

**Fig. 1.** Overall survival curves of the entire patient population by treatment groups in the Dutch trial.

modest survival benefit, this study cannot be considered as solid evidence for the superiority of D2 over D1 dissection.

#### Results of Adjuvant Chemoradiotherapy

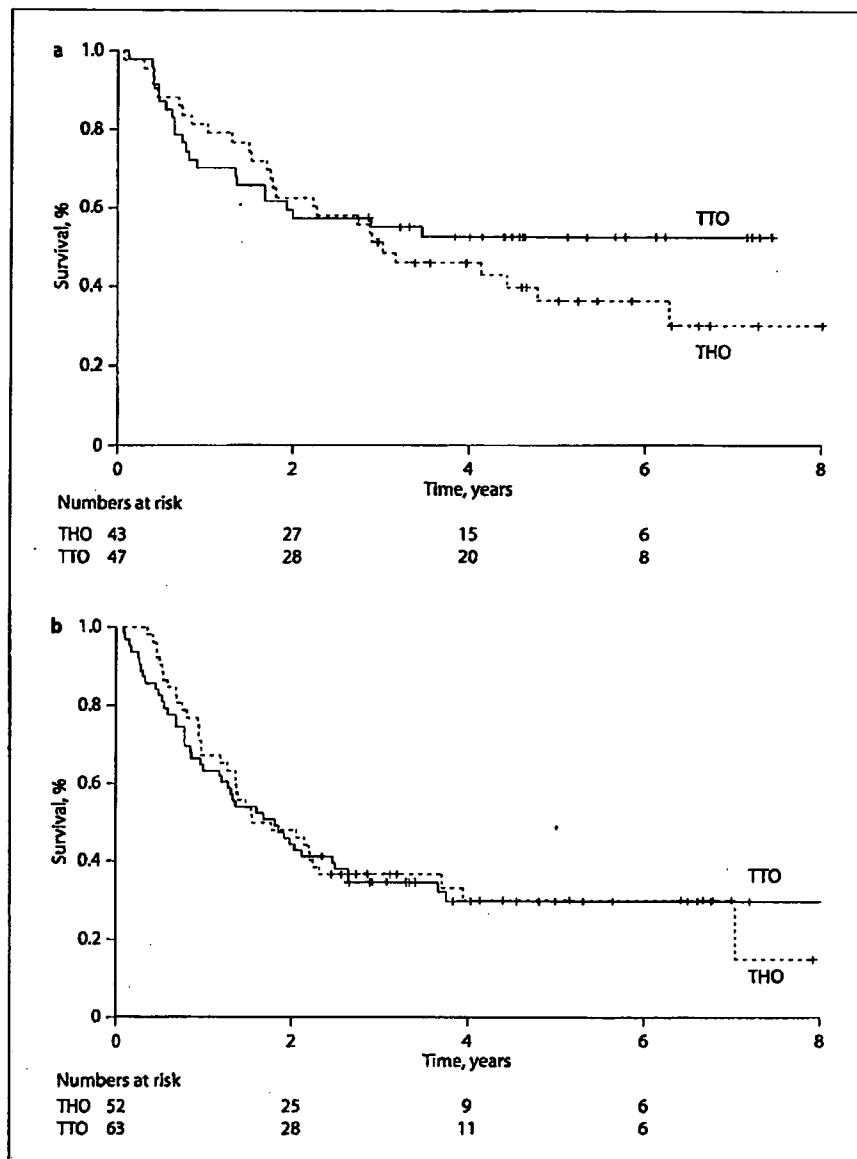
A phase III study comparing surgery alone with postoperative adjuvant chemoradiotherapy (CRT), the INT0116/SWOG9008, showed a large survival benefit of CRT for curable gastric cancer; the median survival time of surgery alone was 27 months, compared with 36 months for CRT [18]. The hazard ratio for death was 1.35 (95% CI 1.09–1.66;  $p = 0.005$ ). In this trial, the tested arm included curative surgery and radiation therapy of 45 Gy with combination chemotherapy using fluorouracil and leucovorin (5 courses of 5-day continuous infusion, including 2 courses of concomitant administration). However, detailed analysis of the type of surgery revealed that 54 and 36% of the patients underwent D0 and D1 surgery, respectively, while only 10% underwent D2 dissection. Although there was no statistically significant interaction between the subgroups divided by the degree of lymph node dissection and the effect of treatment, a benefit from treatment was observed only in the D0 or D1 group in the subset analysis [19]. In the retrospective detailed analysis, the researchers of this study found that surgical undertreatment clearly undermined the survival of patients [20]. Thus this study for the first time proved

the efficacy of local control by radiation for gastric cancer and proved that limited surgery alone cannot be sufficient treatment for this cancer.

The patient population enrolled in the test arm of this study was by chance quite similar to the population enrolled in a Japanese clinical trial comparing surgery alone with surgery followed by adjuvant CTX (JCOG9206-2) [21]. Table 3 shows the tumor and patient characteristics of the 2 groups. Most of the prognostic factors, i.e., histological type, tumor location, age, tumor size, and, most important, tumor depth, were reasonably comparable between the groups. Although these 2 groups were the patients of two different trials with two different treatment methods, they are identical and therefore the treatment results are more or less comparable. The 5-year overall survival was 42 and 61% in the INT0116 and JCOG9206-2, respectively. This suggests strongly that D2 surgery alone might produce better survival than limited surgery followed by CRT and that the effect of adjuvant CTX might not be expected after D2 as suggested by the subgroup analysis.

#### Surgical Treatment for Esophagogastric Junction Tumors

Hulscher et al. [13] reported the results of a phase III trial for Siewert type 1 and 2 tumors, comparing two surgical approaches, a transthoracic esophagogastric resection

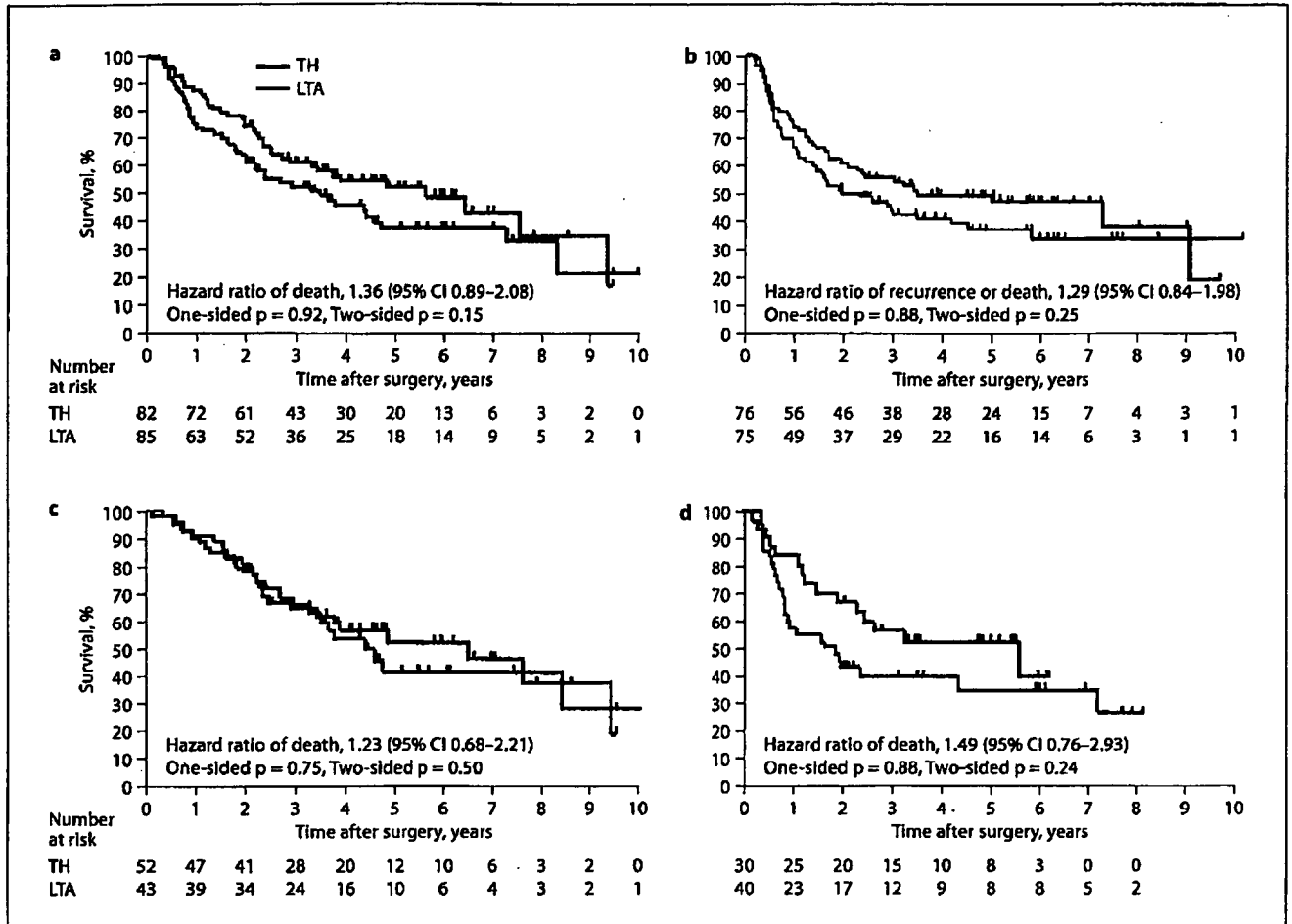


**Fig. 2.** Overall survival curves in patients with Siewert type 1 (a) and Siewert type 2 (b) tumors, by treatment groups. THO = Transthoracic esophagectomy; TTO = transhiatal esophagectomy.

via right thoracotomy with transhiatal one. The overall survival in the entire study population did not show statistically significant differences between the 2 groups. However, the actual difference in the survival curves was impressive and the overall 5-year survival rate was 29% for the transhiatal approach and 39% for the transthoracic one ( $p = 0.38$ ; fig. 1). In the subgroup analysis according to the Siewert classification, the difference in overall 5-year survival was as large as 17% (95% CI -3 to 37%) for Siewert type 1 ( $n = 90$ ), while it was only 1% for Siewert type 2 ( $n = 115$ ; fig. 2) [22]. Due to the small sam-

ple size, this study was not able to show any statistically significant difference, but the results strongly suggest that thorough mediastinal dissection via right thoracotomy is needed for Siewert type 1 but not for type 2. With higher morbidity after transthoracic dissection, the transhiatal approach might be better treatment for Siewert type 2.

Sasako et al. [23] reported the results of a phase III trial for Siewert type 2 and 3 tumors, comparing a left thoraco-abdominal approach versus a transhiatal one. All these tumors were diagnosed to have esophageal in-



**Fig. 3.** Overall survival (a) and disease-free survival (b) of the entire patient population and overall survival in patients with Siewert type 2 (c) and type 3 (d) tumors by treatment groups. TH = Transhiatal; LTA = left thoraco-abdominal. Reprinted with permission from *The Lancet Oncology* [23].

**Table 3.** Comparison between the INT0116 study and JCOG9206-2 study

	IT0116/SWOG9008	JCOG9206-2
Surgery (D0/1/2), %	54/36/10	4/67/33
Adjuvant	Rad (45 Gy)+CX (5FU+LV)	CDDP+5FU+UFT (50%), none (50%)
Number of patients	281 (tested arm)	268 (control = 133, tested = 135)
Tumor location	A (53%), Corp (24%), cardia (21%), multifocal (2%)	L (31%), M (32%), U (28%), wide (9%)
pT (T1/T2/T3/T4)	14/74/175/18	5/87/165/11
Proportion of T3/4, %	69	66
Node positive, %	85	72
TRD	3 (1.1%)	4 (1.5%)
Overall survival (5 years), %	42	control 61, tested 62

Rad = Radiation; CX = chemotherapy; LV = leucovorin; 5FU = 5-fluorouracil; CDDP = cis-diamminedichloroplatinum; UFT = uracil-ftegafur; A = antrum; Corp = gastric body; L = distal one third; M = middle one third; U = upper one third; wide = wide spread; TRD = treatment-related death.

vasion of 3 cm or less. They clearly demonstrated that there was no survival benefit from the left thoraco-abdominal approach which was accompanied by a much higher morbidity and more remarkable deterioration of pulmonary function than the transhiatal approach. The subgroup analysis showed no survival benefit for both Siewert type 2 and 3. Especially for Siewert type 3, the

transhiatal approach showed much better survival than the left thoracotomy approach (fig. 3).

From these two trials, the transhiatal approach is regarded as the standard treatment for Siewert type 2 and 3 tumors, while the transthoracic approach via right thoracotomy is recommended for Siewert type 1 tumors.

## References

- Nakajima T: Gastric cancer treatment guideline in Japan. *Gastric Cancer* 2002;5:1-5.
- Bonenkamp JJ, Hermans J, Sasako M, van De Velde CJ, et al; Dutch Gastric Cancer Group: Extended lymph-node dissection for gastric cancer. *N Engl J Med* 1999;340:908-914.
- Cuschieri A, Weeden S, Fielding J, Bancewicz J, Craven J, Joypaul V, Sydes M, Fayers P: Patient survival after D1 and D2 resection for gastric cancer: long-term results of the MRC randomized surgical trial. *Br J Cancer* 1999;79:1522-1530.
- Degiuli M, Sasako M, Ponti A, Soldati T, Danese F, Calvo F: Morbidity and mortality after D2 gastrectomy for gastric cancer: results of the Italian Gastric Cancer Study Group prospective multicenter surgical study. *J Clin Oncol* 1998;16:1490-1493.
- Maruyama K, Sasako M, Kinoshita T, Sano T, Katai H, Okabayashi K: Pancreas-preserving total gastrectomy for proximal gastric cancer. *World J Surg* 1995;19:532-536.
- Degiuli M, Sasako M, Calgaro M, Garino M, Rebecchi F, Mineccia M, Scaglione D, Andreone D, Ponti A, Calvo F: Morbidity and mortality after D1 and D2 gastrectomy for cancer: interim analysis of the Italian Gastric Cancer Study Group (IGCSG) randomized surgical trial. *Eur J Surg Oncol* 2004;30:303-308.
- Robertson CS, Chung SC, Woods SD, et al: a prospective randomized trial comparing R1 subtotal gastrectomy with R3 total gastrectomy for antral cancer. *Ann Surg* 1994;220:176-182.
- Cuschieri A, Fayers P, Fielding J, Craven J, Bancewicz J, Joypaul V, Cook P; Surgical Co-operative Group: Postoperative morbidity and mortality after D1 and D2 resections for gastric cancer: preliminary results of the MRC randomised surgical trial. *Lancet* 1996;347:995-999.
- Roviello F, Marrelli D, Morgagni P, de Manzoni G, Di Leo A, Vindigni C, Saragoni L, Tomezzoli A, Kurihara H, Italian Research Group for Gastric Cancer: Survival benefit of extended D2 lymphadenectomy in gastric cancer with involvement of second level lymph nodes: a longitudinal multicenter study. *Ann Surg Oncol* 2002;9:894-900.
- Sasako M: Principles of surgical treatment for curable gastric cancer. *J Clin Oncol* 2003;21(suppl):274s-275s.
- Japanese Research Society for the Gastric Cancer: The general rules for the gastric cancer study in surgery and pathology. *Jpn J Surg* 1981;11:418-425.
- Sasako M: Risk factors for surgical treatment in the Dutch Gastric Cancer Trial. *Br J Surg* 1997;84:1567-1571.
- Hulscher JBF, van Sandick JW, de Boer AGEM, Wijnhoven BPL, Tijssen JGP, Fockens P, Stalmeier PFM, ten Kate FJW, van Dekken H, Obertop H, Tilanus HW, van Lanschot JJB: Extended transthoracic resection compared with limited transhiatal resection for adenocarcinoma of the esophagus. *N Engl J Med* 2002;347:1662-1669.
- Bunt TMG, Bonenkamp JJ, Hermans J, van de Velde CJH, Arends JW, Fleuren G, Bruijn JA: Factors influencing noncompliance and contamination in a randomized trial of 'Western' (R1) versus 'Japanese' (R2) type surgery in gastric cancer. *Cancer* 1994;73:1544-1551.
- Degiuli M, Sasako M, Ponti A, Calvo F: Survival results of a multicenter phase II study to evaluate D2 gastrectomy for gastric cancer. *Br J Cancer* 2004;90:1727-1732.
- Wu CW, Hsiung CA, Lo SS, Hsieh MC, Chen JH, Li AFY, Lui WY, Peng JW: Nodal dissection for patients with gastric cancer: a randomized controlled trial. *Lancet Oncol* 2006;7:309-315.
- Japanese Gastric Cancer Association: Japanese Classification of Gastric Carcinoma, ed 1. Tokyo, Kanahara, 1995, p 15.
- Macdonald JS, Smalley SR, Benedetti J, Este SANC, Stemmermann NG, Haller DG, Ajani JA, Gunderson LL, Jessup JM, Martenson JA: Chemoradiotherapy after surgery compared with surgery alone for adenocarcinoma of the stomach or gastroesophageal junction. *N Engl J Med* 2001;345:725-730.
- Macdonald JS: Postoperative combined radiation and chemotherapy improves disease-free survival (DFS) and overall survival (OS) in resected adenocarcinoma of the stomach and gastroesophageal junction: update of the results of Intergroup Study INT-0116 (SWOG 9008). Virtual Meeting of ASCO GI Symposium.
- Hundahl SA, Macdonald JS, Benedetti J, Fitzsimmons T: Surgical treatment variation in a prospective, randomized trial of chemoradiotherapy in gastric cancer: the effect of undertreatment. *Ann Surg Oncol* 2002;9:278-286.
- Miyashiro I, Furukawa H, Sasako M, Yamamoto S, Nashimoto A, Nakajima T, Kinoshita T, Kobayashi O, Arai K; Gastric Cancer Surgical Study Group of the Japan Clinical Oncology Group: No survival benefit with adjuvant chemotherapy for serosa-positive gastric cancer (JCOG9206-2). *Proc 2005 Gastrointestinal Cancer Symp*, p 84.
- Hulscher JBF, van Lanschot JJ: Individualised surgical treatment of patients with an adenocarcinoma of the distal oesophagus or gastro-oesophageal junction. *Dig Surg* 2005;22:130-134.
- Sasako M, Sano T, Yamamoto S, Saironji M, Arai K, Kinoshita T, Nashimoto A, Hiratsuka M: Left thoracoabdominal approach versus abdominal-transhiatal approach for gastric cancer of the cardia or subcardia: a randomised controlled trial. *Lancet Oncol* 2006;7:644-651.

# Influence of Overweight on Surgical Complications for Gastric Cancer: Results From a Randomized Control Trial Comparing D2 and Extended Para-aortic D3 Lymphadenectomy (JCOG9501)

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**Background:** The impact of overweight on the outcome of gastrectomy with lymphadenectomy is controversial, and data from a well-controlled, randomized study are needed to identify a possible relationship.

**Methods:** We used data from 523 patients registered for a prospective randomized trial comparing D2 and extended para-aortic D3 lymphadenectomy to compare the effects of body mass index (BMI) and the extent of lymphadenectomy for the development of general or major surgical complications (anastomotic leakage, abdominal abscess, and pancreatic fistula).

**Results:** Seventy-seven patients were classified as overweight with BMI  $\geq 25$ , and 38 and 39 of these patients underwent a D2 or D3 lymphadenectomy, respectively. Among the 446 patients classified as nonoverweight with BMI  $< 25$ , 225 received D2 and 221 received D3 lymphadenectomy. Surgical complications, operation time, and blood loss were statistically significantly associated with BMI, and logistic regression analysis revealed that overweight directly affected the occurrence of surgical complications even after considering operation time

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and blood loss as intermediate factors instead of outcome variables. Among patients undergoing D2 lymphadenectomy, being overweight increased the risk for surgical complications and blood loss, whereas overweight was associated with only blood loss and operation time among patients receiving D3 lymphadenectomy.

**Conclusions:** Overweight increased the risk of surgical complications in patients undergoing gastrectomy both directly and indirectly through operation time and blood loss. The impact of overweight on surgical complications was more evident in patients undergoing a D2 dissection.

**Key Words:** Overweight—BMI—Complication—Gastric cancer—RCT—JCOG.

The incidence of overweight and obesity has been increasing in the general population, but the impact of overweight on surgical outcomes is unclear. Cancer surgery in overweight patients often takes longer and is associated with greater blood loss than in lean individuals as a result of the presence of excessive fat tissue impairing surgical procedures and lymph node dissection. The influence of overweight on the outcomes, e.g., surgical complications, surgical quality, hospital stay, and prognosis, of gastrectomy with D2 lymph node dissection for patients with gastric cancer is controversial.<sup>1-5</sup> These data were derived retrospectively from a single institution, but the surgical procedures and disease stages varied.

A prospective study from multiple institutions that use a similar surgical procedure is the ideal means to assess the impact of overweight on surgical outcomes and overall prognosis. A randomized trial, Japan Clinical Oncology Group (JCOG) 9501, was launched in 1995 to explore the potential survival benefit of extended para-aortic D3 dissection over standard D2 dissection. This trial provided the opportunity to prospectively evaluate collected data regarding the effect of overweight on surgical outcome after D2 or D3 dissection. Because a patient's physical condition, including body mass index (BMI), could affect treatment indications for either D2 or D3, an observational study may not correctly compare potential differences between groups. Thus, we used the JCOG data to investigate the interaction of D2/D3 dissection and overweight on surgical complications in a randomized trial. In addition, we examined whether overweight directly influences the occurrence of complications or if the effects of overweight may be mediated by associated factors, such as operation time and blood loss.

## PATIENTS AND METHODS

Between June 1995 and April 2001, a total of 523 patients registered in the JCOG9501 study were randomly allocated to either D2 (n = 263) or D3

dissection (n = 260) by balancing the groups according to institution, tumor growth pattern (expansive vs. infiltrative growth) and tumor (T) stage (cT2b vs. cT3/cT4). Patients aged <76 years with histologically proven and resectable primary gastric carcinoma with an estimated depth of SS (invading subserosa: cT2b), SE (penetrating serosa: cT3), or SI (invading adjacent structures: cT4) were recruited after providing informed consent as described elsewhere.<sup>6</sup> Patients with free cancer cells by cytological examination of peritoneal washes and those with type 4 tumor (limitis plastica type) were excluded.

Patients underwent appropriate gastrectomy with systematic lymphadenectomy as allocated by the study protocol. Perigastric lymph nodes (nodal station nos. 1, 3, 4, 5, and 6 according to the Japanese Classification of Gastric Cancer) and nodes at the base of the left gastric artery (no. 7), along the common hepatic artery (no. 8) and at the base of the splenic artery (no. 11) were routinely resected. Lymph nodes along the hepatoduodenal ligament and behind the pancreatic head (nos. 12 and 13) were resected when the primary lesion was located in the lower third of the stomach. Lymph nodes along the left side of the cardia (no. 2), within the splenogastric ligament (no. 4sa) and at the splenic hilum (no. 10), were resected with the spleen when total or proximal gastrectomy was performed. In patients randomized to a D3 lymphadenectomy group, para-aortic lymph nodes from the level of the celiac trunk down to the root of the inferior mesenteric artery (nos. 16a2 and 16b1) were dissected. The mode of reconstruction after resection was not specified.

Information on complications (including major surgical complications) and patient backgrounds (including height and body weight) was extracted from the case report forms for the trial. In this study, anastomotic leakage, pancreatic fistula, and abdominal abscess are defined as surgical complications. Anastomotic leakage was defined as dehiscence confirmed by radiographic examination that used contrast medium. Pancreatic fistula was diagnosed if

there was prolonged purulent discharge that contained pancreatic juice from the drainage tube. In addition, pneumonia and other complications were evaluated as complications.

According to the World Health Organization classification, BMI  $\geq 25$  is considered as overweight and BMI  $< 25$  as nonoverweight.<sup>7</sup> Factors that might affect the risk of overall and major surgical complications, such as sex, age, tumor location, pathological (p) T category (pT2 and pT3 vs. pT4), extent of lymphadenectomy, type of gastrectomy, splenectomy, and pancreatectomy were evaluated as potential confounding factors. The difference in the distribution of these factors between BMI  $< 25$  and BMI  $\geq 25$  were examined by  $\chi^2$  test. The effect of overweight on the complications was evaluated by odds ratio. In addition, the effect of overweight on operating time, amount of blood loss, need for autologous blood transfusion, reoperation, and hospital death was also evaluated by odds ratio. Operating time, blood loss, and the number of retrieved lymph nodes were divided into tertiles as previously described<sup>8</sup> and used as binary variables by dichotomizing the highest tertiles and the remaining two tertiles because biologically meaningful cutoff points could not be defined. In addition to the univariate analysis, all the analyses were conducted adjusting all the potential confounding factors by logistic regression.

To evaluate the effect of overweight on complications, logistic regression on the complications were conducted with overweight as exposure and operating time and blood loss as intermediate factors in addition to the other potential confounding variables. This analysis reveals whether overweight affects complications directly, or indirectly through these intermediate factors.

To see the difference of the effect of overweight between D2 and D3 dissection, all the analyses were repeated separately for the D2 and D3 subgroups, and these interactions were also evaluated. All statistical analyses were performed SAS software version 8.12 (SAS Institute, Tokyo, Japan). *P* values less than .05 were considered statistically significant, and all tests were two-sided.

## RESULTS

Seventy-seven patients were classified as overweight with BMI  $\geq 25$ , and 38 and 39 of these patients underwent D2 or D3 lymphadenectomy, respectively. In 446 patients classified as nonoverweight with BMI

TABLE 1. Backgrounds of patients according to body mass index (BMI)

Factor	BMI < 25 (n = 446)	BMI $\geq 25$ (n = 77)	Total number	<i>P</i> value
Sex				
M	301	57	358	.26
F	145	20	165	
Age				
< 56	137	23	160	.93
56-65	176	31	207	
> 65	133	23	156	
Location				
A (lower third)	188	29	217	.59
M (middle third)	173	33	206	
C (upper third)	85	15	100	
Clinical tumor stage				
cT2b	161	31	192	.38
cT3	268	41	309	
cT4	17	5	22	
Lymph node dissection				
D2	225	38	263	.86
D3	221	39	260	
Type of gastrectomy				
Distal	272	48	320	.82
Total/proximal	174	29	203	
Splenectomy				
No	283	49	332	.98
Yes	163	28	191	
Pancreatectomy				
No	427	74	501	.88
Yes	19	3	22	

$< 25$ , 225 received D2 and 221 received D3 lymphadenectomy. Total gastrectomy was performed in 199 (38.0%) of 523 patients and proximal gastrectomy in 4; the remaining patients underwent distal gastrectomy. Splenectomy was performed in 191 patients (36.5%) and distal pancreatectomy in 22 (4.2%). The background characteristics of patients with different BMIs are listed in Table 1. There were no statistically significant differences in sex, age, tumor location, clinical T stage, lymph node dissection, type of gastrectomy, and incidence of combined resection between the two groups, and the two groups were well balanced.

In the entire sample, any complications were identified in 128 patients (24.5%), and major surgical complications occurred in 49 patients (9.4%). Among overweight patients, however, the proportion developing either any or surgical complications was 35.1% and 19.5%, respectively. When assessed by univariate analysis, overweight statistically significantly increased the risk for pancreatic fistula, abdominal abscess, operation time, and blood loss (Table 2). Additionally, the number of retrieved lymph nodes was less in overweight patients. Multivariate analysis identified that overweight was significantly associated

TABLE 2. Effect of overweight on postoperative complications and other outcome variables<sup>a</sup>

Factors	BMI < 25	BMI ≥ 25	Univariate analysis		Multivariate analysis	
			Odds ratio of BMI > 25 (95% CI)	P value	Odds ratio of BMI > 25 (95% CI)	P value
Operation time (min)						
> 297	141	36	1.90 (1.16–3.10)	.01	2.24 (1.29–3.87)	.004
≤297	305	41	–		–	
Blood loss (mL)						
> 710	131	44	3.21 (1.95–5.26)	< .001	3.74 (2.19–6.39)	< .001
≤710	315	33	–		–	
Blood transfusion						
Yes	98	17	1.01 (.56–1.80)	.98	1.10 (.59–2.03)	.77
No	348	60	–		–	
No. of retrieved lymph nodes						
≤54	137	33	1.69 (1.03–2.77)	.037	1.82 (1.06–3.14)	.031
> 54	309	44	–		–	
Reoperation						
Yes	9	3	1.97 (.52–7.44)	.32	1.85 (.47–7.29)	.38
No	437	74	–		–	
Hospital death						
Yes	3	1	1.94 (.20–18.92)	.56	1.96 (.20–19.50)	.56
No	443	76	–		–	
Any complication						
Yes	101	27	1.84 (1.10–3.10)	.021	1.90 (1.11–3.24)	.019
No	345	50	–		–	
Surgical complication						
Yes	34	15	2.93 (1.51–5.69)	.002	3.35 (1.65–6.78)	< .001
No	412	62	–		–	
Anastomotic leak						
Yes	8	3	2.22 (.58–8.56)	.25	2.14 (.54–8.47)	.28
No	438	74	–		–	
Pancreatic fistula						
Yes	20	10	3.18 (1.43–7.09)	.005	4.18 (1.71–10.22)	.002
No	426	67	–		–	
Abdominal abscess						
Yes	19	10	3.35 (1.50–7.52)	.003	3.51 (1.52–8.12)	.003
No	427	67	–		–	
Pneumonia						
Yes	12	4	1.98 (.62–6.31)	.25	1.88 (.58–6.13)	.29
No	434	73	–		–	
Other complication						
Yes	65	11	0.98 (.49–1.95)	.95	0.97 (.48–1.95)	.93
No	381	66	–		–	

BMI, body mass index; 95% CI, 95% confidence interval.

<sup>a</sup> Multivariate covariables: BMI, sex, age, tumor location, clinical tumor stage, lymph node dissection, type of gastrectomy, splenectomy, pancreatectomy.

with pancreatic fistula, abdominal abscess, operation time, and blood loss, and the odds ratios (95% confidence intervals) were 4.18 (1.71–10.22), 3.51 (1.52–8.12), 2.24 (1.29–3.87), and 3.74 (2.19–6.39), respectively. The number of retrieved lymph nodes decreased in overweight patients with an odds ratio of 1.82 (1.06–3.14). When operation time and blood loss were treated as intermediate factors, the odds ratios for the development of pancreatic fistula and abdominal abscess decreased to 3.48 and 2.47, respectively, but were still statistically significant.

We next analyzed the D2 (n = 263) and D3 (n = 260) dissection subgroups (Table 3). In the D2 subgroup, overweight was significantly associated with pancreatic fistula, abdominal abscess, and blood loss

with odds ratios (95% confidence intervals) of 4.74 (1.42–15.89), 4.72 (1.49–14.99), and 2.83 (1.33–6.04), respectively. In the D3 subgroup, only blood loss with an odds ratio of 5.05 (2.27–11.26) and operation time with an odds ratio of 2.27 were significantly associated with overweight, although the interaction P values between the D2 and D3 subgroups were not statistically significant for any of the factors examined.

## DISCUSSION

We clearly showed that overweight patients are at increased risk for the development of organ/space



**TABLE 3.** Effect of overweight on postoperative complications and other outcome variables stratified with lymph node dissection (D2 or D3)<sup>a</sup>

Factor	D2 subgroup (n = 263)		D3 subgroup (n = 260)		Interaction P value
	Multivariate odds ratio of BMI ≥ 25 (95% CI)	P value	Multivariate odds ratio of BMI ≥ 25 (95% CI)	P value	
Operation time					
Operation time > 297 min	2.19 (.96–5.02)	.063	2.27 (1.09–4.73)	.028	.95
Blood loss > 710 mL	2.83 (1.33–6.04)	.007	5.05 (2.27–11.26)	< .001	.30
Blood transfusion	1.73 (.70–4.26)	.23	0.78 (.34–1.79)	.56	.20
No. of retrieved lymph nodes ≤ 54	2.73 (1.28–5.85)	.01	1.06 (.43–2.62)	.9	.12
Reoperation	4.21 (.64–27.61)	.13	0.82 (.09–7.39)	.86	.27
Hospital death	6.82 (.40–117.43)	.19	NE	.98	.94
Any complication	2.62 (1.23–5.61)	.013	1.39 (.65–2.98)	.4	.25
Surgical complications	4.20 (1.59–11.10)	.004	2.60 (.91–7.40)	.074	.51
Anastomotic leak	2.77 (.47–16.19)	.26	1.49 (.16–14.09)	.73	.67
Pancreatic fistula	4.74 (1.42–15.89)	.012	3.61 (.96–13.55)	.057	.77
Abdominal abscess	4.72 (1.49–14.99)	.009	2.55 (.73–8.85)	.14	.48
Pneumonia	2.81 (.79–10.04)	.11	NE	.97	.94
Other complications	1.08 (.34–3.37)	.9	0.91 (.37–2.23)	.83	.82

BMI, body mass index; NE, not able to estimate.

<sup>a</sup> Covariables: BMI, sex, age, tumor location, clinical tumor stage, type of gastrectomy, splenectomy, pancreatectomy.

surgical site infection (SSI) (abdominal abscess and pancreatic fistula) complications after gastrectomy with D2 or D3 dissection. Risk factors for the development of SSI in abdominal surgery have been intensively investigated. The presence of a preoperative cutaneous abscess or necrosis, sutures or anastomoses of the bowel, postoperative abdominal drainage, surgical treatment for cancer, and postoperative anticoagulant therapy were identified as risk factors for SSI in noncolorectal abdominal surgery.<sup>9</sup> However, others reported that operation time was the only statistically significant risk factor for SSI after gastrectomy,<sup>10</sup> and in colorectal surgery, diabetes and a 10% weight loss were associated with SSI.<sup>11</sup> Among all of these studies, overweight was not identified as a risk factor for SSI. BMI exhibited a direct relationship with operation time in cholecystectomy, colectomy, and unilateral mastectomy, but it was not associated with surgical complications.<sup>12</sup> Thus, BMI may not directly influence the occurrence of surgical complications or SSI in abdominal surgery, but increased operation time and blood loss secondary to BMI may be responsible for any identified negative outcomes. However, we analyzed operation time and blood loss as intermediate factors instead of outcome variables, and BMI was still associated with the development of pancreatic fistula and abdominal abscess, as seen previously.<sup>8</sup> This fact suggests that BMI has a direct effect on surgical complications besides indirect effects through operation time or blood loss.

Practically, the presence of a large amount of the viscera may disturb drainage of exudates and coag-

ula, and excess fatty tissue may become necrotic more easily as a result of surgical manipulation. In addition, the demarcation between pancreas and fat tissues in overweight individuals is obscure because of greater fat deposition in the pancreas.<sup>13,14</sup> This could also be relevant in cases of gastrectomy requiring peripancreatic nodal dissection and mobilization of the pancreas. These factors may contribute to the increased occurrence of abdominal abscess and pancreatic fistula in overweight surgical patients.

Whites in general have a higher BMI than Japanese individuals, and the incidence of morbid obesity is marked and growing among patients in the United States and Europe. The proportions of patients with BMI ≥ 25 and BMI > 30 in the present study were only 14.7% and 1.0%, respectively, whereas one-third of the U.S. population is obese (BMI > 27).<sup>15</sup> These differences in patients' physique may partly explain observed differences in mortality and morbidity between the UK Medical Research Council (MRC) and Dutch trials and the present study.<sup>16,17</sup> The mortality of patients undergoing D2 dissection in the two Western studies was 13% and 10%, whereas morbidity was 46% and 43%. In contrast, we observed only 1.3% mortality and 35.1% morbidity in overweight patients undergoing D2 or D3 dissection. In addition to possible differences in patients' physique, experience and workload volume of surgeons are important factors that could contribute to different surgical outcomes.

In patients undergoing D2, but not D3, dissection, overweight was associated with surgical complications. Although these differences were not statistically

significant, this may be because of low statistical power to test the interactions. In contrast, only the odds ratios of long operation time and excessive blood loss increased were statistically significant in the D3 dissection group, as reported previously.<sup>6</sup> The increased risk of complications in nonoverweight patients in the D3 subgroup could explain these differences. Indeed, the cumulative incidence of all complications in normal patients was 17.8% in the D2 subgroup and 27.6% in the D3 subgroup. Thus, greater care should be taken in performing gastrectomy not only in all patients undergoing D3 dissection, but also in overweight patients undergoing D2 dissection.

The relationship between overweight and overall prognosis in patients with cancer is an important issue to resolve. The presence of excess fat impairs precise nodal dissection and decreases the yield of lymph nodes. In this study, the number of lymph nodes retrieved from overweight patients was far less compared with nonoverweight patients undergoing a D2, but not D3, dissection. In addition to the quality of lymph node dissection, comorbid conditions associated with overweight, such as cardiovascular diseases, pulmonary dysfunction, diabetes, and hypertension, may negatively affect the prognosis of postoperative patients.<sup>18</sup> The relationship between overweight and overall survival in patients with gastric cancer remains controversial.<sup>1-4</sup> A conclusive result cannot be obtained without a well-controlled prospective study, and the final results of the JCOG9501 trial should answer this important question. However, the present study provides some insight into this issue.

The proportion of overweight patients in this trial was low (14.7%). Therefore, the obtained results are not definitely conclusive, but they clearly suggest that caution is needed when performing gastrectomy for gastric cancer in overweight patients. In conclusion, overweight increased the risk of surgical complications in patients undergoing gastrectomy with lymphadenectomy.

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#### REFERENCES

1. Kodera Y, Ito S, Yamamura Y, et al. Obesity and outcome of distal gastrectomy with D2 lymphadenectomy for carcinoma. *Hepatogastroenterology* 2004; 51:1225-8.
2. Inagawa S, Adachi S, Oda T, Kawamoto T, Koike N, Fukao K. Effect of fat volume on postoperative complications and survival rate after D2 dissection for gastric cancer. *Gastric Cancer* 2000; 3:141-4.
3. Dhar DK, Kubota H, Tachibana M, et al. Body mass index determines the success of lymph node dissection and predicts the outcome of gastric carcinoma patients. *Oncology* 2000; 59:18-23.
4. Barry JM, Blackshaw GRJC, Edwards P, et al. Western body mass indices need not compromise outcomes after modified D2 gastrectomy for carcinoma. *Gastric Cancer* 2003; 6:80-5.
5. Moriwaki Y, Kunisaki C, Kobayashi S, Harada H, Imai S, Kasaoka C. Does body mass index (BMI) influence morbidity and long-term survival in gastric cancer patients after gastrectomy?. *Hepatogastroenterology* 2003; 50:284-8.
6. Sano T, Sasako M, Yamamoto S, et al. Gastric cancer surgery: results of morbidity and mortality of a prospective randomized trial (JCOG9501) comparing D2 and extended para-aortic lymphadenectomy. *J Clin Oncol* 2004; 22:2767-73.
7. Seidell JC, Flegal KM. Assessing obesity: classification and epidemiology. *Br Med Bull* 1997; 53:238-52.
8. Kodera Y, Sasako M, Yamamoto S, Sano T, Nashimoto A, Kurita A. Identification of risk factors for the development of complications following extended and superextended lymphadenectomy for gastric cancer. *Br J Surg* 2005; 92:1103-9.

9. Pessaux P, Msika S, Atalla D, Hay J-M, Flamant Y. Risk factors for postoperative infectious complications in noncolorectal abdominal surgery: a multivariate analysis based on a prospective multicenter study of 4718 patients. *Arch Surg* 2003; 138:314-24.
10. Imai E, Ueda M, Kanao K, Miyaki K, Kubota T, Kitajima M. Surgical site infection surveillance after open gastrectomy and risk factors for surgical site infection. *J Infect Chemother* 2005; 11:141-5.
11. Tang R, Chen HH, Wang YL, et al. Risk factors for surgical site infection after elective resection of the colon and rectum: a single-center prospective study of 2,809 consecutive patients. *Ann Surg* 2001; 234:181-9.
12. Hawn MT, Bian J, Leeth RR, et al. Impact of obesity on resource utilization for general surgery procedures. *Ann Surg* 2005; 241:821-8.
13. Yeo C, Cameron JL, Maher MM, et al. A prospective randomized trial of pancreaticogastrostomy versus pancreaticojejunostomy after pancreaticoduodenectomy. *Ann Surg* 1995; 222:580-8.
14. Yang YM, Tian XD, Zhuang Y, Wang WM, Wan YL, Huang YT. Risk factors of pancreatic leakage after pancreaticoduodenectomy. *World J Gastroenterol* 2005; 11:2456-61.
15. Kuczmarski RJ, Flegal KM, Campbell SM, Johnson CL. Increasing prevalence of overweight among US adults. *JAMA* 1994; 272:205-11.
16. Cuschieri A, Fayers P, Fielding J, et al. Postoperative morbidity and mortality after D1 and D2 resection for gastric cancer: preliminary results of the MRC randomised controlled surgical trial. *The Surgical Cooperative Group. Lancet* 1996; 347:995-9.
17. Bonenkamp JJ, Songun K, Hermans J, et al. Randomised comparison of morbidity after D1 and D2 dissection for gastric cancer in 996 Dutch patients. *Lancet* 1995; 345:745-8.
18. Pi-Sunyer FX. Medical hazards of obesity. *Ann Intern Med* 1993; 119:655-60.

# Urology View

[別刷]

メジカルビュー社

# 非神経温存前立腺広汎切除術 における排尿機能

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前立腺全摘除術における排尿機能については、とかく術後の尿失禁のみが強調される傾向がある。もちろんこれはこの手術における術後後遺症として重要であるが、単に尿禁制のみではなく、排尿困難のない適切な排尿も重要な因子であると考えている。つまり失禁はないが逆に排尿困難があるような症例が見受けられるが、めざすものは、このような点についてもより自然に近い形で機能回復が望ましいと考えている。

かねてから局所進行癌に対しても根治を可能とする広汎前立腺切除術を開発、施行してきた。この方法は確実な切除を可能にすることを目的として開発されたが、結果的に前立腺尖部の把握を、より正確にすることが可能で、確実な切除のみにとどまらず術後の排尿機能についてむしろ良好な方向に作用しているように思われる。

実際には確実な切除断端を確保しながら機能を温存するための尖部の位置関係の把握が重要である。さらにどのような再建を行うかが次のポイントと考えている。具体的に「私はこうして

いる、ここにこだわっている」という点を概説する。

## 直腸固有筋膜の処理と 尖部の確認

広汎前立腺全摘除術についてはすでにいくつかの成書に記載してきた<sup>1,2)</sup>。概要を解説する。

まず内骨盤筋膜を切開して直腸固有筋層が認められるまで肛門挙筋を剝離する。前立腺尖部付近では肛門挙筋が前立腺外側に付着していることが多々ある。このような場合にはこの段階では無理に剝離は行わない。直腸固有筋膜をよく観察する。このとき多数の血管が認められる場合、これは前立腺の神経血管束であり、このような場合にはさらに外側に剝離を進める。このような処理を行うことで最終的には固有筋膜に包まれた直腸が濃い黄色調の脂肪を伴って確認される。

次に固有筋膜の縦切開を行う。展開された直腸のちょうど中心付近で血管の疎な場所を選んで切開を開始する。脂肪織の切開を進めると、尾側より脂

肪織が持ち上がってくるような場面に出くわす。これは直腸からの流出静脈であり、この周囲を剥離して静脈を把持する。このことにより直腸筋層への「道しるべ」を得た状態となる。なぜならこの静脈は最終的には直腸筋層から分枝しているからである。この静脈を絹糸で保持することにより後の展開は容易となる。

静脈に沿って、より中枢に剥離を進めると直腸筋層が確認される。直腸筋層付近になると構造が急に粗なfasciaとなる。慣れてくると、このことにより直腸筋層が近いことが認識できる。筋層が確認されたら、末梢に向かい剥離を進める。大切なことは直腸と平行に剥離を進めることである。ともすれば前立腺側に剥離をしがちである。神経血管束から無用な出血をみる原因となる。一般的に生検などの影響が軽微な場合、容易に末梢に向かい剥離が可能である。

剥離を進めると、あるポイントから容易に剥離ができなくなる。これは腱中心に到達したことを意味する。末梢に向かう剥離はここまでとし、直腸を外側に牽引しながら前立腺後面との間の剥離を進めるが、無理に左右を交通することはしない。これはそもそも直腸尿道筋の前立腺との付着のため剥離が難しいことと、盲目的な処理は直腸損傷の危険があるためである。癒着を認めない場合には前立腺尖部後面で容易に左右を貫通することが可能であるが、直視下での処理が困難なこともあり、あまり好まない。

直腸尿道筋は精囊付近で前立腺に付

着しており、この部分をのぞいては筋層を維持することで剥離が可能である。付着部では電気メスで切開することで初めて剥離が可能となる。

最後に最も中枢で直腸筋層の露出を横方向に進める。これは前立腺を逆行性に処理する際、直腸尿道筋、直腸筋層、前立腺を剥離する際の重要なメルクマールとなる。直腸尿道筋と前立腺との付着について模式的に図1に示した。

### 前立腺尖部の把握とDVCの処理

前立腺尖部の形態はさまざまである。前立腺尖部前面と後面のレベルがずれているような場合には前立腺尖部の把握には相当な技術が必要である。特に後面の前立腺が張り出したような場合、前面のみの情報により処理を行うことは、後面での切除断端陽性の危険があ

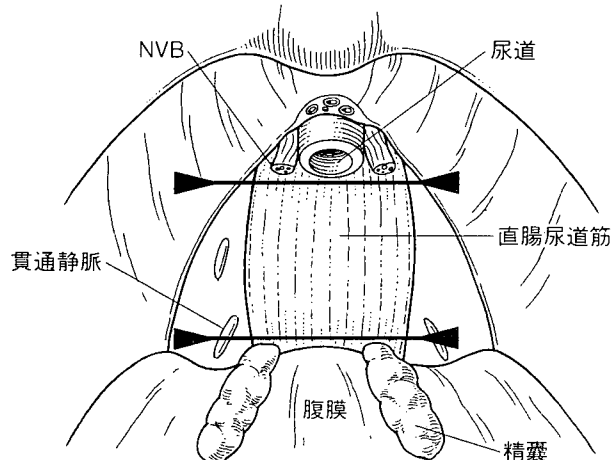
る。またPSA eraの現在、前立腺尖部前面が癌の好発部位であり、尖部をいかに的確に把握するかが、確実な切除断端の確保のみならず尿道機能の確保、勃起神経温存において何よりも重要である。

以前はまず陰茎背静脈（dorsal vein complex；DVC）をバンチング処理しながら前立腺尖部の把握を行っていたが、腱中心を利用し、前立腺後面の把握を行う広汎前立腺全摘除術においては側方から前立腺尖部を展開することで、より正確に尖部の把握が可能と考えている。実際には先に剥離した直腸筋層と前立腺の間にクーパーを挿入し、前立腺尖部を左右に振ってみると可動性の乏しい尿道との把握が容易となる。

この段階で前立腺尖部をよく観察すると尖部に肛門挙筋の一部、恥骨尿道筋が前立腺尖部に付着している。さらによく観察すると尿道には尿道を包み込むように輪状に肛門挙筋の成分が存

図1 直腸尿道筋

直腸筋層前面を走行し、末梢は腱中心、中枢側は精囊基部付近に付着している。したがって図中の矢印の部位で処理することにより、はじめて完全に切除できる。



在することが確認される。前立腺尖部に付着する恥骨尿道筋をていねいに前立腺から剝離するが、癒着を認める場合には恥骨尿道筋を切開し前立腺に付着させる。これはこの筋肉を切開することは容易であり、この部位で被膜外浸潤がある危険性を考慮して、このような処理を行っている。バンチング鉗子を用いてDVCを仮の状態に把持し、位置関係の把握をさらに確実にする(図2)。

前立腺尿道移行部を認識し、尿道外側に付着する肛門拳筋を最小限剝離し、尿道後面とおぼしき部位で、尿道外周に沿うようにメツェンバウムを滑り込ませ、lateral pelvic fasciaを一枚貫通させることで尿道後面に到達できる。左右同様に処理を行い尿道後面に鉗子を通し、血管テープで尿道後面を把持する。

この処理により尿道後面の切断で前立腺後面を不用意に取り残してしまう危険を回避することが可能であり、さらにはDVCの切断部位、あるいはそもそもDVCのバンチング部位のメルクマールが確立したことになり、よりの確な処理を可能にすると考えている(図3)。以前の方法では順次DVCをバンチングし、DVCを切断しながら尿道前立腺移行部の把握を行っていたのであるが、どの部位を把持するかメルクマールがないこともあり、技術が必要であり、またいくぶん不正確であった。

DVCの処理ではバンチングは2針程度運針するのみとなっている。これは前述の尿道移行部の把握がすでに終了しているため、必要以上に運針する必要がなくなったからである。前立腺尿道移行部の中枢と末梢それぞれ5mm程度の部位に運針するのみである。その

後、前立腺を牽引してDVCの最も末梢側にstay sutureをおき、出血に際して順次、収束結紮を繰り返し、止血を得るようにしている。最近では他の方法においてもこのような処理が一般的ではと思われる。

前立腺尖部の位置関係を触診・視診あるいは前立腺を可動させて最終確認を行った後、DVCを切開する。DVCはまさに前立腺尿道移行部直上から切開を開始するようにする。以前はいわゆるavascular spaceに鉗子を貫通させていたが、尖部での不要な切除断端陽性となる危険性がありこの処理は行わず、DVCを可能な限り末梢で切断するようにしている。またバンチングされたDVCを手前から切開し尖部に至る処理は行っていない。これも尖部前面における不必要な切除断端陽性につながるためである。

図2 側方アプローチにおける尖部の把握

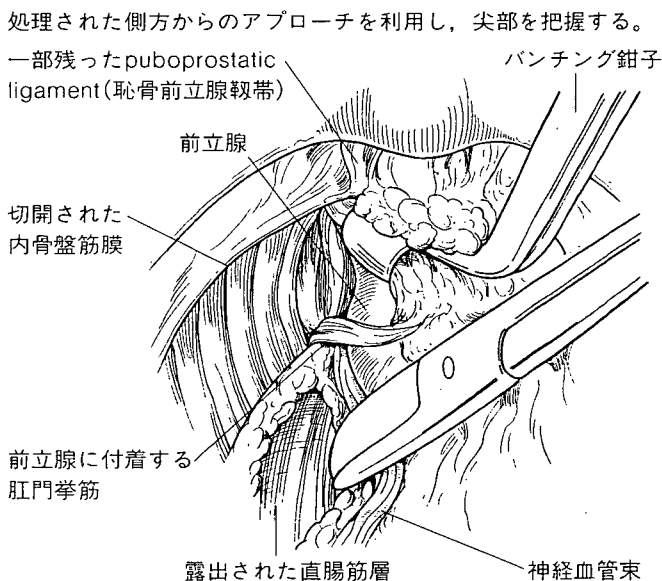
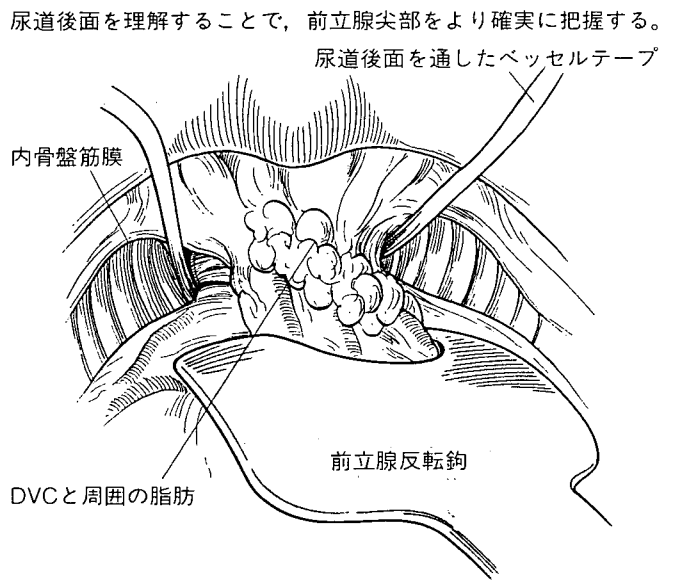


図3 尿道後面を利用した尖部の把握



前立腺被膜と収束結紮されたDVCの深さに注意しながら処理を進める。DVCの切開の深さが被膜より深くなっている場合には当然、前立腺内に切り込んだことを意味する。DVCの切開では前立腺被膜の深さに到達する前に鋭的な切断に変更する。これは尿道筋層、あるいはその中に進展しているかもしれない前立腺組織の認識をより確実にするためである。

直視下で切断するDVCあるいはその先に何が存在するか、最大の注意を払いながら切断を進める。広汎全摘除術を行う場合にある程度の進行癌が予想されるか、患者が神経温存を希望しない場合に実施されるが、尖部では予想外の癌の尿道側への進展があることもあり、尿道と前立腺との間を剝離することはせず、そのまま先ほどの把握した尿道後面に向かい垂直に尿道を離断している。尿道側方の切離ではときにlateral pelvic fasciaと尿道筋層間に進展した前立腺組織を認めることがあり、側方の切開も順次「そこに何かがあるか」を、確認しながら進めることが肝要であると考えている（図4）。

### 尿道への吻合糸

近年、尿道カテーテルを早期に抜去することにより尿禁制の早期回復が確認されている。これはカテーテルを長期に留置することにより、本来閉鎖している尿道が開口した状態におかれるため、周囲の炎症なども相まって尿道閉鎖に悪影響を及ぼすものと推定される。したがって尿道吻合におけるポイ

ントとしては尿道括約筋のダメージを最小限にし、かつ確実に尿道と膀胱を吻合することが大切であると考えている。

吻合のリークは吻合部の無用な炎症の原因となり、決して尿道機能に有利には働かない。ただ吻合部のリークがなければよいというものでもなく、尿道と膀胱が口径差のなく適切に密着することが肝要と考えている。このようなポイントを考慮しながら吻合糸を尿道に運針することが必要である。

実際の吻合にあたっては3-0 monocryl SH針10本で吻合している。10本もの吻合糸を使わなくても問題はないとの考えもあるが、前述の問題意識から尿道を大きく運針することはせず、比較的小さいbiteとpitchで運針するためこの程度の本数が必要なことと、尿道後面に対する吻合不全の問題を克服するため試行錯誤を繰り返しているうちに、結果的にこのような本数となったものである。

尿道の上半分を切開し尿道カテーテルが露出した段階で尿道前面への運針を開始する。尿道への運針ではすでに重要性が指摘されているようにまずlateral pelvic fasciaに運針を行う。10時から2時の位置ではlateral pelvic fasciaの認識は容易であるが、症例によっては肛門拳筋内に埋没したような状況となることもある。

ときにlateral pelvic fasciaではなく肛門拳筋に運針しているようなことがあるが、直視下によく確認するとともにlateral pelvic fasciaを拾った後、少し緊張をかけてみると、きっちり運針

されている場合には確実に運針されている緊張を感じる。次に尿道粘膜のみを拾うように運針し、針の先端を尿道カテーテルとの間に抜く（図5）。

この運針に際しては粘膜を拾うときに運針の角度を変える必要がある。尿道粘膜は非常に脆弱であり、運針した後、針を抜くときにも十分注意をする。尿道運針に関してはできるだけ無用な抵抗を避けるため、著者は血管持針器を使っている。

以前は尿道離断後に改めてブジーを挿入し運針を行っていたが、尿道が完全に離断されると尿道断端が肛門拳筋内に埋没してしまい、正確にlateral pelvic fasciaあるいは尿道粘膜を認識することに困難があることと、特に尿道後面の運針ではまったく不正確な部位に運針していること、あるいは切断され、埋没してしまった尿道後面への運針が技術的に困難があるからである。「そんなことをしなくても大丈夫である」という意見もあるかと思われるが、目標はこの手術を受けたすべての症例に対して、尿道カテーテルの早期抜去とともに、確実な尿禁制とスムーズな尿排出を可能とする方法の確立をめざしているのである。

順次、角度を調整しながら1時、3時、4時に運針を行う。この段階で尿道を少し切り足し尿道が4時から8時のみを残した状態となった段階でカテーテルを把持し、これを切断する。切断された尿道カテーテル末梢側は抜かせず、尿道断端に位置させるようにする。このことにより尿道が管状構造を維持し、後の運針を正確にすることが



図4 DVC・尿道の離断

DVCあるいは尿道の離断に際しては、切開する部位が何であるかを常に確認しながら処理を行う。

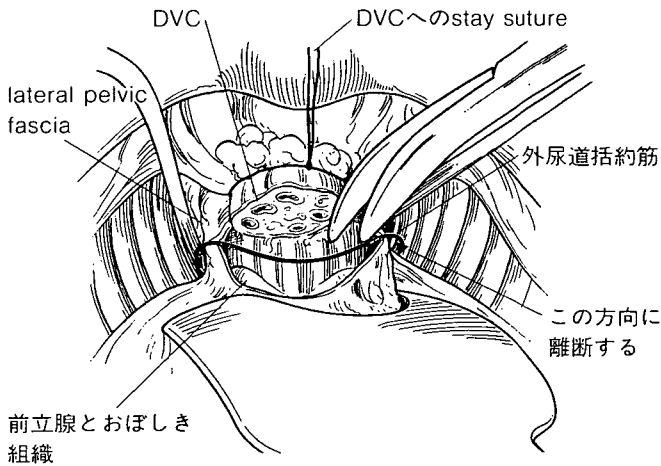
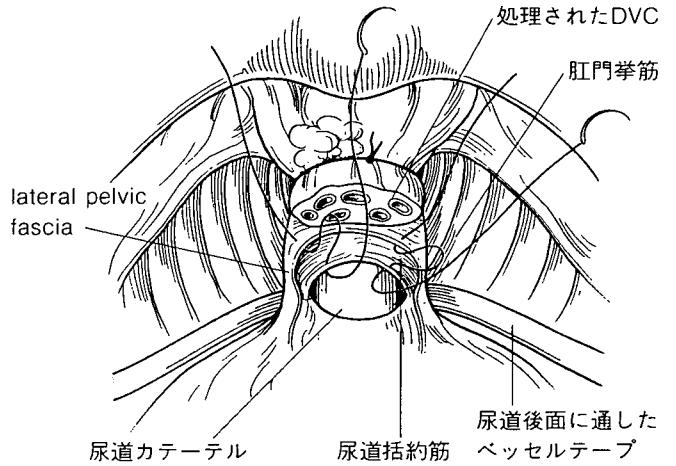


図5 尿道への運針

離断されたlateral pelvic fasciaと尿道粘膜のみに運針するようなイメージで行う。



できる(図6)。

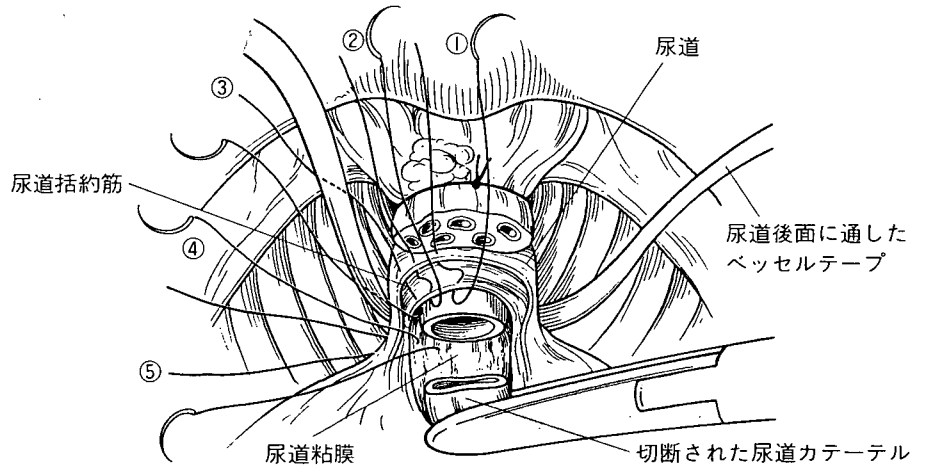
後面の運針ではlateral pelvic fasciaがはつきりしないことも多い。これは神経血管束が尿道把持の段階で外側に剥離されているためである。可能なら神経血管束付近の比較的丈夫な組織を拾う。また後面の運針では尿道粘膜面のみを拾うことはできず、外尿道括約筋もそれほど発達していないことを考慮し、全層で運針している。

5時の運針ではイメージ的には尿道の6時付近を運針するようにする。これはさらに尿道の切開を進めてみると、切断された尿道が広がり結局4時あたりに運針したことになるからである。

一般的に尿道吻合不全は後面で起こりやすいと思われる。この理由がわからず、運針したつもりなのになぜ吻合不全が起こるのか、悩んだ時期があった。この原因の1つは次のようなものと考えている。運針してから尿道の切断を順次進める方法にしてみ初めて

図6 尿道後面への運針

切断した尿道カテーテルをそのまま尿道末梢側に位置し、尿道後面の運針を全層で行う(ここでは半分の運針のみ記載した)。特に④・⑤の部位は尿道を切開しながら順次運針する。



認識したことであるが、特に後面では尿道の切断に伴い、尿道が少しずつ開いていくようであり、最終的には5時に運針したつもりなのだが、結局尿道が完全に離断されたときによく確認してみると、運針された部位が3~4時あたりになっていることが確認される。このことが後方での吻合不全の一因に

なっていると考えるようになった。

したがって最後の運針では尿道6時の位置で左右の糸がほとんど同じ場所に運針されているようにする。この状況でも尿道を完全に離断してやると2~3mmの隙間が形成されることが一般的である。

図7 内尿道口の形成

必要以上に内径を狭くすることはせず、また粘膜も反転させずに形成する。また、膀胱周囲の脂肪を寄せることで三角部後面を縫縮する。

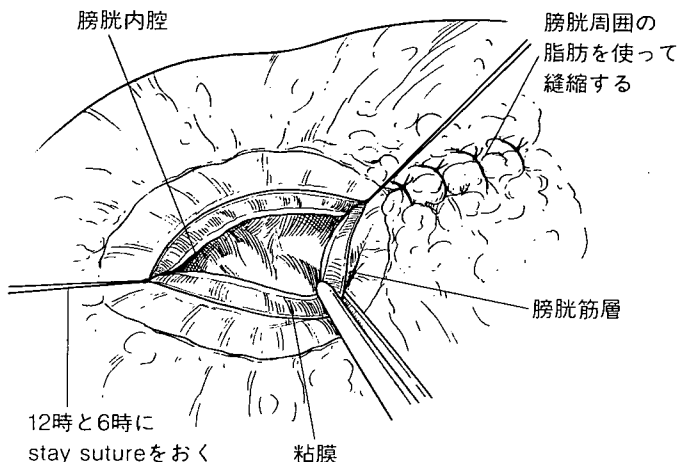
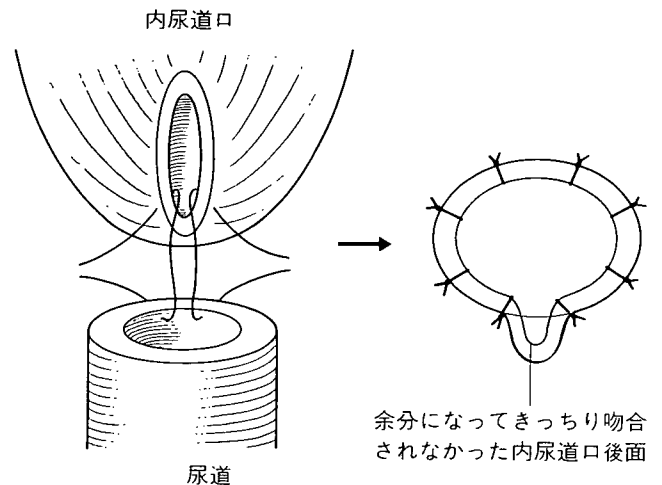


図8 吻合される内尿道口と尿道の関係

6時の部位をぎりぎりに運針しないと、吻合されたとき尿道後面に内尿道口後面が余ってしまう危険性がある。



### 膀胱頸部の処理

広汎前立腺全摘除術ではいわゆる posterior peel法はまったく行わない。精囊と膀胱三角部のある程度の剝離を行った後、尿道カテーテルのバルーンを膀胱前面で触知する。明らかに前立腺を越えたと認識できる場所から膀胱前面を横方向に切開する。

ある程度切開し、尿道カテーテルのバルーンが露出された段階で膀胱に1針指示糸を掛ける。以前は粘膜面を強く反転するように運針していたが、反転された粘膜面は尿道との接着にはむしろ逆効果になるため、最近では粘膜をむしろ反転させないようにしている。

尿道カテーテルを膀胱外に引き出し、尿管口ならびに三角部を確認して、原則三角部のみを残して膀胱頸部筋層を離断している。したがって前立腺を摘

出後、膀胱頸部を縫縮する必要がある。

ポイントは2つである。1つは筋層をしっかり縫合することともに膀胱粘膜が反転しないようにすることである。これは膀胱頸部の接着に逆効果になるとの認識からである。最終的に7~8針必要なことが多いが、順次、膀胱筋層を縫縮して内尿道口を形成する。近年はむしろ狭い内尿道口を形成しないようにしている。これは内尿道口の形成で尿禁制を確保しようとする結局、排尿困難の原因となりやすく、過度の形成は術後膀胱頸部硬化症様となりうるからである。これのもう1つのポイントである。実際には縦長で1.5~2cm程度の内尿道口としている。切断された尿道断端の口径を思い出しながら形成する。

広汎前立腺全摘除術では直腸筋層が露出されており、膀胱筋層との間で瘻孔をつくる危険性がある。このため膀胱

筋層の縫縮の後、露出された膀胱筋層の外側の膀胱漿膜と脂肪織を縫縮し2層に縫縮するようにしている。この操作は止血の効果もある(図7)。

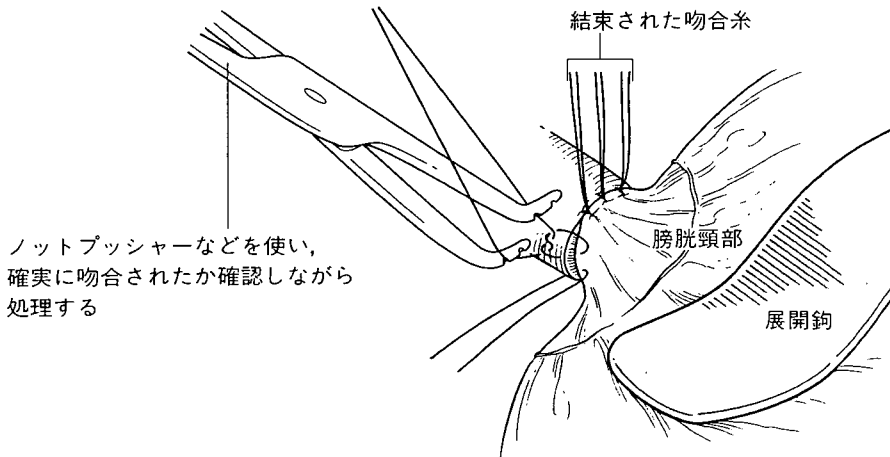
### 尿道吻合

形成された内尿道口に運針を行う。まず6時の位置では、まさに断端ぎりぎりに運針するようにしている。これは、内尿道口は縦線、尿道は円形の状況となっており、内尿道口の6時の位置で断端から離れて運針すると尿道に吻合されたときに内尿道口後面がV字となり、吻合不全の原因となるのではとの考えからである(図8)。

内尿道口の運針については尿道の運針と同じbiteとpitchで膀胱筋層と粘膜を運針するようにする。過度に大きく膀胱筋層に運針すると吻合部が「竹の節」のような状況となり、尿道狭窄な

図9 尿道・膀胱吻合

吻合にあたっては、直視下での処理を心がける。これにより確実に吻合されているか確認できる。そのために術野の展開が大切である。



どの原因となるのではとの考えから、まさに切断された尿道に口径差なく、そのまま素直に内尿道口を「置いてくる」ようなイメージで対応している。

また粘膜面に関しても尿道の粘膜にそのまま連続させるようなイメージで運針するようしており、過度に粘膜を運針することはしない。吻合糸の最後の2本を残した段階で尿道カテーテ

ルを尿道に挿入し、膀胱に導く。

吻合に関しては直視下でノットプッシャーなどを利用して確実に吻合することである。特に後面の4時から6時の位置では尿道吻合糸の締め付ける角度に注意し、吻合糸が尿道に対して垂直に吻合されるように対応する。またこのためには尿道吻合部の展開は非常に重要である(図9)。

吻合後、膀胱に空気を250ml程度注入して、吻合の状態を確認する。水によるリークテストは曖昧であり、空気を使用して確認している。漏れない場合には術後5日目の朝にそのままカテーテルを抜去している。その後、傷の抜糸も不要(埋没縫合)で尿禁制も良好なため、手術を受けた症例は「その後1~2日で自ら進んで退院していく」というイメージとなっている。



以上、広汎前立腺全摘除術において、尿道機能の早期回復のために「私はこうしている」という点について概説した。もちろん、「こうする」ことに対する確固たるエビデンスはなく、これまでもそうであったように、このような「こだわり」が結果によってはまったく間違った発想であるかもしれない。そのことを常に念頭に置きながら、さらに手術法の改良を日々行っているところである。

◎文献

- 1) 中川 徹, 蔦巢賢一, 藤元博行: 前立腺全摘除術. 新 癌の外科学-手術手技シリーズ2 泌尿器科癌, p89-107, メジカルビュー社, 東京, 2001.
- 2) 藤元博行, 松岡直樹: 神経温存を意図しない前立腺広汎切除術. Urologic Surgeryシリーズ6 前立腺の手術, p82-89, メジカルビュー社, 東京, 2001.

## Abdominal Sacral Resection for Posterior Pelvic Recurrence of Rectal Carcinoma: Analyses of Prognostic Factors and Recurrence Patterns

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**Background:** Local recurrence of rectal cancer presents challenging problems. Although abdominal sacral resection (ASR) provides pain control, survival prolongation, and possibly cure, reported morbidity and mortality are still high, and survival is still low. Thus, appropriate patient selection and adjuvant therapy based on prognostic factors and recurrence patterns are necessary. The purpose of this study was to evaluate the results of ASR for posterior pelvic recurrence of rectal carcinoma and to analyze prognostic factors and recurrence patterns.

**Methods:** Forty-four patients underwent ASR for curative intent in 40 and palliative intent in 4 cases. All but one could be followed up completely. Multivariate analyses of factors influencing survival and positive surgical margins were conducted.

**Results:** Morbidity and mortality were 61% and 2%, respectively. Overall 5-year survival was 34%. The Cox regression model revealed a positive resection margin (hazard ratio, 10 [95% confidence interval, 3.8–28]), a local disease-free interval of <12 months (4.2 [1.8–9.8]), and pain radiating to the buttock or further (4.2 [1.6–11]) to be independently associated with poor survival. The logistic regression model showed that macroscopic multiple expanding or diffuse infiltrating growths were independently associated with a positive margin (7.5 [1.4–40]). Of the patients with recurrence, 56% had failures confined locally or to the lung.

**Conclusions:** ASR is beneficial to selected patients in terms of survival. To select patients, evaluation of the resection margin, the local disease-free interval, pain extent, and macroscopic growth pattern is important. To improve survival, adjuvant treatment should be aimed at local and lung recurrences.

**Key Words:** Therapy—Surgery—Rectal cancer—Local recurrence—Recurrence—Prognostic factor.

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Posterior pelvic recurrence<sup>1–3</sup> (PPR) of rectal carcinoma, which involves the sacrum and/or sacral nerves, presents challenging clinical problems. It may cause sacral nerve pain, perineal ulcers, fistula formation, bleeding, bowel and/or urinary tract

obstruction, sepsis, and, finally, death.<sup>4</sup> These conditions are difficult to treat, and chemotherapy provides only minimal benefits at present.<sup>4–6</sup> Radiotherapy may give pain relief, but its effectiveness is limited and temporary.<sup>4,7–9</sup> Conventional abdominoperineal resection or local excision is only palliative.<sup>10,11</sup>

In 1981, Wanebo and Marcove<sup>11</sup> reported the advantage of the abdominal sacral resection (ASR), which was first described by Brunschwig and Barber<sup>12</sup> in 1969, for PPR of rectal carcinoma. Although published data on this operation are still limited and

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