

Original Article

Predictive Factors of Surgical Mortality after Hartmann's Procedure for Colorectal Emergencies in the Elderly

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Key Words

Hartmann's procedure;
Predictive factors;
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Purpose. The most frequent colorectal emergencies faced by surgeons are obstructions and perforations. Hartmann's procedure is still frequently used to treat colorectal emergencies. Advanced age significantly increases surgical morbidity and mortality in colorectal surgeries. In this study, patient outcomes were analyzed to determine factors predictive of surgical mortality in elderly patients who underwent Hartmann's procedure.

Methods. The records of patients 65 years of age or older diagnosed with a colorectal emergency and treated with Hartmann's procedure from January 2002 to December 2006 were retrospectively reviewed. The patients were divided into subgroups by sex, age, diagnosis, tumor location, cancer stage, laboratory data, perioperative events, and American Society of Anesthesiologists (ASA) score. All potential predictive factors of surgical mortality were analyzed.

Results. A total of 96 patients were included in the analysis. Sixty patients had primary colorectal cancer, three had cervical or ovarian cancer, and 33 were diagnosed with colorectal emergencies caused by benign diseases. The presence of chronic obstructive pulmonary disease (COPD), diabetes mellitus, heart disease, or hypertension was correlated with an increased mortality rate; however, none of these factors reached statistical significance. Patients with bowel perforations had a mortality rate that was lower than that of patients with obstructions (8.8% to 19.4%) but still did not reach statistical significance ($p = 0.287$). Elevated serum creatinine level or decreased hemoglobin level was significantly correlated with an increased mortality rate.

Conclusions. Elevated serum creatinine and low hemoglobin level were predictive factors of surgical mortality in elderly patients who underwent Hartmann's procedure for a colorectal emergency.

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The most frequent colorectal emergencies faced by surgeons are obstructions and perforations.¹ Colorectal cancer, followed by diverticulitis, are by far the most common causes of colorectal emergencies.² The majority of cases of perforation of the colon

and rectum are due to cancer or diverticulitis, and cancer is the leading cause of large bowel obstruction.² The frequency of colorectal emergencies is increased with age, and a 3-fold increase of mortality has been reported in elderly patients.¹

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Hartmann's procedure is still frequently used by many surgeons to treat colorectal emergencies.³⁻⁵ The procedure involves creation of an end colostomy after resection of the primary lesions and closure of the distal colorectal stump. Another surgical option is one-stage surgery, in which the anastomosis is performed immediately after resection of the involved segment of large bowel. One-stage surgery has been proposed by many authors in recent decades.^{4,6,7} Due to overall favorable results, it has become a popular option at many institutions.⁷⁻⁹ At our hospital, Hartmann's procedure is the procedure of choice for high-risk patients because bowel anastomosis is not performed, and the risk of anastomosis leakage and related complications are avoided. However, Hartmann's procedure had been criticized because the reversal and restoration of bowel continuity carries a high complication rate.¹⁰ Anastomotic leakage rate of 30% and mortality rate of 14.3% had been reported.⁴

Advanced age significantly increases the surgical morbidity and mortality in the case of colorectal surgical emergencies.^{1,11} A review article reported that surgical morbidity increased from 28% to 51%, and mortality from 2.3% to 7% in patients aged 80 years and older.¹² Preoperative transfusion, emergency surgery, weight loss, and prolonged operative duration were reported to be risk factors of surgical mortality.

At our institution, Hartmann's procedure by laparotomy was the only option to treat colorectal emergencies of the distal colon/rectum before 2006, at which time we began treating some patients with a better general condition with a one-stage procedure combined with intra-operative colon decompression. The purpose of this study was to analyze the records of patients with colorectal emergencies treated prior to 2006 with Hartmann's procedure to determine factors predictive of surgical mortality in elderly patients who underwent the procedure.

Materials and Methods

The records of patients 65 years of age or older diagnosed with a colorectal emergency and treated with Hartmann's procedure from January 2002 to Decem-

ber 2006 were retrospectively reviewed. Patients treated after December 2006 were excluded because most patients with a favorable general condition were treated with one-stage surgery, as judged appropriate by the attending surgeon.

Surgical mortality was defined as death within 30 days after the surgery. Emergent operation was defined as surgery performed within 4 hours after diagnosis. Colorectal cancers were staged according to the 7th edition of the American Joint Committee on Cancer TMN system for colorectal cancer.

Patients were divided into subgroups according to age, sex, tumor location, cancer stage, laboratory data, and American Society of Anesthesiologists (ASA) score. All potential predictive factors of surgical mortality were analyzed.

Statistical analysis

Qualitative data were compared by means of the Yate's correction of contingency, and two-tailed Fisher's exact test. Chi-square test was used to compare quantitative data. A two-tailed value of $p < 0.05$ was considered statistically significant. The SPSS software package (SPSS, Chicago, IL) was used to manage patient data, and perform statistical calculations.

Results

A total of 96 patients were included in the analysis (Table 1). Sixty patients had primary colorectal can-

Table 1. Diagnosis of the patients

Diagnosis	Number of patients (% of total)
Malignant disease	63 (65.6%)
Colorectal cancer	60 (62.5%)
Ovarian cancer	2 (2.1%)
Cervical cancer	1 (1.0%)
Benign disease	33 (34.4%)
Diverticulitis	18 (18.8%)
Colon ischemic necrosis	6 (6.3%)
Stercoral ulcer	6 (6.3%)
Pelvic abscess	1 (1.0%)
Toxic megacolon	1 (1.0%)
Sigmoid colon volvulus	1 (1.0%)

cer, and 20 of them had liver or lung metastases diagnosed by preoperative computed tomography (CT). No synchronous metastasectomy was performed in any of the patients due to unstable medical status and advanced age. Three patients had large bowel obstructions caused by cervical or ovarian cancer, and 33 patients had colorectal emergencies due to benign diseases. Diverticulitis was the most frequent benign diagnosis (18.8% of total), followed by ischemic necrosis of the colon (6.3%) and stercoral ulcer (6.3%).

Of the 96 patients, there were 49 males and 47 females (Table 2). Most patients had comorbidities such as diabetes mellitus (DM), hypertension, heart disease, chronic obstructive pulmonary disease (COPD), or previous cerebral vascular accident (CVA). Statistical analysis revealed that the mortality rate was not influenced by sex or the presence of an old CVA ($p = 1.0$). The patients were divided into five age groups, and analysis indicated the mortality rate increased with age. For the extremely old age group, the mortality rate was 31.0% in patients older than 80 years (9 deaths in 29 patients), but only 8.9% (6 patients) in those younger than 80 years. The presence of COPD increased the mortality rate from 14% to 30%. The presence of DM, heart disease, or hypertension was correlated with an increased mortality rate. However, analysis of these factors did not reach statistical significance.

Sixty patients were diagnosed with colorectal cancers (Table 3), and 20 patients (33.3%) had distant metastasis identified on pre-operative CT. Fifty-four patients (90%) with colorectal cancers presented with

obstruction due to the tumor. The obstruction rate was not correlated with the stage or location of the tumors, and some patients with stage I colorectal cancer pre-

Table 2. Patient characteristics and mortality rate

Category	Number of patients (% of total)	Number of mortalities (% mortality)	<i>p</i> -value
Sex			1.000 ^y
Male	49 (51.0%)	8 (16.3%)	
Female	47 (49.0%)	7 (14.9%)	
Age (y)			0.100 ^c
65-69	13 (13.5%)	1 (7.7%)	
70-74	27 (28.1%)	2 (7.4%)	
75-79	27 (28.1%)	3 (11.1%)	
80-84	14 (14.6%)	4 (28.6%)	
≥ 85	15 (15.6%)	5 (33.3%)	
Diabetes mellitus			0.343 ^f
No	73 (76.0%)	10 (13.7%)	
Yes	23 (24.0%)	5 (21.7%)	
Hypertension			0.534 ^y
No	55 (57.3%)	7 (12.7%)	
Yes	41 (42.7%)	8 (19.5%)	
Heart disease			0.323 ^f
No	74 (77.1%)	10 (13.5%)	
Yes	22 (22.9%)	5 (22.7%)	
COPD			0.187 ^f
No	86 (89.6%)	12 (14.0%)	
Yes	10 (10.4%)	3 (30.0%)	
Previous CVA			1.000 ^f
No	75 (78.1%)	12 (16.0%)	
Yes	21 (21.9%)	3 (14.3%)	

CVA, cerebrovascular accident; COPD, chronic obstructive pulmonary disease.

^c Chi-square test; ^y Yate's correction of contingency; ^f Fisher's exact test.

Table 3. Stage and location of colorectal malignancies

Variables	Number of patients (% of total)	Obstruction (% of subgroup)	Perforation (% of subgroup)
Tumor location			
Descending colon	2 (3.3%)	1 (50%)	1 (50%)
Sigmoid colon	17 (28.3%)	15 (88%)	2 (12%)
Upper rectum	16 (26.7%)	15 (94%)	1 (6%)
Middle or lower rectum	25 (41.7%)	23 (92%)	2 (8%)
Stage*			
I	4 (6.7%)	3 (75%)	1 (25%)
II	20 (33.3%)	19 (95%)	1 (5%)
III	16 (26.7%)	13 (81%)	3 (19%)
IV	20 (33.3%)	19 (95%)	1 (5%)

* According to American Joint Committee on Cancer TNM staging system for colorectal cancer, seventh edition, 2010.

sented with bowel obstruction. Twenty-eight of the 33 (90.3%) patients diagnosed with benign disease presented with a bowel perforation. The three patients with cervical or ovarian cancer presented with obstruction.

The mortality rates of patients with various perioperative factors are presented in Table 4. The overall surgical mortality rate of patients with colorectal cancer was 20%, while the mortality rate of patients with benign diseases or other types of cancer was 8.3% ($p = 0.217$). Considering one of the three patients with malignancies other than colorectal cancer expired after surgery, the mortality rate was 20.6% for malignant disease and 6.1% for benign disease ($p = 0.116$). Patients with bowel perforations had a mortality rate much lower than that of patients with obstructions (8.8% vs. 19.4%, respectively). The administration of an intra-operative transfusion increased the mortality rate from 10.2% to 24.3%. However, all these results did not reach statistical significance. Emergent opera-

tion did not change the mortality rate ($p = 1.00$).

The mortality rates of patient subgroups by laboratory data are presented in Table 5. Elevated serum creatinine level or decreased hemoglobin level was correlated with a statistically significant increased mortality rate. The mortality rate was also increased with an elevated white blood cell (WBC) count, but this trend did not reach statistical significance. In addition, platelet count was not correlated with mortality rate ($p = 0.506$). Furthermore, the mortality rate was not statistically associated with ASA score ($p = 0.777$) (Table 6).

Discussion

This retrospective study focused on predictive factors of surgical mortality in elderly patients who underwent Hartmann's procedure for large bowel obstructions or perforations. The study included 96 pa-

Table 4. Perioperative factors and mortality rate

Factor	Number of patients (% of total)	Number of mortalities (% of subgroup mortality)	<i>p</i> -value
Diagnosis			0.217 ^y
Colorectal cancer	60 (62.5%)	12 (20.0%)	
Other disease	36 (37.5%)	3 (8.3%)	
Benign or malignant			0.116 ^y
Malignant disease	63 (65.6%)	13 (20.6%)	
Benign disease	33 (34.4%)	2 (6.1%)	
Location of colorectal cancer			0.299 ^c
Descending colon	2 (2.1%)	1 (50.0%)	
Sigmoid colon	17 (17.7%)	2 (11.8%)	
Upper rectum	16 (16.7%)	3 (18.8%)	
Middle or lower rectum	25 (26.0%)	6 (24.0%)	
Obstruction or perforation			0.287 ^y
Obstruction	62 (64.6%)	12 (19.4%)	
Perforation	34 (35.4%)	3 (8.8%)	
Emergent operation			1.000 ^y
No	46 (47.9%)	7 (15.2%)	
Yes	50 (52.1%)	8 (16.0%)	
Intraoperative transfusion			0.116 ^y
No	59 (61.5%)	6 (10.2%)	
Yes	37 (38.5%)	9 (24.3%)	
Cancer stage			0.181 ^c
I or II	24 (25.0%)	3 (12.5%)	
III	16 (16.7%)	5 (31.3%)	
IV	20 (20.8%)	4 (20.0%)	

^c Chi-square test, ^y Yate's correction of contingency.

Table 5. Laboratory data and mortality rates

Laboratory data	Number of patients (% of total)	Number of mortalities (% subgroup mortality)	<i>p</i> -value
WBC count (1000/mm ³)			0.157 ^c
< 5	13 (13.5%)	1 (7.1%)	
5-10	47 (49.0%)	5 (10.6%)	
10-15	26 (27.1%)	5 (19.2%)	
> 15	10 (10.4%)	4 (40.0%)	
Serum creatinine (mg/dl)			0.015 ^c
< 1.5	68 (70.8%)	6 (8.8%)	
1.5-2.0	14 (14.6%)	4 (28.6%)	
> 2	14 (14.6%)	5 (35.7%)	
Hemoglobin (gm/dl)			0.010 ^c
< 8.5	6 (6.3%)	3 (50.0%)	
8.5-9.9	19 (19.8%)	1 (5.3%)	
10-11.9	31 (32.3%)	8 (25.8%)	
≥ 12	40 (41.7%)	3 (7.5%)	
Platelet count (×1000/mm ³)			0.506 ^c
< 60	3 (3.1%)	0 (0.0%)	
60-119	5 (5.2%)	1 (20.0%)	
120-330	78 (81.2%)	11 (14.1%)	
> 330	10 (10.4%)	3 (30.0%)	

^c Chi-square test.

tients who received surgery during the time period when Hartmann's procedure was the only recommended surgical option at our hospital for colorectal emergencies. This design was to eliminate potential selection bias from the attending physicians.

Elevated serum creatinine or low hemoglobin level was associated with a statistically significantly increased mortality rate (Table 5). Sebastiaiano et al.² reported that renal failure, old age, high ASA score, and damage of the proximal colon were risk factors for postoperative mortality in patients who underwent surgeries for large bowel obstructions. Turrentine et al.¹² studied 7,696 elderly patients who underwent various surgeries, and reported that preoperative transfusion, emergent operation, and weight loss best predicted morbidity for those 80 years of age and older. In a national surgical quality improvement program, Halabi¹³ reported that transfusions were associated with increased mortality, morbidity, length of stay, and pneumonia in colorectal cancer surgery patients. In that study, the odds ratio for mortality in patients who received a perioperative transfusion was

Table 6. The ASA scores and mortality rate

ASA score	No. of patients (% of total)	No. of mortality (% subgroup mortality)	<i>p</i> -value
I	7 (7.3%)	0 (0.0%)	0.777 ^c
II	46 (47.9%)	7 (15.2%)	
III	37 (38.5%)	7 (18.9%)	
IV	6 (6.3%)	1 (16.7%)	

^c Chi-square test.

1.78. Ballian et al.¹⁴ concluded renal dysfunction, hypoalbuminemia, ASA classification, and old age were predictive factors for 30-day surgical mortality in patients with colonic diverticulitis.

We found that older age, increased WBC count, diabetes mellitus, hypertension, heart disease, COPD, and perioperative transfusion were associated with increased mortality (Table 2). However, statistical significance was not reached, and this is likely due to the small number of cases. Other studies have reported these factors are statistically significantly related to surgical mortality in patients with colon obstruction, colon cancer, the elderly, anastomosis leakage, colon diverticulitis, and colon perforation.^{1,2,11,12,14-18}

Surgery performed within 4 hours vs. after 4 hours was not associated with a difference in mortality rate in our study (Table 4). A prolonged waiting time before surgery will increase the severity of local contamination in patients with perforations, and physiological stress induced by bacterial translocation in obstructed patients. We suppose that a delay of treatment did not increase the mortality rate because the pathology was adequately treated and antibiotics were effective.

The mortality rates were 20.0% and 8.3% in patients with and without colorectal cancer, respectively ($p = 0.217$). If the patients were divided by malignant or benign disease, the surgical mortality rates were 20.6% and 6.1%, respectively ($p = 0.116$). We think the increased mortality rate of the cancer patients was related to numbers of patients with obstructions caused by the cancers (54 of 60 patients with colorectal cancer, and 57 of 63 patients with any cancer, Table 3). In a study of risk factors of mortality in elderly patients who underwent surgery in an elective setting for colo-

rectal cancers, the overall mortality rate was 15.5%.¹¹ However, a mortality rate of 37% was reported for patients who underwent emergent colectomies for fulminant *Clostridium difficile* infection.¹⁹ Our study did not include cases with this diagnosis. Ballian et al.¹⁴ reported a 30-day postoperative mortality rate of 5.1% in patients with perforated diverticulitis. Turrentine et al.¹² reported an overall surgical mortality rate of 7% in patients 80 years of age and older who underwent any type of surgery. Our results are comparable to the results of the aforementioned studies.

We found that mortality rate was not related to colorectal cancer stage (Table 3). This observation suggested that in our patients the surgical mortalities were the result of cancer complications, rather than cancer progression. In our experience, malignant disease did not cause death in of itself. Malignant diseases resulted in patient mortality by inducing organ failure in the terminal disease stage after tumor progression and metastasis.

The mortality rate was 8.8% in patients with perforations, and 19.4% in patients with obstructions (Table 4). These findings indicate that colon perforations, with fecal peritonitis or abscess formation, did not create a physiological impact greater than that resulting from a colon obstruction. We suppose that the physiological impact induced by perforation is due to stool leakage and bacterial contamination. However, these factors were relieved quickly after surgical resection, peritoneal irrigation, and drain tube insertion. The physiological stress induced by obstructions was the effect of sepsis caused by bacterial translocation into the blood stream. Bowel stasis will persist for days after a major abdominal surgery, and bacteria translocation will not be eradicated immediately after the surgical intervention. We think that Hartmann's procedure may create a new physiological impact in patients with obstructions, and relief of the obstruction did not occur soon enough to save the life of some of these patients.

We did not find a statistically significant relation between ASA score and mortality ($p = 0.777$) (Table 6). The small number of total patients, and patients with scores of I and IV (only 13 of 96 patients) might contribute to the lack of statistical significance.

According to our data, elevated serum creatinine level and low hemoglobin level were statistically significant predictive factors of surgical mortality for elderly patients who underwent Hartmann's procedure. We suggest surgeons treat these high risk patients with surgery as soon as possible to stop bleeding and sufficient fluid to avoid deterioration of renal function.

Conclusions

Elevated serum creatinine and low hemoglobin level were predictive factors of surgical mortality in elderly patients who underwent Hartmann's procedure for colorectal emergencies.

References

1. Pavlidis TE, Marakis G, Ballas K, Rafailidis S, Psarras K, Pissas D, et al. Safety of bowel resection for colorectal surgical emergency in the elderly. *Colorectal Dis* 2006;8:657-62.
2. Biondo S, Pares D, Frago R, Marti-Rague J, Kreisler E, De Oca J, et al. Large bowel obstruction: predictive factors for postoperative mortality. *Dis Colon Rectum* 2004;47:1889-97.
3. Oomen JL, Cuesta MA, Engel AF. Reversal of Hartmann's procedure after surgery for complications of diverticular disease of the sigmoid colon is safe and possible in most patients. *Dig Surg* 2005;22:419-25.
4. Constantinides VA, Tekkis PP, Athanasiou T, Aziz O, Purkayastha S, Remzi FH, et al. Primary resection with anastomosis vs. Hartmann's procedure in nonelective surgery for acute colonic diverticulitis: a systematic review. *Dis Colon Rectum* 2006;49:966-81.
5. Villar JM, Martinez AP, Villegas MT, Muffak K, Mansilla A, Garrote D, et al. Surgical options for malignant left-sided colonic obstruction. *Surg Today* 2005;35:275-81.
6. Hsu TC. Comparison of one-stage resection and anastomosis of acute complete obstruction of left and right colon. *Am J Surg* 2005;189:384-7.
7. Patriti A, Contine A, Carbone E, Gulla N, Donini A. One-stage resection without colonic lavage in emergency surgery of the left colon. *Colorectal Dis* 2005;7:332-8.
8. Dudley HA, Racliffe AG, McGeehan D. Intraoperative irrigation of the colon to permit primary anastomosis. *Br J Surg* 1980;67:80-1.
9. Forloni B, Reduzzi R, Paludetti A, Colpani L, Cavallari G, Frosali D. Intraoperative colonic lavage in emergency surgical treatment of left-sided colonic obstruction. *Dis Colon Rectum* 1998;41:23-7.

10. Banerjee S, Leather AJ, Rennie JA, Samano N, Gonzalez JG, Papagrigroriadis S. Feasibility and morbidity of reversal of Hartmann's. *Colorectal Dis* 2005;7:454-9.
11. Heriot AG, Tekkis PP, Smith JJ, Cohen CR, Montgomery A, Audisio RA, et al. Prediction of postoperative mortality in elderly patients with colorectal cancer. *Dis Colon Rectum* 2006;49:816-24.
12. Turrentine FE, Wang H, Simpson VB, Jones RS. Surgical risk factors, morbidity, and mortality in elderly patients. *J Am Coll Surg* 2006;203:865-77.
13. Halabi WJ, Jafari MD, Nguyen VQ, Carmichael JC, Mills S, Pigazzi A, et al. Blood transfusions in colorectal cancer surgery: incidence, outcomes, and predictive factors: an American College of Surgeons National Surgical Quality Improvement Program analysis. *Am J Surg* 2013;206:1024-32.
14. Ballian N, Rajamanickam V, Harms BA, Foley EF, Heise CP, Greenberg CC, et al. Predictors of mortality after emergent surgery for acute colonic diverticulitis: analysis of National Surgical Quality Improvement Project data. *J Trauma Acute Care Surg* 2013;74:611-6.
15. Tekkis PP, Kinsman R, Thompson MR, Stamatakis JD, Association of Coloproctology of Great Britain I. The Association of Coloproctology of Great Britain and Ireland study of large bowel obstruction caused by colorectal cancer. *Ann Surg* 2004;240:76-81.
16. Al-Homoud S, Purkayastha S, Aziz O, Smith JJ, Thompson MD, Darzi AW, et al. Evaluating operative risk in colorectal cancer surgery: ASA and POSSUM-based predictive models. *Surg Oncol* 2004;13:83-92.
17. Mueller MH, Karpitschka M, Renz B, Kleespies A, Kasperek MS, Jauch KW, et al. Co-morbidity and postsurgical outcome in patients with perforated sigmoid diverticulitis. *Int J Colorectal Dis* 2011;26:227-34.
18. Tan KK, Hong CC, Zhang J, Liu JZ, Sim R. Predictors of outcome following surgery in colonic perforation: an institution's experience over 6 years. *J Gastrointest Surg* 2011;15:277-84.
19. Pepin J, Vo TT, Boutros M, Marcotte E, Dial S, Dube S, et al. Risk factors for mortality following emergency colectomy for fulminant *Clostridium difficile* infection. *Dis Colon Rectum* 2009;52:400-5.

原 著

老年人因大腸直腸急症接受哈特曼手術後 手術死亡的預測因子

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目的 穿孔與阻塞是最常見的大腸直腸外科急症，哈特曼手術至今仍然常被使用於處置大腸直腸急症，高齡會顯著增加手術的併發症與死亡機率，本研究經由分析病歷紀錄，試圖找出高齡者接受哈特曼手術後死亡的預測因子。

方法 從 2002 年 1 月到 2006 年 12 月，將年齡大於等於 65 歲並且因大腸直腸外科急症接受哈特曼手術的病人的病歷紀錄加以分析，病人被依性別、年齡、診斷、腫瘤位置、癌症分期、檢驗數據、手術前後事件、以及美國麻醉學會 (ASA) 分數加以分組，分析所有可能預測手術死亡的因子。

結果 總共 96 位病患被列入分析，六十位病人罹患大腸直腸癌，三位有子宮頸或是卵巢癌，三十三位為良性疾病造成的大腸直腸外科急症。慢性阻塞性肺病、糖尿病、心臟病、或是高血壓跟死亡率的增加有相關，但是未達到統計學上的意義。穿孔的病人較阻塞的病人有較低的死亡率 (8.8% 與 19.4%)，但是仍然未達到統計學上的意義 ($p = 0.287$)，升高的血清肌酸酐濃度或是降低的血紅素濃度跟手術後死亡率的增加有達到統計學上的相關性。

結論 血清肌酸酐上升與血紅素降低是老年人因大腸直腸外科急症接受哈特曼手術後手術死亡的預測因子。

關鍵詞 哈特曼手術、預測因子、手術死亡、老年人。