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ORIGINAL ARTICLE

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Large contractions in the colonic J-pouch as a possible cause of incomplete evacuation

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Abstract *Background and aim:* Restoration of neo-rectal capacity is of importance in obtaining better bowel function after low anterior resection for rectal carcinoma. However, evacuatory disorders, such as incomplete evacuation, have been reported in some patients undergoing colonic J-pouch reconstruction. Therefore, we conducted this study to explore the possible factor affecting incomplete evacuation following low anterior resection for rectal carcinoma. *Patients/methods:* The subjects were 37 consecutive patients who had undergone low anterior resection for rectal tumor (colonic J-pouch in 13 patients, straight anastomosis in 24). Clinical and physiological outcomes were determined at a mean follow-up time of 12 months after the operation, and the parameters were compared between patients with and without postoperative incomplete evacuation. *Results:* Although anastomosis level from the anal verge was lower in the J-pouch group (6.5 cm vs 3.9 cm, $P<0.05$), there was no significant difference between J-pouch and straight reconstruction regarding clinical and physiological outcomes. Postoperative incomplete evacuation was significantly more frequent in the J-pouch group than in the straight group (46% vs 25%, $P<0.05$). Postoperative large contractions on anorectal manometry were also significantly more apparent in the J-pouch group than in the straight group (31% vs 4%, $P<0.05$). Presence of postoperative large contractions ($P=0.004$), anastomotic stricture ($P=0.019$) and smaller postoperative maximum tolerable volume ($P=0.009$) were significantly and independently associated with incomplete evacuation by multivariate analysis. *Conclusion:* Colonic J-pouch reconstruction following ultra-low anterior resection was comparable with higher level straight anastomosis from the clinical and physiological point of view. The presence of large contractions might be an important indicator of incomplete evacuation in patients who are undergoing rectal resection.

Keywords Low anterior resection · Colonic J-pouch · Evacuation · Rectal cancer

Introduction

Low anterior resection with colonic J-pouch reconstruction is now widely accepted as a standard operation for middle or lower rectal carcinoma. Frequency of bowel movement of J-pouch from summarized data was less than three times per day, which was significantly less than that of straight anastomosis [1]. However, colonic J-pouch sometimes (25%–46%) results in difficult or incomplete evacuation. This peculiar phenomenon was reported initially by Parc et al. [2], followed by Kusunoki et al. [3], Mortensen et al. [4], and Ho et al. [5]. Hida et al. reported that evacuation difficulty might be caused by large pouch size [6]. Additionally, inclination of the lon-

gitudinal axis of the J-pouch [7], and the appearance of rectocele-like prolapse [8], were reported as the effect of evacuation difficulties or incomplete evacuation. As another factor contributing to incomplete evacuation, Romanos et al. [9] reported specific large contractions in the colonic J-pouch. During manometric observation, we also encountered specific large contractions in some patients. Although not so frequently as in patients undergoing colonic J-pouch reconstruction, incomplete evacuation was also observed in patients undergoing straight anastomosis, suggesting that various factors might contribute to incomplete evacuation. Therefore, we examined rectal physiological function after J-pouch reconstruction or straight anastomosis and analyzed the functional, clinical and postoperative parameters to clarify possible factors affecting incomplete evacuation. We found that large contractions were independently and significantly associated with incomplete evacuation.

Materials and methods

From July 1997 to June 2001, 37 patients underwent low anterior resection for rectal cancer (n=36) and rectal carcinoid tumor (n=1). The type of reconstruction was colonic J-pouch in 13 patients with lower rectal cancer and straight anastomosis in 23 patients with middle rectal cancer and one patient with lower rectal cancer.

All patients underwent total mesorectal excision [10]. A colonic J-pouch, a median of 7 cm (range 5–10 cm) in length, was fashioned by the folding back of the sigmoid colon and creation of a side-to-side anastomosis by use of linear cutting staplers (GIA, United States Surgical Corp., Norwalk, Conn., USA) introduced through the apex of the pouch. The short limb of the J-pouch was closed by linear cutting stapler. The anastomosis was constructed with an intra-luminal stapling device (ILS, Johnson & Johnson, Ethicon, Tokyo, Japan). A temporary transverse colostomy was fashioned in all J-pouch patients, but not for straight reconstruction. Colostomy was usually closed 3–6 months after low anterior resection. Intra-operative radiation (total of 36 Gy, 18 Gy × 2 on each side of pelvic nerve plexus) was given in four patients with colonic J-pouch anastomosis that were enrolled in our randomized controlled trial. In the straight anastomosis group, one had intra-operative radiation therapy.

Clinical outcomes were reviewed by means of a patient's questionnaire regarding the frequency of bowel movement, history of incontinence and urgency, any experiences of indiscrimination between gas and stool, and incomplete evacuation. According to the definition reported by Ikeuchi et al., [11] with minor modification, incomplete evacuation was defined as the returning for second or multiple evacuations within 15 min after leaving the toilet. Incontinence was assessed objectively with Wexner's continence grading scale [12]. Physiological outcomes were determined by ano-rectal manometry (Andorfer AMS-400, Star Medical, Tokyo, Japan) with station pull-through technique. A water perfusion polyvinyl catheter with side holes and a tip hole of 0.8 mm (Star Medical, Tokyo, Japan) was placed in the rectum 6 cm above the anal verge and was withdrawn 1 cm at a time to measure the resting and anal canal squeezing pressures. With 1 ml/s water infusion, rectal sensory threshold was assessed at the point when the patient felt any sensation, such as coldness or pressure in the rectum. When patients had been given a low anastomosis, within index-finger reach (approximately 7 cm from the anal verge) a balloon was positioned in the neo-rectum above the anastomosis. All J-pouch patients were assessed with this modality. Maximum tolerable volume was determined when the patient felt unable to accept further water infusion. Rectal and neo-rectal capacities were calculated by the subtraction of the sensory threshold volume from the maximum tolerable volume, as described previously [12]. The duration of manometric examination was approximately 30–40 min. Rectal contractile activity was monitored for approximately 20–30 min. For our study a contraction greater than 40 mmHg and lasting 20 s or longer was defined as large contractions. These assessments of clinical outcomes and physiological functions were performed on the ward just after the patient's admission and during the postoperative outpatient office visit 6–20 months (mean 12 months) after straight anastomosis or colostomy closure with J-pouch cases.

Preoperative clinical parameters, manometric parameters before and after operation, and operating parameters were examined by univariate analysis so that we could identify predictive factors for incomplete evacuation. In univariate analyses, numeric data were analyzed by the Mann–Whitney U test for two groups comparison, and preoperative and postoperative numeric values were compared with Wilcoxon's sum-rank test. Categorized data were analyzed by Fisher's exact test. Significant factors in the univariate analysis were then included into the multivariate analysis. Logistic regression analysis (SPSS 11.0J, SPSS Japan, Tokyo, Japan) was used for multivariate analysis. A P value less than 0.05 was considered as significant.

Results

Although anastomosis level from the anal verge was lower in the J-pouch group (6.5 cm vs 3.9 cm, P<0.05), there was no significant difference between J-pouch and straight reconstruction with regard to clinical and physiological outcomes. To elucidate the possible causes of incomplete evacuation, we compared clinical and physiological parameters in patients with (the presence group) and without (the absence group) incomplete evacuation (Table 1). With regard to operating factors, incomplete evacuation was significantly more frequent in the J-pouch patients. Among early postoperative complications, anastomotic stricture requiring bougie dilatation was significantly higher in proportion in the presence group. Preoperative clinical and physiological parameters were not different between the two groups, suggesting that none of these factors was predictive of incomplete evacuation.

Postoperative clinical and physiological parameters are shown in Table 2. In an-rectal manometry, the presence group showed significantly decreased and smaller postoperative maximum tolerable volume and neo-rectal capacity than did those examined preoperatively. Presence of large contractions was more significantly frequent in the presence group.

During these large contractions, patients had a strong urge to have a bowel movement, even though the balloon in the neo-rectum was not expanded enough for the patient to feel that the rectum was full. A representative case with incomplete evacuation showing large contractions is shown in Fig. 1. In the neo-rectum, there were large contractions greater than 40 mmHg lasting more than 20 s.

Table 1 Patients' background and complication (*NS* not significant, *pts* number of patients)

Parameter	Incomplete evacuation		
	Presence (12)	Absence (25)	*P*
Patients' backgrounds			
Age	60	70	NS
Gender (male/female)	9/3	17/8	NS
TNM tumor stage (T1/T2/T3) (pts)	2/2/8	0/3/22	NS
Lymph node metastasis (pts)	7	8	NS
Anastomosis level (≦3 cm from the anal verge) (pts)	4	3	NS
Mode of reconstruction, J-pouch (pts)	6	7	$P<0.05$
Postoperative complications			
Anastomotic leak (pts)	3	1	NS
Pelvic abscess (pts)	0	1	NS
Anastomotic stricture (pts)	4	0	$P<0.05$

Table 2 Postoperative clinical and manometric parameters. Values are means unless otherwise specified. *Parentheses* indicates the range. *NS* not significant, *pts* number of patients

Parameter	Incomplete evacuation		
	Presence (12)	Absence (25)	*P*
Daily bowel movements (≦ 5/day) (pts)	8	7	$P<0.05$
Continence grading scale (Weiner's score, 0–20)	5 (0–13)	3 (0–16)	NS
Indiscrimination between gas and stool (pts)	4	4	NS
Manometry			
Mean resting pressure (mmHg)	26 (10–57)	28 (9–66)	NS
Maximum resting pressure (mmHg)	35 (12–70)	35 (12–70)	NS
Mean squeezing pressure (mmHg)	99 (21–158)	91 (5–163)	NS
Maximum squeezing pressure (mmHg)	137 (26–290)	113 (10–206)	NS
Length of high pressure zone (cm)	3 (2–5)	3 (2–5)	NS
Sensory threshold (ml)	13 (4–30)	19 (5–45)	NS
Maximum tolerable volume (ml)	63[a] (28–120)	102 (40–220)	$P<0.05$
Neo-rectal capacity (ml)	50[a] (16–102)	82 (31–185)	$P<0.05$
The presence of large contractions (pts)	5	0	$P<0.05$

[a] Significantly decreased when compared with preoperative values

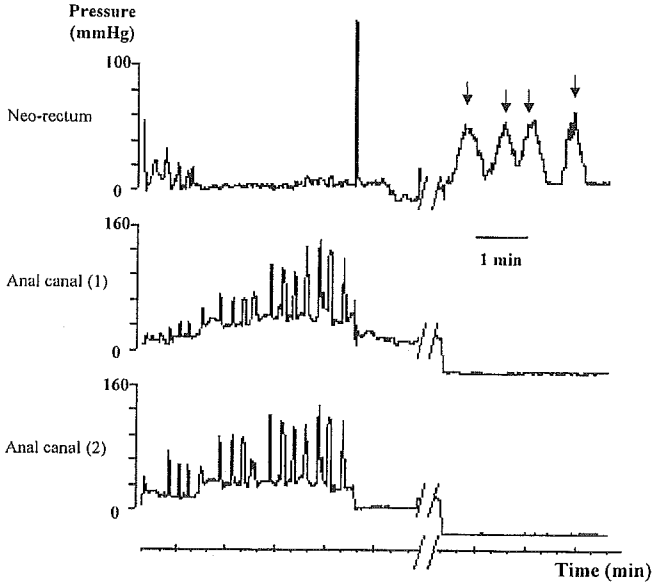

Fig. 1 The ano-rectal manometric findings of a representative case with large contractions in the colonic J-pouch (*arrows* indicate large contractions)

Univariate analysis revealed that five factors (reconstruction with J-pouch, anastomotic stricture, postoperative maximum tolerable volume, neo-rectal capacity, and presence of large contractions) were significantly associated with the presence of incomplete evacuation. By logistic regression analysis, the presence of large contractions (P=0.004, odds ratio 1.72, 95% CI 1.21–2.43), postoperative maximum tolerable volume (P=0.009, odds ratio 0.996, 95% CI 0.994–0.998) and anastomotic stricture (P=0.019, odds ratio 1.61, 95% CI 1.10–2.36) were significantly and independently associated with the presence of incomplete evacuation. Moreover, the presence of large contractions was the most significant factor among three parameters affecting the presence of incomplete evacuation.

Discussion

In our study, risk factors for incomplete evacuation were maximum tolerable volume, anastomotic stricture and presence of large contractions. Previous randomized controlled trials [13–15] showed that colonic J-pouch reconstruction was superior to straight anastomosis from the functional point of view. However, some patients com-

plain of incomplete evacuation after J-pouch reconstruction, the incidence being 25%–46% [2–6]. Hida et al. showed that a large pouch causes difficult or incomplete evacuation [6] due to its position in the pelvic cavity [7], and this would also result in the appearance of rectocele-like prolapse [8]. We showed that maximum tolerable volume was significantly smaller in the group of patients with incomplete evacuation, even though several patients underwent colonic J-pouch reconstruction. Although postoperative compliance and distensibility were not assessed in our study, smaller maximum tolerable volume may lead to reduced pouch compliance and result in incomplete evacuation, which was shown in the previous randomized trial [15]. The incidence of anastomotic stricture ranged from 0% to 44% after straight anastomosis [16–18] and from 0% to 7% after J-pouch reconstruction [18–20]. However, previous studies did not discuss the relationship between anastomotic stricture and incomplete evacuation. In our study, anastomosis stricture developed in three of 13 (23%) J-pouch cases and in one of 24 (4%) straight anastomosis cases, and all of them required bougie dilatation. In this study, a significant association between anastomotic stricture and incomplete evacuation was elucidated. Motility abnormality, such as hyper-motility of the anal canal sphincter [21] or large contractions, was also advocated as one of the contributing factors for difficulties in postoperative evacuation. Romanos et al. [9] reported that ambulatory manometric examination showed large contractions in ten of 12 colonic J-pouch patients. Of these ten patients, seven complained of incomplete evacuation. In our study, large contractions were recognized in one of 24 (4%) straight anastomosis cases and in four of 13 (36%) J-pouch cases. The incidence of large contractions was significantly higher in J-pouch cases than in straight anastomosis cases. On the other hand, Ho et al. [14] reported that eight of 20 (40%) patients with a J-pouch had incomplete evacuation, but none of them showed large contractions, even during a 4-h examination, and concluded that large contraction was not associated with incomplete evacuation. Precise reasons for these conflicting results have not yet been determined. During these large contractions, patients had a strong urge to have a bowel movement, even though the balloon in the neo-rectum was not fully expanded. These results suggested that large contractions may be a cause of incomplete evacuation. The precise mechanism of large contractions has not been clarified. Romanos et al. [9] speculated that the presence of residual pouch contents, gradual pouch filling or a primary abnormality of a malfunctioning pouch may contribute to large contractions. We speculate that these large contractions may frequently occur from the simultaneous contraction in the J-shape of the neo-rectum. Further imaging studies are needed to reach conclusions on this point.

Using multivariate analysis, we showed, for the first time, that among clinical and functional parameters, large contractions may contribute most significantly to postoperative incomplete evacuation in the early postoperative period. However, this study is still a preliminary one, and the implication of this phenomenon in the late postoperative period remains to be elucidated. Further long-term follow-up and larger numbers of patients are warranted.

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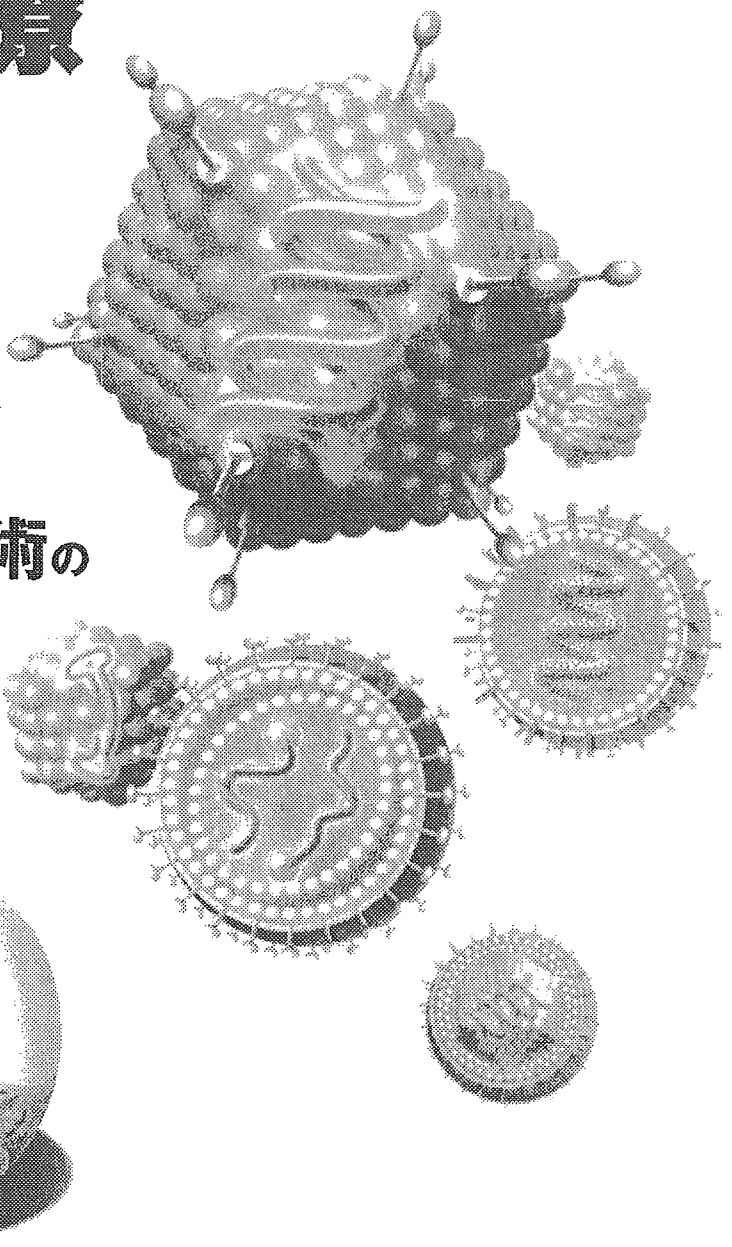

内視鏡的粘膜切除術の適応拡大

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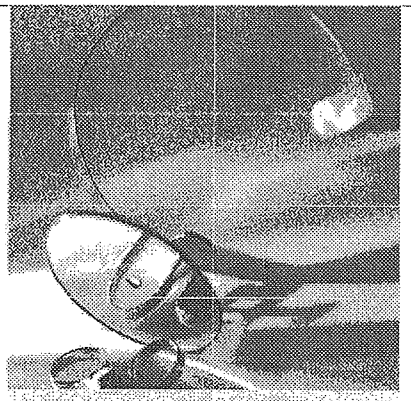

大腸

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☞ Point

●大腸sm癌の内視鏡的粘膜切除術（Endoscpic mucosal resection；EMR）の適応に関しては、大腸癌取り扱い規約ではきわめて浅い浸潤（約200～300μm）が適応とされている[1]。しかしながら、最近その適応を見直す動きがでてきている。

●われわれの施設の検討の結果、sm浸潤距離が1,500μm以上、組織型が中分化腺癌もしくは低分化腺癌、脈管浸襲（＋）の3因子がリンパ節転移のきわめて重要な独立危険因子であった。それぞれの条件を満たしたとき、リンパ節転移の可能性はそれぞれ12.6％、19.0％、22.4％であった。危険因子を多く満たすほどリンパ節転移の危険は当然ながら上昇する。3危険因子を全て満たす場合、リンパ節転移の危険性は30.9％にまで及ぶ。

●長期予後の観点からも、①浸潤距離1,500μm以下、②主組織型が高分化腺癌、③脈管浸襲（－）の3因子全てを満たす症例をわれわれの施設はEMRの適応と考えている。またEMRもしくは局所切除のみでフォーローアップされた症例とEMR後に外科的追加切除した症例もしくは外科手術のみの症例と5年無再発生存、5年生存率は有意差を認められておらず、3因子を満たせば、手術と同等の長期予後が望めることを示している。

●当センターでは、高分化線癌で脈管浸襲もなく浸潤距離が1,500μm以下であれば、EMRの絶対適応としている。それ以外は外科的手術を勧めることとしているが、高分化腺癌かつ脈管浸襲（－）であれば、浸潤距離が1,500μm以上であっても2,000μm未満であれば、リンパ節転移の可能性は低く、EMRのみでフォローアップすることの患者選択の余地があるのではないかと考えている。

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大腸sm癌の内視鏡的粘膜切除術（Endoscpic mucosal resection；EMR）の適応に関しては、大腸癌取り扱い規約ではきわめて浅い浸潤（約200～300μm）が適応とされている[1]。しかしながら、sm癌のリンパ節転移は10%程度であり[2]、浸潤度が200～300μm以上のsm癌を外科的追加切除とするとoversurgeryとなる可能性があり、最近その適応を見直す動きがでてきている[3,4]。2003年の大腸癌研究会でのsm癌プロジェクト委員会によるアンケート集計中間報告から、有茎性以外のsm癌のsm浸潤距離が1,000μm未満を将来的にはEMRの適応とするように変更される予定である。この稿では、さらなるsm癌の適応拡大の可能性について概説することとする。

sm癌の適応拡大の可能性

sm癌の適応拡大の可能性を探るために、長期的予後とリンパ節転移および遠隔転移の実績について検討した。

1. 対象

国立がんセンター東病院（1992～2002年6月）、国立がんセンター中央病院（1980～2002年6月）のsm癌769例中、①有茎性ポリープ（Ip）115例、②フォローアップ1年未満65例、③FAPもしくはHNPCC症例12例、④進行大腸癌合併例42例、⑤詳細な組織学的検討が不可能であった症例69例を除いた466例を対象とした。フォローアップ期間の中央値は4年11カ月で、3年以上の症例は76%であった。

われわれは、sm浸潤距離（絶対浸潤距離）を計測する際、
①sm浸潤領域内に粘膜筋板が残存する場合、粘膜筋板を、
②粘膜筋板が部分的に破壊されるも粘膜筋板が想定可能な場合、粘膜筋板想定線を、
③sm浸潤領域内に粘膜筋板が認められない場合、sm浸潤部最表層を、
④sm浸潤領域が複数存在する場合、最深領域のsm浸潤部位を
基点としている[3,5]（図1）。

2. リンパ節転移の危険因子

リンパ節転移の主要な危険因子を明らかにするために、性差、年齢、腫瘍の部位、腫瘍の大きさ、腫瘍の増殖形式、腫瘍異型度、主組織型、sm浸潤距離、先進部低分化の有無、脈管浸襲（リンパ管浸襲のもしくは静脈浸襲の有無）の10項目について解析を行った。多変量解析の結果、sm浸潤距離が1,500μm以上、組織型が中分化線癌もしくは低分化腺癌、脈管浸襲（+）の3因子はリンパ節転移のきわめて重要な独立危険因子であった（表1）。

3. sm癌内視鏡治療後の長期予後について

sm癌の長期予後について詳細な検討をした報告は少ないが、今後sm癌

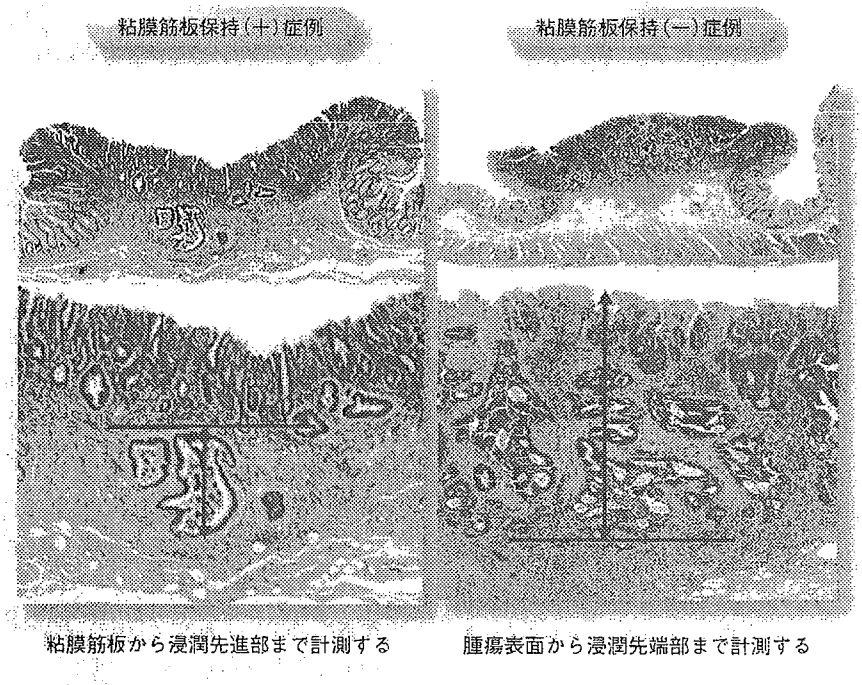

図1　sm浸潤距離の測り方

粘膜筋板保持（+）症例では、粘膜筋板から浸潤先進部まで、粘膜筋板保持（−）症例では腫瘍表面から浸潤先端部までを計測する[5]。

	リンパ節転移 (−)	(+)	p	オッズ比	95%信頼区間
sm浸潤距離 (≦1,500 vs >1,500μm)	146/277	3/40	0.0243	5.0	1.1〜21.6
組織型 (Wel vs Mod, Por)	313/110	17/26	0.0079	2.5	1.2〜5.1
脈管浸襲 (−) vs (+)	326/97	15/28	<0.0001	4.2	2.1〜8.5
先進部低分化 (−) vs (+)	364/60	31/12	0.3934	1.2	0.6〜2.6

表1　多変量解析（リンパ節転移と危険因子）

sm浸潤距離（≧1,500μm）、組織型（中・低分化線癌）、脈管浸襲（+）が、リンパ節転移の非常に強い独立危険因子であった。
Wel：高分化線癌、Mod・Por：中・低分化線癌

の内視鏡治療適応拡大を図るために、生存率をendpointにおいた考え方が必要な時期にきている。われわれはこれらの3因子（①浸潤距離1,500μm以下、②主組織型が高分化線癌、③脈管浸襲（−））が内視鏡治療の適応拡大のための指標となりうるかを長期予後の観点からも解析を行った。われわれの施設では、この3因子全てを満たす症例をLow Risk群（Low群）とし、それ以外をHigh Risk群（High群）に分類した。

さらにそれらをEMRもしくは局所切除のみでフォーローアップされた症例をER群、EMR後に外科的追加切除した症例もしくは外科手術のみの症例をOP群に亜分類した。

5年生存率はLow-EMR群とLow-OP群で有意差を認められておらず、3因子を満たせば、手術と同等の長期予後が望めることを示している（図2）。

4. 再発について（表2）

現在までに8例の再発症例を認めた。Low群に1例認めたが、EMR（局所切除）から1年9カ月同部位腸管に局所再発した。これはCut endが不明瞭な症例であった。残りの7例はすべてHigh群であり、EMR群4例、OP群3例であった。7例中6例（86％）で遠隔転移を認め、肝4例、肺2例であった。

再発症例は全て直腸、S状結腸に位置していたことから、再発・遠隔転移に病変の占拠部位が関与している可能性も示唆される。

遠隔転移症例に着目すると、6例中4例（67％）で脈管浸襲（+）または組織型が中分化腺癌であった。残りの2例はsm浸潤距離が2,500μ以上であった。また6例中5例（83％）でsm浸潤距離が2,500μ以上であった。脈管浸襲や組織型、より深いsm浸潤距離が遠隔転移と関与している可能性も示唆されるが、いまだ再発症例が少なく今後の課題といえる。

再発予防の観点からは、再発形式が肝、肺を中心とした遠隔転移であ

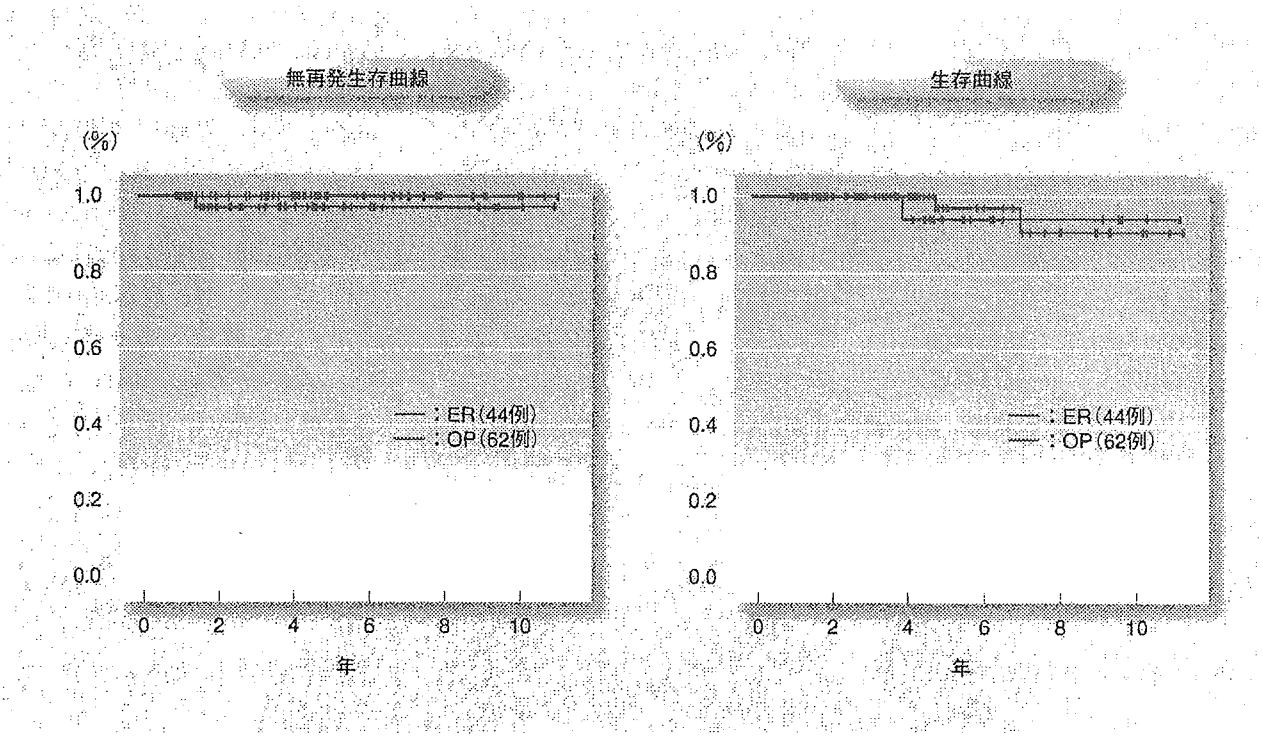

図2　Low群におけるER群とOP群の無再発生存曲線および生存曲線

Low群においてER群とOP群に5年無再発生存・5年生存率に有意差はなかった。

初回手術	占拠部位	脈管浸襲	組織型	sm浸潤距離 (μm)	再発までの期間	再発部位	救済処置	予後	
①L-ER*	Rb	−	well	400	1y9m	局所(同部腸管)	OP*	4y6m	生存
②H-ER*	Rb	−	mod	225	1y3m	リンパ節	OP	2y2m	生存
③H-ER*	R	＋	well	750	1y	肝	OP	6y10m	現病死
④H-ER*	R	＋	mod	3,250	4y2m	局所(同部脂肪識) 肝	RT＋OP	13y7m	生存
⑤H-ER#	Rs	−	well	3,000	8m	局所(同部腸管) 肺、リンパ節	OP	3y3m	現病死
⑥H-OP	S	−	well	2,625	1y6m	肺	OP	8y8m	生存
⑦H-OP	S	＋	mod	3,000	1y8m	肝	OP	6y9m	生存
⑧H-OP	S	−	mod	2,750	3y8m	肝	OP	4y1m	現病死

表2　再発症例

原発腫瘍の占拠部位は全例S状結腸・直腸であった。再発部位は肝・肺など遠隔転移が8例中6例を占めた。脈管浸襲(＋)もしくは中・低分化線癌であるか、sm浸潤距離がより深い(＞2,500μm)ものに遠隔転移が多いようであった。再発までの期間に一定の傾向は見出せなかった。
L：Low群、H：High群、-ER：ER群、-OP：OP群、＊：局所切除、＃：ポリペクトミー
R：直腸、Rb：下部直腸、Rs：直腸S状部、S：S状結腸
well：高分化線癌、mod：中分化線癌、por：低分化線癌
OP：外科的切除、RT：放射線治療

ることがほとんどであり、切除後にCT(肝・肺)画像診断、CEAなどの腫瘍マーカーなどを使っての厳重なフォーローアップが必要である。また、過去の検討[6]ならびにわれわれのデータでも再発時期に一定の傾向を認めないことから、切除後のフォーローアップの時期・期間へも配慮が必要であろう。

危険因子とリンパ節転移の相互関係(図3)

図3のように危険因子を多く満たすほどリンパ節転移の危険は当然ながら上昇する。

脈管浸襲もしくは主組織型に注目すると、多くの症例で浸潤距離も1,500μm以上となり、2危険因子以上となる割合は、それぞれ88.0%(110例

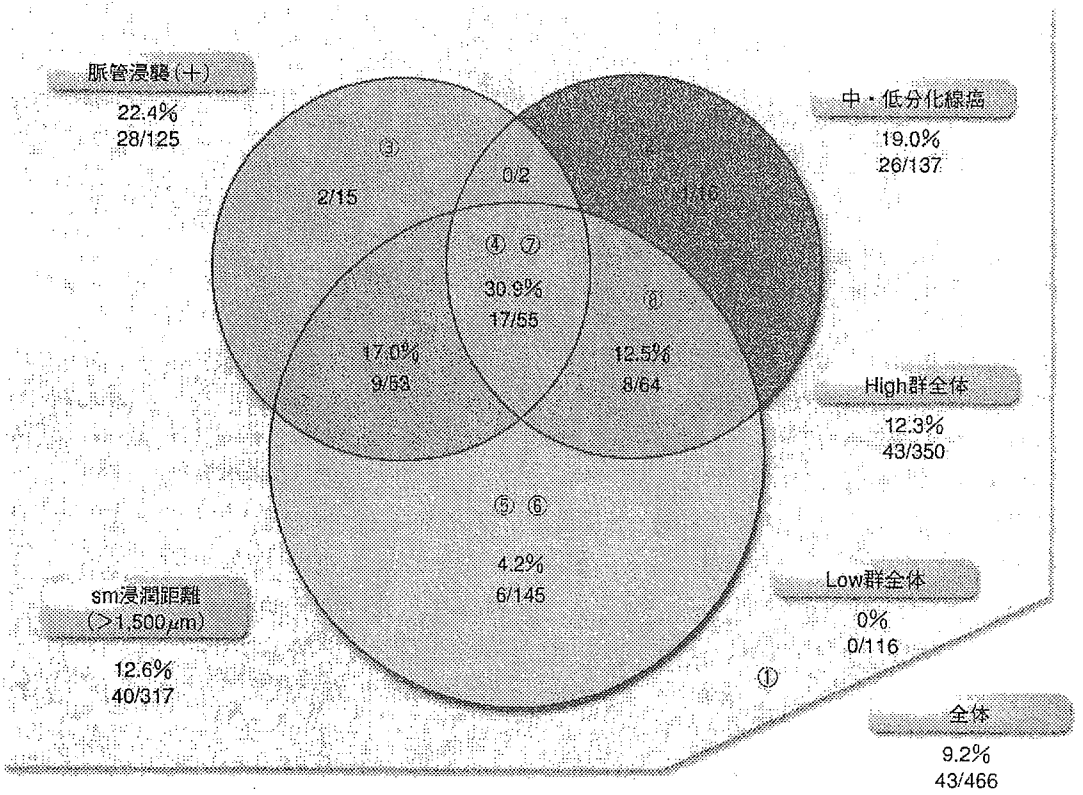

図3 3因子と再発・リンパ節転移との関係

3因子を1つも満たさない場合(Low群)では、リンパ節転移の可能性は0%。High群全体では12.3%。sm浸潤距離が1,500μm以上では12.6%、組織型が中・低分化腺癌では19.0%、脈管浸襲(+)では22.4%であった。危険因子を多く満たすほど、リンパ節転移の危険は当然ながら上昇する。3危険因子を全て満たす場合、リンパ節転移の危険性は30.9%にまで及んだ。浸潤距離および脈管浸潤、浸潤距離および主組織型の2危険因子のみを満たす場合、リンパ節転移の危険性は、それぞれ17.0%(9例/53例)、12.5%(8例/64例)と相当高くなった。脈管浸襲(+)もしくは中・低分化線癌の場合、2危険因子以上となる割合は、それぞれ88.0%(110例/125例)、88.3%(121例/137例となり、ほとんどの症例で浸潤距離も1,500μm以上となった。一方、浸潤距離が1,500μm以上の症例に注目すると、2危険因子以上を満たすのは53%(169例/317例)に過ぎず、およそ半数は1危険因子のみである。この場合、リンパ節転移の危険性は4.2%(6/145)となる。

丸数字は表2の再発症例に対応する。赤数字は死亡例。
上段はリンパ節転移の頻度、下段は症例数。

/125例)、88.3%(121例/137例となる。浸潤距離および脈管浸潤、浸潤距離および主組織型の2危険因子のみを満たす場合、リンパ節転移の危険性は、それぞれ17.0%(9例/53例)、12.5%(8例/64例)と相当高くなる。

さらに3危険因子を全て満たす場合、リンパ節転移の危険性は30.9%(17例/55例)にまで及ぶ。

一方、浸潤距離が1,500μm以上の症例に注目すると、2危険因子以上を満たすのは54%(172例/317例)に過ぎず、およそ半数は1危険因子のみである。この浸潤距離が1,500μm以上で脈管浸襲(−)かつ高分化腺癌であった場合のリンパ節転移の危険性は4.2%(6例/145例)となるが、後述するように深く浸潤するほどリンパ節転移の危険は増大する。

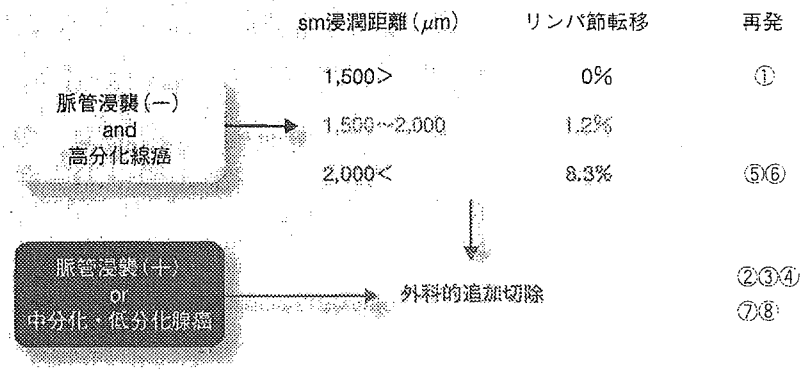

図4 sm浸潤距離別にみた3危険因子とリンパ節転移・再発の関係

高分化線癌で脈管浸襲もなく浸潤距離が1,500μm以下であれば、EMRの絶対適応としている。それ以外は外科的手術を勧めることとしているが、高分化線癌で脈管浸襲もなければ、浸潤距離が1,500μm以上であっても、2,000μm未満であれば、リンパ節転移の可能性は1.2%(1例/84例)にすぎない。

EMRの適応について

以上より長期的観点からもEMRの適応は、

①浸潤距離1,500μm以下
②主組織型が高分化線癌
③脈管浸襲(−)

の全ての条件を満たす症例となり、実際われわれの施設でもこの条件をEMRの適応としている。

現状の適応とわれわれの適応との比較評価

EMRの適応を従来の大腸癌取り扱い規約[4]のきわめて浅い浸潤(sm浸潤距離200~300μmまで)までとすると、適応となる症例は全症例の6.4%(30例/466例)となり、リンパ節転移は0%(0例/30例)である。

われわれの適応では、全症例の24.8%(116例/466例)が含まれることになり、リンパ節転移も0%(0例/116例)となっている。

仮にEMRの適応をsm浸潤距離が1,000μmまでで、他の基準を加えない条件とすると、全体の23.6%(110例/466例)が含まれるが、そのうちリンパ節転移が2.7%(3例/110例)含まれてしまう。2例は脈管浸襲(+)で、1例は主組織型が中分化線癌であり、われわれの基準では適応外となっている症例である。

以上のことより、従来の適応条件よりもわれわれの適応のほうが、より多くの症例がしかも安全にEMRのみで治療ができ、無用な外科的追加切除を避けることが可能であると考えている。

実際の臨床の現場では(図4)

基本的にはわれわれの基準全てを満たさなければ、外科的追加切除を強く勧めている。しかし、実際の臨床の場では、高齢などの医学的理由で外科的追加手術が危険と判断されたり、他に患者サイドからさまざまな理由で内科的にフォーローすることを希望されることもしばしばである。

ここで、さらに浸潤距離を1,500μm以下、1,500~2,000μmと2,000μm以上に分けて検討してみると、高分化線癌で脈管浸襲もなければ、浸潤距離が1,500μm以上であっても、2,000μm未満であれば、リンパ節転移の可能性は1.2%(1例/84例)である。ただし2,000μm以上になると同じ条件でリンパ節転移の危険性は8.3%(5例/61例)と高率となる。

われわれの施設では、高分化線癌で脈管浸襲もなく浸潤距離が1,500μm

以下であれば、EMRの絶対適応としている。それ以外は外科的手術を勧めることとしているが、浸潤距離が1,500 μm以上であっても2,000 μm未満であれば、高分化線癌で脈管浸襲もない条件であれば、リンパ節転移の可能性は低く、EMRのみでフォローアップすることの患者選択の余地があるのではないかと考えている。

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• *CASE REPORT* •

Pneumoscrotum: A rare manifestation of perforation associated with therapeutic colonoscopy

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Abstract

Pneumoscrotum 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 pneumoscrotum, 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 pneumoscrotum 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. Pneumoscrotum could be a sign of colonic perforation after EMR, and treatment should be carefully chosen.

Key words: Pneumoscrotum; Colonic perforation; Endoscopic mucosal resection

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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, pneumoscrotum 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 pneumoscrotum 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-carmine dye spraying. (Figure 1A) Magnifying colonoscopy after indigo-carmine dye and crystal violet staining disclosed type IIIL 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-carmine 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

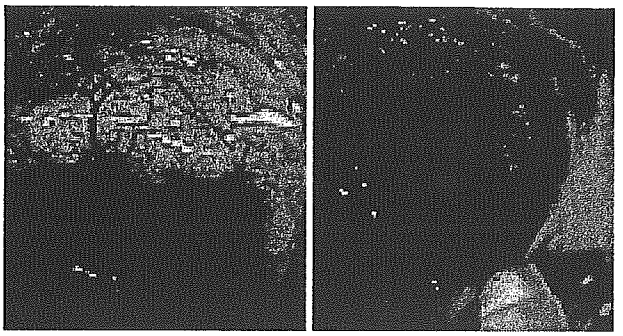

Figure 1 **A:** Colonoscopy after indigo-carmine dye spraying showed a laterally spreading tumor 35 mm in diameter in the descending colon. **B:** The ulcer after piecemeal EMR and APC revealed no active bleeding or perforation.

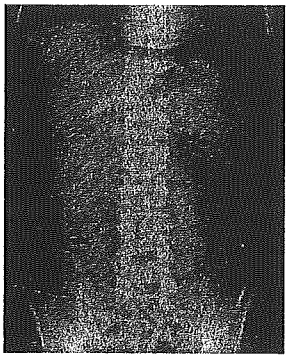

Figure 2 Upright abdominal X-p film showed free air in the sub-diaphragmatic space.

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 tomograhy (CT) of the chest and abdomen revealed pneumopericardium, pneumoperitoneum and bilateral pneumoscrotum. (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 pneumoscrotum resolved within 2 d, the resolution of the pneumoscrotum 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.

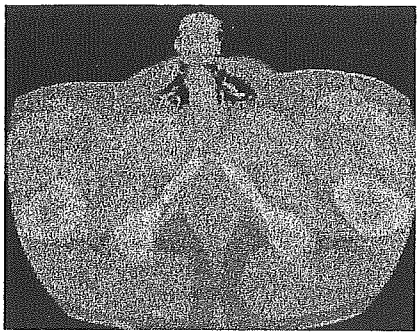

Figure 3 Abdominal computed tomography disclosed free air in the scrotum. Edited by Helen.

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 pneumoscrotum as a sign of a colonic perforation after EMR in delayed fashion. Pneumoscrotum is a term which implies the presence of air within the scrotum[1]. Although pneumoscrotum 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 pneumoscrotum 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 pneumoscrotum, which presented as the first symptom and sign of colonic perforation.

Colonic perforation may be intraperitoneal or retroperitoneal, or both[11]. Our case presented pneumoscrotum, 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 pneumoscrotum 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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進行直腸癌に対する腹腔鏡下低位前方切除術

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特集 直腸癌に対する手術のコツ

進行直腸癌に対する腹腔鏡下低位前方切除術*

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* Laparoscopic low anterior resection for advanced rectal cancer

キーワード：腹腔鏡下低位前方切除術，進行直腸癌，内側アプローチ，自律神経・肛門温存

要旨：腹腔鏡下手術には近接視や拡大視効果により狭い骨盤腔内でもきわめて繊細な観察が可能で，チーム全員がその良好な術野を得られる大きな利点がある．適切な器具と的確な手技を用いれば進行直腸癌に対しても腹腔鏡下手術の利点を生かしつつ，自律神経完全温存の腹腔鏡下低位前方切除術を適切に行える．しかし，進行直腸癌に対する腹腔鏡下低位前方切除術では病変部への直接操作を避けた直腸の剝離・授動，適切な切離面と surgical margin（AW）を確保した肛門側腸管切離に特に注意する必要がある．不用意な合併症や再発を予防し，その有用性を最大限に引き出すためには段階的な適応の決定，周到な術前処置，適切な器具と的確な手術手技に加えて，さらなる工夫と器械の改良・開発を続けていく必要がある．

はじめに

進行直腸癌に対する腹腔鏡下低位前方切除術では病変部への直接操作を避けた直腸の剝離・授動，適切な切離面と surgical margin（AW）を確保した肛門側腸管切離に特に注意する必要がある．一方，腹腔鏡下手術には拡大視や近接視効果により狭い骨盤腔内でもチーム全員が良好な術野を得られる大きな利点がある[1]．

本稿では進行直腸癌に対する腹腔鏡下低位前方切除術のコツについて述べる．

適応

直腸癌に対する腹腔鏡下低位前方切除には高度の技術が要求されるため，その適応が最初の重要なポイントとなる．すなわち，手術チームの熟練度やデータをもとに適応を明らかとし，インフォームドコンセントを得て手術が決定される．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，直腸S状部から上部直腸では漿膜浸潤癌まで，下部直腸では適切な剝離操作や側方郭清の困難性から病変が腸壁内に確実にとどまり，リンパ節に明らかな転移のない MP，N（−）までを適応としてきた．これにより腹腔鏡下低位前方切除では自律神経完全温存の total mesorectal excision（TME）の層での直腸の剝離・授動が基本となる．ただし，手技の向上により下部直腸の適応を拡大し，症例を選択して腹腔鏡下の自律神経温存側方郭清も行っている[2]．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，部位や骨盤腔の広さ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，肥満者も適応外とはせず，開腹手術既往者にも腹腔内癒着に注意しつつ腹腔鏡下手術を行っている．さらに，高齢者や全身状態（心・肺・肝・腎機能）障害者でも activity があって全身麻