Ⅳ-2 吻合部確認とリークテスト

Point

- 必ず，確実な吻合が行われていることを確認する。

1 吻合が終了したら，吻合部の口側腸管を鉗子を用いてクランプする。腹腔内に生理食塩水を注入する。

2 肛門から空気を注入し，空気漏れのないことを確認する。

3 当科では，この時点で全例に肛門より内視鏡を挿入しリークテストを行っている。利点としては，リークテストと同時に吻合部の状態や出血のないことの確認が行える点である（図29）。

4 温生理食塩水で腹腔内を洗浄し，止血されていることも確認する。

図29 吻合部の術中内視鏡

吻合部がきれいなドーナツになっていること，リークのないこと，口側腸管の血流が良好であること，止血されていることを確認する。吻合部に凝血塊があれば鉗子孔から水を注入して洗浄する。ほとんどの場合自然止血するが，止血しなければ止血用クリップなどで止血する。

合併症の回避

合併症

- 不適当な自動吻合器の使用による縫合不全。

1 リークテストを行い，空気漏れのないことを確認する。

2 空気漏れがあれば躊躇なく再吻合を行うか回腸ストーマを造設する。

Ⅳ-3 ドレーン挿入・閉腹

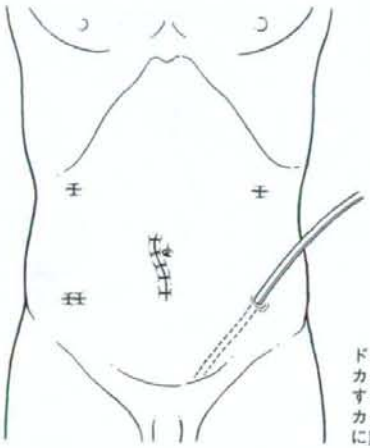
Point

- ポート部の切開の大きさで留置するドレーンを選択する。
- 創部感染を防ぐために，十分な洗浄を行う。

1 ドレーンは通常，左下腹部の5mmトロカー部を使用するとよい。ダグラス窩に向かって挿入する(図30)。当科では19FrのJ－VACドレーンを使用している。

2 開腹創は5cm程度と小さく操作がやや困難であるので，縫合ごとに結紮はせずに視野を確保しながら，白線または腹直筋前哨・後鞘を確実に縫合する。5mmのトロカー部はスキンステイプラーで皮膚のみを

図30 術後の腹部



ドレーンは左下の5mmトロカーよりダグラス窩に挿入する。右下の12mmのトロカーはヘルニア防止のために筋膜を確実に閉鎖する。

合併症の回避

合併症

- 洗浄不十分なための創部感染，不十分な閉創のための腹壁瘢痕ヘルニア

1 創部感染を予防するために，温生理食塩水で皮下組織を十分に(約500ml)洗浄するとよい。

2 創が小さいので，注意しながら確実に腹膜，前鞘，後鞘を縫合閉鎖する。

一言アドバイス 腹腔鏡手術では患者は特に美容的な創を期待しがちであるので，閉創までをしっかり気を抜かずに行う。

消化器内視鏡外科手術ベーシックテクニック

2008年1月20日　第1版第1刷発行

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ISBN 978-4-7583-0335-4 C3047

直腸の外科解剖（TMEに必要な骨盤解剖）

絹笠祐介，齊藤修治，石井正之　静岡県立静岡がんセンター大腸外科

直腸癌の手術であるtotal mesorectal excision（TME）は，癌の根治性と機能温存を両立させた術式である。誤った解剖の理解は，術中・術後の合併症を増加させるだけでなく，癌の根治性を損なうおそれがある。直腸の授動の際には層を認識したていねいな操作を心がけ，腫瘍の露出を避けるとともに，温存すべき神経を損傷しないように注意を払う必要がある。

解剖学的に神経損傷の起きやすい部位の把握はいうまでもなく，術前のMRIなどから得られる情報を元に，術中に癌が露出しやすい部位の操作を術前にシュミレーションしておくことがこの手術において大事である。術前・術中所見によっては，機能温存を犠牲にする選択が必要な場合もある（図1）。

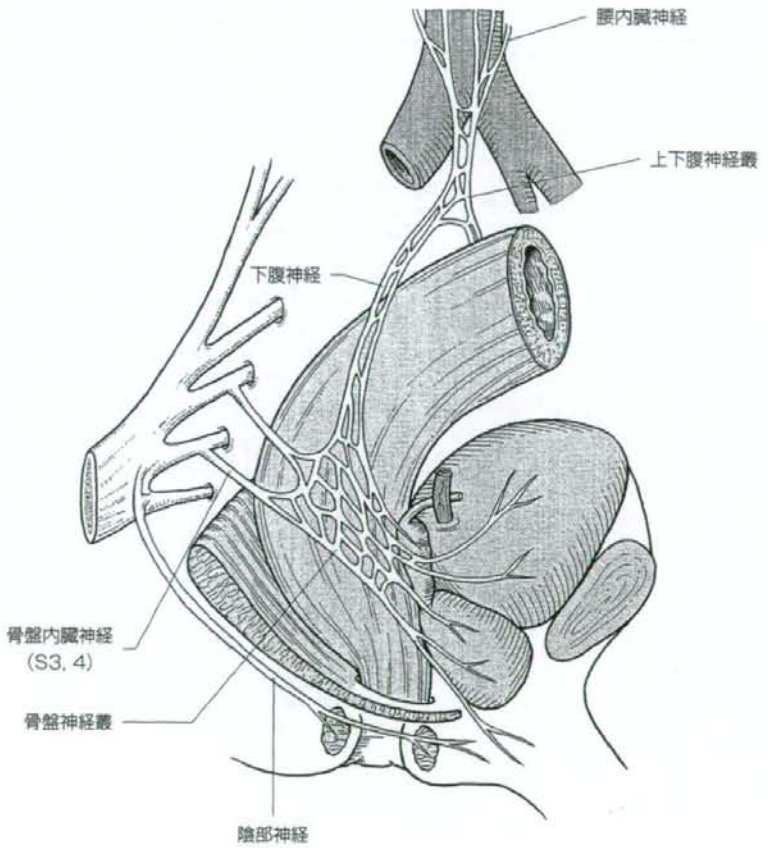


図1　直腸と周囲臓器・神経との位置関係
直腸周囲には，交感神経である下腹神経および副交感神経である骨盤内臓神経が走行している。両者は直腸前外側にて骨盤神経叢を形成し，泌尿生殖器へ臓側枝をのばしている。下腹神経は主に射精機能を，骨盤内臓神経は主に勃起・排尿・排便機能に関与している。

術前チェック

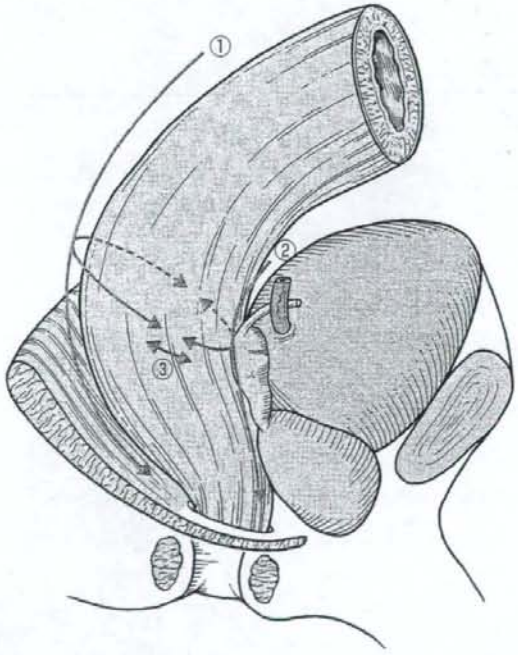
①直腸指診によって，腫瘍の肛門縁からの距離や深達度，周囲臓器（前立腺や膣・子宮）との位置関係を把握する。

②MRIやCT画像にて，腫瘍の直腸固有筋膜外への浸潤や，直腸間膜内および側方リンパ節転移の有無を術前に評価しておく。

手術手順（図2）

[1] 左結腸の授動
[2] 中枢側郭清・下腸間膜動脈（IMA）の処理
[3] 直腸後壁の剥離
[4] 直腸前壁の剥離
[5] 直腸側壁の剥離
[6] 直腸洗浄・切離
[7] 吻合

図2 手術手順
直腸の授動は剥離層がわかりやすい順に後壁→前壁→側壁と行いながら肛門側に向かう。



手術手技

1 左結腸の授動

●外側アプローチ

左側結腸と壁側腹膜との生理的な癒着を剥離し，Toldtの癒合筋膜を切開・剥離を行い，尿管を覆う腎筋膜を温存しながら内側へ向かって左結腸を十分に授動する。

●内側アプローチ

大動脈―右総腸骨動脈の右側縁にて臓側腹膜を切開し，尿管・性腺血管（精巣・卵巣動静脈）を確認しながら外側へと剥離を行う。外側アプローチより層が一層深くなりやすいことに注意が必要である。

2 中枢側郭清・下腸間膜動脈の処理

●D3郭清

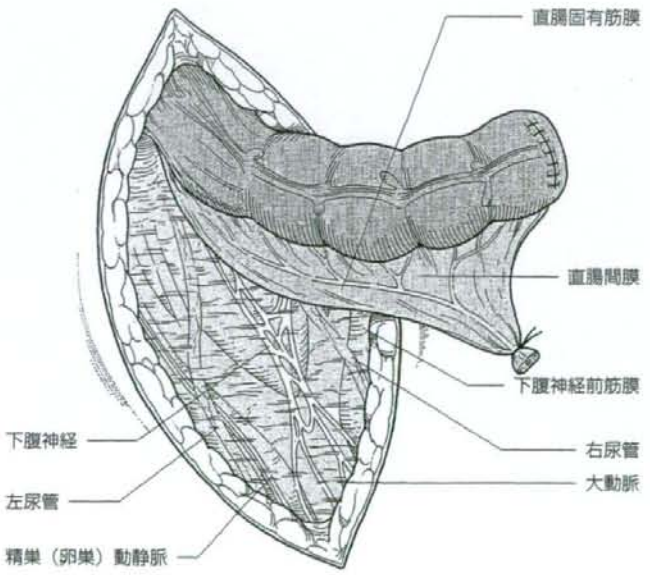
大動脈前面のリンパ節を含む脂肪を郭清し，下腸間膜動脈根部付近にて腰内臓神経より生じる結腸枝を切離し，下腸間膜動脈根部を露出する。左結腸動脈を温存する場合には，根部から分岐部を露出するまで脂肪をむきあげるように下腸間膜動脈沿いを郭清する。

3 直腸後壁の剥離

●仙骨岬角～第3仙骨付近

直腸を腹側へ牽引し，下腹神経前筋膜と直腸固有筋膜の間に出現する疎な結合織間で剥離を行う。常に直腸間膜の脂肪を視認しながら剥離を行うと，層が深くならずに一定の層を保つことができる（図3）。

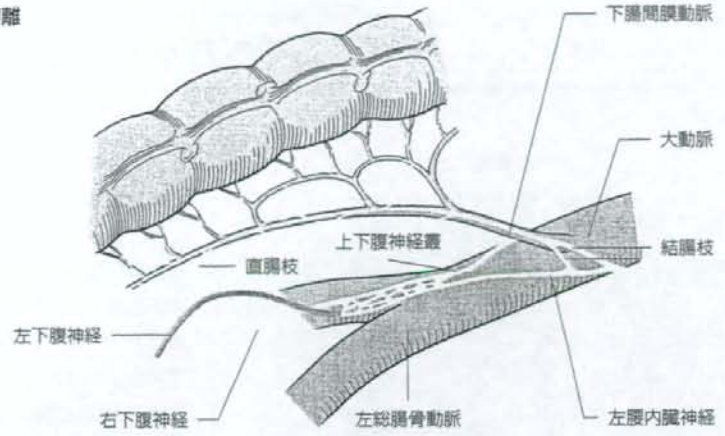
図3　直腸後方の授動（上部）



手技のポイント　下腹神経前筋膜の温存

下腹神経を覆う下腹神経前筋膜と直腸固有筋膜の間の疎な結合組織の間を剥離する。下腹神経が下腹神経前筋膜の背側を走行しているのが術中に透見される。常に直腸間膜の脂肪と直腸固有筋膜を視認しながら剥離を行うと，層が深くならずに一定の層を保つことができる。

図4　下腹神経からの直腸枝の切離



左の下腹神経から上直腸動脈周囲へ向けて直腸枝を出すことがあり，直腸を腹側へ牽引することによって，左下腹神経がつり上がって損傷しやすくなる場合があることに注意が必要である（図4）。

Dangerous Point

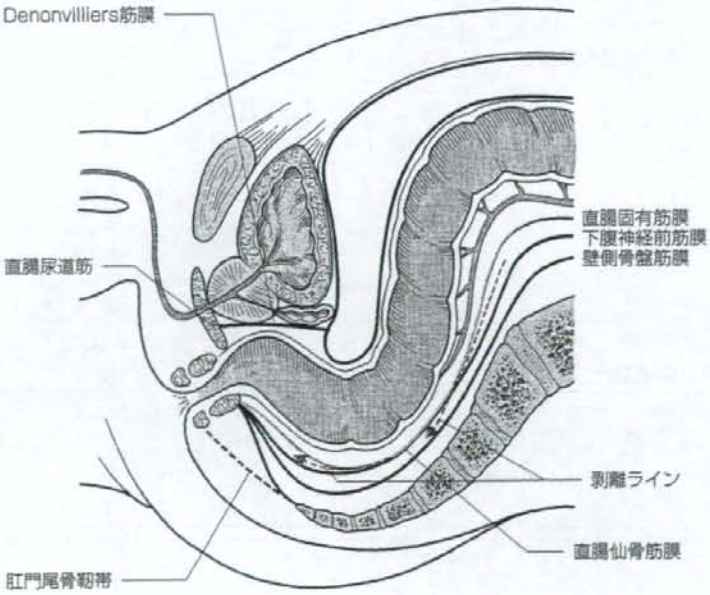
下腹神経の損傷に注意

下腹神経から直腸へ向かう直腸枝については個体差があるが，左下腹神経から上直腸動脈周囲へと交通していることが多く，直腸間膜を腹側へ牽引する際に，直腸枝に引っ張られ左下腹神経がつり上がってくることがあり注意を要する。

●直腸仙骨筋膜

第3－4仙骨のレベルで仙骨から直腸間膜へ向かう直腸仙骨筋膜（rectosacral fascia）が出現する。これは下腹神経前筋膜と直腸固有筋膜が癒着している部分を指している。症例によっては両筋膜を分け入るように肛門側まで剥離を進めることも可能だが，同筋膜を切離してさらに肛門側へ剥離を進めていく場合には，層が一層深くなることを認識しなければならない（図5）。

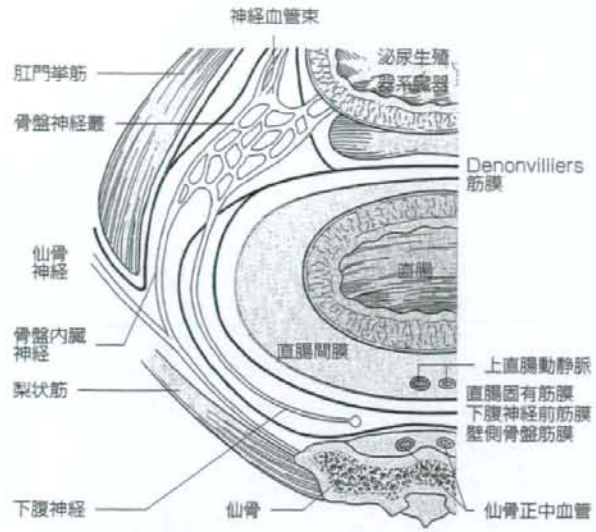
図5　直腸後壁の剥離



手技のポイント 直腸後方の筋膜構成

直腸仙骨筋膜は直腸固有筋膜と下腹神経前筋膜の癒着によって生じている。同筋膜を切離して肛門側に進む場合には，そのまま側方へ剥離を延長する際に剥離層が一層深くなることを認識し，神経（下腹神経～骨盤神経叢）を損傷しないように注意する必要がある。

知っておくべき解剖



直腸周囲の筋膜構成

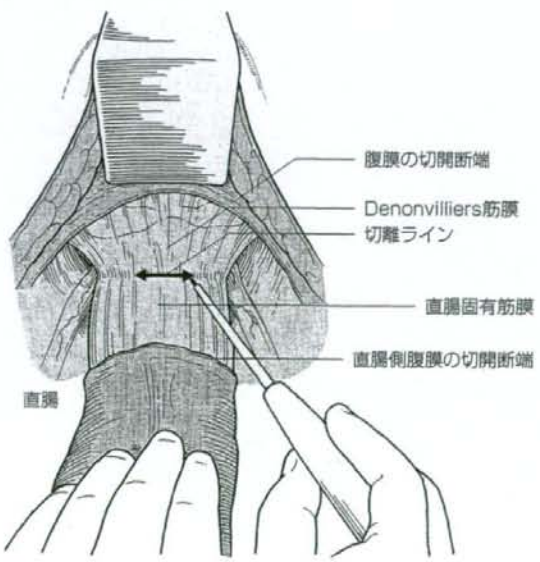
直腸癌の根治性と機能温存を両立させるためには，直腸周囲の筋膜構成の理解が不可欠である。直腸固有筋膜と下腹神経の間には，後方では下腹神経前筋膜，前方ではDenonvilliers筋膜が境界となって走行し，これらの筋膜が神経温存のメルクマールとなる。一方で，骨盤内臓神経は壁側骨盤筋膜に覆われ骨盤神経叢へと流入し，同筋膜が下腹神経前筋膜やDenonvilliers筋膜と合流する。

術者の左手や助手の鉤を使って，剥離部位への適切な緊張を与え，ていねいに出血をさせないように剥離を進め，常にどの層で剥離を行っているかを認識しながら手術を行うことが大事である。

4 直腸前壁の剥離

鉤や左手での直腸の牽引を利用して腹膜反転部に適度なカウンタートラクションを与えて腹膜を切開する。Denonvilliers筋膜と直腸固有筋膜間の疎な結合織にはいると，そのまま直腸尿道筋まで剥離が可能であるが，Denonvilliers筋膜を切除側へつけた場合には，前立腺中程で剥離が困難となり，同筋膜を切開して肛門側の剥離を延長する（**図6**）。

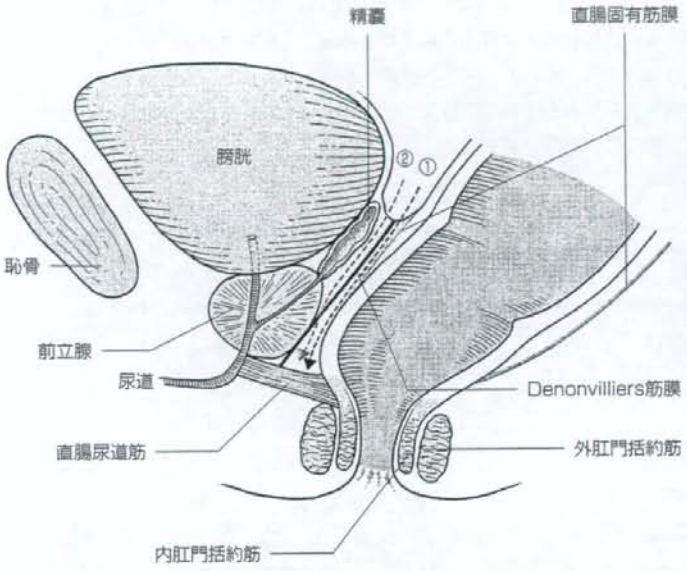
図6　直腸前壁の剥離



手技のポイント 腹膜反転部の切開～下部直腸前壁の剥離

鉤と直腸を持つ手のカウンタートラクションを利用し，腹膜反転部に緊張を与えて腹膜反転部を切離する。腹膜反転部の最も谷底で切離をすれば，自然とDenonvilliers筋膜と直腸固有筋膜間の疎な結合織に入って，そのまま直腸尿道筋まで剥離が可能である。

知っておくべき解剖



Denonvilliers筋膜と剥離層

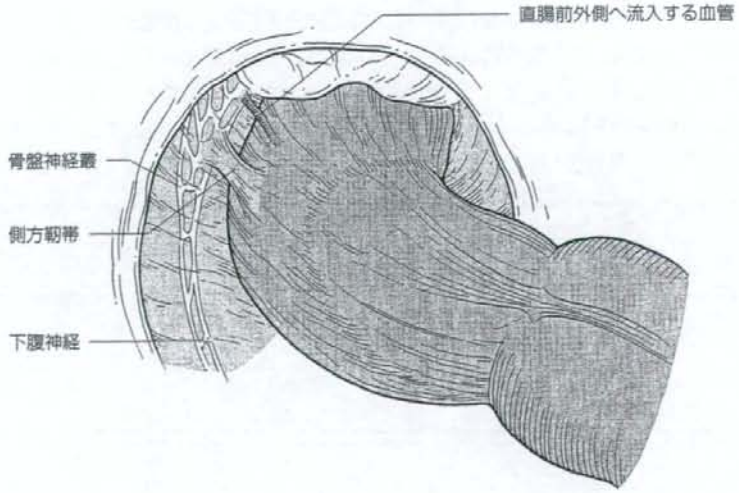
Denonvilliers筋膜は直腸固有筋膜と前立腺・精嚢および温存すべき神経とを境界する膜で，一般に若い男性のほうが厚い。多くの場合，前立腺中程で前立腺皮膜に癒合し剥離が困難となる。Denonvilliers筋膜を切除側につけた場合は，同筋膜を切開しないとさらに肛門側までの剥離が困難となることと，外側へ剥離を延長した場合に，神経を含む領域に入り込みやすいことに注意が必要である。女性の場合，直腸腟中隔がこれに相当するが，一般にDenonvilliers筋膜より薄く，前後どちらの剥離層で剥離しても肛門管までの剥離が容易である。

5 直腸側壁の剥離

側方靱帯（lateral ligament）は骨盤神経叢からの直腸枝や，側方向からのリンパ管などが直腸へ流入する部位で，一連の層構造が消失する部位である。後方および前方の剥離層をつなげるように慎重に剥離を進めて神経を温存する。

この際，中直腸動脈が側方靱帯を貫かずに，精管動脈や腟動脈（下膀胱動脈の分枝であることが多い）などから直腸前外側へ流入することが多く，不用意に剥離をすると同部位より出血をきたすことがあるので注意が必要である（**図7**）。

図7　直腸側壁の剥離

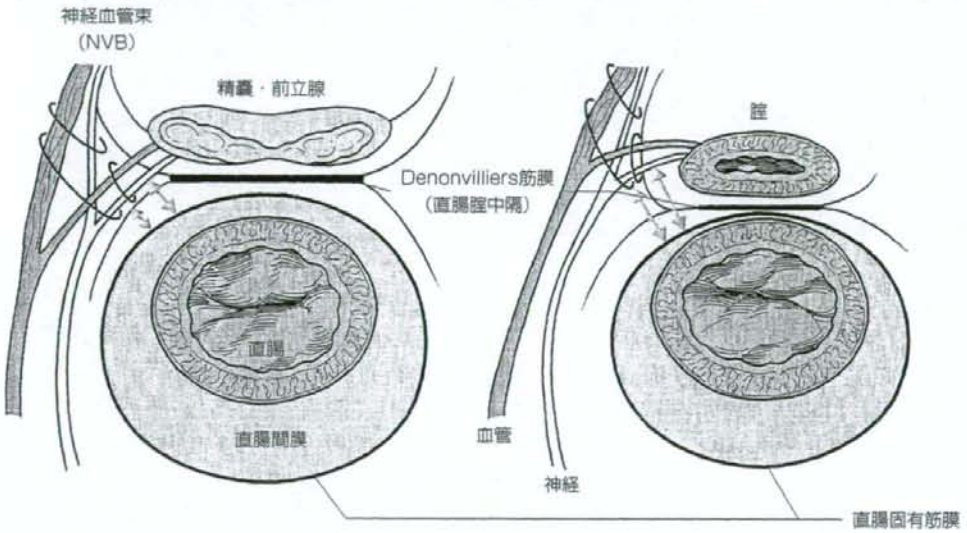


Dangerous Point

側方靱帯と中直腸動脈の流入部位

側方靱帯とは腹膜反転部直下の直腸側壁と骨盤壁を結ぶ結合組織索で，直腸の側方向リンパ流の通路とされている。骨盤神経叢からの直腸枝が主な構造物として側方靱帯に含まれる。比較的出血なく，容易に剥離できる後壁・前壁と違って，直腸の前外側壁～側壁では層を横切って神経・リンパ管・血管が流入することが多く，TMEを行う際の難所の一つである。内腸骨動脈本幹から側方靱帯を貫いて直腸の側壁へ流入する中直動脈の頻度はそれほど多くなく，むしろ下膀胱動脈からの末梢枝として精嚢や膣の外側あたりで直腸へ流入する場合が多い。不用意に出血をさせ，背側を走行する神経を損傷しないように注意深く操作する必要がある。

知っておくべき解剖



神経血管束neurovascular bundle（NVB）—男女の違い

骨盤神経叢からの臓側枝は内陰部動静脈の末梢枝とともに泌尿生殖器へと流入するため，同部位は神経血管束とよばれる。最も背側を走行する陰茎海綿体神経は勃起機能に関与している。骨盤深部に位置し視野がとりにくいこともあり，TMEの際に前立腺や膣の後外側，すなわち直腸前外側においてこれらを損傷することがある。Denonvilliers筋膜の外側がNVBと直腸固有筋膜を境界している。男性では一般に骨盤が狭く精嚢や前立腺が張り出しており，直腸壁とNVBの距離が狭く，剥離が女性と比べて難しいことが多い。

6 直腸洗浄・切離

前方切除が可能な場合は，腫瘍より十分肛門側まで授動を行った後，腫瘍の肛門側にて直腸鉗子等で直腸を閉鎖し残存直腸を洗浄する。腫瘍より可能であれば2cm以上，少なくとも1cm肛門側にて腸管軸に垂直になるように縫合器を挿入して直腸を切離する。十分な切離断端が確保できない場合には，経肛門的に内括約筋の一部を含めて直腸を切除する。

7 吻合

器械吻合の場合，少なくとも直径28mm以上の吻合器を肛門より挿入し吻合する。DSTが不可能なときには，経肛門吻合を行う。必要に応じて一時的人工肛門を作成する。

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Original articles

Surg Endosc (2006) 20: 1348–1352
DOI: 10.1007/s00464-004-8247-9

SURGICAL ENDOSCOPY
and Other Interventional Techniques

A multicenter study on laparoscopic surgery for colorectal cancer in Japan

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Received: 1 March 2005/Accepted: 28 March 2005/Online publication: 24 July 2006

Abstract

Background: Laparoscopic colectomy for malignant disease technically is feasible but not widely accepted because there are no large-series studies or data on long-term outcomes. A retrospective, multicenter study investigating a large series of patients was conducted in Japan to evaluate preliminary long-term results of laparoscopic surgery for colorectal cancer.

Methods: The study group comprised 2,036 patients who underwent laparoscopic colorectal resection April 1993 to August 2002 in 12 participating surgical units (Japanese Laparoscopic Surgery Study Group).

Results: Of the 1,495 patients with colon cancer, 781 (59%) had International Union Against Cancer (UICC) stage I, 248 (19%) had stage II, and 284 (22%) had stage III disease. Cancer recurred for 61 (4.1%) of 1,367 curatively treated patients (median follow-up period, 32 months; range, 6–125 months). The 5-year survival rate was 96.7% for stage I, 94.8% for stage II, and 79.6% for stage III disease. Of the 541 patients with rectal cancer, 220 (56%) had stage I, 62 had (16%) stage II, and 108 (28%) had stage III disease. Cancer recurred for 30 (5.6%) of 476 curatively treated patients (median follow-up period, 25 months; range 6–102 months). The 5-year survival rate was 95.2% for stage I, 85.2% for stage II, and 80.8% for stage III disease.

Conclusions: The findings indicate that laparoscopic surgery for colorectal cancer yields an oncological outcome as good as that reported for conventional open surgery in the Japanese Registry for all disease stages.

Key words: Laparoscopic surgery — Colorectal cancer — Multicenter study — Outcome — Survival rate

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Rapid advances in instruments and techniques have promoted widespread use of laparoscopic surgery as a treatment for colorectal disease. Multiple clinical studies confirm the usefulness of laparoscopic colectomy [5, 14], and investigators report faster recovery, less pain, shorter hospital stay, and a quicker return to normal activities with laparoscopic than with conventinal open colectomy [3, 4, 9, 10]. Thus, it is generally accepted that laparoscopic colectomy is less invasive and more beneficial than open colectomy.

However, laparoscopic surgery for the treatment of malignancies remains controversial because of concerns about the adequacy of lymphadenectomy, the extent of resection, early findings of port-site metastases, and the lack of data on long-term results. Several randomized controlled trials comparing laparoscopic and conventional open surgery were conducted in Western countries in the late 1990s. In a recent study of patients with stage III tumors, Lacy et al. [12] reported superior long-term surgical results in terms of cancer-related survival with laparoscopic colectomy than with conventional open colectomy. However, the long-term oncologic results of laparoscopic surgery for colorectal cancer remain unclear [7, 13, 19].

In Japan, laparoscopic surgery for colorectal cancer was introduced in 1992. To date, individual institutions have reported decreased invasiveness, improved quality of life for patients, and satisfactory short-term oncologic results [1, 6, 11, 16, 20], but there have been no large-scale studies in Japan.

Thus we designed a retrospective study to analyze the data obtained from 12 surgical units participating in the Japanese Laparoscopic Surgery Study Group, supported in part by a Grant-in-Aid for Cancer Research from the Japanese Ministry of Health, Labour, and Welfare. We report the perioperative results and pre-

liminary long-term outcomes for large number of patients who underwent laparoscopic surgery for colorectal cancer in Japan.

Materials and methods

The study group consisted entirely of patients who underwent laparoscopic resection for colorectal cancer in the 12 participating institutions during the period April 1993 to August 2001. Each surgeon in the participating institutions had experienced at least 30 laparoscopic surgeries for colorectal cancer as an operator. All the participating surgeons were personally responsible for obtaining the written informed consent of their patients. Clinical data including patient age, sex, surgical procedures, body mass index (BMI), conversion to open surgery, previous laparotomy, postoperative complications, and postoperative oncologic outcome, and histopathologic data including histologic type, depth of tumor invasion, lymph node metastasis, and TNM stage International Union Against Cancer (UICC) were obtained for each patient.

All the patients underwent standard mechanical cathartic bowel preparation with polyethylene-glycol (+) electrolyte solution the day before surgery. Laparoscopic colonic resection consisted of the following procedures: mobilization of the colon under carbon dioxide pneumoperitoneum, division of the mesentery and ligation of the main vessels inside the peritoneal cavity or via a minilaparotomy resection of the tumor-bearing portion of the colon via a minilaparotomy approximately 5 cm long, anastomosis for a right or transverse colectomy extraabdominally via the minilaparotomy, or anastomosis for a sigmoid colectomy or low anterior resection inside the peritoneal cavity with a circular stapler introduced transanally, and observation and irrigation of the peritoneal cavity under a reestablished pneumoperitoneum. Conversion from laparoscopically assisted surgery to open surgery was allowed at the surgeon's discretion for the patient's safety and because of technical difficulties, the presence of associated conditions, or findings of advanced disease or inadequate oncologic margins.

All patients were monitored postoperatively by means of physical examinations; blood tests; serum carcinoembryonic antigen testing at least every 3 months for the first year, every 6 months for the next 2 years, and yearly for 5 years; liver ultrasonography; abdominal and pelvic computed tomography scanning, chest x-ray; and colonoscopy at least yearly.

Differences in categorical variables among postoperative complications, tumor recurrences, and other clinicopathologic data were analyzed by chi-square test, and differences in continuous variables were analyzed by the Student's t-test. Survival rates were calculated using the Kaplan–Meier method

Results

During the study period, 2,036 patients (1145 men, 891 women) underwent laparoscopic cancer. colorectal resection 1,495 for colon cancer and 541 for rectal cancer. The laparoscopic surgical procedures for colon and rectal cancer are shown in Table 1. Sigmoid colectomy was the most common laparoscopic procedure for colon cancer patients, and anterior resection was the most common for rectal cancer patients. The clinicopathologic characteristics of patients with colon and rectal cancer are shown in Table 2. The rate of conversion to open surgery was 4.8% of patients with colon cancer and 4.4% of patients with rectal cancer. The reasons and frequencies of conversion are given in Table 3.

Of the 1,495 patients with colon cancer, 188 (12.6%) had postoperative complications (Table 4). Complications occurred more frequently after transverse colectomy than after other surgical procedures ($p < 0.05$).

Table 1. Laparoscopic procedures for colorectal cancer

	Patients n (%)
Colon cancer	1495 (100)
Ileocecal resection	188 (13)
Right colectomy	409 (27)
Transverse colectomy	206 (14)
Left colectomy	132 (9)
Sigmoid colectomy	560 (37)
Rectal cancer	541 (100)
Anterior resection	500 (92)
Abdomino perineal resection	41 (8)

Table 2. Clinicopathologic characteristics of patients with colorectal cancer

	Patients n (%)	
	Colon cancer (n = 1495)	Rectal cancer (n = 541)
Previous laparotomy		
Absence	1061 (71)	400 (74)
Presence	434 (29)	141 (26)
BMI		
<26	1051 (77)	406 (75)
26 to 32	314 (21)	124 (23)
>32	30 (2)	11 (2)
Histologic type		
Well	1017 (68)	292 (54)
Moderate	403 (27)	211 (39)
Poor	15 (1)	6 (1)
Others	60 (4)	32 (6)
Depth of invasion		
T1	493 (33)	147 (27)
T2	239 (16)	124 (23)
T3	449 (30)	146 (27)
T4	314 (21)	124 (23)
Lymph node metastasis		
Absence	1151 (77)	384 (71)
Presence	344 (23)	157 (29)
Curability		
Curable	1405 (94)	487 (90)
Noncurable	90 (6)	54 (10)
Tumor staging[a]		
Stage I	837 (56)	287 (53)
Stage II	269 (18)	87 (16)
Stage III	299 (20)	149 (26)
Stage IV	90 (6)	27 (5)

BMI, body mass index
[a] International Union Against Cancer (UICC-TNM) staging

The presence of complications was not associated with any other factor, such as tumor stage or patient age, sex, history of laparotomy, or body mass index (BMI). Curative surgery was performed for 1,411 patients (94.4%), but not for 84 patients (5.6%) because of liver metastasis (n = 46), lung metastasis (n = 13), peritoneal dissemination (n = 20), or metastases (n = 5).

Cancer recurred in 61 (4.3%) of the 1411 curatively treated patients during a median follow-up period of 32 months (range, 6–125 months) (Table 5). Recurrence was not associated with any surgical procedure or conversion to open colectomy. The 5-year survival rate was 96.6% for the patients with stage I, 94.8% for those with stage II, and 79.6% for those with stage III disease (Fig. 1). The 5-year survival rates were not associated

Table 3. Reasons for conversion to open surgery[a]

	Patients *n* (%)	
	Colon cancer	Rectal cancer
Advanced disease	34 (47)	11 (46)
Intraoperative complications	22 (31)	7 (29)
Bleeding	15 (21)	4 (16)
Injury to other organs	7 (10)	3 (13)
Adhesion	4 (6)	3 (13)
No visualization of critical structures	4 (6)	2 (8)
Complicating disease	2 (3)	0
Others	6 (8)	1 (4)
Total	72 (100)	24 (100)

[a] There were 1,495 patients with colon cancer and 541 patients with rectal cancer

Table 4. Postoperative complications[a]

	Patients *n* (%)	
Postoperative complications	Colon cancer	Rectal cancer
Bowel obstruction	31 (19)	13 (20)
Anastomotic leakage	22 (14)	22 (33)
Postoperative bleeding	5 (3)	1 (1)
Wound infection	97 (60)	29 (43)
Pneumonia	4 (2)	0
Intraabdominal abscess	3 (2)	2 (3)
Total	162 (100)	67 (100)

[a] There were 1,495 patients with colon cancer and 541 patients with rectal cancer

Table 5. Tumor recurrence[a]

	Patients *n* (%)	
	Colon cancer	Rectal cancer
Tumor recurrence	61 (100)	30 (100)
Location of recurrence		
Liver	35 (65)	14 (48)
Lung	6 (11)	2 (7)
Peritoneum	7 (13)	6 (21)
Locoregional	2 (4)	4 (14)
Lymph node	4 (7)	3 (10)
Portsite	0	0

[a] There were 1,411 patients with colon cancer and 508 patients with rectal cancer

with any surgical procedure, presence of complications, or conversion to open colectomy.

Of the 541 patients with rectal cancer, 76 (14.1%) experienced had postoperative complications (Table 4). The complications were not associated with any of the factors studied, including surgical procedure, tumor stage, sex, age, history of laparotomy, or BMI.

Curative surgery was performed for 508 patients (93.9%), but not for 33 patients (6.1%) because of liver metastasis (n = 13), lung metastasis (n = 5), peritoneal dissemination or (n = 4), or and other metastases (n = 11). Cancer recurred in 30 (5.9%) of the 508 curatively treated patients during a median follow-up period of 25 months (range, 6–102 months) (Table 5).

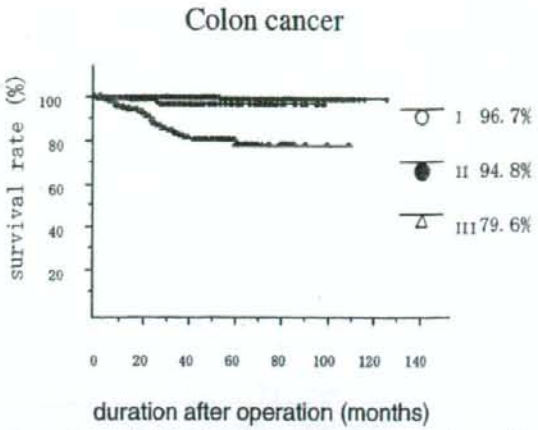

Fig. 1. The survival rate for 1,411 curatively treated patients with colon cancer is, shown. The 5-year survival rate was 96.7% for stage I, 94.8% for stage II, and 79.6% for stage III disease. International Union Against Cancer (UICC-TNM) staging was used.

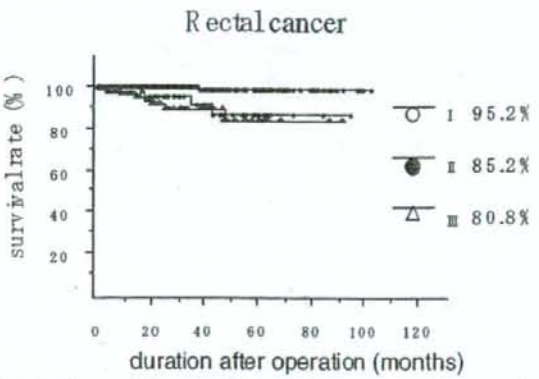

Fig. 2. The survival rate for 508 curatively treated patients with rectal cancer is shown. The 5-year survival rate was 95.2% for stage I, 85.2% for stage II, and 80.8% for stage III disease. International Union Against Cancer (UICC-TNM) staging was used.

Recurrence was not associated with any surgical procedure or conversion to open colectomy. The 5-year survival rate was 95.2% for the patients with stage I, 85.2% for those with stage II, and 80.8% for those with stage III disease (Fig. 2). The 5-year survival rates were not associated with any surgical procedure, presence of complications, or conversion to open colectomy. No port-site or abdominal wall recurrences were found in any of the 2,036 patients.

Discussion

This multicenter study reflects 10 years of experience with laparoscopic surgery for colorectal cancer in a large patient series in Japan. The short-and long-term outcomes for our patients suggest that laparoscopic surgery is a safe and effective treatment for colorectal cancer, in light of reported outcomes for conventional open surgery.

The records of the Multi-Institutional Registry of Large Bowel Cancer in Japan indicate that the 5-year survival rates for those undergoing curative open surgery were 93.4% (stage I), 84.5% (stage II), and 74.0% (stage III) for colon cancer, and 93.9% (stage I), 79.8% (stage II), and 64.7% (stage III) for rectal cancer (UICC stages) [15]. The 5-year survival rates of patients undergoing laparoscopic surgery in our study are as good as those for patients undergoing conventional open surgery for disease at each stage of the UICC stages. In fact, the 5-year survival rate for our stage II colon cancer patients undergoing laparoscopic surgery was superior to that reported for patients undergoing conventional open surgery (94.8% vs 84.5%). Furthermore, the 5-year survival rate for our stage III rectal cancer patients undergoing laparoscopic surgery was superior to that reported for patients undergoing conventional open surgery (80.8% vs 64.7%). Lacy et al. [12] reported recently that the cancer-related survival rate after laparoscopic surgery was significantly higher than that after conventional open surgery for patients with stage III tumors. The superiority of laparoscopic over open colectomy may involve the relation between immunologic status and surgical stress. Our study investigated a large series of patients undergoing laparoscopic surgery, but it was an uncontrolled study. To evaluate the oncologic outcome of laparoscopic surgery, long-term results of prospective randomized controlled trials are needed.

Among the curatively treated patients in our study, 4.1% of the patients with colon cancer and 5.6% of those with rectal cancer had recurrence. The rates and types of recurrence were similar to those reported for conventional open surgery. There were many reports of patients with port-site metastases and abdominal incisional recurrence [2]. In recently reported laparoscopic series, the frequency of port-site metastasis has been very low, ranging from 0% to 1.3% [17]. It was considered that port-site metastases were related to the unskillful laparoscopic technique in early periods. Experimental studies investigating murine models showed that carbon dioxide pneumoperitoneum, as comparsed with laparotomy, reduced lung metastases and peritoneal dissemination and enhanced liver metastases [8, 18]. Conclusions about the influence of carbon dioxide pneumoperitoneum on tumor development cannot be drawn from these studies because the data on ecological outcome are inadequate.

In this study, postoperative complications were observed in 12.6% of patients with colon cancer and 14.1% of patients with rectal cancer, and the frequency of complications was consistent with that in previous studies [3, 9, 12]. No specific laparoscopic complications were detected. An examination of the relation between the occurrence of complications and surgical procedures showed that postoperative complications occurred more frequently for patients undergoing transverse colectomy than in patients undergoing any other procedure. The technical difficulties in ligating the roots of middle colic vessels in laparoscopic surgery may account for this finding.

In our series, about three-fourths of all the patients underwent laparoscopic right colectomy, sigmoid colectomy, or anterior resection. Histopathologic examination showed that Tl, T2, T3, and T4 disease each accounted for one-fourth of the total patients, and that stage I disease was present in more than half of our patients. Curative surgery was performed for 94.4% of all patients with colon cancer and 93.9% of those with rectal cancer. These findings suggest that laparoscopic surgery for colorectal cancer has been accepted as a radical treatment for potentially curable patients in Japan.

We conclude from our findings that laparoscopic surgery is safe treatment for colorectal cancer, with an oncologic outcome as good as that of conventional open surgery. The results of our nonrandomized retrospective clinical analysis must be confirmed by large-scale prospective randomized trials.

Acknowledgement. This work was supported in part by a Grant-in-Aid for Cancer Research from the Japanese Ministry of Health, Labour, and Welfare (No. 13-17). The following centers and surgeons participated in the multicenter study initiated by the Japanese Laparoscopic Surgery Study Group (JLSSG): Seigo Kitano, Norio Shiraishi, Masafumi Inomata, Oita University Faculty of Medicine (Oita); Masaki Kitajima, Kasuhiro Yasuda, Hirotoshi Hasegawa, Keio University School of Medicine (Tokyo); Fumio Konishi, Yutaka Kawamura, Omiya Medical Center Jichi Medical School (Omiya); Masahiko Watanabe, Kitasato University (Sagamitara); Susumu Satomi, Tohoku University Faculty of Medicine (Sendai); Nobuyoshi Shimizu, Okayama University Faculty of Medicine (Okayama); Masaki Fukunaga, Urayasu Hospital Juntendo University School of Medicine (Tokyo); Yoshinobu Sumiyama, Yoshihisa Saida, Ohashi Hospital Toho University School of Medicine (Tokyo); Shinei Kudo, Junichi Tanaka, Northern Yokohama Hospital Showa University (Yokohama); Nobuhiko Tanigawa, Junji Okuda, Osaka Medical University (Osaka), Tatsuro Yamakawa, Nobuyoshi Miyajima, Mizonoguchi Hospital Teikyo University (Tokyo), Hideo Yamada, Sakura National Hospital (Chiba), and Masao Nakata, Shikoku Cancer Center (Matsuyama).

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Long-term Outcome of Laparoscopic Wedge Resection for Gastric Submucosal Tumor Compared With Open Wedge Resection

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Abstract: Little is known about the outcomes of laparoscopic wedge resection (LWR) in comparison with conventional open wedge resection (OWR) for gastric submucosal tumor. Outcomes of 21 patients who underwent LWR (n = 14) or OWR (n = 7) for gastric submucosal tumor between 1993 and 2004 were investigated. We compared the short-term and long-term operative results between the 2 groups. LWR showed several advantages over OWR for gastric submucosal tumor: less blood loss, lower fever on day 1, lower analgesic usage rate, earlier first postoperative flatus and oral intake, lower leukocyte count on days 1 and 7, and lower C-reactive protein level on days 1 and 3. All patients, except 2 with histologically diagnosed high-risk gastrointestinal stromal tumor, survived during the mean follow-up period of 60 months. LWR is feasible for the management of patients with gastric submucosal tumor.

Key Words: gastrointestinal stromal tumor, gastric GIST, gastric submucosal tumor, local resection, laparoscopy

(*Surg Laparosc Endosc Percutan Tech* 2006;16:82–85)

Gastric submucosal tumor including gastrointestinal stromal tumor (GIST) is a rare, nonepithelial, mesenchymal neoplasm of the gastrointestinal tract, and surgery remains the standard treatment.[1] Because of the low frequency of lymph node involvement, lymphadenectomy is not usually required.[2] Local resection enables one to completely resect the tumor.[3] Therefore, wedge resection of the stomach for gastric submucosal tumor is accepted worldwide.

Laparoscopic gastrectomy is becoming popular in Japan for the treatment of gastric cancer, because it improves the patient's postoperative quality of life.[4] Several reports[5–7] have indicated that laparoscopy-assisted distal gastrectomy is more useful than open gastrectomy for gastric cancer because of decreased postoperative pain, shorter hospital stay, and better quality of life after surgery. However, there are few reports of the short-term operative results of laparoscopic wedge resection (LWR) in comparison with open wedge resection (OWR) for the treatment of gastric submucosal tumor.[8–10] Also, little is known about the long-term operative results of LWR of gastric submucosal tumor.

We compared the outcomes of patients who underwent LWR with those who underwent OWR of the stomach, to evaluate the usefulness of LWR for gastric submucosal tumor.

PATIENTS AND METHODS

The study subjects were 21 patients with gastric submucosal tumor that was treated surgically in the Department of Surgery I, Oita University Faculty of Medicine and Surgery Division, Arita Gastrointestinal Hospital, between 1993 and 2004. The age and sex of patients, surgical procedures, tumor characteristics, and operative outcomes were obtained from medical charts. The 21 patients comprised 2 groups: an LWR group (n = 14) and an OWR group (n = 7). Use of LWR or OWR was selected on the basis of a preoperative assessment of the size, location, and progression of the tumor by endoscopy, barium radiology, abdominal echography and computed tomography, and endoscopic ultrasonography. A tumor diameter of 20 to 50 mm or a tumor less than 20 mm in diameter with rapid growth because of malignant potential indicated the need for LWR (Fig. 1). OWR was used for tumors larger than 50 mm in diameter, because laparotomy was required for the tumor removal without tumor rupture and subsequent peritoneal seeding. In the LWR group, the entire surgical procedure was performed laparoscopically. Hasson trocar was inserted at the subumbilical portion with the open technique, and 3 additional trocars were inserted in the upper abdomen after carbon dioxide pneumoperitoneum was established. When the tumor was located on the posterior wall of the stomach, it was exposed after division and dissection of the greater or lesser omentum with laparoscopic coagulating shears. Wedge resection of the gastric wall was performed with a multifire endoscopic

Received for publication September 14, 2005; accepted February 11, 2006.

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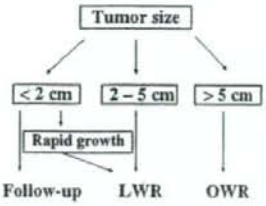

FIGURE 1. Strategy for the treatment of gastric submucosal tumor in our institution.

stapler under laparoscopic techniques, assisted by intraoperative gastroscopy. The resected specimen was removed in a plastic bag through the umbilical wound. In the OWR group, laparotomy was performed via upper midline incision, and wedge resection of the stomach was performed as described above.

Pathologic findings including tumor diameter, microscopic margin status of the surgical specimen, mitotic count as the number of mitoses per 50 high-power fields, and immunohistochemical staining for c-kit, CD34, SMA, and S-100 were examined. Histologic resectability was determined according to the International Union Against Cancer TNM classification system[11]: R0 (no residual tumor; wide margins), R1 (microscopic residual tumor; tumor at the resection line), or R2 (macroscopic residual tumor; partial resection).

Differences between groups were analyzed by Mann-Whitney *U* test, Fisher exact test, or *t* test. A *P* value of < 0.05 was considered statistically significant.

RESULTS

The groups were similar in patient age and sex ratio (Table 1). The mean tumor diameter was less in the LWR group than in the OWR group ($P < 0.01$). All but 2 tumors were located in the upper and middle third of the stomach, and there were no differences in longitudinal and cross-sectional tumor location between the groups.

TABLE 1. Patient and Tumor Characteristics in 2 Treatment Groups

	LWR* (n = 14)	OWR* (n = 7)	*P*
Patient			
Age (y)	61 ± 14	67 ± 8	0.332†
Sex ratio (M:F)	6:8	4:3	0.659‡
Tumor			
Size (mm)	2.9 ± 1.0	8.5 ± 7.6	< 0.05†
Location (longitudinal) U/M/L	5/9/0	3/2/2	0.074‡
Location (cross-sectional) A/P/G/L	5/3/2/4	1/4/1/1	0.401‡

*Values are mean ± standard deviation.
†By Mann-Whitney *U* test.
‡By Fisher exact test.
A/P/G/L indicates anterior wall/posterior wall/greater curvature side/lesser curvature side; U/M/L, upper/middle/lower.

TABLE 2. Operative Findings in 2 Treatment Groups

	LWR* (n = 14)	OWR* (n = 7)	*P*
Operation time (min)	118 ± 55	165 ± 108	0.351†
Blood loss (g)			
< 20	13	3	< 0.05‡
> 20	1	4	
Intraoperative complications	0	0	

*Values are mean ± standard deviation.
†By Mann-Whitney *U* test.
‡By Fisher exact test.

There was no difference in operation time between the 2 groups (Table 2). Blood loss was less in the LWR group than in the OWR group. No intraoperative or postoperative complications occurred in either group.

Clinical courses are summarized in Table 3. Body temperature on day 1 was lower in the LWR group than in the OWR group (37.4 vs. 38.0°C). Analgesics were given less frequently in the LWR group than in the OWR group (2.9 vs. 5.3 times). The first flatus was detected earlier in the LWR group than in the OWR group (2.1 vs. 3.5 d), and the time to oral intake was shorter in the LWR group than in the OWR group (2.9 vs. 5.2 d). The postoperative course after LWR was better than that after OWR.

As shown in Table 4, significant differences were observed between the 2 groups in the leukocyte count on days 1 and 7, proportion of granulocytes on day 1, proportion of lymphocytes on days 1 and 3, C-reactive protein level on days 1 and 3, and albumin level on day 3. The inflammatory response was lower in the LWR group than in the OWR group, and nutrition was less impaired in the LWR group than in the OWR group.

Pathologic findings and recurrence are shown in Table 5. The most common histologic type of tumor was GIST (17 patients, 81%). Other histologic types were schwannoma (3 patients, 14%) and leiomyoma (1 patient, 5%). Microscopic examination showed that all tumors were completely resected (R0). The mitotic count was

TABLE 3. Postoperative Course in 2 Treatment Groups

	OWR* (n = 14)	LWR* (n = 7)	*P*†
Body temperature (°C)			
Day 1	37.4 ± 0.4	38.0 ± 0.5	< 0.05
Day 3	37.0 ± 0.4	37.2 ± 0.6	0.282
Day 7	36.4 ± 0.4	36.7 ± 0.3	0.120
No. days to body temperature > 37°C	2.9 ± 1.4	3.0 ± 1.1	0.912
No. times analgesics given	2.9 ± 1.5	5.3 ± 3.4	< 0.05
No. days to first walking	1.4 ± 0.6	2.2 ± 1.0	0.060
No. days to first flatus	2.1 ± 0.8	3.5 ± 0.8	< 0.05
No. days to liquid diet	2.9 ± 0.9	5.2 ± 1.6	< 0.05
Postoperative hospital stay (d)	11.0 ± 4.2	18.7 ± 9.9	0.091
Postoperative complications	0	0	

*Values are mean ± standard deviation.
†By *t* test.
Day indicates postoperative day.

TABLE 4. Blood Analyses in 2 Treatment Groups

	LWR*(n = 14)	OWR*(n = 7)	P
Leukocytes ($\times 10^9$/L)			
Day 1	7.1 ± 1.4	11.5 ± 3.4	< 0.05
Day 3	5.9 ± 1.6	6.4 ± 1.1	0.525
Day 7	4.5 ± 1.2	6.1 ± 0.8	< 0.05
Proportion of granulocytes (%)			
Day 1	72.1 ± 6.1	84.6 ± 2.3	< 0.05
Day 3	65.4 ± 6.0	70.0 ± 2.6	0.239
Day 7	60.2 ± 13.5	66.3 ± 5.3	0.485
C-reactive protein (mg/dL)			
Day 1	2.6 ± 1.8	8.2 ± 6.1	< 0.05
Day 3	5.0 ± 4.2	12.1 ± 7.1	< 0.05
Day 7	2.5 ± 3.4	3.7 ± 2.7	0.583
Albumin (g/dL)			
Day 1	3.8 ± 0.3	3.4 ± 0.4	0.134
Day 3	4.0 ± 0.5	3.2 ± 0.1	< 0.05
Day 7	4.0 ± 0.4	3.6 ± 0.3	0.167
Proportion of lymphocytes (%)			
Day 1	18.4 ± 5.3	8.7 ± 0.1	< 0.05
Day 3	21.0 ± 2.6	14.6 ± 2.0	< 0.05
Day 7	26.4 ± 9.5	17.3 ± 2.9	0.160

*Values are mean ± standard deviation; *t* test.
†Mann-Whitney *U* test.
Day indicates postoperative day.

more than 10 mitoses per 50 high-power fields in 2 patients with GIST; these 2 developed metachronous liver metastasis. One of these patients was in the LWR group; the GIST was 4.5 cm in diameter, and the patient died of liver metastasis 32 months after LWR. The other patient was in the OWR group; the GIST was 25 cm in diameter, and the patient died of liver metastasis 9 months after OWR. No lymph node metastasis was found in either of these patients at the time liver metastasis was found. With the exception of these 2 patients and 1 patient in whom local recurrence of leiomyoma developed after LWR with an inadequate tumor-free margin (2 mm), patients remain disease free (mean follow-up period, 60 mo; range, 3 to 130 mo).

TABLE 5. Pathologic Findings and Recurrence in 2 Treatment Groups

	LWR* (n = 14)	OWR* (n = 7)
Pathologic findings histology		
GIST	11	6
Leiomyoma	1	0
Schwannoma	2	1
Mitotic count (/50 HPF)		
≦5	13	6
6 to 10	0	0
> 10	1	1
Margin		
R0/R1/R2	14/0/0	7/0/0
Recurrence		
Local	1	0
Liver	1	1
Lymph node	0	0
Peritoneum	0	0
Follow-up (mo)	60.2 (5–119)	61.3 (3–130)

*Values are mean (range).
HPF indicates high-power field.

DISCUSSION

This study showed that LWR is safe and useful for small submucosal tumor of the stomach because, in comparison with OWR, it causes less pain, is less invasive, impairs nutrition less, and allows for earlier recovery of bowel function. When LWR with an adequate tumor-free margin was performed for gastric submucosal tumor in our series, there was no local recurrence. Thus, we showed better short-term and long-term outcomes in patients who underwent LWR rather than OWR for gastric submucosal tumor.

The surgical indication and selection of surgical procedures for GIST is controversial.[12–14] In the present study, GIST measuring 2 to 5 cm indicated the need for LWR. In Japan, LWR for small GIST (2 to 5 cm) has come to be popular and feasible surgical outcomes of LWR have been reported.[10,15] Most of the tumors smaller than 2 cm are considered to be very low risk[16] and the tumors are usually followed-up carefully in Japan.[17] Only when the small GIST is assessed to have malignant potential by biopsy or rapidly increases in size, suggesting a malignant tumor, is the small GIST treated.[15] Recently, the European consensus meeting recognized a careful follow-up for small (2 cm) intramural tumors as a choice of treatment.[14] On the other hand, OWR is usually used for GIST larger than 5 cm in Japan and in western countries. Most tumors have malignant potential and laparotomy is required for tumor removal without tumor rupture and subsequent peritoneal seeding.[12]

There have been several reports of successful treatment of gastric submucosal tumors by LWR[15,18–20] and that LWR is superior to OWR because its short-term outcome is better.[8–10] Cheng et al[8] showed the advantages of LWR to be a lower analgesic usage rate, earlier postoperative oral intake, and shorter hospital stay. Matthews et al[9] also reported a shorter hospital stay after LWR for gastric submucosal tumor. Shimizu et al[10] indicated better short-term outcomes, including earlier ambulation after surgery, earlier first flatus and oral food intake, lower leukocyte count on day 1, shorter period of high fever, and shorter period of postoperative hospitalization after LWR than after OWR. Our short-term results supported these published results.

In our series, patients in the LWR and OWR groups were discharged 11 and 19 days after operation, respectively. Postoperative hospital stay in Japan is known to be longer than that in western countries. Hospitalization in Japan is not as expensive as in western countries because of special medical insurance. Therefore, most patients in Japan want sufficient rest after surgery, and are permitted to spend a long time in the hospital. In our knowledge of English literature, postoperative

hospital stay after LWR was much longer in Japan than that in western countries.[8–10]

Complete local resection is widely accepted for the treatment of gastric submucosal tumor including GIST. In several studies, patients who underwent complete resection of GIST had better overall survival than those who underwent incomplete resection.[1,21] The. optimum margin from the cut-line to the tumor edge has not been defined for wedge resection; however, wedge resection of the stomach with an adequate tumor-free margin should be performed. In this study, all patients underwent wedge resection of the stomach with microscopically negative margins. However, one patient with leiomyoma in the LWR group suffered local recurrence because of an inadequate tumor-free margin (2 mm). Thus, resection with an adequate tumor-free margin is important in LWR for gastric submucosal tumor.

About 10% to 30% of GISTs are reported to be malignant.[22,23] In cases of GIST, the mitotic rate and tumor size are thought to be prognostic factors.[23] Fletcher et al[16] proposed a scheme for assessing the risk (low, intermediate, or high) of aggressive behavior in GIST. In our study, 2 patients with high-risk GIST, according to the Fletcher et al[16] classification, died of liver metastasis. Our data support the clinical usefulness of Fletcher et al[16] risk categories. However, even when histologic features indicate a low risk, GIST can behave as a malignant tumor with delayed recurrence.[22] Therefore, Fletcher et al[16] advocated that all patients with GIST be carefully and regularly followed up for an indefinite period. To prevent the recurrence of high-risk tumors, imatinib is being evaluated for adjuvant therapy after complete resection of primary GIST.[1] In the future, adjuvant therapy with imatinib for high-risk tumors may be considered.[13,14]

In conclusion, LWR has several advantages over OWR for gastric submucosal tumor, including less pain, less invasiveness, less impaired nutrition, and earlier recovery of bowel function, with no decrease in operative curability. We believe that LWR with an adequate tumor-free margin is feasible for the management of patients with gastric submucosal tumor. Further investigations and a randomized trial to establish whether LWR is as safe and useful as OWR are needed before this procedure can be recommended as a standard treatment.

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