10, 11). The decrease in mortality was apparently due to the use of fluid and electrolytes, blood replacement, and the sulfa drugs. The large increase in obstruction with gangrene from 1932-1943 apparently was due to primary treatment by intestinal decompression. It seems likely that many cases of simple obstruction pro-

TABLE 9. *Mortality in Intestinal Obstruction. (Total Deaths/Total Cases)*  
*From Collected Series in the Literature and from Hermann Hospital*

Group I	(1905-1932)	28.5%
Group II	(1932-1943)	16.8%
Group III	(1940-1953)	13.0%
Group IV	(Hermann Hospital Cases 1944-1956)	14.1%

gressed to gangrene where primary intestinal decompression was the treatment of choice. Early surgical exploration should eliminate this cause of mortality in intestinal obstruction.

The Hermann Hospital cases from 1944 through 1956 have been analyzed from an etiological standpoint to emphasize important mortality factors. Also, an etiological appraisal will provide an estimate of prognosis. The 493 cases have been separated into etiological categories. The more frequently occurring etiological groups have been separated into survivals and deaths. The items used for analysis are presented as an average for each group.

**Adhesions.** The distinguishing features between survivals and deaths in this category are: 1) duration of the obstruction; 2) whether or not bowel was re-

TABLE 10. *Percentage of Gangrenous Bowel in Intestinal Obstruction.*

(*Total Cases of Gangrenous Bowel/Total Cases of Intestinal Obstruction*)  
*From Collected Series in the Literature and from Hermann Hospital*

Group I	(1905-1931)	9.8%
Group II	(1932-1943)	23.3%
Group III	(1940-1953)	8.8%
Group IV	(Hermann Hospital 1944-1956)	16.3%

sected; and 3) postoperative peritonitis. The mortality of 4.5 per cent is lower than in any other group (Table 12).

**Hernia.** The outstanding difference between survival and death in this group is the duration of the obstruction. Gangrenous bowel and postoperative complications are the result of persistence of an incarcerated hernia (Table 13).

**Carcinoma.** The annular carcinoma slowly encroaching upon the bowel lumen accounts for the lengthy duration of obstruction before the patient seeks aid. Undoubtedly this depletes reserves, deranges fluid and electrolytes and leads to increased postoperative complications and mortality (Table 14).

**Volvulus.** Most of these obstructions occur in the small bowel secondary to adhesive bands with enough rotation of the loop to produce obstruction and ischemia. Only a small percentage had volvulus of the sigmoid colon. The outstanding difference between survival and death with volvulus was the presence of gangrene (Table 15).

In each of these categories there are only a few factors which distinguish survivors from nonsurvivors and are evident in any analysis.

TABLE 11. *Percentage of Total Deaths with Gangrenous Bowel. (Deaths with Gangrenous Bowel/Total Deaths)*  
*From Collected Series in the Literature and from Hermann Hospital*

Group I	(1905-1931)	21.8%
Group II	(1932-1943)	41.7%
Group III	(1940-1953)	23.7%
Group IV	(Hermann Hospital 1944-1956)	33.3%

TABLE 12. *Profile of Average Patient with Intestinal Obstruction—Etiology Adhesions*

	Survival	Death
Age	42	44
Sex	Female	Female
Previous operation	Pelvic Lap.	Pelvic Lap.
Previous obstruction	No	No
WBC	10,350	13,700
Preoperative temperature	99.0	99.4
Onset to operation	3 Days	5.5 Days
Site of obstruction	Ileum	Ileum
Type obstruction	Simple	Simple
Bowel resection	No	Yes
Complications	None	Peritonitis
Length of stay	15 Days	13 Days
Mortality	—	4.5%

TABLE 13. *Profile of Average Patient with Intestinal Obstruction—Etiology Hernia*

	Survival	Death
Age	47	49
Sex	Equal	Equal
Previous operation	No	No
Previous obstruction	No	No
WBC	11,450	11,500
Preoperative temperature	99.2	100.0
Onset to operation	1.5 Days	3.5 Days
Site of obstruction	Ileum	Ileum
Type obstruction	Simple	Gangrenous
Bowel resection	No	Yes
Complications	None	Peritonitis
Length of stay	13 Days	8 Days
Mortality	—	10.3%

TABLE 14. *Profile of Average Patient with Intestinal Obstruction—Etiology Carcinoma*

	Survival	Death
Age	53	59
Sex	Equal	Female
Previous operation	Equal	Equal
Previous obstruction	No	No
WBC	10,700	12,200
Preoperative temperature	99.0	99.4
Onset to operation	8 Days	9 Days
Site of obstruction	Colon	Colon
Type obstruction	Simple	Simple
Bowel resection	Colostomy	Colostomy
Complications	Evisceration postop. obst.	Shock, peri- tonitis
Length of stay	29 Days	14 Days
Mortality	—	31.9%

1. There is a consistent difference between survivors and nonsurvivors in the time interval between onset of symptoms and operation. This varies from 12 to 48 hours according to the etiology of the obstruction.

2. There is a distinct difference in survival according to whether or not bowel was resected. This is not true in cases with carcinoma where exteriorization was the most common operation.

3. The presence of gangrene is an important factor, but only in those categories which predispose to segmental obstruction, i.e., hernia, volvulus, and mesenteric thrombosis.

4. Postoperative complications for the most part reflect what has gone before; nevertheless, peritonitis and toxemia were present in 70 per cent of deaths and only 2 per cent of survivors.

The importance of location of obstruction as a factor in mortality is clearly shown in Table 16. Obstruction of the colon accounted for nearly four times as many deaths as small bowel obstructions. Age of the patient is another factor that may be important in intestinal obstruction. Table 17 shows that the very young and the elderly do not tolerate obstructions nearly as well as other age groups.

TABLE 15. *Profile of Average Patient with Intestinal Obstruction—Etiology Volvulus*

	Survival	Death
Age	46	43
Sex	Female	Equal
Previous operation	Yes	Yes
Previous obstruction	No	No
WBC	12,500	13,700
Preoperative temperature	100.4	100.2
Onset to operation	2.5 Days	3 Days
Site of obstruction	Ileum	Ileum & jejunum
Type obstruction	Simple	Gangrenous
Bowel resection	No	Yes
Complications	None	Toxemia & peri- tonitis
Length of stay	17 Days	6 Days
Mortality	—	25.9%

TABLE 16. *Location of Obstruction as a Factor in Mortality*

	No. Cases	Average Age	Onset to Operation	Type Obstruction	Bowel Resected	P. O. Complications	Mortality %
Small Bowel Deaths	49	46	4.9 Days	50% Simple 50% Gang.	66%	100% had complications. Peritonitis most common	11.8
Small Bowel Survivors	365	43	3.7 Days	91% Simple 9% Gang.	24%	22% had complications. Wound infection and evisceration most common	
Large Bowel Deaths	30	60	9 Days	83% Simple 17% Gang.	22%	100% had complications. Peritonitis most common	37.0
Large Bowel Survivors	51	53	6.7 Days	98% Simple 2% Gang.	16%	12% had complications. Fecal fistula most common	

**Discussion**

Age and location of obstruction are very important in mortality statistics. However, these factors are important only in selected groups. The findings which are common to all cases of obstruction and which are evident in any analysis are: 1. presence of gangrene; 2. duration of the obstruction; and 3. contamination of the peritoneal cavity.

A great deal of experimental work has been done in an effort to determine the factors associated with mortality. Clostridium welchii and its toxic products have been the most frequently incriminated agents causing toxicity accompanying gangrenous obstruction. Williams,<sup>25</sup> in 1926, and Wangenstein and Waldron,<sup>23</sup> in 1928, showed experimentally that a toxin existed. However, no proof of what it was has been available until Bornside and Cohn<sup>3</sup> produced evidence that clostridial toxins were the major lethal factor of the peritoneal fluid in strangulation obstruction in the rabbit.

**Conclusions**

Early surgical relief of all intestinal obstructions is extremely important provided the patient can tolerate operation. This is evident from the cases with gangrene produced by primary intestinal decompression and from the correlation between mortality and duration of the obstruction.

Preventing contamination of the peritoneal cavity is a big step in lowering mortality. Contamination occurs in decompression or resection of the bowel unless this is meticulously guarded against. The Barnes decompression instrument<sup>1</sup> is a technical advance that minimizes the possibility of contamination. The value of antibiotics in experimental intestinal obstruction has been well documented. Intestinal obstruction from any cause is an emergency and should be treated as such.

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TABLE 17. *Age as a Factor in Mortality of Intestinal Obstruction*

Age	Mortality
0-1	45%
2-20	5%
21-40	10%
41-60	6%
61 and over	44%

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#### DISCUSSION

DR. J. WILLIAM HINTON: I would like to discuss Dr. Raiford's paper and compliment him on the surgical management of the pathologic lesion which he encountered after removing the stone.

I have had occasion to operate upon five patients, and the first was a man, 66 years of age. In 1936, he suffered from a dull pain in his upper abdomen. After 2 to 3 hours this was followed by excessive vomiting.

X-rays revealed a huge calculi in his gallbladder, approximately 5 × 5 cm., in the mid-portion of the abdomen and a diagnosis, therefore, was not difficult to make. A diagnosis of a gallstone ileus was made. The pain he suffered was moderately severe, but the vomiting was out of all proportion to the pain.

A laparotomy was immediately performed and the stone was removed from the lower ileum, and a cholecystoduodenal fistula was not even palpated. The patient lived until he was 89 years old; he had no further biliary tract symptoms.

A second case was a woman in her early sixties. She likewise had excessive vomiting, out of proportion to the amount of pain. A flat plate of her abdomen was suggestive of a calculi in the lower small intestine. A laparotomy was performed and the stone was removed. On exploring the abdomen an annular carcinoma of the descending sigmoid was found.

After recovering from the first operation, she was operated upon again for the carcinoma of the sigmoid. It was found that a large stone had lodged in the annular carcinoma, and could not pass further distally, although it had obviously