

Operative Risk Factors of Colon Resection in the Elderly

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Between January 1, 1974, and December 31, 1978, 357 patients over 50 years of age underwent colon resections in three West Virginia Hospitals. The patients were studied by decades of age to compare the operative risks in younger and elderly patients. Preoperative assessments of cardiovascular, pulmonary, renal, hepatic, metabolic and nutritional states were compared with the postoperative morbidity and mortality rates. Complications occurred in 33% of all the patients who had resections, with 17 (4.8%) deaths. Mortality rates compared by decades of age correlated with the number of pre-existing conditions, and not with age as an isolated factor. There were no deaths in patients with no pre-existing conditions. The rate of infectious complications increased because the number of emergency procedures increased. This was also true for the mortality rate. Preoperative pulmonary and nutritional problems were significant contributing factors in the patients who died from sepsis. Careful preoperative assessment, correction of pre-existing pulmonary and nutritional deficiencies, and avoidance of emergency procedures may improve the morbidity and mortality rates associated with colon resections in elderly patients.

THE MEDICAL CARE OF ELDERLY patients has become an increasingly important problem. The absolute number and the percentage of persons over 65 years of age continues to increase in the United States (Table 1). Cancer is the second leading cause of death in the elderly. Colon and rectal cancer is the second leading cause of death by cancer, following lung cancer for males and breast cancer for females. Therefore, colon resection was chosen as the procedure to assess operative risk factors in elderly patients.

A retrospective study of colon resections in patients over 50 years of age (according to decades of age) was undertaken to 1) define pre-existing conditions, 2) identify preoperative factors associated with the morbidity and mortality rates, 3) define the criteria to predict operative risks and 4) identify ways to improve patient care.

Materials and Methods

Between January 1, 1974 and December 31, 1978, 357 patients over 50 years of age underwent colon

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resections in three West Virginia Hospitals. Seventy per cent of the resections were to treat carcinoma, 16% were to treat diverticular disease and 14% were to treat other conditions (Table 2). The other conditions included Crohn's disease, ulcerative colitis, volvulus, appendiceal abscess, and iatrogenic injury. One hundred sixty-eight left colectomies, 96 right colectomies, 59 abdominoperineal resections and 37 other resections were performed. Nine and one-half per cent of the resections were performed as emergency procedures.

Preoperative evaluations included cardiovascular, pulmonary, renal, hepatic, metabolic and nutritional assessments. Cardiac factors included previous myocardial infarction, congestive heart failure, and hypertension. Pulmonary factors included chronic lung disease, pneumonia, and previous lung resection. Renal factors included renal calculi, chronic renal failure, and a preoperative serum creatinine level greater than 2.0 mg/dl. Hepatic disease included liver metastases and significant elevations in liver function tests. Metabolic conditions included diabetes, arthritis, and steroids. The patient's nutritional status was not always evaluated, but a serum albumin level of less than 3.0 mg/dl was used as an indicator of nutritional problems. Other preoperative conditions included previous major surgery and peptic ulcer disease.

Postoperative complications occurred in 33% of all the patients who had colon resections. Cardiopul-

TABLE 1. USA Population Statistics

Date	Total	People Over 65	Per Cent
1900	76,094,000	3,099,000	4.1
1950	152,271,000	12,297,000	8.1
1970	204,878,000	20,087,000	9.8
2000	282,837,000	31,822,000	11.3

TABLE 2. Primary Disease Related to Morbidity and Mortality Rates

Primary Disease	Number of Patients	Morbidity Rate	Mortality Rate
Cancer	251(70%)	76(30%)	7(2.8%)
Diverticular disease	56(16%)	18(32%)	6(10.7%)
Other	50(14%)	24(48%)	4(8%)
Total	357(100%)	118(33%)	17(4.8%)

monary complications included myocardial infarction, stroke, pneumonia, pulmonary embolus, and atelectasis. Infectious complications included wound infection, intra-abdominal abscess, wound disruption, and anastomotic leak. Other complications included cholecystitis, liver failure, urinary tract infections, renal failure and postoperative gastrointestinal bleeding. Eighty patients developed postoperative sepsis from multiple causes. There were 17 deaths (4.8%): one patient died from a pulmonary embolus, five patients died from myocardial infarctions and 11 patients (65%) died from sepsis and multisystem failures.

Results

The morbidity and mortality rates related to the primary disease and ages of the patients are demonstrated in Tables 2 and 3. Complications occurred in 33% of the patients who had colon resections, with a 4.8% mortality rate. Seventy per cent of the resections were performed to treat carcinoma, with a 2.8% mortality rate. Sixteen per cent of the resections were performed to treat diverticular disease, with a 10.7% mortality rate. The mortality rate for abdominoperineal resection was zero as compared with 9.4% for right colectomy and 3.6% for left colectomy. The mortality rate increased with each decade of age, for patients less than 70 years of age the mortality rate was 2.3% compared with 8.5% for those patients over 70 years of age. The incidence of pre-existing conditions and the number of pre-existing conditions per patient are tabulated according to decade of age in Tables 4 and 5. Pre-existing cardiovascular disease was very common and increased with age. The in-

TABLE 3. Age Related to Morbidity and Mortality Rates

Age	Number of Patients	Morbidity Rate	Mortality Rate
50-59	95	27(28%)	3(3.1%)
60-69	121	47(39%)	2(1.7%)
70-79	100	30(30%)	5(5%)
>80	41	14(34%)	7(17%)
<70	216	74(34%)	5(2.3%)
>70	141	44(31%)	12(8.5%)
Total	357	118(33%)	17(4.8%)

TABLE 4. Incidence of Preoperative Conditions (Per Cent)

Condition	50-59	60-69	70-79	Over 80	Total
Cardiovascular	36	52	57	85	53
Pulmonary	8	17	20	17	16
Renal	5	8	24	15	13
Hepatic	7	10	16	20	12
Nutritional	2	7	10	22	8
Other	13	18	21	20	18

cidence of pre-existing conditions increased by decades.

Table 6 lists the incidence of pre-existing conditions of the patients who died after their resections. Pre-existing pulmonary and nutritional problems increased the mortality rates in patients who had emergency colon resections. Two or more pre-existing conditions doubled the mortality rate for emergency versus elective procedures. All of the patients who died after emergency colon resections had two or more pre-existing conditions.

The mortality rates of the young and elderly groups of patients as related to the number of pre-existing conditions are demonstrated in Table 7. No significant mortality rate occurred in either group of patients with zero or one pre-existing condition. A mortality rate of 8.6% in patients younger than 70 years of age, and a mortality rate of 16.2% in patients over 70 years of age occurred in groups of patients with two or more pre-existing conditions. The pre-existing conditions and not age, as an isolated factor, affected mortality rates. Pre-existing disease had a more significant effect on mortality rates in the elderly group than in the younger group of patients.

The number of complications after emergency versus elective procedures are compared in Table 8. The overall incidence of complications was similar in the two groups (38% compared with 32%). However, infectious complications such as, wound infection, intra-abdominal abscess, anastomotic leak, and respiratory problems occurred three times more often in the emergency group. The mortality rate in the patients who had emergency procedures was 17.6%,

TABLE 5. Number of Preoperative Conditions Per Patients (Per Cent)

Number	50-59	60-69	70-79	Over 80	Total
0	46	33	21	5	30
1	37	34	28	37	33
2	13	27	23	41	24
3 or more	3	8	22	15	11

TABLE 6. Mortality Rates Related to Preoperative Conditions in Emergency Compared to Elective Procedures

	Emergency	Elective	Total
Patients	6(35)	11(65)	17(100)
Cardiovascular	5(83)	8(73)	13(76)
Pulmonary	2(33)	0(0)	2(12)
Renal	1(17)	2(18)	3(18)
Hepatic	1(17)	1(9)	2(12)
Metabolic	1(17)	4(36)	5(29)
Nutritional	5(83)	4(36)	9(53)
Two or more conditions	6(100)	5(45)	11(65)

Numbers in parentheses indicate per cent.

as compared with 3.4% in the patients who had elective procedures.

Eleven of the 17 deaths were secondary to sepsis and multisystem failures. Table 9 compares the incidence of pre-existing conditions in these 11 patients with the overall group of patients. Patients over 70 years of age, emergency operations, pre-existing pulmonary and nutritional problems, and two or more pre-existing conditions were contributing factors as the cause of death in the patients who died from sepsis. Age may not be a significant factor because of the increase in coexisting diseases with age. Nutritional status had a dramatic effect on the death rate from sepsis, as did multiple pre-existing conditions.

Discussion

Powers¹ demonstrated the increasing frequency of surgery in elderly patients. Between 1931 and 1959 overall surgical admissions increased 274%, surgical operations increased 423% and operations in patients over the age of 60 years increased 1209%. Forty per cent of the procedures were performed on patients over 60 years of age, but 76.5% of the deaths occurred in this group of patients. The operative mortality rate for the elderly patient who had surgery, performed is a significant health care problem that needs evaluation.

Greenfield,² Cole^{3,4} and others^{5,6} have discussed the

TABLE 7. Mortality Rates of Young and Elderly Patients Related to Number of Preoperative Conditions

	Less than 70		Greater than 70	
	Patients	Per Cent Mortality Rate	Patients	Per Cent Mortality Rate
Zero or one conditions	0/160	0	1/66	1.5
Two or more conditions	5/58	8.6	11/68	16.2

TABLE 8. Postoperative Complications Related to Emergency Versus Elective Procedures

	Emergency	Elective	Total
Patients	34(9.5%)	323(90.5%)	357(100%)
Incidence	13(38%)	105(32%)	118(33%)
wound infection	10(29%)	38(12%)	48(15%)
abscess	3(9%)	10(3%)	13(4%)
leak	3(9%)	11(3%)	14(4%)
dehiscence	1(3%)	4(1%)	5(2%)
respiratory	4(12%)	14(4%)	18(6%)
pulmonary embolus	2(6%)	9(3%)	11(3%)
other	3(9%)	42(13%)	45(14%)
Deaths	6(17.6%)	11(3.4%)	17(4.8%)

problems of surgery for the elderly patient. Greenfield² emphasized early treatment, minimizing complications, avoiding emergency surgery, and assessing intercurrent disease. Cole⁴ stressed close observation for potential complications, meticulous operative technique and short operative time.

Cole⁴ found a mortality rate of 4.6% in patients under 60 and 7.7% in patients over 60 who had colon resections. This compares with 3.1% and 5.5% for similar groups in the present study. Glenn⁷ reported a significant increase in the mortality rates in elderly patients with pre-existing diseases who underwent biliary tract surgery. Our study confirms this and emphasizes the importance of evaluating preoperative cardiovascular, pulmonary, renal, metabolic, and nutritional states. No deaths occurred in patients without preexisting diseases, and not with age as an isolated factor.

Wilder and Fisherhein⁸ reported a mortality rate of 61% in patients over 65 years of age with postoperative complications, as compared with only 10% in patients with no complications. In our study of colon resection in elderly patients the mortality rate in patients with no complications was zero, as compared with 13% for patients with complications. In patients over 60 years

TABLE 9. Deaths Secondary to Sepsis Related to Preoperative Conditions (11 Patients)

Condition	Deaths from Sepsis (11 patients)	Overall (357 patients)
Emergency	5(45)	34(10)
Cardiovascular	7(64)	189(53)
Pulmonary	5(45)	56(16)
Renal	3(27)	45(13)
Hepatic	2(18)	4(1)
Metabolic	2(18)	43(12)
Nutritional	7(64)	30(8)
Two or more preoperative conditions	10(91)	126(35)

Numbers in parentheses indicate per cent.

of age, Cole⁴ found a mortality rate of 18.5% for patients who had emergency procedures, compared to 6.5% for patients who had elective procedures. These mortality rates are similar to our study (17.6 versus 3.4%). In particular, we found that pre-existing pulmonary or nutritional problems or multiple preoperative conditions significantly increased mortality rates in emergency cases.

Irvin and Zeppa⁹ did a prospective study to quantify the operative risks of patients undergoing operations for complications of peptic ulcer disease. The mortality rates increased significantly with age, and emergency procedures carried a high risk. Cardiovascular, pulmonary and renal factors all correlated well with mortality rates. Nutritional status was not studied. Computer analysis effectively predicted operative risks in Irvin and Zeppa's prospective study. Computer analysis of preoperative risk factors of colon resection in elderly patients should be able to predict the postoperative mortality rates, as did Irvin's study with peptic ulcer disease.

The morbidity and mortality rates of colon resections in elderly patients may be improved by 1) careful preoperative assessment, 2) correcting pre-existing pulmonary, nutritional, or other deficiencies, 3) avoiding emergency procedures and 4) minimizing perioperative complications. Age as an isolated factor

had no effect on the mortality rate of colon resections. Pre-existing diseases increase with age and must be carefully evaluated.

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References

1. Powers JH. *Surgery of the Aged and Debilitated Patient*. Philadelphia, W. B. Saunders, 1968.
2. Greenfield LJ. *Surgery in the Aged. Major Problems in Clinical Surgery*, Vol. XVII, Philadelphia, W. B. Saunders, 1975.
3. Cole WH. Operability in the young and aged. *Ann Surg* 1953; 138:145-57.
4. Cole WH. Medical differences between the young and the aged. *Am Geriatr Soc* 1970; 18:589-614.
5. Kessler HJ, Seton JZ. The treatment of operable breast cancer in the elderly female. *Am J Surg* 1978; 135:664-66.
6. Owens BJ, Hamit JF. Appendicitis in the elderly. *Ann Surg* 1978; 187:392-96.
7. Glenn F, Hayes, DM. The age factor in the mortality rate of patients undergoing surgery of the biliary tract. *Surg Gynecol Obstet* 1955; 100:11-18.
8. Wilder RJ, Fishbein RH. Operative experience with patients over 80 years of age. *Surg Gynecol Obstet* 1961; 113:205-12.
9. Irvin GL, Zeppa R. Predicted survival in peptic ulcer patients based on computer analysis of preoperative variables. *Ann Surg* 1976; 183:594-98.