Original Article

Chronic Obstructive Pulmonary Disease and End-Stage Renal Disease are Independent Risk Factors of Anastomotic Leakage after Sphincter-Preserving Surgery for Rectal Cancer

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Background. Anastomotic leakage after sphincter-preserving surgery for rectal cancer is serious and has impacts on therapeutic results.
Patients and Methods. 170 patients who underwent curative sphincter-preserving surgery for UICC stage I-III rectal cancer were retrospectively analyzed. Univariate and multivariate analyses of characteristics of patient and tumor, details of treatment, as well as clinical and oncological results were employed to identify risk factors for anastomotic leakage and therapeutic results.
Results. Anastomotic leakage occurred in 18 of 170 patients. By the univariate and multivariate analysis, the risk of anastomotic leakage was significantly higher in patients with chronic obstructive pulmonary disease (COPD) (OR = 9.73) or end-stage renal disease (ESRD) (OR = 11.29). Anastomotic leakage resulted in higher postoperative mortality (p = 0.004), longer postoperative hospital stay ($p < 0.001$), poorer 5-year overall survival (p = 0.007), but comparable 5-year disease-specific survival (p = 0.451).
Conclusion. COPD and ESRD were demonstrated to be independent risk factors of anastomotic leaks after sphincter-preserving surgery for patients with rectal cancer. Surgeons should be aware to manage patients with COPD or ESRD in sphincter-preserving surgery for rectal cancer.
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Key Words
Risk factor;
Anastomotic leakage;
Sphincter-preserving surgery;
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Sphincter-preserving surgery allows patients with rectal cancer to avoid a definite stoma.[1-3] The introduction of preoperative chemoradiotherapy (PRCT),[4,5] total mesorectal excision (TME),[6-8] and

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stapling techniques[9-11] made sphincter-preserving surgery possible for rectal cancer. However, anastomotic leakage is one of the most unwanted and life-threatening postoperative complications and remains a major issue for surgeons to manage in clinical practice. The reported anastomotic rate after sphincter-preserving surgery ranges from 2.5% to 17.4%[12-28] and has increased significantly since sphincter-preserving surgery is more popular for rectal cancer with anastomosis nowadays.[26,27] The consequences of anastomotic leakage may lead to increased postoperative mortality,[19,29,30] poor functional results,[31] greater local recurrence, as well as the decreased long-term survival.[25,29,32,33] Despite a number of studies being conducted to explore risk factors for anastomotic leakage after rectal cancer-specific surgery,[12-28] information of a comprehensive overview of correlation between anastomotic leakage and combination of demographic, histopathologic, and treatment characteristics, co-morbidities as well as clinical and oncologic impacts of anastomotic leakage is scant. To identify risk factors for anastomotic leakage after sphincter-preserving surgery for rectal cancer is mandatory, and occurrence of anastomotic leakage should be cautiously and carefully managed. The aim of this study is to identify the incidence and risk factors of anastomotic leakage after sphincter-preserving surgery for patients with UICC stage I-III rectal cancer at a single institution.

Patients and Methods

Patients

From January 2002 to December 2008, a total of 179 consecutive patients with rectal cancer underwent sphincter-preserving surgery at the Department of Surgery of Kaohsiung Medical University Hospital. Rectal cancer was defined as carcinomas located between the anal verge and 15 cm above it. Total mesorectal excision (TME) with sphincter preservation was performed in 179 rectal patients with UICC stage I to III, and 170 patients pathologically proven with margin-free resection (ie, no microscopic residual tumors at anastomoses) were finally enrolled into the current study. Despite the metastatic rectal cancer, rectal resection is recommended with or without synchronous liver only or lung only metastases. However, in order to investigate the oncologic influence of anastomotic leakage after sphincter-preserving surgery for rectal cancer, metastatic disease was excluded in the present study. The tumor location was measured by rigid rectoscopy or digital measurement and classified as lower rectum (< 5 cm above the anal verge), middle rectum (5-10 cm above the anal verge), and upper rectum (> 10 cm above the anal verge).

The following variables were documented: age, gender, size of tumor, tumor location, depth of tumor invasion, lymph node metastasis, International Union against Cancer (UICC) stage, vascular invasion; perineural invasion, histology, preoperative chemoradiotherapy (PRCT), body mass index (BMI), preoperative hemoglobin level, preoperative serum albumin level, co-morbidities including diabetes mellitus (DM), hypertension, chronic obstructive pulmonary disease (COPD), end-stage renal disease (ESRD), liver cirrhosis (child A and B), cardiovascular disease, operation time, perioperative bleeding amount, anastomotic method (hand suture or stapler), conventional or laparoscopic surgery, defunctioning stoma, postoperative hospital stay and disease-free survival.

Anastomotic leakage was defined as radiological evidence of fluid collection and/or pneumoperitoneum combined with clinical symptoms of fever, peritonitis, sepsis, pus and/or gas from the pelvic drain or from the rectum, development of rectovaginal, and rectovesical fistula or operation that confirmed anastomotic leakage. Postoperative mortality was defined as death within 30 days or during hospital stay. Patients were followed-up at least every 3 months in the first 2 years and then at least every half of a year thereafter. Local recurrence and distant metastasis were defined as radiological, pathological, or postmortem evidence of recurrent disease in the pelvis and distant metastases in the peritoneum, liver, lung, bone or brain. Overall, postoperative recurrence included local recurrence and distant metastasis.

All patients were followed-up until their death, and only patients who died of rectal cancer were included into the cancer-specific death category. Cancer-specific survival was defined as the time elapsed between primary surgery and death from rectal can-

cer. Overall survival was defined as the time elapsed between primary surgery and death from any cause.

Statistical analysis

All data were statistically analyzed using the Statistical Package for the Social Sciences, version 17.0 (SPSS Inc., Chicago, IL, USA). The median value of each continuous variable (age, BMI, preoperative hemoglobin and albumin levels, operation time, perioperative bleeding amount and hospital stay from operation to discharge) was used as the cut-off value to classify patients into two groups. The association between clinicopathologic characteristics and anastomotic leakage was analyzed by means of Chi-square or Fisher's exact tests as appropriate. A Cox proportional hazards model with forward stepwise variable selection was used for multivariate testing of those factors found to be significant by univariate analysis (the inclusion factors were those with a p value of less than 0.1 by univariate analysis). Overall and cancer-specific survival rates were calculated by the Kaplan-Meier method, and the differences in survival rates were analyzed by the log-rank test. A p value of less than 0.05 was considered to be statistically significant.

Results

The clinicopathologic characteristics of 170 patients with UICC stage I-III rectal cancer undergoing sphincter-preserving surgery are summarized in Tables 1 and 2. The median age of patients was 65.5 (range 28 to 89) years and 102 (60.0%) were male and 68 (40.0%) were female. There were 114 (67.1%) tumors less than 5 cm in size and 56 (32.9%) tumors larger or equal to 5 cm. Tumors were located in the upper rectum in 40 (23.5%) patients, in the middle rectum in 107 (62.9%) patients, and in the lower rectum in 23 (13.5%) patients (median: 8 cm above the anal verge; range 2 to 15 cm). 104 (61.2%) patients were UICC stage I and stage II diseases, and 66 (39.2%) patients were UICC stage III diseases. Anastomotic leakage was identified in 18 out of 170 patients (10.6 %). One third of leakage cases underwent immediate or delayed laparotomy: ileostomy for 3 patients, transverse loop colostomy for 2 patients and Hartmann's procedure for 1 patient. Computed tomography (CT)-guided transcutaneous drainage was adapted for the remaining two-thirds of the patients. Defunctioning stoma was made in 18 patients and no anastomotic leakage developed. The median length of postoperative hospital stay was 11 days (range 5 to 147) and was statistically significant between the leakage and non-leakage groups ($p < 0.001$). There was higher postoperative mortality in the leakage group (16.7% vs. 0.7%, $p = 0.004$) but distant metastasis, local recurrence and overall recurrence showed no differences between the two groups.

Univariate analysis showed that lymph node metastasis ($p = 0.049$), vascular invasion ($p = 0.092$), perineural invasion ($p = 0.079$), COPD ($p = 0.010$), and ESRD ($p = 0.003$) were factors associated with an increased risk of anastomotic leakage. No association between age, gender, tumor size, tumor location, tumor invasion depth, tumor stage, PRCT, anemia, anastomotic method, or defunctioning stoma was found. Multivariate analysis demonstrated that COPD [$p = 0.043$; odds ratio (OR): 9.73, 95% confidence interval (CI): 1.01-93.44] and ESRD ($p = 0.007$; OR: 11.29, CI: 1.95-65.42) were independent risk factors for anastomotic leakage (Table 3).

Four patients (22.2%) in the leakage group and twelve (11.8%) in the non-leakage group encountered distant metastasis ($p = 0.258$). Local recurrence occurred in one patient (5.6%) with anastomotic leakage and in twelve patients (7.9%) without anastomotic leakage ($p = 1.000$). Overall recurrence rates, including coinciding distant metastasis and local recurrence were 22.2% vs. 18.4% ($p = 0.75$). The survival rates of leakage and non-leakage patients are depicted in Fig. 1. The 5-year overall survival rates were 42.4% in the leakage patients and 68.4% in the non-leakage patients group ($p = 0.007$). On the other hand, the 5-year disease-specific survival rates were 76.9% in the leakage group and 73.5% in the non-leakage group ($p = 0.451$).

Discussion

The rate of anastomotic leakage in the present

Table 1. Univariate analysis of predictive factors for anastomotic leak in 170 patients with rectal cancer undergoing sphincter-preserving surgery

Variables	Anastomoitic leak (+) n = 18 (%)	Anastomotic leak (-) n = 152 (%)	*p* value
Gender			
Male/Female	9 (50.0)/9 (50.0)	93 (61.2)/59 (38.8)	0.360
Age (year) (median: 65.5; range 28-89)			
≦ median/> median	7 (38.9)/11(61.1)	77 (50.7)/75(49.3)	0.345
Tumor size (cm)			
< 5/≧5	12 (66.7)/6 (33.3)	102 (67.1)/50 (32.9)	0.970
Distance of tumor from anal verge (cm) (median: 8; range 2-15)			
< 5/5-10/10-15	3 (16.7)/12 (66.7)/3 (16.7)	20 (13.2)/95 (62.5)/37 (24.3)	0.743
Depth of tumor invasion			
T1+T2/T3+T4	3 (16.7)/15 (83.3)	51 (33.6)/101 (66.4)	0.186
Lymph node metastasis			
Negative/Positive	8 (44.4)/10 (55.6)	103 (67.8)/49 (32.2)	0.049
UICC stage			
Stage I + II/Stage III	8 (44.4)/10 (55.6)	96 (63.2)/56 (36.8)	0.123
Vascular invasion			
Positive / Negative	8 (44.4)/10 (55.6)	39 (25.7)/113 (74.3)	0.092
Perineural invasion			
Positive/Negative	9 (50.0)/9 (56.25)	45 (29.6)/107 (70.4)	0.079
Histology			
WD/MD/PD	1 (5.6)/17 (94.4)/0 (0)	16 (10.5)/130 (85.5)/6 (3.9)	0.534
PRCT			
Yes/No	3 (16.7)/15 (83.3)	29 (19.1)/123 (80.9)	1.000
Anastomotic method			
Hand-sewn/Stapler	8 (44.4)/10 (55.6)	54 (35.5)/98 (64.5)	0.457
Laparoscopic v.s. conventional			
Laparoscopic / Conventional	5 (27.8)/13 (72.2)	52 (34.2)/100 (65.8)	0.793
Defunctioning stoma			
Yes/No	0 (0)/18 (100.0)	18 (11.8)/134 (88.2)	0.223
Comorbidity			
DM[d] (Yes/No)	3 (16.7)/15 (83.3)	29 (19.1)/123 (80.9)	1.000
Hypertension (Yes/No)	7 (38.9)/11 (61.1)	60 (39.5)/92 (60.5)	0.962
COPD (Yes/No)	2 (11.1)/16 (88.9)	2 (1.3)/150 (98.7)	0.010
ESRD (Yes/No)	4 (22.2)/14 (77.8)	3 (2.0)/149 (98.0)	0.003
Liver cirrhosis (Yes/No)	1 (5.6)/17 (94.4)	5 (3.3)/147 (96.7)	0.494
Hyperlipidemia (Yes/No)	0 (0)/18 (100.0)	7 (4.6)/145 (95.4)	1.000
Cardiovascular disease (Yes/No)	5 (27.8)/13 (72.2)	30 (19.7)/122 (80.3)	0.536
BMI (median: 23.65; range 15.2-36.5)			
≦ median/ > median	11 (61.1)/7 (38.9)	74 (48.7)/78 (51.3)	0.319
Pre-operative Hb (g/dl) (median: 12.2; range 8.0-16.7)			
≦ median/> median/Missing	10 (55.6)/8 (44.4)	76 (50.0)/75 (49.3)/1 (0.7)	0.675
Pre-operative albumin (g/dl) (median: 3.71; range 2.49-4.78)			
≦ median / > median / Missing	7 (38.9)/9 (50.0)/2 (11.1)	65 (42.8)/62 (40.8)/25 (16.4)	0.575

UICC = International Union Against Cancer; WD = Well differentiated; MD = Moderately differentiated; PD = Poorly differentiated; PRCT = Preoperative radiochemotherapy; DM = Diabetes mellitus; COPD = Chronic obstructive pulmonary disease; ESRD = End-stage renal disease; BMI = Body mass index.

Table 2. Univariate analysis of clinical outcome of predictive factors for anastomotic leak in 170 patients with rectal cancer undergoing sphincter-preserving surgery

Variables	Anastomoitic leak (+) n = 18 (%)	Anastomotic leak (-) n = 152 (%)	*p* value
Operation time (min) (median: 245; range 110-645) ≦ median/> median	10 (55.6)/8 (44.4)	78 (51.3)/74 (48.7)	0.734
Perioperative bleeding (ml) (median: 225; range 50-1750) ≦ median/> median	11 (61.1)/7 (38.9)	75 (49.3)/77 (50.7)	0.345
Postoperative hospital stay (day) (median: 11; range 5-147) ≦ median/> median	0 (0)/18 (100)	92 (60.5)/60 (39.5)	< 0.001
Postoperative death Positive/Negative	3 (16.7%)/15 (83.3%)	1 (0.7%)/151 (99.3%)	0.004
Distant Metastasis Positive/Negative	4 (22.2%)/14 (77.8%)	18 (11.8%)/134 (88.2%)	0.258
Local recurrence Positive/Negative	1 (5.6%)/17 (94.4%)	12 (7.9%)/140 (92.1%)	1.000
Overall recurrence Positive/Negative	4 (22.2%)/14 (77.8%)	28 (18.4%)/124 (81.6%)	0.75

UICC = International Union Against Cancer; WD = Well differentiated; MD = Moderately differentiated; PD = Poorly differentiated; PRCT = Preoperative radiochemotherapy; DM = Diabetes mellitus; COPD = Chronic obstructive pulmonary disease; ESRD = End-stage renal disease; BMI = Body mass index.

Table 3. Multivariate analysis of predictive factors for 170 patients with rectal cancer undergoing sphincter-preserving surgery

Variables	*p* value	Odds ratio	95% confidence interval
Lymph node metastasis (positive/negative)	0.22	2.03	0.66-6.22
Vascular invasion (positive/negative)	0.53	1.49	0.43-5.25
Perineural invasion (positive/negative)	0.22	2.13	0.64-7.10
COPD (positive/negative)	0.043	9.73	1.11-93.44
ESRD (positive/negative)	0.007	11.29	1.95-65.42

COPD = Chronic obstructive pulmonary disease; ESRD = End-stage renal disease.

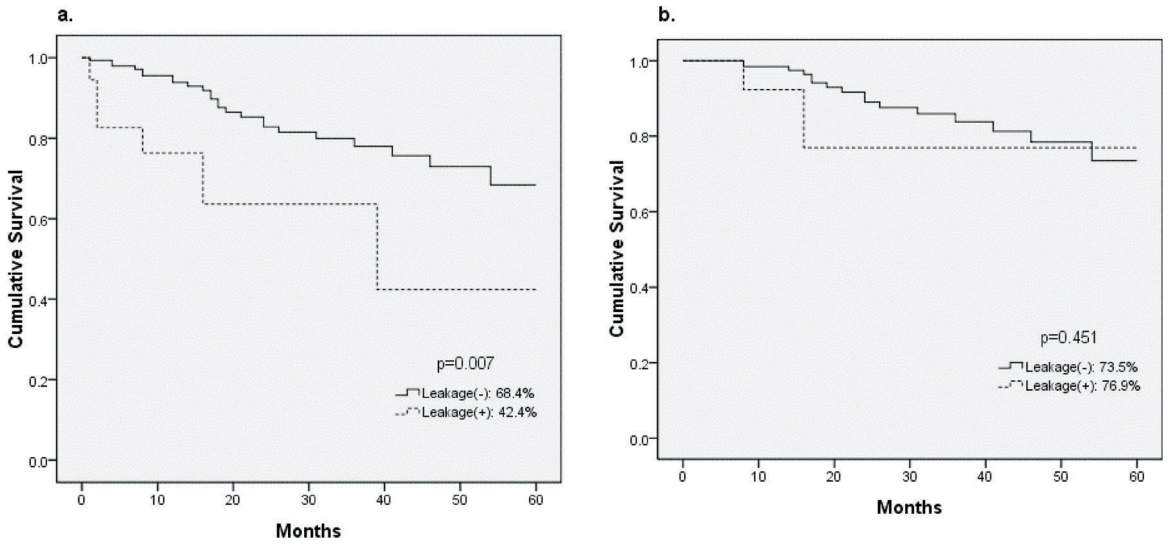

Fig. 1. Kaplan-Meier curves for (a) 5-year overall survival rate; (b) 5-year disease-specific survival in patients with or without anastomotic leakage. Anastomotic leakage resulted in poorer 5-year overall survival (42.4% vs. 68.4%, p = 0.007), but comparable 5-year disease-specific survival (76.9% vs. 73.5%, p = 0.451).

study is 10.6%, which is favorable compared to those of the reported studies ranging from 2.5% to 17.4%,[12-28] in which the definition of leakage differs. Many factors were investigated and associated with anastomotic leakage after rectal cancer surgery, including older age,[25] male gender,[14,15,18,19,23,25,26] tumor size,[24] tumor location,[13,14,18-20,23-25,27] PCRT,[18,19,21,26,27] preoperative bleeding,[20,23] smokers,[22,23] and coronary heart disease;[22] however, there was no significant correlation between these factors and anastomotic leakage in the present study. Tumor location, especially at the lower third of the rectum, is generally accepted as a risk factor for anastomotic leakage,[13,14,18-20,23-25,27] which was not revealed in this study. According to observations of Rullier et al. and Lee et al., the risk of anastomotic leakage was higher for an anastomotic level lower than 5 cm above the anal verge; whereas Matthiessen et al. and Eriksen et al. stated that the risk of anastomotic leakage was higher for an anastomotic level lower than 6 cm above the anal verge. Eberl et al. and Jung et al. reported that anastomotic leakage was more frequent in tumors located in the middle and lower rectum, however patients with middle and lower rectal cancer underwent TME and partial mesorectal excision was performed for those with upper rectal cancer in both studies. TME is the standard procedure for rectal cancer in our institute; hence, this might eliminate the influence of tumor location on anastomotic leaks. Consequently, it is the probable explanation that the higher anastomotic leak rate reported in the present study because all patients with rectal cancer received TME.

Defunctioning stoma is controversial; some reports in the literature have shown that it reduces anastomotic leakage,[14,18,23,24,27,34] whereas others have not.[13,19,21] In the present study, neither anastomotic leakage nor postoperative death developed in patients where defunctioning stoma was used. However, defunctioning stoma diverts the fecal stream and prevents severe complications, such as peritonitis, sepsis, and even death, if anastomotic leakage develops. As a result, we agree with the methodology of using defunctioning stoma in patients with risk of anastomotic leaks although there was no significant difference in our study.

Meanwhile, there was no difference between laparoscopic and conventional surgery. Laparoscopic colorectal surgery has been performed for more than a decade, and has been gradually accepted in surgical practice. Nevertheless, efficacy and safety of laparoscopic surgery applied in rectal cancer compared with conventional surgery are concerned. It's hard to conclude this issue in the present study, since there is no statistical significance between laparoscopic and conventional surgery concerning anastomotic leak rates. Currently, the American College of Surgeons Oncology Group (ACOSOG) activated an ongoing prospective randomized trial, protocol Z6051 (http://clinicaltrials.gov/ct2/show/NCT00726622) to elucidate this unclear point.

However, the present study demonstrated that COPD and ESRD were both independent factors that contributed to anastomotic leakage after sphincter-preserving surgery for rectal cancer. COPD was significantly 9.73 times higher (CI 1.11-93.44), and ESRD was significantly 11.29 times higher (CI 1.95-65.42) than in those without. Co-morbidities were seldom mentioned and seldom investigated with anastomotic leakage, either. The mechanism is unclear and needs further investigation. We try to explain the correlation between co-morbidities and anastomotic leakage based on the pathophysiology. Patients with COPD have impaired gas exchange, pulmonary hyperinflation, pulmonary vascular disease, and systemic vascular dysfunction,[36] which all may lead to ischemia at anastomosis and the resultant leakage. COPD patients are usually malnourished accompanied with body weight loss, and skeletal muscle dysfunction,[36,37] which may progress to acute respiratory failure requiring mechanical ventilator support and this probably worsens anastomotic healing. Furthermore, most patients with COPD were smokers, which was a risk factor of anastomotic leakage from reports of Kruschewski et al.[22] and Bertelsen et al.,[23] however, smoking was not included in this study because we could not retrieve valid data on smoking habits.

ESRD is both the reason and result of hypertension, and is also associated with both coronary heart disease and left ventricular hypertrophy and eventually heart failure.[38,39] In addition, due to loss of renal mass, epoetin is deficient and anemia is frequent. Furthermore, hypotension during hemodialysis may oc-

cur because of depletion of intravascular volume. All the factors mentioned above could impair delivery of oxygen to anastomosis and result in anastomotic leakage. In contrast to reports from Kruschewski et al.[22] in which coronary heart disease was a risk factor for anastomotic leakage, it may be present in ESRD. In addition, liver cirrhosis was not significantly related to anastomotic leakage might be that only child A and B patients receiving radical resection were included in the current study.

Anastomotic leakage is one of the most serious complications after rectal cancer surgery and has impacts on clinical and oncological results. Bertelsen et al. reported significantly increased 30-day mortality with anastomotic leakage at a rate of 11%.[30] In the present study, there was also more postoperative mortality in the leakage group (n = 3, 16.7% vs. n = 1, 0.7%; p = 0.004). Out of three patients, two died within 30 days and the other died before discharge. Overall median postoperative hospital stay was 11 days, and there was a significant difference between the leakage and non-leakage groups where the non-leakage patients had shorter than overall median postoperative hospital stay. The median postoperative hospital stay for patients with leakage was 26 days (range 14-147), while the median postoperative hospital stay for those without leakage was 11 days (range 5-56), consistent with results from Mattiessen et al.[18]

Other studies demonstrated that anastomotic leakage resulted in greater local recurrence and decreased long-term survival as well.[25,29,32,33] In the present study, the rate of distant metastasis was 22.2% in the leakage group and 11.8% in the non-leakage group, and the rate of local recurrence was 5.6% in the leakage group and 7.9% in the non-leakage group, respectively. In addition, the overall recurrence rate in the leakage group was 22.2% and 18.4% in the non-leakage group. No matter what distant metastasis, local recurrence or overall recurrence made no statistic significance between both groups. Consistent with Lee et al.,[26] the present study showed that the 5-year overall survival rate was significantly lower in the leakage group (42.4% vs. 68.4%, p = 0.007), but the 5-year disease-specific survival rate had no difference (76.9% vs. 73.5%, p = 0.451). This was owing to high postoperative mortality in the leakage group with anastomotic leakage following intraabdominal infection and finally, sepsis being responsible for death. The result proved that anastomotic leakage was a major postoperative complication and the consequent postoperative death contributed to a significant decline of the 5-year overall survival rate. However, there was no correlation between anastomotic leakage and local recurrence, distant metastasis, or overall postoperative recurrence. The local recurrence and overall recurrence rates were comparable to TME,[7] no matter whether in patients with or without anastomotic leakage. The present study confirmed that histopathological characteristics, including tumor stage, depth of tumor invasion, lymph node metastasis, lymphvascular invasion, and tumor differentiation, were determinant for recurrence,[7,25] instead of anastomotic leakage.

In 18 patients with anastomotic leakage, one-third was complicated with peritonitis and was managed with immediate or delayed reoperation: ileostomy for three patients, transverse loop colostomy for two patients and Hartmann's procedure for one patient. Three of them developed sepsis and they died eventually. Conservative treatment composed of no oral feeding, total parenteral nutrition, systemic antibiotics, and CT-guided percutaneous pelvic drainage, was adapted for the remaining two-thirds of the patients. Two patients had consequence of rectovaginal fistula. All patients, in which peritonitis developed, needed reoperation and had a higher mortality rate. However, it's difficult to make a conclusion about the best therapeutic strategies of anastomotic leakage owing to the small number of such cases in this study.

Conclusion

Anastomotic leakage is one of the most serious complications after sphincter-preserving surgery for rectal cancer and affects clinical and oncological results, including postoperative mortality, postoperative hospital stay, and 5-year overall survival. COPD and ESRD are independent risk factors that contribute to anastomotic leakage and should be taken into consideration before sphincter-preserving surgery for

patients with rectal cancer is carried out. However, it will be necessary to analyze clinical data from multiple institutions to find additional related variables in order to develop a more efficient and accurate way for predicting anastomotic leakage and surgical outcome for these patients.

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原　著

慢性阻塞性肺病和末期腎臟疾病對直腸癌患者行肛門括約肌保留手術後造成之吻合處滲漏是獨立的危險因子

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背景　對於直腸癌患者，在施行肛門括約肌保留手術後，產生吻合處滲漏是嚴重的情形，對治療結果也會產生重大衝擊。

病人與方法　共有 170 個 UICC 分期為一到三期的直腸癌病患，執行肛門括約肌保留手術後參與這個回溯性的研究。使用單變數和多變數分析，項目包括病人和腫瘤特性、治療方式、臨床和病理結果，全部用來分析吻合處滲漏的危險因子和治療結果的變項。

結果　170 個病患有 18 人產生吻合處滲漏。藉由單變數和多變數分析發現，慢性阻塞性肺病 (OR = 9.73) 和末期腎臟疾病 (OR = 11.29) 是造成吻合處滲漏較高的危險因子。與五年相關疾病存活率 (p = 0.451) 比較，吻合處滲漏造成較高的術後死亡率 (p = 0.004)、較長的住院天數 (p < 0.001) 和較差的五年總存活率 (p = 0.007)。

結論　慢性阻塞性肺病和末期腎臟疾病被證實是直腸癌患者行肛門括約肌保留手術後造成之吻合處滲漏的獨立危險因子。外科醫師應小心處理患有慢性阻塞性肺病或末期腎臟疾病而欲行肛門括約肌保留手術的直腸癌患者。

關鍵詞　危險因子、吻合處滲漏、肛門括約肌保留手術、直腸癌。