

図6 外側からの腸管剥離

- a) S-D junction部の壁側腹膜を損傷しないよう授動する。腹腔鏡の視野を尾側あるいは頭側より剥離層に対し水平方向に構える。
- b) 挿入ガーゼ前面の内側からの剥離層と外側からの剥離層を膜1枚切開し連続させる。

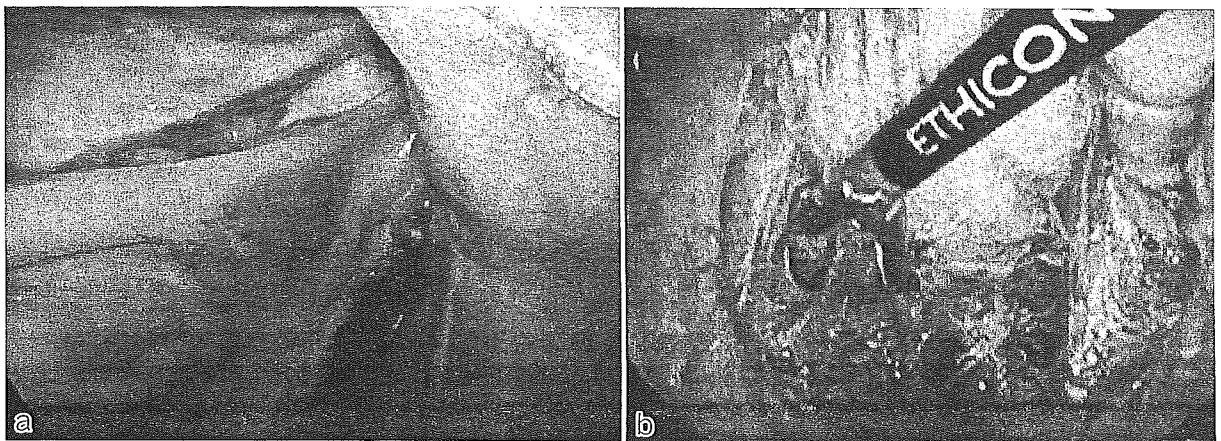


図7 直腸剥離

- a) 傍直腸溝に沿って直腸間膜を切離する。
- b) 安全なDSTには直腸後腔の十分な剥離が必要である。

離すると出血をみない(図8)。直腸切離予定部より肛門側を余分に剥離しておくことは、のちの腸間膜・腸管切離を安全に行うために必須である⁶⁾。

9. 直腸切離

直腸の切離にあたっては、まず右側の直腸間膜から切開を加え、注意深く鈍的に脂肪組織を剥離し直腸壁を確認する。その脂肪組織を血管

とともに超音波凝固切開装置で丹念に止血しながら切開してできるかぎり直腸壁を露出する。その際、超音波凝固切開装置のアクティブブレードは手前側にして直腸壁や脂肪組織内の血管に当たらないように注意する。この操作では、キャビテーションが直腸壁側に向かい組織が脆弱化してしまう危険性があり、のちの縫合不全を招くおそれがあるので注意する。直腸後壁の脂

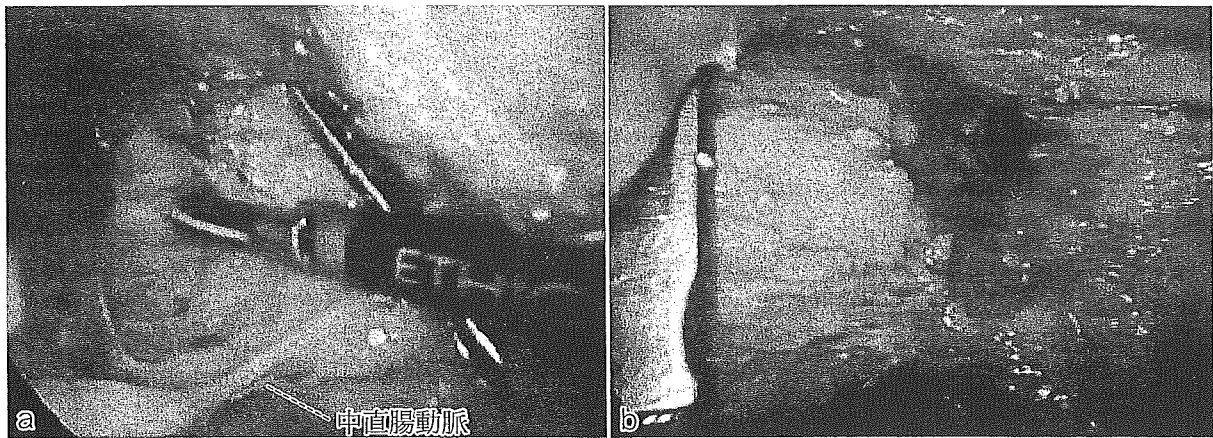


図 8 腹膜翻転部以下の剝離

a) 左側の膀胱直腸間隙と中直腸動脈 b) 右側の膀胱直腸間隙と側方靱帯

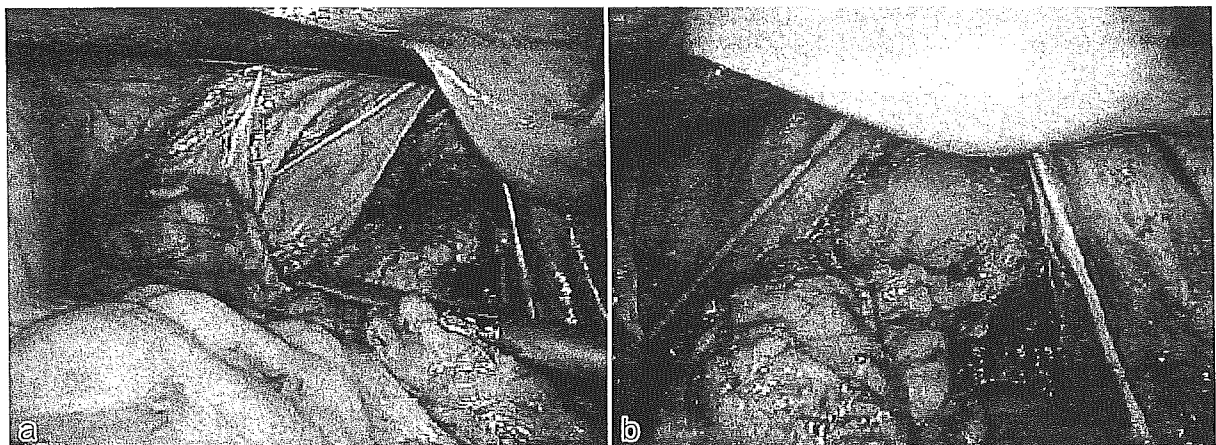


図 9 直腸洗浄

a) 腫瘍の肛門側を 5 mm 径腸鉗子によりクランプ b) 洗浄

肪組織をできるだけ右側から処理したのちに直腸左側を右側と同様に脂肪組織を切離して左右同じレベルで直腸壁を露出する。超低位吻合の場合では、これらの腸間膜処理は不要である。腫瘍の肛門側に腸クランプ鉗子を掛け直腸洗浄と切離を行う(図9)。その際、山本らが開発した屈曲可能な直腸クランプ鉗子を使用すると大変便利である。洗浄を容易とするばかりではなく、腸管が扁平となり自動縫合器がスムーズに挿入でき安全な切離が可能となる(図10)⁷⁾。腸管切離の自動縫合器はなるべく直腸に直角にかけ1度で切離ができるようにする。

1度で切離が完了しない場合は、2度目の自動縫合器の切離線が1度目の切離線よりやや肛門側になるように掛ける。前述したように切離予定部より肛門側が余分に剝離されていないと、自動縫合器は直腸長軸に直角には掛からず、腸管の切離線が肛門側に斜めになって2度目の切離線はさらに斜めになり、切離に要する縫合器の数が増し吻合が的確に行えない。

10. 体外操作

下腹部正中のラップディスクミニ(八光社)周囲を大ガーゼで覆う。肛門側切離断端より病変腸管を体外へ引き出し、血流と吻合口への緊

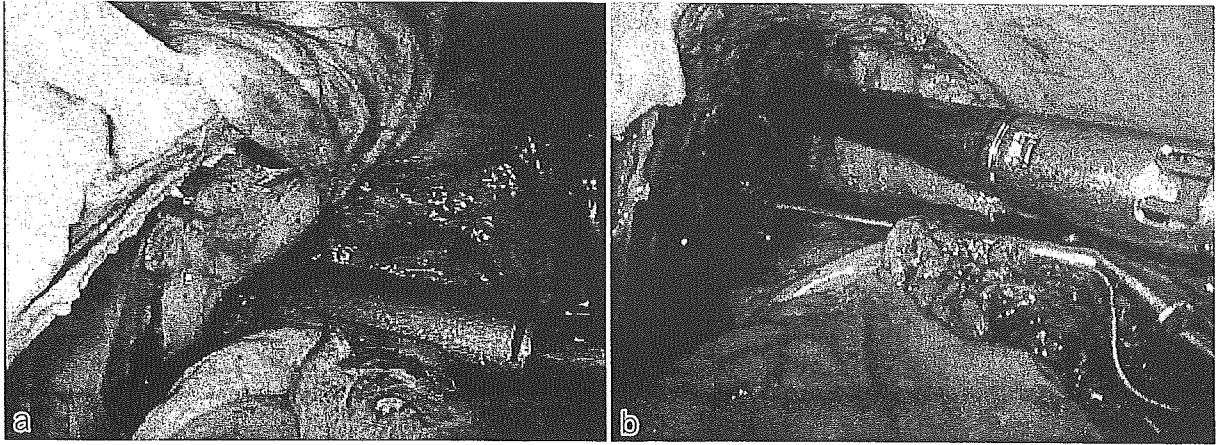


図 10 下部直腸の切離

- a) 下部直腸は長軸に対し直角に把持し切離することがむずかしい。
 b) 腸把持部分の屈曲可能なクランプ鉗子を使用すると容易に自動縫合器の挿入から切離までを可能とする。

張具合を確認し病変切除を行う。口側切離断端が恥骨結合部まで届くよう腸間膜処理することは周知のとおりである。アンビルヘッドを断端に挿入して腸管壁が全周性に縛り込まれるよう巾着縫合で縛りこむ。

11. 直腸吻合

アンビルヘッドを装着した切離断端を腹腔内に還納、ラップディスクミニを閉鎖する。再気腹後、体位変換を行い直腸断端周囲の視野を良好に保つ。自動吻合器を肛門から愛護的に挿入し吻合器の先端が直腸断端に到達したら、センターロッドが縫合線の近くぎりぎりになるように操作する。このとき吻合器を前後左右に動かすだけでなく、時計回りや反時計回りに捻るとなお合わせやすい。縫合線が先端の水平部分の中央にくるように、先端が漿膜を押し上げた段階で、電気メスで漿膜を切開すると容易にセンターロッドが露出する。さらにアンビルホルダーで断端を押し下げてセンターロッド全体を露出させる (図 11 a)。アンビルヘッドをセンターロッドと連結させ口側腸管に捻れがないことを確認する、その後ゆっくりと周囲の脂肪組織や間膜を巻き込まないように注意深く吻合する (図 11 b)。製造メーカーにより自動吻合器の使用法に若干の違いがあるのであらかじめ確

認しておく。自動吻合器を引き抜いたら、必ずドーナツの形成を確認する。吻合に緊張が加からず口側腸管がやや弛む程度がよく、もし緊張がかかっているようなら脾彎曲部を授動する。ドレーンは仙骨前面に留置するが、なるべく先端が吻合部に直接当たらないようにする。

III. 適応と本法の問題点

直腸癌の腹腔鏡下手術においてその拡大視効果はきわめて有用である。適正な剝離層や神経走行の詳細な観察が可能で、骨盤内の解剖を理解していれば無血野に神経温存しつつ直腸周囲を剝離することが可能である。しかし、腸間膜脂肪が厚く狭骨盤の症例では、開腹手術と同様に腹腔鏡下手術でも視野展開は困難である。低位直腸での剝離操作や腸管切離は習熟を要し、腫瘍への愛護操作が困難なため腫瘍散布の危険性は高い。Rs 癌なら S 状結腸癌と同様な手技であり進行癌でも適応可能と考えるが、Ra~Rb 癌においては手技に習熟するまでは適応を早期癌にとどめ習熟した術者でも MP 癌までが適応として妥当と考える。また、側方郭清が必要な進行癌は、現時点では適応外としている。

本法を遂行するにあたりもっとも問題となるのは、洗浄から切離をいかにストレスなく安全

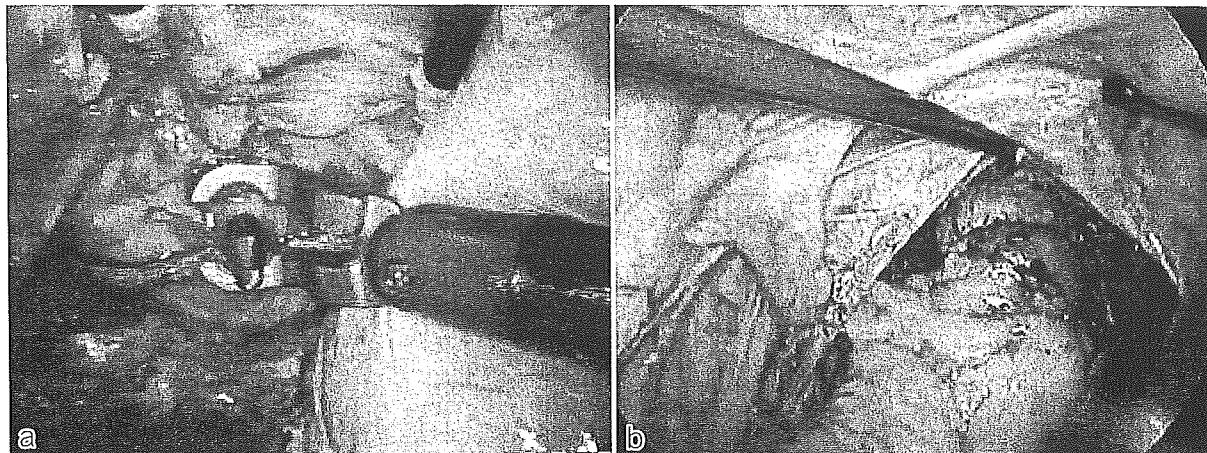


図 11 結腸直腸吻合

- a) センターロッドを縫合線の近くぎりぎりに出す。アンビルホルダーにより断端を押し下げてセンターロッド全体を露出させる。
- b) 口側腸管の捻れがないことを確認し、周囲組織を巻き込まないように注意深く吻合する。

に行うかである。拡大視効果により良好な視野下で直腸低位までの剝離操作は開腹手術以上の繊細な手技が可能となった。しかし、現存の腹腔鏡手術用腸鉗子では直腸低位における腫瘍肛門側の適切なクランプは困難である。着脱式腸鉗子なども開発され解決されつつあるが、満足の得られるものとはいいがたい。腸把持部分の屈曲が調節でき把持力の強い腹腔鏡用クランプ鉗子が開発され、これを使用すると比較的完全に洗浄から切離が行える⁷⁾。超低位の切離にも対応できるようさらなる改良が望まれる。DST 吻合においては、現在使用可能な自動縫合器では、長軸に対し垂直に 1 回での確実な直腸切離は困難である。厚い直腸壁では確実な stapling が得られず、ミスファイアとなる場合がある。これら器具の改良が進み安全な直腸切離が可能となれば、腹腔鏡特有の拡大視効果と相まって、腹腔鏡手術は直腸癌手術における必須の手術法となるであろう。

おわりに

直腸癌に対する腹腔鏡下手術の視野の展開から直腸切離までの工夫につき紹介した。本法を遂行するにあたって、その腫瘍学的要因と技術

的要因の両方を考慮し慎重に適応を広げることが肝要である。

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A new technique of laparoscopic surgery for rectal disease

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RESUMEN

La cirugía laparoscópica rectal es una técnica que tiene que realizarse en un espacio reducido de la pelvis. Si se realiza una operación excesiva con una visión difícil, por ejemplo, en una mujer en la que el campo está perturbado por el útero, es posible producir un trauma en el órgano o un sangrado inesperado. Teniendo presentes estos problemas, realizamos cirugía laparoscópica en 44 casos de enfermedad rectal con varias técnicas que hemos inventado. En estos casos, se realizó en el pequeño espacio una retracción ya sea del útero o el recto y en caso de tener que realizar resección anterior, se amarró la cinta de manera ajustada alrededor del recto por debajo del tumor para evitar tocar el tumor y para permitir una adecuada irrigación vascular en el resto del recto. Con el uso de nuestras técnicas, no tuvimos daños intestinales ni sangrados inesperados en mujeres. Además, la resección anterior laparoscópica del recto no causó ningún daño intestinal, ni sangrado inesperado ni fuga anastomótica. Tampoco tuvimos ninguna recurrencia de tumor local. Creemos que estas técnicas pueden reducir las complicaciones que traumatizan al intestino con fórceps e impiden la implantación en la anastomosis. Este informe técnico valida que nuestras modificaciones en la técnica de cirugía laparoscópica rectal son útiles cuando un cirujano tiene que trabajar en un espacio reducido.

PALABRAS CLAVES: Cirugía Laparoscópica, Enfermedad rectal.

SUMMARY

Laparoscopic rectal surgery is a technique that has to be done in a narrow space: the pelvis. If an immoderate operation is performed with a difficult view, for example in female where the field is disturbed by uterus, it is possible to produce organ trauma or an unexpected bleeding. Taking these problems in mind, we performed laparoscopic surgery in 44 cases of rectal disease with several techniques which we have invented. In these cases either the uterus or the rectum was retracted in the narrow space, and if an anterior resection was to be done, the tape was tied tightly around the rectum below the tumor to avoid touching the tumor and leaving adequate vascular irrigation to the remnant rectum. With the use of our techniques, we did not have female intestinal injury or unexpected bleeding. In addition laparoscopic anterior resection of rectum did not cause any intestinal injury, or unexpected bleeding or anastomotic leakage; also we did not have any local tumor recurrence. It is our belief that these techniques can decrease complications that traumatize the grasping intestine with intestinal forceps and prevent implantation in the anastomosis. This technical report validate that our technique modifications for rectal laparoscopic surgery are useful when a surgeon has to work in a narrow space.

KEY WORDS: Surgical laparoscopy, rectal disease.

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INTRODUCTION

In the past decade laparoscopic surgery has become the world standard for cholecystectomy, it is easy to be done by an expert surgeon, has a lower morbidity and mortality compared to conventional cholecystectomy and in addition reduces medical costs. Now laparoscopic colectomy will become a worldwide surgical technique because it has similar advantages. However, laparoscopic colectomy has numerous factors that may be difficult to have an adequate surgical view. This is true specially, when a patient with rectal disease is operated with a restricted view in the narrow space of the pelvis; this event often yields to damage bowel with forceps or to induce an unexpected bleeding. We invented several techniques to get a better view of the pelvis when laparoscopic surgery is performed for rectal disease in a narrow pelvic space.

PATIENTS AND METHODS

Between 1996 and 2003, a total of 208 cases underwent laparoscopic colorectal surgery at the Department of Surgery - Fujita Health University Hospital. Of these, 10 cases were converted to open surgery. So far laparoscopic pelvic surgery was performed in 44 patients.

As operative methods of laparoscopic pelvic surgery, high anterior resection was performed in 18 cases, low anterior resection in 17 cases, Rectopexy in 7 cases, and partial resection, adhesiotomy, enucleation and total colectomy were also performed in every case.

Appliance

For this type of surgery 3 mechanical devices were used:

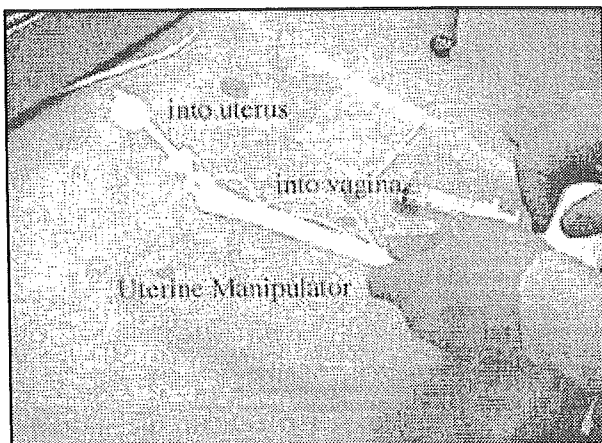


Figure 1. UTERINE MANIPULATOR. This device is introduced from the vagina to the uterus. The assistant controls the bar of it and removes uterus from the field. The uterus is hatched up by this manipulator.

1. Uterine manipulator (Etikon.com products). Figure 1.
2. Tape made with Tetron jointed the dull tip needle

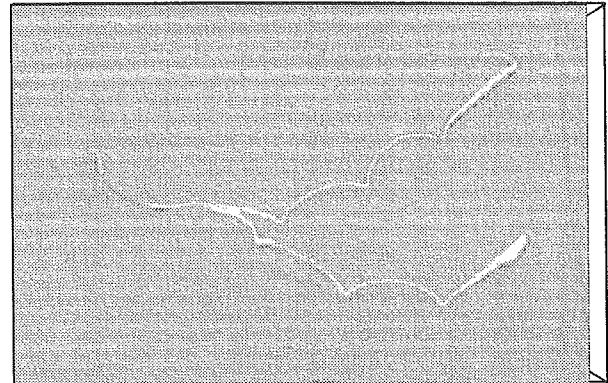


Figure 2. Tetron Tape joint the dull tip needle with obtuse angle, 1-0 (45mm) 3mm.

3. Diamond Flex Retractor 45° (Genzyme Surgical Products)

Surgical technique

1. Previous preparation: Patients were placed on clear liquid diets two days before surgery, and received GOLYTELY mechanical bowel preparation one day before the operation.
2. In order to get a better pelvic view in a female patient where the field is disturbed by uterus:
 - 2.1 Use of uterine manipulator. (Etikon.com products)
 - 2.1.1 The uterine manipulator is inserted from the vagina to the uterus by the assistant. The uterus is controlled by the bar of it and

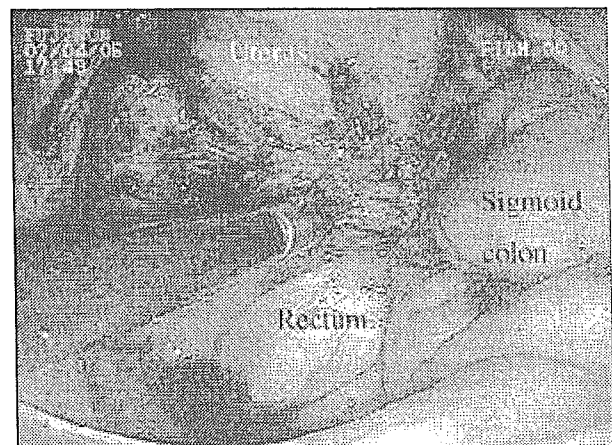


Figure 3. Endometriosis between uterus and intestine with a severe adhesion. Using UTERINE MANIPULATOR during surgery allows a better view and adequate mobilization between uterus and bowel. By controlling the UTERINE MANIPULATOR it is easy to remove things with the scissors and abrasive forceps.

is removed from the operating field by the assistant. Figure 3.2.1.2 Lifting of the uterus with a thread. A needle with a thread is inserted into the abdominal cavity through the trocar. A needle is passed directly into the uterus using the blunt tip of the needle. The thread is caught and taken out through the abdominal wall. The thread is tied and fixed to the abdominal wall.

2.2 Another technique is used as a straight needle with a thread:

2.2.1 A straight needle is inserted from the abdominal wall into the peritoneal cavity. The needle is passed through the broad ligament and the needle is taken out at around the same site of insertion. Then a thread is tied from the exterior and the uterus is fixed to the abdominal wall. Figure 4.

3. Technique of laparoscopic surgery for non-resectable disease

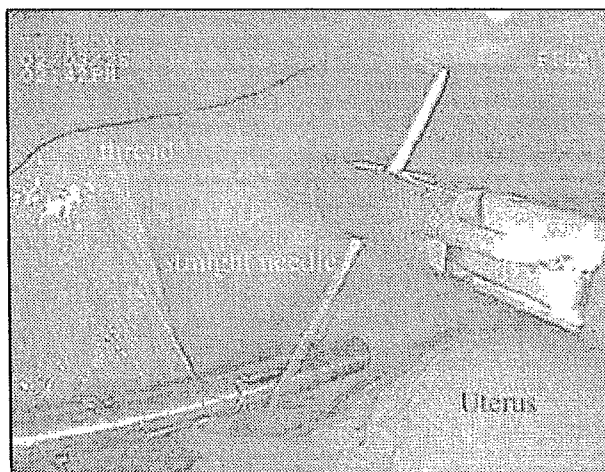


Figure 4. A straight needle is inserted from the abdominal wall into the peritoneal cavity. The needle is passed through the broad ligament and the needle is taken out at around the same site of insertion.

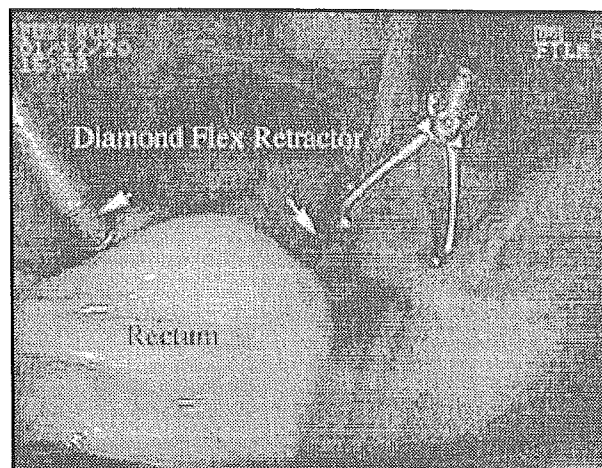


Figure 5. The soft pre-sacral connective tissue on the left side is dissected and passed through the contra-lateral cavity. Through this hole the Diamond Flex Retractor is inserted behind the rectum. The tip of the Diamond Flex Retractor is flexed and lifted up the rectum.

- 3.1 When the mesorectum is mobilized, the rectum is lifted up using Diamond Flex Retractor or 45° that was pulled through behind the rectum (Figure 5).
- 3.2 Technique of laparoscopic surgery for Rectal Cancer
- 3.3 Exclusion criteria for laparoscopic anterior resection of the rectum are tumor size > 5cm, T4, or rectum below the peritoneal reflection (Rb).
- 3.4 The position is changed from supine to Trendelenburg and lifted up about 15 cm. on an electrical operating room table. The technique and sites of trocar in laparoscopic low anterior resection has been presented in detail elsewhere.
- 3.5 To start with, the promontrium is a symbol of the starting point that retroperitoneum is opened with diathermy scissors from right side at the bottom of the rectum.
- 3.6 The dissection proceeds to the root of IMA, this is performed after the upper border of presacral fascia is confirmed. Following confirmation of the left ureter and part of retroperitoneum, the ureter and lumbar plexus are covered behind.

- 3.7 Lymph node dissection around the root of Inferior Mesenteric Artery (IMA) is performed and dissection of the root of left colic artery is confirmed.
- 3.8 Left colic artery is taped and is cut at the near by lesion.
- 3.9 A loop tie is performed with dyps and IMA is divided here.
- 3.10 Left colon, from sigmoid to the splenic flexure, is mobilized by division of its peritoneal attachments with diathermy scissors and Laparoscopic Coagulating Shears.
- 3.11 Mesorectum is mobilized posteriorly and laterally into the soft presacral connective tissue with diathermy scissors.
- 3.12 Superior hypogastric plexus and hypogastric nerve is carefully preserved during the procedure. When the dissection proceeded down to the peritoneal reflection, the uterus is controlled with the uterine manipulator.
- 3.13 After getting better view, the diathermy scissors and Laparoscopic Coagulating Shears cut the peritoneal reflection that is prolonged on either side of the base of the mesorectum and mesosigmoid are divided.
- 3.14 At the orontape with dull needle which is designed in Fujita Health University is passed through the 2mm working trocars (Fig.6- 12). It is passed through behind the rectum in the sagittal plane 2- 3cm below the palpable lower edge of the primary lesion, the rectum is ligated with and then apex fixed by dyps (Figures 7- 12). By the grasping tape, the rectum is managed and the mesorectum is irrigated with Laparoscopic Coagulating Shears.
- 3.15 The her tape which is taken measure of the distal line of resection and is cut.
- 3.16 The remnant rectum is irrigated with 200 ml distilled water from and side by a newly inverted Irrigation system. The sponge cytodiagnosis in the distal rectal mucosa

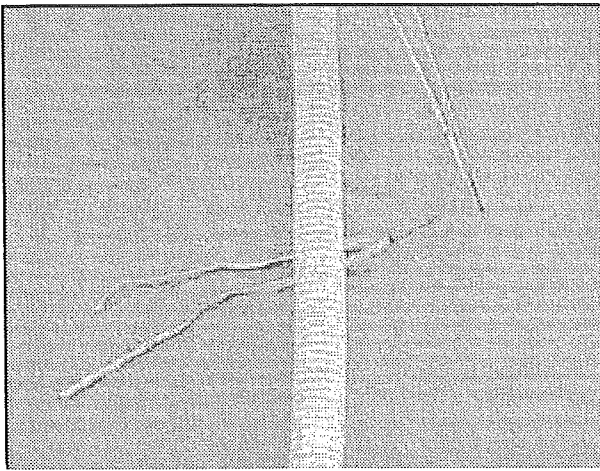


Figure.6-1. Demonstrating the procedure by a model (please consider a tube as the rectum): A needle is passed under the tube with tape and thread of the needle and cut .

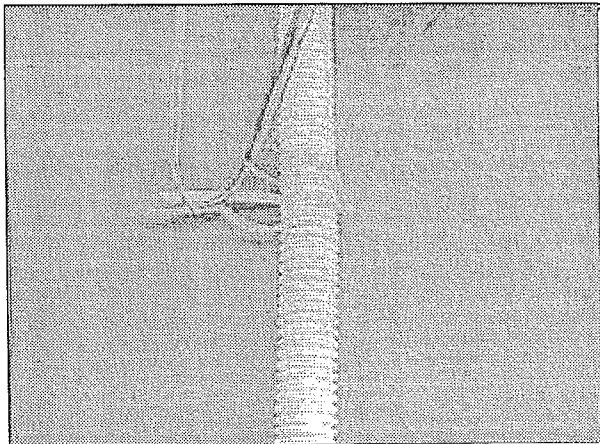


Figure.6-2. the edge of the tape is grasped with forceps and pulled through the loop and then tied up. By the grasping tape the tube can be managed.

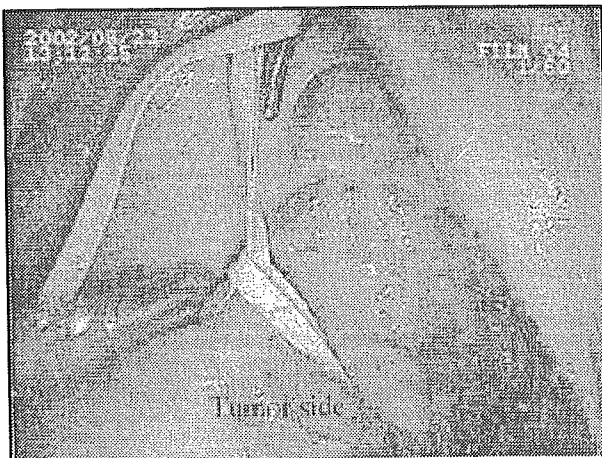


Figure.7-1. The procedure is now performed in the real pelvis. A needle is passed behind the rectum, an this is ligated with the tape and fixed by clips. A needle is passed through and behind the rectum.

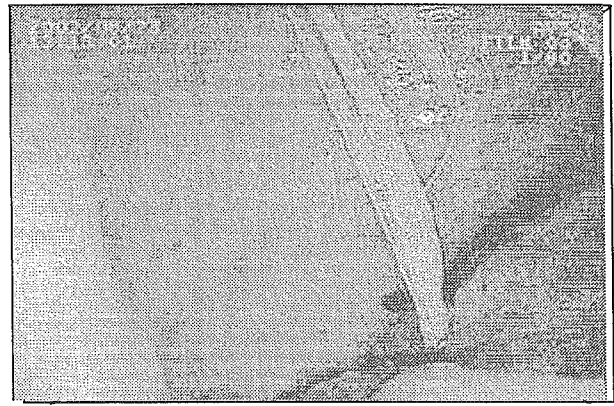


Figure.7-2. the tape is ligated with forceps and fixed by clips.

is performed after this irrigation,
 3.17 The rectum is divided by the ENDO-stapler (Figure 7-3). The excised colorectum is taken out through the small incision. An anvil head is fitted to the proximal colon and the colon is returned into the abdomen (Figure 7-4). Double stapling technique is being performed.



Figure.7-3. After the remnant rectum is irrigated with a 20cc of distilled water from anal side by a newly inverted irrigation system. Grasping and lifting the tape, the rectum is divided by ENDO-stapler.



Fig.7-4. An anvil head is fitted to the proximal colon and returned into the abdomen. Double stapling technique is being performed.

Between 1996 and 2003, 203 patients had laparoscopic assisted colorectal surgery. 44 patients of 203 patients were rectal disease and were performed with these surgical techniques. In a further case, these techniques have been gotten a better view of the pelvis and have gotten a safer procedure at the pelvis. The result of the sponge cytodiagnosis was negative for neoplastic cells. There were no operative significant complications especially intestinal injury and unexpected bleeding. Also local recurrence and post site recurrence were none.

DISCUSSION

We have done laparoscopic surgery for colon disease since 1996. Although being cautious, laparoscopic procedure of rectal disease had to be modified because this one in an indistinct view at the narrow space of the pelvis has the possibility of making a trauma to bowel with the forceps used or an unexpected bleeding. For these reasons we had to create several techniques to get a better view of the pelvis. With these techniques we performed laparoscopic surgery for colorectal cancer type T1 or T2, as well as surgery for benign rectal disease.

In female cases, the pelvic space was closed by uterus; therefore it was necessary to add on port. It must be said that to operate in a narrow space was extremely difficult, more taking in account the added forceps; as a result of these problems, we had to lift up the uterus using uterine manipulator and a thread with a straight needle. Using uterine manipulator, it made us able to control it between left and right side, as a result it was easier to use the device to move the lesion that was tense. It must be emphasized that this technique needs the support of an assistant to control uterine manipulator. We usually used uterine manipulator when it was necessary to do an anterior resection and a severe adhesiotomy had to be done.

Another technique has been performed that the uterus was fixed to the abdominal wall using a straight needle with a thread. This technique was careful of a bleeding from the uterine vessel a needle was passed through the broad ligament or the myoma and it was impossible to tense the mobilized tissue. This technique was used for the purpose of getting a better view of the pelvis when the benign rectal disease was operated.

Diamond Flex Retractor 45 was used for the purpose of tending between mesorectum and presacral fascia to mobilize the connective tissue and getting a view behind the mesorectum. It follows that this method was minimized to grasp the rectum with the intestinal forceps and was shorter operative time by getting a better view. The result could decreased complications of the intestinal injury with intestinal forceps.

Our technique for the anterior resection in the cancer was based on non-touch isolation technique which avoid to the intestinal injury by numerous grasping of the intestine or the lesion while getting a better view of the pelvis and excluding a tumor cell before division of the rectum.

The reported having used a vessel clamp clip when the rectum was irrigated. But the technique was often removed the clip and couldn't retract a bowel with grasping a vessel clamp clip and then mobilize the mesorectum.

However a tetoron tape with dull needle which was designed in Fujita health university can use to assist bowel retraction and rectal manipulation and irrigate the rectum, and even if it can use in the narrow pelvic space according to guide a dull needle behind mesorectum carefully.

The technique can prove the results of that the sponge cytodiagnosis is no tumor cells and our techniques of the narrow space for the rectal disease is no operative significant complications especially intestinal injury and unexpected bleeding. We expected that these techniques could decreased complications that traumatized the grasping intestine with intestinal forceps and they would prevent implantation to the anastomosis and would be able to operate safely even in the narrow space.

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Pneumoserotum: A rare manifestation of perforation associated with therapeutic colonoscopy

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Received: 2004-12-31 Accepted: 2005-01-13

Abstract

Pneumoserotum is uncommon and also rarely reported as a complication associated with colonic perforation. A case of colonic perforation in delayed fashion associated with EMR, revealed by pneumoserotum, is reported and the associated literatures are reviewed. A 52-year-old male received piecemeal EMR for a laterally spreading tumor 35 mm in size in our hospital. He complained of enlargement of the scrotum and revisited our hospital the day after the procedure. A diagnosis of pneumoserotum was made, and as most such cases have been reported to be associated with pneumoperitoneum, colonic perforation was suspected. Free air but no fluid collection was found by abdominal computed tomography, and delayed colonic perforation was diagnosed. However, as there were no clinical signs of peritoneal irritation, conservative treatment was administered and the patient recovered uneventfully. Pneumoserotum could be a sign of colonic perforation after EMR, and treatment should be carefully chosen.

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Key words: Pneumoserotum; Colonic perforation; Endoscopic mucosal resection

Fu KI, Sano Y, Kato S, Fujii T, Sugito M, Ono M, Saito N, Kawashima K, Yoshida S, Fujimori T. Pneumoserotum: A rare manifestation of perforation associated with therapeutic colonoscopy. *World J Gastroenterol* 2005; 11(32): 5061-5063
<http://www.wjgnet.com/1007-9327/11/5061.asp>

INTRODUCTION

Endoscopic mucosal resection (EMR) is a well-established and non-invasive therapeutic procedure for colorectal neoplasm in the early stage. Although rare, various complications including hemorrhage and perforation have been reported. On the other hand, pneumoserotum is uncommon and it is generally a term used for the expression of the presence of gas within the scrotum^[1]. Although most cases are associated with pneumoperitoneum, there have only been two reported cases after colonoscopy. We report herein a delayed colonic perforation revealed by a rare manifestation of pneumoserotum after EMR of a laterally spreading tumor in the descending colon.

CASE REPORT

A 52-year-old man underwent total colonoscopy because of a positive fecal occult blood test in our hospital. The colonoscopy showed a laterally spreading tumor with uneven nodules in the descending colon, of which the superficial margin was clear after chromoendoscopy using indigo-carmin dye spraying. (Figure 1A) Magnifying colonoscopy after indigo-carmin dye and crystal violet staining disclosed type IIIIL and type IV pit patterns, therefore, this lesion was endoscopically diagnosed as an intra-mucosal carcinoma in an adenoma^[2]. Endoscopic mucosal resection (EMR) was attempted with a curative intent. Subsequently, for better elevation and identification of the submucosal layer, 20 mL of 10% glycerin (GLYCEOL[®]) containing a small amount of 0.4% indigo-carmin dye was injected into the submucosal layer^[3]. The lesion was well-elevated, and was resected with five fragments. After the EMR, magnifying observation revealed a small amount of residual tumor at the periphery, and argon plasma coagulation (APC) was performed for ablation. (Figure 1B) The argon plasma coagulator was used with setting at 2.0 L/min gas flow and with power of 50 W. To reduce the risk of perforation, APC was only applied to coagulate the edge of the EMR site and the duration of application was as short as 5 s. The patient did not complain of abdominal pain or fullness during or immediately after the therapeutic procedure, and no complication such as bleeding or perforation was identified during colonoscopy. The patient's education included no alcohol and no exercise for 1 wk after EMR. He was discharged 1 h after the procedure, uneventfully. However, he revisited our center the next day because of mild inguinal pain and an enlarged scrotum. Before admission, he had taken two meals including a dinner and a breakfast as usual. On admission, his vital

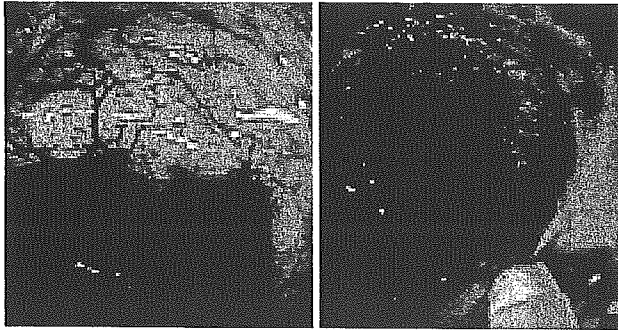


Figure 1 A: Colonoscopy after indigo-carmin dye spraying showed a laterally spreading tumor 35 mm in diameter in the descending colon. B: The ulcer after piecemeal EMR and APC revealed no active bleeding or perforation.

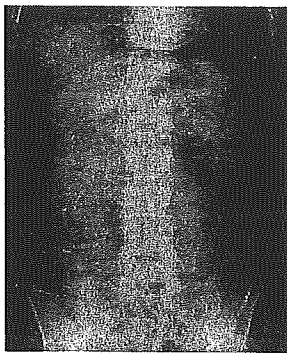


Figure 2 Upright abdominal X-p film showed free air in the sub-diaphragmatic space.

signs were within normal limits excluding mild fever, and physical examination disclosed only an enlarged but light scrotum, and no abdominal tenderness or muscular defense was found. Upright abdominal X-ray film showed free air in the left sub-diaphragm. (Figure 2) Computed tomography (CT) of the chest and abdomen revealed pneumopericardium, pneumoperitoneum and bilateral pneumoscotum. (Figure 3) The laboratory data showed that white blood cell count was 12 000 and C-reactive protein was 58 mg/dL, respectively. Other data were within normal limitation. A diagnosis of colonic perforation in delayed fashion was made. After consultation with the surgeons, the patient was first treated medically under NPO; administration of antibiotics (cefmetazole sodium, 4 g/d) and subsequent hyperalimentation were carried out for 2 d. The fever and inguinal pain were relieved within 24 h. The pneumoscotum resolved within 2 d, the resolution of the pneumoscotum was judged by CT and physical examination and the symptom of the patient. C-reactive protein levels decreased from 5.8 to 0.6 mg/dL in 4 d. The permission of oral intake was based on the clinical course, physical examination, laboratory data, and the patient's symptoms. Oral intake was started on the third day at hospital, and he was discharged uneventfully after five days of hospitalization. The removed specimen was histologically diagnosed as a tubular adenoma, with focal carcinoma limited to within the mucosal layer. No muscle layer was identified in the resected specimens.

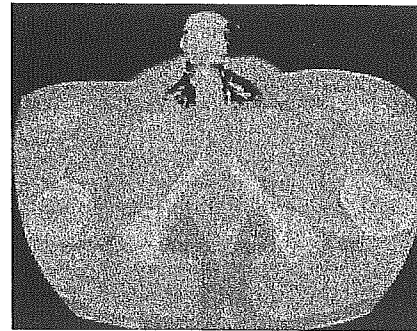


Figure 3 Abdominal computed tomography disclosed free air in the scrotum. Edited by Helen.

DISCUSSION

Colonic perforation associated with therapeutic colonoscopy is uncommon, and the reported incidence ranges from 0.073% to 2.14%^[4-6]. It could occur immediately or in delayed fashion. Most of the signs of colonic perforation are abdominal symptoms including peritonitis. However, our case presented pneumoscotum as a sign of a colonic perforation after EMR in delayed fashion. Pneumoscotum is a term which implies the presence of air within the scrotum^[1]. Although pneumoscotum associated with pneumomediastinum and subcutaneous emphysema secondary to pneumothorax is a well-described entity, there have only been two reported cases following colonoscopy and both cases occurred immediately after the procedures^[7-11]. Our patient developed pneumoscotum in delayed fashion, which is different from the previous reports. The reason why we diagnosed the perforation developed in delayed fashion is as follows, first, our patient did not complain of any symptoms related to colonic perforation during EMR or in the recovery room before discharge. Second, repeated review of the recorded video tape of the procedure also revealed no definite perforation. Therefore, the perforation was suggested to have developed in a delayed fashion to firstly create pneumoperitoneum, and the air then reached the scrotum and created pneumoscotum, which presented as the first symptom and sign of colonic perforation.

Colonic perforation may be intraperitoneal or retroperitoneal, or both^[11]. Our case presented pneumoscotum, pneumopericardium and pneumoperitoneum, which suggested that the perforation developed in the retroperitoneal space. That our case developed in delayed fashion also supported that the perforation was retroperitoneal, as, compared to intraperitoneal perforation, retroperitoneal perforation is reported to be relatively painless and to become clear some hours after the procedure. Furthermore, most cases presenting pneumoscotum are associated with pneumoperitoneum, like ours^[12-14].

Our case was treated successfully without laparotomy, however, the choice of conservative or surgical treatment for iatrogenic colonic perforation remains controversial^[15-18]. The finding of air in the scrotal sac may be an early sign of a life-threatening condition, or may represent an incidental finding associated with more common benign conditions^[1]. It depends on the local air production or movement of air

from the peritoneal space. Local air production suggests gas gangrene or scrotal trauma, which is infectious and may be fatal unless treated appropriately. On the other hand, movement of air from the peritoneal space is usually non-infectious and can be treated conservatively. The reported case of pneumoscrotum secondary to colonic perforation in the retroperitoneal space following colonoscopy were successfully treated non-operatively^{10,11}. In this case, the choice of non-surgical treatment was based on the following: first, the patient's vital signs were stable; second, the abdominal pain was mild and localized; and third, the pneumoscrotum was painless and the air was not locally produced but originated from the pneumoperitoneum. Additionally, and perhaps most important, no unexplained peritoneal fluid was found in the abdominal CT, which suggested no severe peritonitis. Therefore, in this case the pneumoscrotum and pneumoperitoneum was finally judged to be non-infectious.

In conclusion, we report a case of colonic perforation occurring in delayed fashion after EMR, which was revealed by pneumoscrotum. Although rare, colonoscopists should keep in mind that pneumoscrotum could present as a sign of colonic perforation, and the choice of treatment should be chosen carefully.

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Language Editor Elsevier HK

S状結腸・直腸Rs癌に対する腹腔鏡下手術

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腹腔鏡下大腸手術手技の最前線 II

S 状結腸・直腸 Rs 癌に対する腹腔鏡下手術

State-of-the-art technique of laparoscopic colorectal surgery
-Laparoscopic surgery for sigmoid colon and rectosigmoid cancer-

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TANIGAWA Nobuhiko

S 状結腸・直腸 Rs の癌に対する腹腔鏡下手術は、腹腔鏡下大腸癌手術の中でも最も頻度が高い。これに伴い手術手技も向上し、上下腹神経叢を温存した下腸間膜動脈根部までの D₃ 郭清が、従来の開腹手術では得られなかった拡大された良い視野でより精密に行えるまでになった。筆者らは、癌手術の原則の遵守と合理的な操作の点から内側アプローチを基本とし、3D-CT 画像なども参考に、郭清の程度や病変の占居部位に応じて血管処理にも工夫を加え、個々の症例に最も適切な低侵襲手術を施行するように心がけている。

はじめに

腹腔鏡下大腸癌手術の中でも S 状結腸・直腸 Rs 癌に対する腹腔鏡下手術の頻度は最も高い。これに伴い手術手技も向上し、上下腹神経叢を温存した下腸間膜動脈根部までの D₃ 郭清が従来の開腹手術では得られなかった拡大された良い視野でより精密に行えるまでになった。さらに、本邦では S 状結腸の長い人が多いため、筆者らは、郭清の程度や病変の占居部位に応じて血管処理にも工夫を加え、個々の症例に最も適切な低侵襲手術となるように心がけている。本稿では、S 状結腸・直腸 Rs の癌に対する腹腔鏡下手術の実際について述べる。

I. 適 応

筆者らは、癌手術の原則を遵守した適切な手技のもとに適応を段階的に拡大し、減圧不能の腸閉塞・高度他臓器浸潤や巨大腫瘍などの症例を除

き、内視鏡的粘膜切除(EMR)適応外の早期癌から漿膜浸潤癌までを適応としている¹⁾。なお、巨大腫瘍とは、大きさの目安として 8 cm を越えるものであるが、体型などによっても難易度が異なるため、病変部への直接操作が避けられない大きさの腫瘍とした。また、リンパ節郭清は、EMR 困難な粘膜内癌(M'癌)には D₀~1、隆起型粘膜下層癌(SM'癌)には D₂、陥凹型 SM'癌と進行癌には D₃ 郭清を原則としている²⁾。

II. 術前処置

術数日前に大腸内視鏡で病変部近傍の腸管前壁に点墨を行い、術中病変部位確認の主なマーカーとしている。クリッピング法も併用し点墨が確認できない場合に術中透視でクリップを確認して病変部位を同定できるようにしている。また、筆者らは、放射線科の協力のもと術前大腸内視鏡検査の直後にマルチスライス CT による造影 CT 検

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Key words : 腹腔鏡下手術 / S 状結腸・直腸 Rs 癌 / 内側アプローチ

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査を行って3D-CT 画像を作成してもらい、遠隔転移の検索の他に病変支配血管の分岐形態と走行を確認し、個々の症例に応じた合理的な血管処理を伴う系統的リンパ節郭清や腫大リンパ節・周囲臓器への浸潤の有無の検索に活用している³⁾。なお、腸管の機械的洗浄等の術前処置は厳密に行い、全身麻酔でも笑気を用いないようにして、とくに小腸の拡張による術野の劣化を予防する。

III. 体位とモニター・チームの配置

患者をマジックベッドに固定して碎石位とし、鉗子操作を妨げないよう股関節は伸展させる。図1のごとく器械とチームを配置して全員が同じモニターを見てミラーイメージによる操作困難を予防している。

IV. 有用な手術器具

SD junction を見降ろしで正面視するにはフレキシブルスコープ(オリンパス)がよい⁴⁾。癌散布予防のため病変部腸管はいかなる鉗子でも把持し

ない。また、腸管損傷防止のため鉗子での腸管の直接把持を避けて腸間膜や腹膜垂を把持する。腸間膜や腹膜垂を愛護的に把持するには、有窓の無傷把持鉗子(カールストルツジャパン)がよい。モニター外や不意の臓器損傷を避けるには、モニター外よりもバイポーラの電気鉗(ビー・ブラウンエースクラップ)が安全で、リンパ節郭清や剝離にきわめて効果的である。腸間膜の愛護的な牽引や血管・腸管周囲の剝離にはエンドミニトラクト(タイコヘルスケアジャパン)が有用である。血管周囲などの止血にはマクロ型バイポーラ凝固鉗子(ジョンソン・エンド・ジョンソン)が有用である。大網や腸間膜の切離には超音波振動剪刀が有用で、リガシュアー(タイコヘルスケアジャパン)を用いれば主要な血管切離もクリップレスに行える。創部保護にはラッププロテクター(八光)を常用している。

V. 手術の実際

1. ポートの配置と小切開部・ドレーン挿入部 臍部より open technique にて12 mm のポー

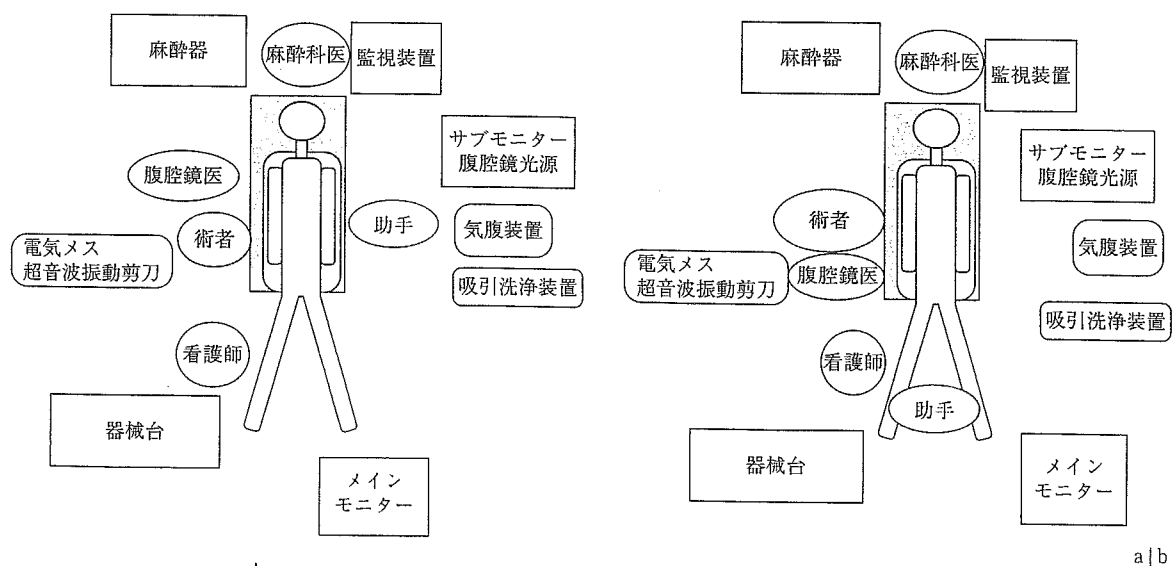


図1 体位とチーム・器械の配置

患者を碎石位とした上でマジックベッドに固定する。全員が同じモニターを見てミラーイメージによる操作困難を予防している。

a:ほとんどの操作はこの位置で行う b:左結腸曲を授動する際の位置

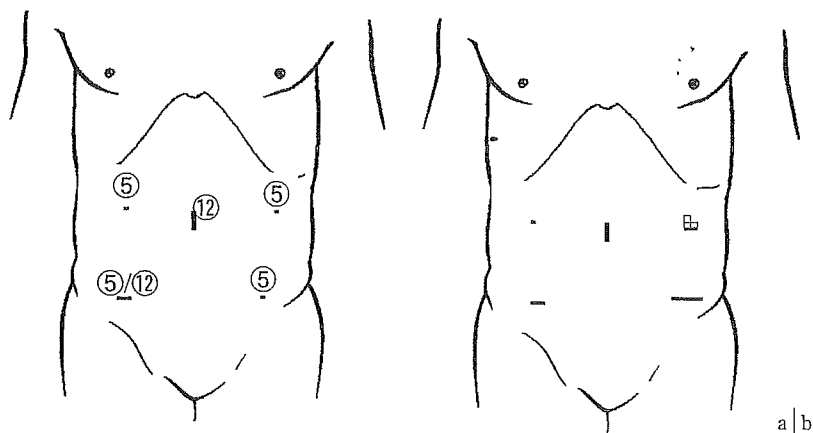


図2 ポートの配置と小切開部・ドレーン挿入部

a: 臍上部より腹腔鏡用12 mm ポート, 左上下腹部と右上腹部に 5 mm ポート, 右下腹部に 5 mm ポート(腸管切離を行う場合はステイプラー用の12 mm ポート)を挿入して5ポートとする。

b: 左下腹部ポート創を 4 cm 程度に延長し, 病変部腸管を体外へ誘導して切除する。吻合終了後に左上腹部ポート創からドレーンを挿入留置する。

丸数字はポートのサイズ(mm)を示す。

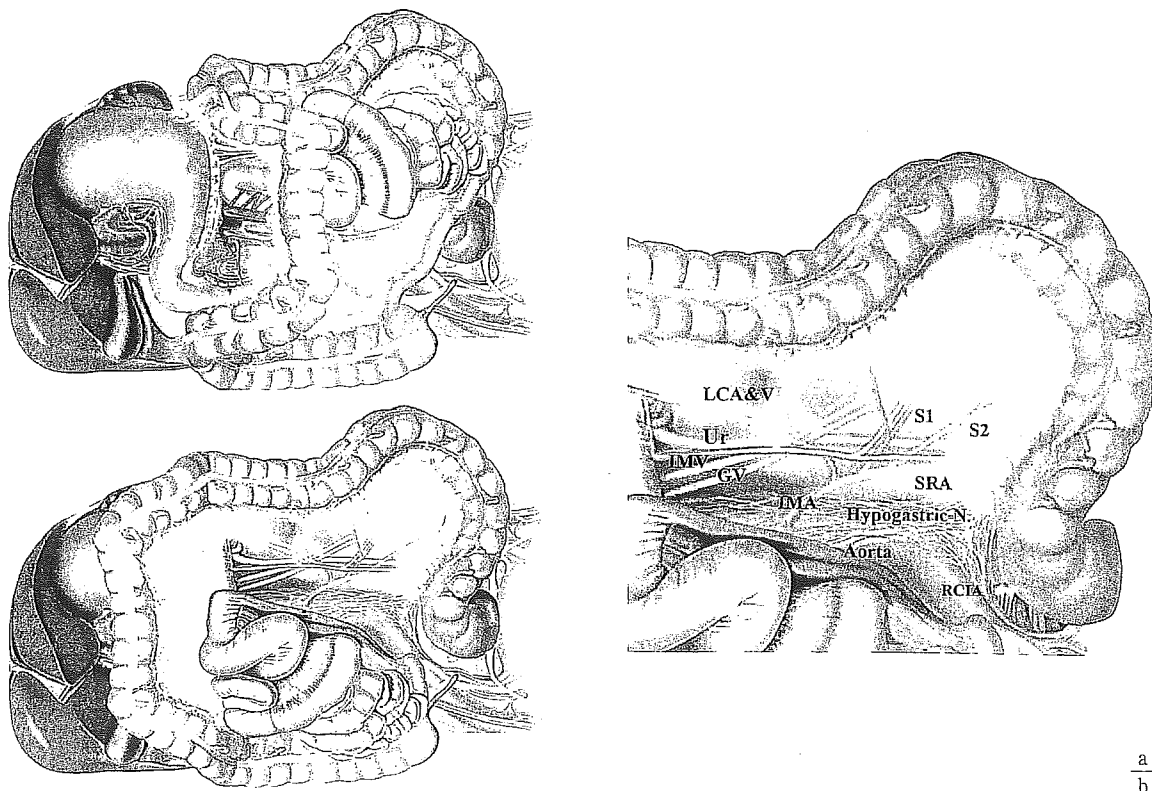


図3 良好な術野の展開

a, b: 大網から横行結腸を挙上して右上腹部にスペースを作り, 次に手術台を頭低位の左高位としつつ, 小腸を最も右下となる中部小腸から上部および下部へと順に右腹部へ移動させると極端な頭低位にしくとも左結腸間膜から小骨盤腔を良好に展開できる。

c: S状結腸間膜内と周囲の外科解剖を明らかとする。

a | c
b |

トを挿入し、気腹法(気腹圧7~8 mmHg)にて広い術野を確保する。左右上下腹部にポートを追加し5ポートとする(図2)。腹腔鏡下操作後に左下腹ポート創を3~5 cmに延長して、病変部腸管を体外へ誘導して標本を摘出し、吻合は体外もしくは体内で行う。左上腹部ポート創からドレーンを挿入留置する。

2. 術中ステージング

腹腔鏡の拡大視効果による詳細な視診に加え、腹腔鏡下超音波検査を適宜利用し、肝転移、腹膜転移やリンパ節腫大の検索を行う。

3. 良好な術野の展開

大網から横行結腸を挙上して右上腹部にスペースを作る。次に手術台を頭低位の左高位としつつ、小腸を最も右下となる中部小腸から上部および下部へと順に右腹部へ移動させると極端な頭低位にしろとも左結腸間膜から小骨盤腔を良好に展開でき、S状結腸間膜内とその周囲の外科解剖が明らかとなる(図3)。点墨などにより病変部を同定し、目的の長さで切った臍帯結紮糸をメジャーとして口・肛門側腸管切離予定部を設定する。

4. EMR 困難な M'癌に対する手技

EMR 困難な M'癌に対する腹腔鏡下手術では、リンパ節郭清は必要ないか万一の sm 浸潤を考慮

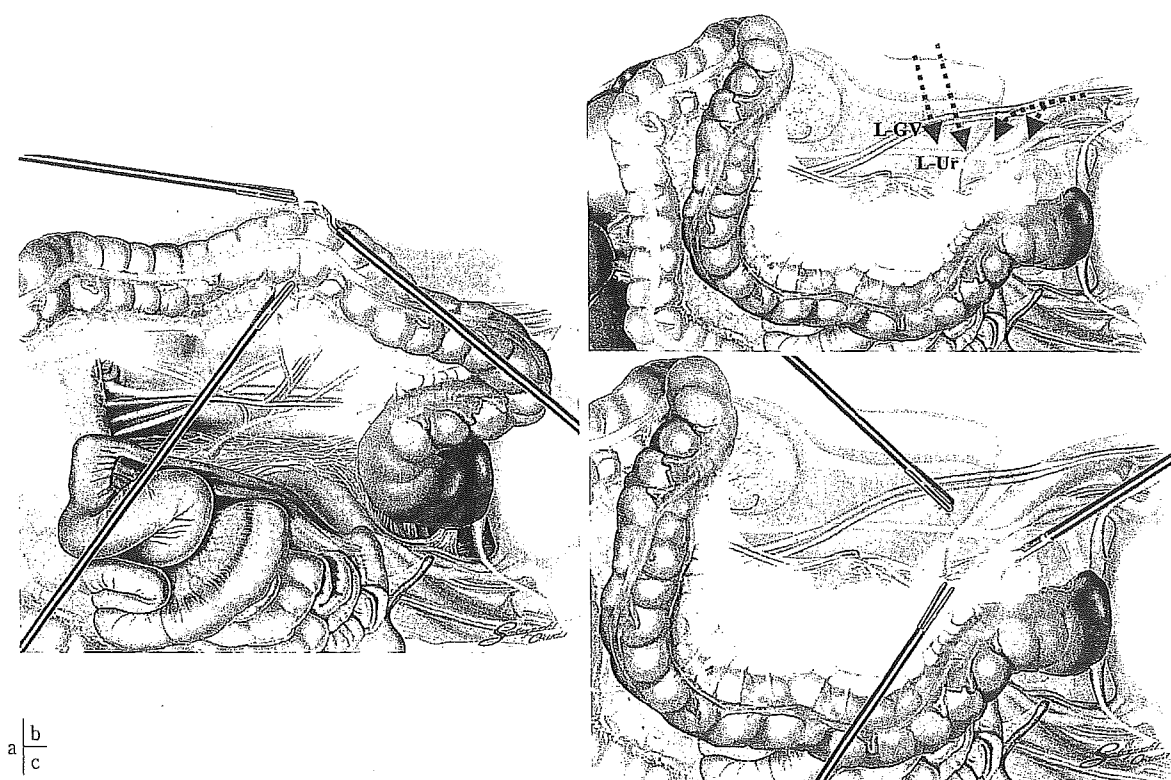


図4 外側アプローチ

- a: SD junction 頭側の下行結腸寄りで壁側腹膜を切離して腸管外側に沿って剝離を進め、後腹膜筋膜前面の層に入る。
 b: 腸間膜から後腹膜下筋膜を剥がし落とすように剝離操作を加えると、後腹膜下筋膜が腸間膜から出血なく剝離されて薄い光沢のある膜として認識できるので、剝離を赤直線の方角に進めて後腹膜下筋膜背側に左精巣/卵巣動静脈と左尿管を確認・温存する。層がわかりにくいときは、青曲線のようにSD junctionの尾側で左精巣/卵巣動静脈を確認し、その前面で剝離を少しづつ頭内側へ進めていくと左尿管を確実に同定して温存できる。
 c: なお、バイポーラ鉗の先1~2 mmを使ってシャープに剝離するのが有効である。
 L-GV: 左精巣/卵巣動静脈 L-Ur: 左尿管

しても $D1+\alpha$ 程度の郭清で良いので、とくに体外への誘導が可能で部位の病変であれば、腹腔鏡下には図4に示す外側アプローチで腸管授動のみを行い、小切開創より体外へ誘導して腸間膜処理、腸切除と吻合を行う。

5. D_2/D_3 郭清を要する S 状結腸・直腸 Rs 癌に対する手技

1) 内側アプローチ

筆者らは、癌手術の原則の遵守と合理的な操作

の点から内側アプローチを推奨している¹⁾。内側アプローチにて中枢側リンパ節郭清と血管処理を先行し、S 状結腸から直腸を授動して肛門側腸管切離を行い、口側腸管の切離は体外で行う。この手技は病変部腸管への操作を最小限にして癌の血管・管腔・腹腔内への散布を抑え、創部再発予防にも有用な手技と考えている。

S 状結腸・直腸 Rs 癌に対する内側アプローチでは上下腹神経叢が後腹膜下筋膜前面の剝離層への landmark となる。腸間膜を腹外側に牽引して、

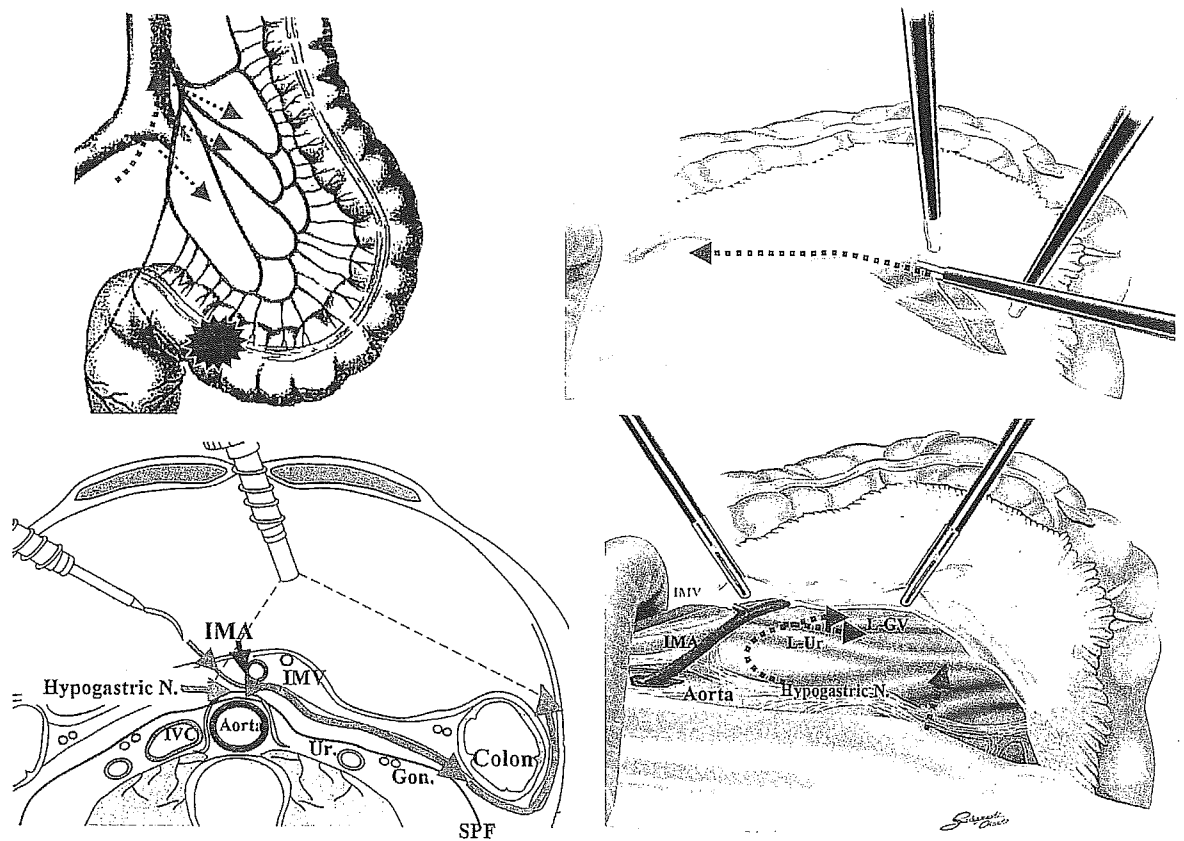


図5 内側アプローチ

a, b: 右総腸骨動脈を指標に大動脈分岐部を確認し、その尾側で大血管のない岬角付近から腸間膜剝離を開始する。上直腸動脈～下腸間膜動脈背側に上下腹神経叢を確認し、本幹を温存して腸間膜への分枝のみを処理しながら剝離を頭側へ進める。
 c: 剝離を腸間膜背側寄り以外側へ進めると後腹膜下筋膜前面の層に入り、左尿管・左精巣/卵巣動脈はその背側に温存される。
 d: 赤点直線のように岬角付近で内側から外側へ腸間膜の剝離を先行させると、同部はエリアが広い後腹膜下筋膜背側の深い層に入ってしまうことが多い。したがって、青点曲線のように上直腸動脈背側に上下腹神経叢を確認し、本幹を温存しながら剝離をまず頭側へ進め、下腸間膜動脈根部近傍で腸間膜寄りの浅い層を意識して外側へ剝離を行った後に剝離を尾側へ進めた方が後腹膜下筋膜を認識しやすく、左尿管・左精巣/卵巣動脈をその背側に確実に温存できる。

Hypogastric N: 上下腹神経叢 Ao: 大動脈 IVC: 下大静脈 IMA: 下腸間膜動脈 IMV: 下腸間膜静脈 Ur: 左尿管 Gon: 左精巣/卵巣動脈 SPF: 後腹膜下筋膜 Colon: 結腸 L-GV: 左精巣/卵巣動脈 L-Ur: 左尿管 Aorta: 大動脈

| | |
|---|---|
| a | b |
| c | d |

間膜内の下腸間膜動脈(IMA)から上直腸動脈(SRA)を索状物として確認する。右総腸骨動脈を指標に大動脈分岐部を確認し、その尾側で大血管のない岬角付近から腸間膜剝離を開始する(図5)。SRA~IMA 背側で上下腹神経叢を確認し、本幹を温存して腸間膜への分枝のみを処理しながら剝離を頭側へ進める。こののち剝離を腸間膜背側寄りを外側へ進めると後腹膜下筋膜前面の層に入りやすく、左尿管・左精巣/卵巣動静脈はその背側に温存される。

2) 近位側 S 状結腸癌に対する D₂ 郭清術

近位側 S 状結腸癌に対する D₂ 郭清で、上直腸動脈(SRA)を温存し、切除後の腸管吻合を体外で行う手技について述べる。

S 状結腸間膜を左外腹側に牽引し、腸間膜内に弓状に吊り上がった SRA を確認する。SRA の背側で大動脈前面の上下腹神経叢を確認・温存しつつ、SRA への分枝を処理して#252リンパ節を切除側へ付けるように郭清する。病変部腸管の支配血管(第1もしくは第2S 状結腸動脈)根部を郭清し、SRA を温存して支配血管を根部で処理して D₂ 郭清とする(図6)。さらに、上直腸静脈に流入する第1, 2S 状結腸静脈を同定して処理し、腸間膜の剝離を外側へ進めるが、この部位は上下腹神経叢の外側のため容易に後腹膜下筋膜前面の剝離層に入れる。

切除側の血管断端を左外腹側へ牽引しつつ、後腹膜下筋膜前面で腸間膜・腸管を内側から外側へ

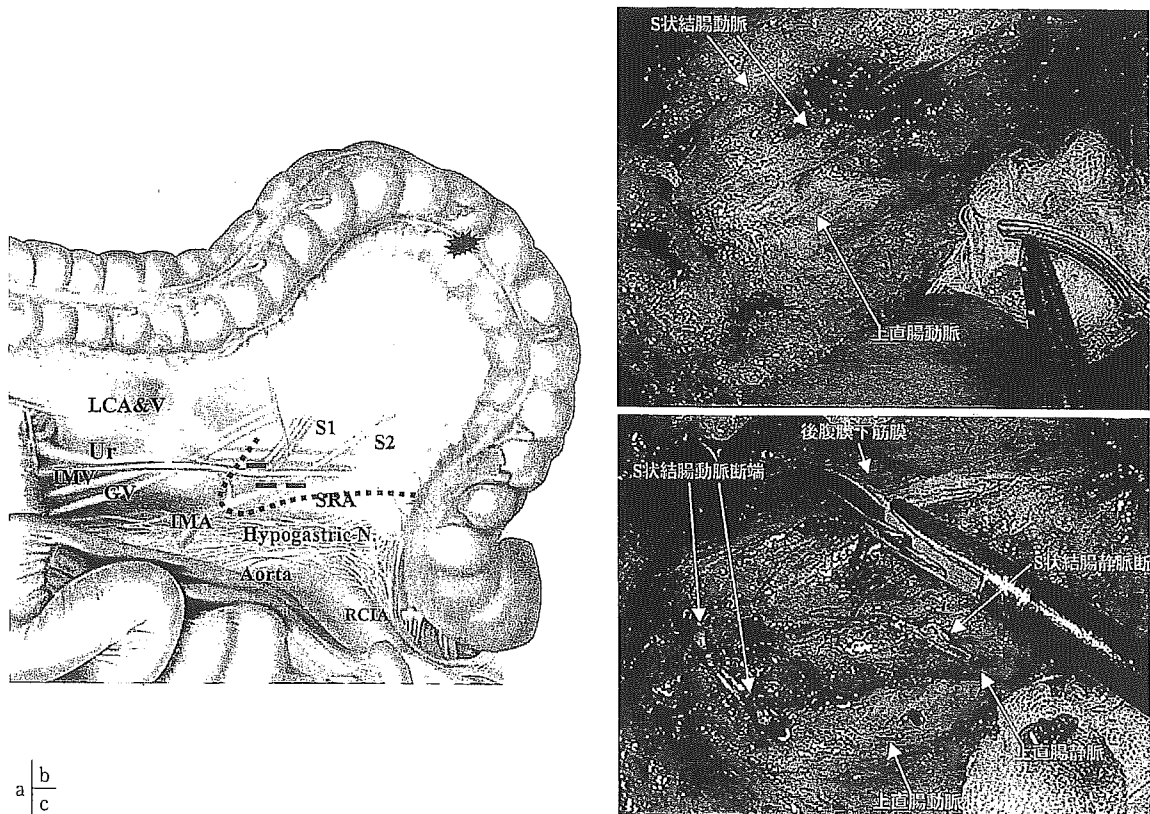


図6 中枢側リンパ節郭清(D₂)と血管処理(S1, S2)

- a 近位側 S 状結腸癌に対する D₂ 郭清：SRA の背側で大動脈前面の上下腹神経叢を温存しつつ、#252リンパ節を切除側へ付けるように郭清する。
- b, c：病変部腸管の支配血管(第1もしくは第2S 状結腸動脈)根部を郭清し、SRA を温存して支配血管を根部で処理して D₂ 郭清とする。さらに、上直腸静脈に流入する第1, 2S 状結腸静脈を同定して処理し、腸間膜の剝離を外側へ進めるが、この部位は上下腹神経叢の外側のため容易に後腹膜下筋膜前面の剝離層に入れる。

と剝離授動する。左尿管・精巣／卵巣動静脈を後腹膜下筋膜背側に確実に温存する。このち腸管外側の壁側腹膜附着部を切離してS状結腸を完全に授動し、病変部腸管を小切開創より体外へ誘導して腸間膜処理、腸切除と吻合を行う。

3) 前項2) 以外のS状結腸・直腸Rs癌に対するD₂/D₃郭清術

腸切除後の再建を体内でdouble stapling法で行う必要のある症例で、中間位S状結腸から直腸Rsの癌に対するD₂郭清例やほとんどのD₃郭清例が対象となる。

(1) 中枢側リンパ節郭清と血管処理

S状結腸間膜を腹外側に牽引して、間膜内の下腸間膜動脈(IMA)から上直腸動脈(SRA)を索状物として確認する。右総腸骨動脈を指標に大動脈分岐部を確認し、その尾側で大血管のない岬角付

近から腸間膜剝離を開始する(図5)。SRA背側で上下腹神経叢を確認し、本幹を温存して腸間膜への分枝のみを処理しながら少しずつ剝離を頭側へ進める。上下腹神経叢は大動脈分岐部のレベルで最も確認しやすく、腹腔鏡の拡大視効果により大動脈前面を頭尾側に走る白色繊維群として明瞭に同定できる。

D₂郭清の場合 大動脈分岐部より1~2cm中枢側のレベルでIMAから頭側に向けて鋭角に分岐する左結腸動脈(LCA)を確認してその分岐部までの#252リンパ節を切除側に付けるように郭清する。そしてLCA分岐部のすぐ末梢でSRAを処理してD₂郭清とし、その外側で上直腸静脈も処理する(図7)。

D₃郭清の場合 本邦ではS状結腸の長い人が多いため、筆者らは遠位S状結腸から直腸Rsの

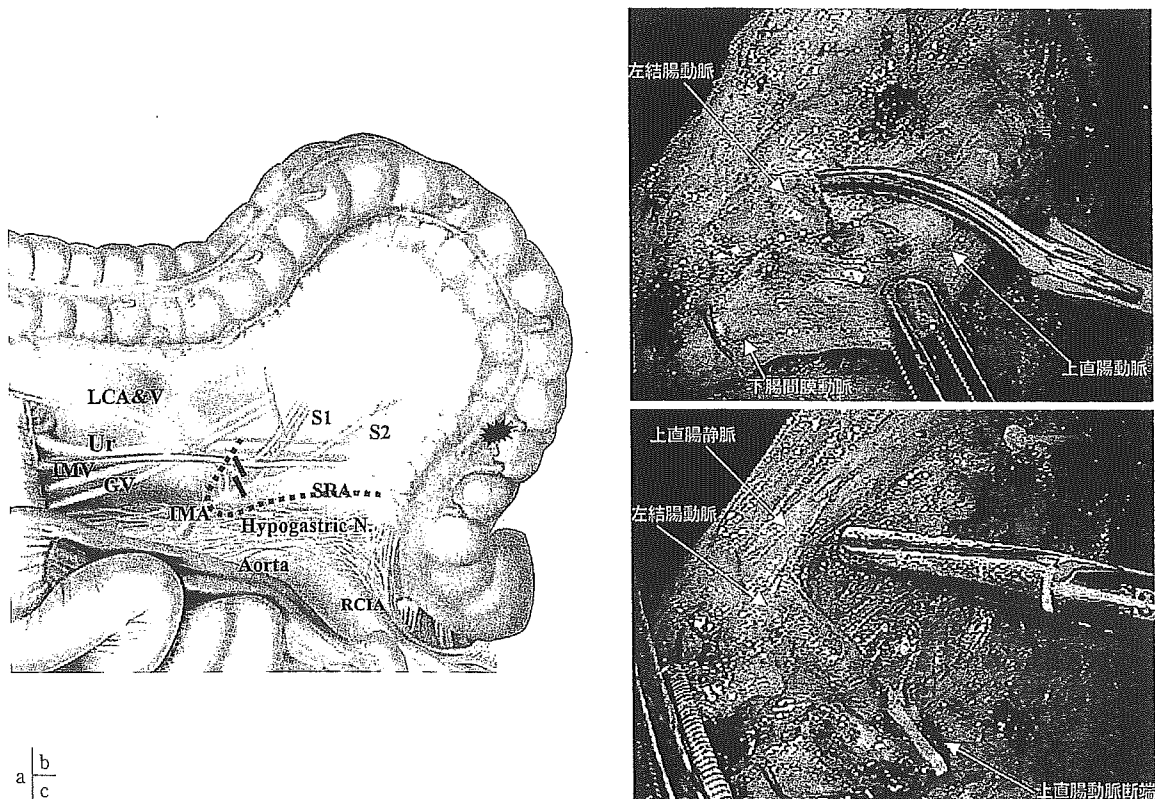


図7 中枢側リンパ節郭清(D₂)と血管処理(SRA)

- a 中間位S状結腸から直腸Rs癌に対するD₂郭清：IMAから頭側に向けて鋭角に分岐する左結腸動脈(LCA)を確認してその分岐部までの#252リンパ節を切除側に付けるように郭清する。
- b, c : LCA分岐部のすぐ末梢でSRAを処理してD₂郭清とし、その外側で上直腸静脈も処理する。