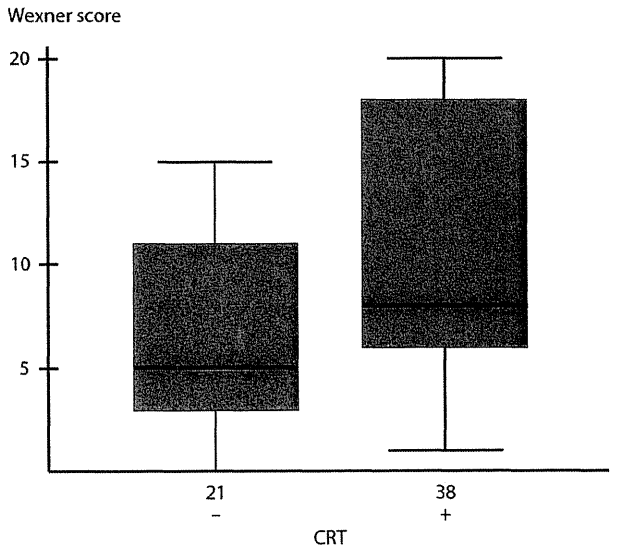

FIGURE 2. Relationship between CRT and Wexner score. Wexner score comparison at 12 months after stoma closure between the CRT and control groups resulted in median values of 8.0 and 5.0 (P = .018 by Mann-Whitney U test). CRT = chemoradiotherapy.

DISCUSSION

The results of the study showed that preoperative CRT had a negative effect on anal function regardless of the surgical method. This suggests that it is important to examine neural degeneration around the internal sphincter muscle for prediction of anal dysfunction. Many cases were of pathological stages I and II because of downstaging by CRT, but total ISR was performed in some of these cases. This approach was used because we were unable to judge the position of the tumor edge on the anal side before preoperative CRT, which prevented maintenance of a clear distal margin. However, this had no influence on the analysis of the Wexner score because the comparison of this score with anal dysfunction was performed only within the CRT group. Moreover, of the factors investigated, preoperative CRT had the greatest effect on anal dysfunction after ISR, and total ISR was more strongly associated with anal dysfunction than either subtotal or partial ISR. Therefore, a negative effect of preoperative CRT on anal function was found regardless of the extent of internal sphincter muscle preservation.[13]

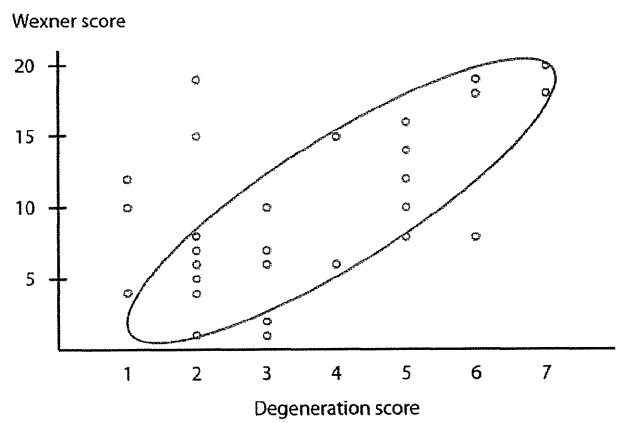

FIGURE 3. Association between the degeneration score and Wexner score. The correlation between the original score (range, 0–7) and the Wexner score was investigated. Correlation was significant with P = .003 and a correlation coefficient of r = 0.477 by Spearman analysis.

The cause of the negative effect of conventionally fractionated CRT on anorectal function is still unclear. Lim et al[15] suggested that poor anorectal function after preoperative CRT was due to damage to the pudendal nerve, and rectal function may also be worsened by radiation-induced proctitis and reduced rectal compliance.[16,17] Moreover, anal sphincter dysfunction may be caused by direct radiation injury to the internal anal sphincter muscles.[18] Our results showed a significantly higher incidence of neural degeneration and fibrosis in the CRT group. In this study, we did not include cases treated with radiation therapy only. However, in another series, we found that treatment with radiation alone caused tissue degeneration, including neural degeneration similar to that caused by CRT. We also evaluated another 8 patients with colorectal cancer who received preoperative folinic acid/fluorouracil/oxiliplatin (FOLFOX) treatment. The incidence of neural degeneration was significantly higher in the CRT group than in the FOLFOX cases. There were no differences in any items of neural degeneration between the FOLFOX cases and control groups, suggesting that radiation may exert a critical damage on tissue damage. In the pathological evaluation, patients treated with preoperative chemotherapy alone had no neural degeneration, with results similar to those in the control group. These results suggest that radiation plays a critical role in tissue damage.

The tissue and nerves were evaluated in surgical tissue specimens, but these specimens and the left internal and external sphincter muscles were similarly affected by CRT, which suggests that the histological changes in the analyzed specimens were also present in the body. The nerve examined in the study is an autonomic nerve that is distributed longitudinally in the intestine and innervates the internal sphincter muscle. After surgery, the somatic and pudendal nerves are involved in anal function and mainly innervate the external sphincter muscle of the anus. Although their origins are different, examination of these 2 nerves may be appropriate for assessment of neural degeneration, because neuronal failure of these nerves may cause anal dysfunction. In this study we evaluated tissue degeneration in the neural range affected by CRT, including the sphincter muscle, and these results are important for prediction of anal function after surgery.

In the CRT group, surgery was performed within 2 to 3 weeks after completion of preoperative CRT, and the investigated histological changes occurred during this period. Anal function improved with the postoperative course in some cases, suggesting that nerves and tissue including muscle can regenerate and result in improved anal function. However, an investigation of anal function after ISR in patients who underwent surgery at our hospital suggested that functional recovery cannot be expected in cases with unfavorable function at 6 to 12 months after surgery.[13] Because CRT-induced early-phase tissue degeneration is associated with anal function at 12 months after surgery (as found in this study), tissue degeneration early after CRT may have a long-term effect on anal function.

Various factors may exert an influence on anal function, and this makes it difficult to predict postoperative anal function before surgery. However, the results of this study showed a significant correlation between the degeneration score defined in the study and the Wexner score in the Spearman analysis. Furthermore, there was no significant relationship between each histological finding and Wexner score, and no significant association between each item for evaluation of neural degeneration and Wexner score in multivariate regression. These results suggest that tissue degeneration should be evaluated by examining various items, rather than based on only a single item, because neural degeneration associated with anal dysfunction may be reflected by several critical items. A further study is needed to identify these important items.

Postoperative maintenance of anal function is important after ISR and further research is necessary to develop a compensatory treatment for maintenance of function (for example, reconstruction of functional muscles) for CRT cases with functional failure. Simultaneous management of therapeutic benefit and anal function is required following ISR, and we intend to examine approaches to maintenance of the therapeutic benefit of preoperative CRT in a future study. For example, preoperative chemotherapy alone may be appropriate based on the improvement of colorectal cancer observed with this approach.

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日鏡外会誌 16：125-130, 2011

直腸癌に対する腹腔鏡下前方切除術における助手の役割

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Key words ◆ 直腸癌，腹腔鏡下手術，前方切除術

◆要旨：【背景目的】腹腔鏡下前方切除術では術者と助手の役割を明確にすることでスムースな術野展開がえられる．術者と助手の役割を定形化することは，腹腔鏡下手術を修練する外科医にとって手技習得に大きく寄与する．剝離部位ごとの術野展開のポイントを，助手の役割を中心に提示する．【方法】剝離部位により次の7つの場面に分けて手術を進めていく．①内側アプローチ，②上方向郭清，③後壁剝離，④前壁剝離，⑤右側壁剝離，⑥左側壁剝離，⑦間膜の処理・吻合【まとめ】助手の習熟度により手術時間が短くなる傾向にあり，術者と助手の共通認識と手術手技習得のための術野展開の定形化は腹腔鏡下直腸癌手術において大切である．

はじめに

近年，腹腔鏡下手術の適応拡大により，直腸癌治療においてもその症例数は増加傾向にある．現在，直腸S状部までの癌はrandomized centrolled trial to eraluate laparoscopic surgery for colorectal cancer：Japan Clinical Oncology Group Study, JCOG 0404による長期成績の報告を待っている状況にあるが，実診療では腹腔鏡下手術の標準化が進んでいる．さらに低位の直腸癌症例においても研究プロジェクト（LAPRC）によりその安全性が検討されており，腹腔鏡下直腸癌手術は今後標準化が望まれる手術として期待されている．

腹腔鏡下前方切除術では剝離部位ごとの術者と助手の役割を明確にすることでスムースな術野展開がえられる．当科では，すべての手術を腹腔鏡経験の豊富な常勤医師1名とレジデント2名の組み合わせで行っており，患者ごとに編成の異なる流動的なスタイルをとっている．レジデントは習熟度に応じて，スコピストから術者までを経験する．手術の役割を明確にして定形化することは，教育的な面でレジデントの手技習得に大きく寄与している．また，術野展開における助手の担う役割は大きく，助手から術者にステップアップする過程で，助手の役割を理解することは必要条件である．しかし，今までに助手の立場から見た，術野展開の要点についての報告はほとんどない．現

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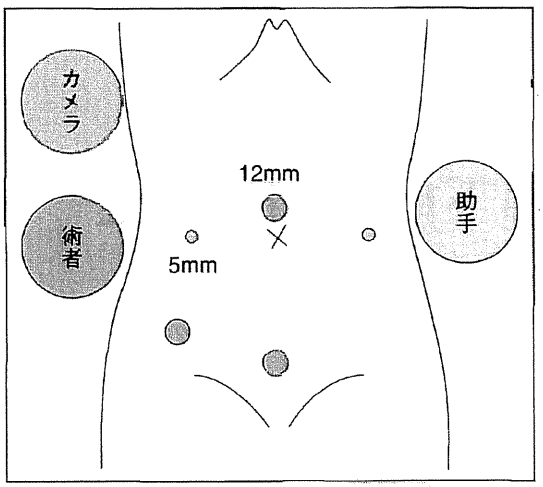

図1　腹腔鏡下前方切除の定形化

術者・助手・スコピストの3名で5ポートを基本とし，剥離部位により7つの場面に分ける．
①内側アプローチ
②上方向郭清
③後壁剥離
④前壁剥離
⑤右側壁剥離
⑥左側壁剥離
⑦間膜の処理・吻合

在多くの施設で，腹腔鏡下手術の教育体制を整備し，助手の手技を向上させるトレーニングシステムの構築は急務である．本稿では，現在標準術式になりつつある直腸癌の前方切除術における剥離部位ごとの術野展開のポイントについて，助手の果たすべき役割を中心に提示する．

対象および手術手技

1．対象

腹腔鏡下前方切除術の適応は，Raまでの場合，T4を除くclinical StageⅢまでとし，Rbにかかる場合，clinical Stage 0-Iで側方郭清を必要としない症例を対象としている．

2．手術手技

1）ポートの位置

恥骨上に12 mmのポートを加えた5ポートを基本としている（**図1**）．恥骨上に12 mmのポートを挿入する理由としては，右下腹部の12 mmポートより直腸切離が困難な，さらに低位の切離となる場合，恥骨上からの直腸縦切離（手袋法も考慮）[1,2]が有効であることが多いためである．右側下腹部ポートから切離可能な場合は，助手が操作しやすい位置に5 mmポートを挿入することで代用できる．

2）剥離部位ごとの場面分け

前方切除術では剥離部位ごとに術野展開が異なる．このため，術者，助手，スコピストの3人が共通した認識で，手術を進めるために，**図1**のように場面分けして，手術を定形化している．

3）場面ごとの助手の役割

①内側アプローチ：直腸間膜のできるだけ足側を把持し左上方向へ牽引し，腹膜の切開ラインを底辺とした，できるだけ底辺の長い3角形を直腸間膜で作るようにする（**図2a**）．1本の鉗子で視野作りが困難な場合は，恥骨上の鉗子でさらに足側の間膜を把持して，底辺の長い，台形を直腸間膜で作るようにし，術者が間膜切開を骨盤底まで見渡せるようにする．

②上方向郭清：上直腸動脈を含んだ間膜を把持し，術者の鉗子と対側の緊張がかかる方向に牽引する．中枢の血管処理の場面では，術者の鉗子の邪魔にならない位置で把持し，術者の両手がクロスしない方向に牽引することが大切である．また，中枢側での術野作りで，小腸のたれ込みが問題になる場合は，恥骨上の鉗子でたれ込みの原因となる小腸間膜を愛護的に把持し，頭側に牽引する．

③後壁剥離：直腸固有間膜の後壁を腹側に牽引することが重要である．剥離の浅い段階では直腸間膜を把持して，上方向に緊張をかけるだけで，視野作りが可能であるが，剥離が深い位置に至れば助手が把持する位置をより低くし，直腸固有間膜自体をつかみ，腹側に牽引する（**図2b**）．特に，肛門挙筋近傍の剥離では，骨盤内の限られた空間の中で視野を確保しなければならないので，術者の剥離部位近傍を把持し，術者と協調しながら，肛門側に剥離を進めることが大切である．また，把持が困難な場合は鉗子の先端をハの字に開いて，直腸後壁を腹側に押し上げることで，視野作りが可能である．

④前壁剥離：恥骨上ポートからの腸鉗子で腫瘍口側の直腸を大きく把持して，頭側に牽引し固定

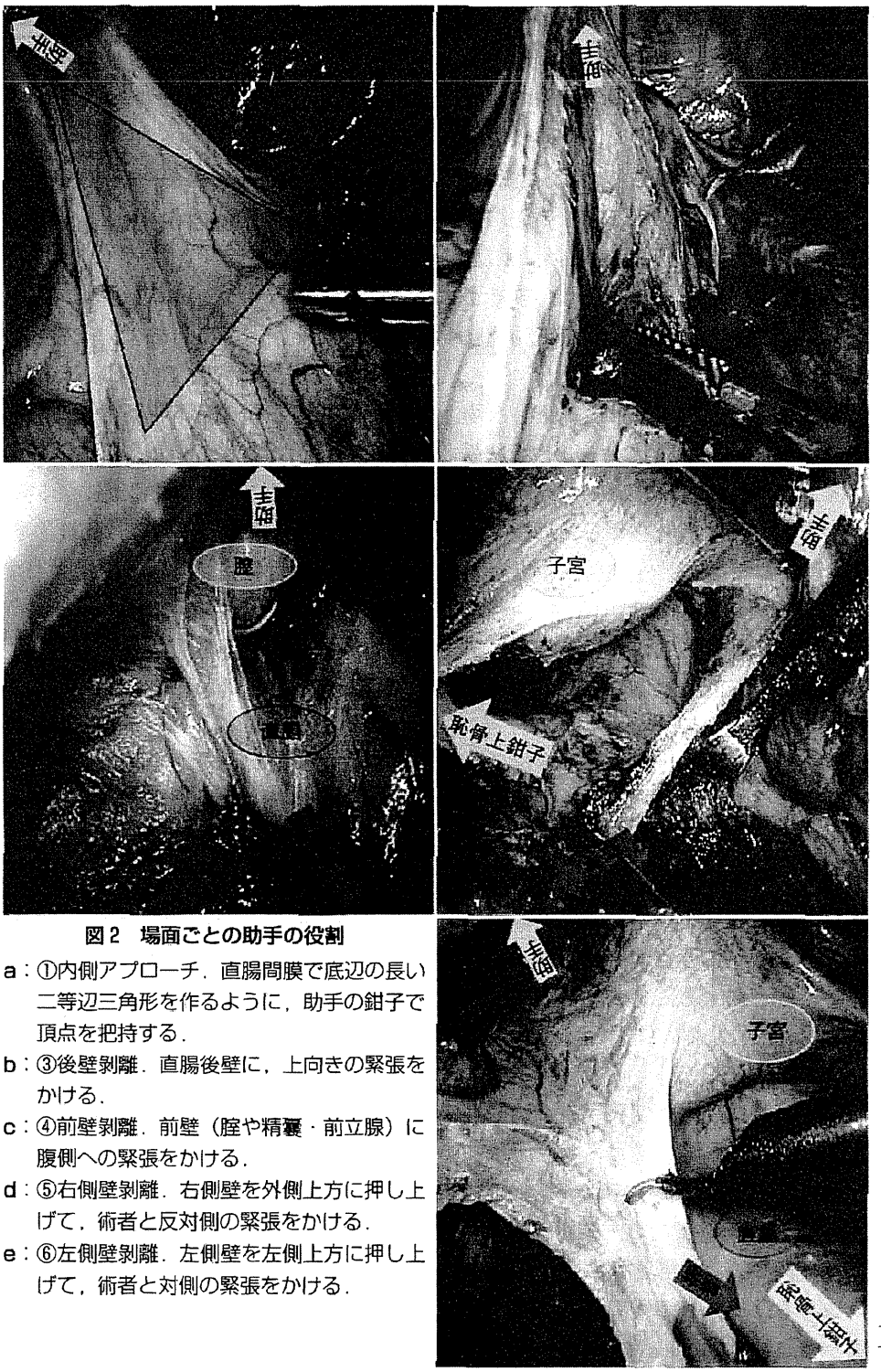

図2　場面ごとの助手の役割

a：①内側アプローチ．直腸間膜で底辺の長い二等辺三角形を作るように，助手の鉗子で頂点を把持する．

b：③後壁剝離．直腸後壁に，上向きの緊張をかける．

c：④前壁剝離．前壁（腟や精嚢・前立腺）に腹側への緊張をかける．

d：⑤右側壁剝離．右側壁を外側上方に押し上げて，術者と反対側の緊張をかける．

e：⑥左側壁剝離．左側壁を左側上方に押し上げて，術者と対側の緊張をかける．

する（**図2c**）．この際に把持した腸管や間膜を損傷しないように十分注意する．術者は剝離部位の直腸側を頭側に牽引しながら，剝離を進めていくので，剝離部位にあわせて前壁（腟や精嚢・前立腺にあたる部位）を上方向に牽引する．腟などは鉗子で把持すると，損傷・出血することがあるので，鉗子の先端をハの字に開いて，腹側に押し上げることで視野作りも有効である．

⑤右側壁剝離：前壁剝離の際に恥骨上ポートから把持した腫瘍口側の直腸をそのまま左側に展開し固定する．術者は直腸間膜の右側を左手の鉗子で牽引しながら，剝離を進めるので，助手は骨盤底の右前壁に術者と対側の緊張をかける（**図2d**）．この場合も，把持が困難であれば，鉗子の先端をハの字に開いて右側壁を押し上げてもよい．また，術者が右側壁に緊張をかけたほうが，よい視野が作れる場面もあるので，その際は助手が直腸間膜の右側を左側手前に牽引する．

⑥左側壁剝離：右側壁剝離に直腸を把持した腸鉗子をそのまま右側に展開し固定することで左側壁の視野が確保される．術者は，直腸間膜の左側を左手の鉗子で右頭側に牽引しながら，剝離を進めていくので，助手は骨盤底の左側壁を術者と対側の緊張がかかる方向に牽引する（**図2e**）．特に左側前壁の剝離では，剝離方向がカメラと同じアングルになるために距離感を誤ることがあるので注意を要する．

⑦間膜の処理・吻合：恥骨上ポートの腸鉗子はそのまま直腸の頭側への牽引に利用する．直腸間膜の処理する位置を明確にし，術野の3人が共通の認識を持つことが大切である．助手は処理する場所から遠くない腸間膜を把持し，術者右手の間膜処理を行うデバイスが入りやすい向きに，徐々に方向を変えながら牽引することが大切である．

考　察

腹腔鏡下大腸癌手術は従来の開腹手術と比較して，低侵襲で整容性に優れているとされ，予後に関しても開腹手術に劣らないとする比較試験の結果が報告されている[3-6]．このため，結腸・直腸S状部癌（RS）に対しては腹腔鏡下手術が一般的手技となりつつある．直腸癌の腹腔鏡下手術に関しては，開腹との比較試験の結果はほとんど報告されていないが，腹腔鏡下直腸癌手術の全国アンケート[7]における中期成績（Ra，Rb，Pも含む）の結果では，生存に関して開腹手術と差がなく，安全性に関しても，合併症の頻度は低いと報告された．現在，直腸癌に対する腹腔鏡下手術が，開腹手術に比べて有効性・安全性について劣っていないことを検証する目的で，大腸癌研究会の腹腔鏡下大腸切除研究会で，「Clinical Stage 0-I期直腸癌に対する腹腔鏡下手術の妥当性に関する第II相試験」が行われている．この試験の結果も参考にして，適応に関しては慎重になる必要があるが，今後腹腔鏡下直腸癌手術は，比較的早期の癌から，さらには進行癌にまで適応を拡大して増えてくると考えられる．

表1　術者・助手の違いによる手術時間

術者	手術時間(分)	助手	手術時間(分)
スタッフ	221	スタッフ	223
レジデント①	220	レジデント①	193
レジデント②	247	レジデント②	241

＊p＝0.035
レジデント①：20例以上の腹腔鏡手術を経験
レジデント②：腹腔鏡手術の経験が20例に満たない

当科でも早期から腹腔鏡下直腸癌手術を導入しているが，初期の段階では手術時間が開腹手術と比較して長くなることが多かった．しかし腹腔鏡下前方切除術における手技の定形化を念頭に置いて手術を施行することでラーニングカーブが短縮され，2008年度には62例の腹腔鏡下前方切除を施行し，平均手術時間223分，開腹移行率は1.6％という成績であった．また，40例以上の術者経験により約50分の手術時間短縮が認められた[8]．

手術を定形化することは，術野の共通認識が深まり，スムースな術野展開が可能となるだけでなくレジデントの技術向上に大きく寄与していると考えられる．2008年度の腹腔鏡下前方切除術に関して，術者と助手の違いによる手術時間を検討した（**表1**）．術者・助手をそれぞれ，腹腔鏡経験の豊富な常勤医と腹腔鏡下手術を20症例以上経験したレジデント（レジデント①）とそれ以下のレジデント（レジデント②）の3群に分けて，手術時間を検討した．どの群が術者になっても手術時間に有意差はなかったが，助手の検討ではレジデント①とレジデント②の間で手術時間に有意差があった．この結果からも，スムースな手術展開に，助手の技量が大きく関わっていることがわかる．

腹腔鏡下手術では医師の育成法や安全管理が重

要であると言われており，これには段階に分けた教育システムを導入することが望ましいとされている．

まず，内視鏡外科手術に特有な合併症，ピットフォールを理解し[9,10]，エネルギーデバイスについても機器の特性を理解して使用することが大切である[11]．

次に剝離・切離・縫合・結紮の全科共通の基本操作を，安全確実に遂行可能となることが重要である．

その後に診療科ごとの術式を実践で修練していく必要があり，術式ごとに目標症例数等を設定して，最終的に指導的助手を必要としない独立した術者の育成が目標となってくる．しかし難易度が高くても，症例数の少ない術式では多くの症例を経験することが困難で，独立した術者を育成することが難しいと考える．

少ない症例で修練していくためには，手術の定形化が最も有効であると考える．今回提示した直腸癌の前方切除術は一般的に難易度が高く，症例数の比較的少ない術式に当てはまると考える[12]．剝離場面ごとに術者と助手の役割を明確にし，手術を進めていくことでより明確な手術の定形化が実現できたと考えている．今までの術者中心であった手術解説から一歩進んで，助手の視点から手術を解説することは，新しい内視鏡外科医の育成に大きく寄与すると思われる．

今後はさらに詳細なマニュアルを作成し，それに沿った動画の教材を充実させていくことを目標にしている．優秀な助手を育成し，術者へのステップアップをしやすくすることで，難易度の高い手術を一般的手技として広めていくことができると考えている．

おわりに

本内容は「第71回日本臨床外科学会総会（京都 2009/11/20）」にて発表した．

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The role of the first assistant in laparoscopic anterior resection for patients with rectal cancer

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Background and objective : In laparoscopic anterior resection, the operative field can be smoothly secured when the roles of the surgeon and first assistant are clearly defined. Definition of these roles contributes to the training of surgeons for laparoscopic surgery. We define the important points required to secure the surgical field in individual exfoliation areas, with a focus on the role of the first assistant. **Method** : For each exfoliation area, surgery is performed through the following 7 steps: ① interior approach, ② upward exfoliation, ③ posterior wall exfoliation, ④ anterior wall exfoliation, ⑤ right wall exfoliation, ⑥ left wall exfoliation, and ⑦ treatment/anastomosis of the mesentery. **Conclusion** : The operation time tends to be shortened when the proficiency of the first assistant is high. In laparoscopic surgery for rectal cancer, it is important for the surgeon and first assistant to have a common purpose and to ensure a uniform surgical field to facilitate good surgical techniques.

2010年2月 3 日受付
2010年4月 30 日受理

Surg Endosc (2011) 25:1748–1752
DOI 10.1007/s00464-010-1310-9

Outcome of 141 cases of self-expandable metallic stent placements for malignant and benign colorectal strictures in a single center

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Received: 20 May 2010 / Accepted: 26 July 2010 / Published online: 25 March 2011

Abstract
Background The use of a self-expandable metallic stent (SEMS) has emerged as an alternative treatment option for malignant colorectal obstruction. Although the technical success rate of SEMS has been widely reported, outcome data are limited.
Methods This retrospective study evaluated the short- and long-term outcomes of colorectal SEMS for malignant and benign disease in patients who underwent SEMS at a single center.
Results One surgeon inserted all stents under endoscopic and fluoroscopic guidance; 141 SEMS procedures were performed in 133 patients (82 males, mean age 69 years). The SEMS procedure was undertaken for: palliation of malignant obstruction in 30 patients (36 cases), and the technical success rate was 94%; a bridge to surgery for colorectal cancers in 98 patients/cases, and the technical success rate was 91%; benign stricture in 5 patients (7 cases), and the technical success rate was 100%. Due to anatomical differences, the success rate was lower at the cecum, descending colon, and sigmoid than in the recto-sigmoid and rectum. In 11 cases of technical failures, the failures were due to technical problems in 9 cases (82%) and due to the state of the stricture in 2 cases (18%). Procedure-related complications occurred in 6 patients (4%): perforation in 3 and migration in 3. All perforation cases and one migration case underwent emergency surgery. There was no mortality. In the bridge to surgery group, postoperative complications were much lower in the clinical success cases (6%) than in the failure group (36%). In the palliation treatment group, long-term SEMS migration occurred in 4 patients (14%), and re-obstruction occurred in 5 patients (18%); the mean insertion period was 201 (range: 10–576) days.
Conclusions Colorectal SEMS had feasible short and long-term results and low morbidity, making it a viable option for various types of colorectal obstruction with careful attention to the indications.

Keywords Colorectal obstruction · Stent · Self-expandable metallic stent (SEMS) · Bridge to surgery

The use of a self-expandable metallic stent (SEMS) has emerged as an alternative treatment option for patients with malignant colorectal obstruction [1–7]. Colorectal SEMS decompression has several benefits in the setting of metastatic or unresectable disease, including the potential avoidance of a diverting stoma, lower morbidity, lower mortality, shorter hospitalization, earlier administration of chemotherapy, and decreased medical costs [8–10]. Recently, the placement of colonic SEMS as a bridge to surgery has been advocated in patients with potentially resectable colorectal cancer [10–13]. Furthermore, the role of endoscopic SEMS in benign conditions, such as radiation- or inflammation-induced stricture, colovaginal fistula, and postoperative anastomotic stenosis, has been investigated with varying degrees of success [14–20]. The purpose of this study was to review the results of our use of endoscopic SEMS in patients with malignant and benign conditions of the colon and rectum.

Presented at the 12th WCES, April 14–17, 2010, National Harbor, MD.

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Patients and methods

Institutional Review Board approval was obtained before the study was carried out. A retrospective review was conducted of all patients who underwent a SEMS placement for colorectal stricture between 1993 and 2010 at Toho University Ohashi Medical Center, Tokyo, Japan. All SEMS procedures were performed by the same board-certified colorectal surgeon proficient in therapeutic endoscopy. Data analyzed included patient demographics, past medical history, type and location of pathology, reason for intervention, intent of intervention (definitive versus bridge to surgery), type of stent, and outcome measures such as technical success rate, procedure-related complications, stent migration rate, rate of endoscopic reintervention, and subsequent operative intervention.

Technique and postprocedure care

A preprocedural water-soluble contrast-agent (gastrografin) enema was routinely given to assess the location, anatomy, and characteristics of the pathology, such as length and degree of stricture and presence or absence of fistula. Bowel preparation and intravenous antibiotics were individualized based on the clinical presentation and degree of obstruction. Informed consent for endoscopic SEMS was obtained from all patients with possible emergency operative intervention. All procedures were performed in the radiology room under fluoroscopic and endoscopic guidance, with or without intravenous sedation. A flexible colonoscope (Olympus, Tokyo, Japan) was used for all cases. Access across the lesion was established using a guidewire (Radifocus™ plastic-coated guidewire, Terumo, Tokyo, Japan, or Jagwire™ or Amplatz Super stiff wire, Boston Scientific, Natick, MA, USA). Balloon dilation was not routinely performed. The choice of which SEMS to use (with respect to length, diameter, wire-guided versus through the scope) was tailored according to the characteristics of the stricture. Four different types of SEMS were deployed during the study period: Z-stent™ (Wilson-Cook Medical, Winston-Salem, NC, USA), esophageal Ultraflex™ (Boston Scientific), colonic Wallstent™ (Boston Scientific), and Niti-S enteral colonic stent (Tae Woong Medical, Gyeonggi-do, Korea). All SEMSs were bare (noncovered), with a diameter of 18–22 mm. Esophageal stents were used in the study because of the lack of availability of colonic stents in Japan, and all colonic stents were imported personally. All patients were observed in the recovery unit for 1–3 h and then transferred to the ward. A full liquid diet was resumed within 2–4 days after the procedure in patients who underwent the procedure successfully, and the diet was advanced as tolerated. Patients were instructed to avoid constipation and to take laxatives such as Milk of Magnesia on an as-needed basis. Postprocedural plain abdominal radiographs were obtained selectively. When stent migration was suspected, a plain abdominal X-ray was performed to confirm the diagnosis. Endoscopic or fluoroscopic surveillance of the SEMS was performed in the majority of patients at intervals of 3–6 months.

Results

A total of 141 SEMS procedures were performed in 133 patients during the study period. There were 82 males (62%) and 51 females (38%), with a mean age of 69 years (median = 70 years, range = 37–94 years). All patients were inpatients. The intent of the procedure was definitive treatment in 35 patients (26%) [43 cases (30%)] and bridge to surgery in 98 patients (74%) [98 cases (70%)]. The stricture was malignant in 134 cases (95%) and benign in 7 (5%). Table 1 summarizes the etiology of the strictures and the technical success rate for each. The SEMS procedure was undertaken for palliation of malignant obstruction in 30 patients (36 cases), with a technical success rate of 94%; bridge to surgery for colorectal cancers in 98 patients/cases, with a technical success rate of 91%; and benign stricture in 5 patients (7 cases), with a technical success rate of 100% (2 cases of ischemic colitis in 1 patient and 7 cases of postoperative anastomotic stenosis in 6 patients).

Table 2 summarizes the location of pathology and the corresponding technical success rate. The most common location of pathology was the sigmoid (44%), followed by rectosigmoid (23%), upper rectum (15%), descending colon (10%), transverse colon (6%), cecum (1%), and lower rectum (1%). The technical success rate was lower at the cecum (50%), descending colon (86%), and sigmoid (90%) than at the rectosigmoid (97%) and rectum (95–100%). The lower technical success rates in the cecum and around the SD junction were due to the poor field of

Table 1 Etiology and technical success rate for malignant and benign strictures

	Success/try cases	Technical success rate (%)
Malignant		
Palliative	34/36	94
Bridge to surgery	89/98	91
Benign		
Ischemic colitis	2/2	100
Postoperative anastomotic stenosis	5/5	100
Total	130/141	92

Table 2 Location of pathology and technical success rate

	Success/try cases	Technical success rate (%)
Cecum	1/2	50
Ascending	0/0	
Transverse	9/9	100
Descending	12/14	86
Sigmoid	56/62	90
Rectosigmoid	31/32	97
Upper rectum	20/21	95
Lower rectum	1/1	100
Total	130/141	92

vision with an endoscope. Endoscopic balloon dilation of the stricture was performed in only one patient.

Nine of the 11 technical failures (82%) were due to technical problems: inability of the guidewire to traverse the stricture in four, perforation of the distal side of the stricture by the guidewire in one, inability to advance the stent delivery device in 1, perforation with the delivery device in one, tumor perforation by the SEMS the day following the procedure in one, and SEMS migration in one. In the other two cases (18%), the failures were due to the state of the stricture: multiple strictures and fistula formation to the small intestine.

Successful stent deployment but persistent pseudo-obstructions were found in two cases in the bridge-to-surgery group. One patient had a mass of packed hard feces and one had decreased bowel peristalsis due to Parkinson's disease. Clinical success was achieved in 128 (91%) of 141 cases.

Procedure-related complications were observed in six patients (4%): perforation in three and stent migration in three. All perforation cases and one migration case underwent emergency surgery. Two migrations were saved with additional SEMS delivery. There was no mortality.

All patients in the bridge-to-surgery subgroup underwent subsequent surgical intervention (Table 3). All clinical success cases, 87 patients, underwent elective surgery with mechanical preparation. The mean preoperative period after SEMS delivery was 7.7 days (range = 3–27 days). The stoma creation rate was 10% in this group, and the operative complication rate was 5.7%. All clinical failure cases, 11 cases, underwent emergency surgery; in 8 cases (73%), a stoma was created.

The most common reason for palliative treatment was unresectable distant metastases with primary colorectal cancer in 14 cases (47%), followed by advanced age in 7 (23%), unresectable recurrent colorectal cancer in 6 (20%), and other organ cancers invading the colorectum in 3 (10%). Figure 1 depicts the long-term outcome of patients who were treated with SEMS for palliation.

Table 3 Clinical outcome of "bridge to surgery" cases ($N = 98$)

Technical success rate	89/98 cases (91%)
Clinical success (release of obstruction)	87/98 (89%)
Preoperative period after SEMS delivery	7.7 ± 4.4 days (mean ± SD, range = 3–27 days)
Stoma creation	
Clinical success	9/87 (10%)
Clinical failure	8/11 (73%)
Postoperative complication (success cases)	5/87 (6%)
Wound infection	1
Intra-abdominal abscess	1
SBO	1
Anastomotic Leakage	2
Mortality	0
Postoperative complication (failure cases)	4/11 (36%)
Wound infection	2
Intra-abdominal abscess	1
SBO	1
Pneumonia	1
Mortality (pneumonia)	1/11 (9%)

During a mean follow-up of 8 months, stent migration occurred in four patients (14%) and reobstruction occurred in five patients (18%) (Fig. 1). Endoscopic reintervention, stent in stent, was undertaken in six patients (21%): two for stent migration and four for tumor overgrowth/ingrowth. The long-term operative intervention rate was 7% (2 patients for stent migration). The mean insertion period was 201 days (median = 152 days, range = 10–576 days).

The benign group comprised one patient with ischemic colitis and four patients with postoperative anastomotic stenosis. Reobstruction occurred in two patients (40%)

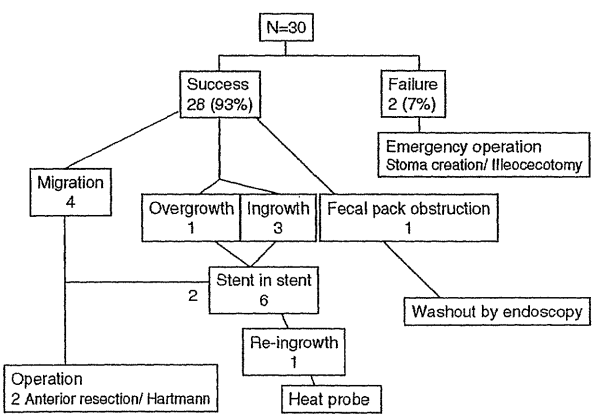

Fig. 1 Short-term and long-term outcomes of patients with SEMS for palliation

after SEMS removal with endoscopy; endoscopic reintervention, stent in stent, was undertaken.

Discussion

Endoscopic SEMS endoprostheses have been clinically applied later for colorectal diseases than for other lesions. Recently, SEMS has been used as palliative treatment for strictures caused by malignant diseases in patients with incurable stages or advanced age, or as a "bridge to surgery" for obstructive colorectal cancers, and good clinical results have been increasingly reported [1–15]. As minimally invasive interventions continue to evolve and gain wider acceptance, colonic SEMS will play an increasing role in the treatment of colonic obstruction. Since the 1990 s there have been numerous studies that have explored the role and documented the utility of endoscopic SEMS to relieve metastatic and incurable large-bowel obstruction [1–9]. More recently, the advantages of preoperative SEMS placement, as a bridge to surgery, have been demonstrated in patients presenting with obstructing but resectable malignancy, converting an emergency operation to an elective one [10–13]. Potential benefits of SEMS under such circumstances include lower morbidity and mortality and avoidance of fecal diversion in a higher proportion of patients. In the present study, SEMS was technically successful in the majority of patients who needed it as a bridge to surgery, palliative treatment, and benign stricture treatment. There were 11 technical failures in which a major problem was the guidewire passing through the stricture. Advanced endoscopes, better guidewire kits, and advanced techniques are needed. Difficult regions for SEMS delivery were the cecum and SD junction. Around that area of the colon it was difficult to get a good front view due to the particular anatomical characteristics. Improvement of EMS devices could increase the success rate of insertion around the SD junction, but the placement of stents in the cecum will remain relatively difficult because of the very special anatomy.

In the bridge-to-surgery group, clinically successful cases had fewer postoperative complications (6%) compared to the failure group (36%). This is the same as had been previously observed by us and other groups [13, 21, 22].

Over the long term, all patients who underwent palliative treatment for malignant stricture avoided surgical intervention with diversion, except two patients who had stent migration laparotomy. The remaining four patients who had tumor overgrowth/ingrowth and two patients with stent migration were successfully treated with reintervention, stent in stent, endoscopically. Although the role of SEMS has been more limited in the setting of benign disease, there is an increasing interest in exploring the effectiveness and durability of endoluminal SEMS for conditions such as radiation- or inflammation-induced stricture, colovaginal fistula, and postoperative anastomotic stenosis; their use in these circumstances have been investigated with varying degrees of success [14–20]. In the present study, five patients underwent SEMS procedures for benign conditions. Technical success in the benign subgroup was similar to that in the malignant cases. However, because of reports of high perforation and migration rates and a lack of long-term outcome results, careful attention is needed before adoption of this technique [20, 23].

Disclosures Dr. Saida has consultant relationships with Boston Scientific Japan. Drs. T. Enomoto, K. Takabayashi, A. Otsuji, Y. Nakamura, J. Nagao, and S. Kusachi have no conflicts of interest or financial ties to disclose.

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Surg Today (2011) 41:630–636
DOI 10.1007/s00595-010-4342-9

SURGERY TODAY

Original Article

Twenty Years of Countermeasures Against Postoperative Methicillin-Resistant *Staphylococcus aureus* Infections

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Abstract

Purpose. A total of 7345 cases of digestive organ surgery were investigated over the course of 20 years.

Methods. Owing to the increasing incidence of methicillin-resistant *Staphylococcus aureus* (MRSA) infections, we classified our countermeasures into periods A (September 1987 to February 1990), B (March 1990 to February 1997), C (March 1997 to February 1999), D (March 1999 to October 2004), and E (November 2004 to August 2007), and compared the number of infections during these periods. In period B, cefazolin and cefotiam were administered as prophylaxes. The treatment continued for 4 days, including the day of surgery. The patients undergoing endotracheal intubation or tracheotomy were managed with nonscreening pre-emptive isolation and cohorting (NSPEI&C), regardless of whether MRSA was present. However, NSPEI&C was halted in period C, but it was thereafter implemented again, and prophylactic antibiotics were administered only on the day of surgery during period D. In period E, prophylactic antibiotics were administered for 3 days.

Results. In period A, MRSA was contracted in 4.1% (34/833) of patients. In period B, the MRSA isolation rate decreased to 0.3% (8/2722). In period C, the MRSA isolation rate increased to 3.4% (23/681). In period D, the MRSA isolation rate fell to 2.2% (40/1807). In period E, MRSA isolation cases significantly decreased to 0.4% (5/1302; $P < 0.002$ vs period D).

Conclusion. The comprehensive management, selection of prophylactic antibiotics, and NSPEI&C were all considered to be effective.

Key words Surgical site infection · Methicillin-resistant *Staphylococcus aureus* · Ventilator-associated pneumonia · Isolation & Cohorting

Introduction

We previously reported that the number of cases of methicillin-resistant *Staphylococcus aureus* (MRSA) isolated from the site of postoperative infection after surgery decreased from 4.1% (34/833) to 0.3% (3/2073) for all cases of digestive tract surgeries, and we were able to maintain this low rate of MRSA contraction from March 1990 to August 1997.[1] During this period, we performed a surveillance of surgical site infection (SSI) cases and postoperative infection cases, including remote infections (RI). The specific measures included prophylactic antibiotics against postoperative infection that were changed to cefazolin (CEZ) or cefotiam (CTM). In addition, the indications for patients to stay in the recovery room in the surgical wards were also determined. Furthermore, nonscreening pre-emptive isolation and cohorting (NSPEI&C) were applied to patients undergoing either endotracheal intubation or a tracheotomy who were admitted to single rooms (isolation) and multiple patients with similar conditions who were placed in one room (cohorting), regardless of whether or not MRSA was detected.

Since August 1997, however, the idea of evidence-based medicine (EBM) has spread all over Japan so we had no other choice but to stop NSPEI&C because there was no confirmed evidence for NSPEI&C. Since that time, however, MRSA has been contracted in postoperative patients with an increasing frequency so NSPEI&C was strictly reinstated, and the dosing period of prophylactic antibiotics for postoperative infection was shortened or extended based on the fact that the isolation rate of MRSA after digestive surgeries could be significantly reduced. We herein describe a novel method that has reduced the incidence of MRSA over the past two decades.

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Received: October 2, 2009 / Accepted: March 30, 2010

Patients and Methods

An examination of all cases involving postoperative infections (SSIs and RIs) was conducted in our department for patients admitted between September 1987 and August 2007. This research targeted all 7345 cases of digestive surgeries, excluding procedures involving hemorrhoids and inguinal hernias. The definition for postoperative infection was made according to the National Nosocomial Infection Surveillance System (NNIS) standards.[2] A surgeon in charge of countermeasures against infections collected the information on the patients, and made rounds to all the patients in the hospital three times a week.

The period of surveillance was divided into the following periods: A (September 1987 to February 1990), B (March 1990 to February 1997), C (March 1997 to February 1999), D (March 1999 to October 2004), and E (November 2004 to August 2007). The periods were defined based on the differences in preoperative management and the comparisons that were made between the different periods. Period A was the same as the former phase and period B was the same as the latter phase in our previous report.[1] Regarding the countermeasures against infection, in period A the enforcement of proper hand-washing practices, isolation and cohorting (I&C) of MRSA-isolated patients, and investigation of MRSA in the environment surrounding the patients were performed. In periods A and C, postoperative patients were accommodated in the recovery room of surgery wards and treated together with postoperative patients who received general anesthesia (Table 1). In periods B, D, and E, infected patients and patients undergoing tracheotomy or endotracheal intubation could not be accommodated regardless of whether MRSA or multiple drug-resistant bacteria (MDR) were isolated.

In period A, NSPEI&C was applied only to the patients whose MRSA was isolated from infectious sites, and in periods B, D, and E, NSPEI&C was applied to all patients undergoing tracheotomy or endotracheal intubation, regardless of whether MRSA or MDR was isolated. In addition, NSPEI&C was applied to patients who had a large SSI that could not be covered because of a large amount of exudates, including MRSA and *Pseudomonas*. However, in period C, NSPEI&C was not applied to the patients undergoing tracheotomy or endotracheal intubation, or MRSA-infected patients.

In period A, each attending surgeon determined the prophylactic antibiotics at their own discretion. However, since period B, a surgeon in charge of the management of infection designated that all antimicrobial drugs be used in the perioperative phase. Since period B, each attending surgeon chose and administered CEZ for esophagectomy, gastrectomy, and the gallbladder. In addition, the attending surgeon chose CTM for colectomy, hepatectomy, and pancreaticoduodenectomy. The dosing period was set to within 3 days, including the day of surgery. In period C, CEZ and CTM were administered for prophylactic use as in period B. In period D, a surgeon in charge of infectious management instructed that the dosing period of prophylactic antibiotics should lie within 24h of the start of surgery. In period E, the dosing period of postoperative infection-preventive drugs was extended to 3 days, including the day of surgery again.

The surgical cases of each period were compared using the average age and gender and the clinical stages with the cancer treatment regulations in Japan, in addition to the degree of contamination by surgery, the rate of emergency surgeries, and the operative methods. The same surgeon was responsible for all surgeries in each period. The present study was a retrospective historical review conducted in a single department. A chi-squared test and *t*-test were used for the statistical analyses. Differences with P values of less than 0.05 were considered to be statistically significant.

Results

There were no significant differences in the rate of emergency surgeries on the operated organs and the operative procedures across the periods. However, regarding the rate of contaminated surgeries, Class IV was significantly higher in period A and significantly lower in period E (Table 2). Regarding the operative procedures of gastric cancer, in period B the number of cases with combined resection of the pancreas and spleen was high, and since period C this number has

Table 1. Changes in countermeasures against postoperative infection

	Period A	Period B	Period C	Period D	Period E
Stay infected patients in recovery room	Yes	No	No	No	No
Nonscreening pre-emptive I&C	No	Yes	No	Yes	Yes
Prophylactic antibiotics	Not elected	CEZ or CTM	CEZ or CTM	CEZ or CTM	CEZ or CTM
Duration of administration	Within 7 days	Within 3 days	Within 3 days	Within 24h	Within 3 days

I&C, isolation & cohorting; CEZ, cefazolin; CTM, cefotiam

Table 2. Cases in this study

	A Sep.'87–Feb.'90	B Mar.'90–Aug.'97	C Sep.'97–Mar.'99	D Apr.'99–Oct.'04	E Nov.'04–Jul.'07	Statistics
Eso. ca.	21	52	10	29	0	A, B, C, D vs E $P < 0.001$
Eso. other	1	6	1	6	0	n.s.
Gast. ca.	194	506	120	265	112	n.s.
Upper GI per.	33	67	18	54	30	n.s.
Liver ca.	11	44	26	62	46	n.s.
Panc. ca.	12	45	15	29	17	n.s.
Panc. others		3	1	0	0	n.s.
Gbs	137	560	121	361	590	n.s.
Gb. ca.	7	23	1	4	9	n.s.
Colon ca.	135	618	164	502	214	n.s.
Colon per.	19	57	10	41	13	n.s.
App.	153	471	109	330	190	n.s.
Others/emerg.	110	270	85	124	81	n.s.
Total cases (7345)	833	2722	681	1807	1302	
Class IV	51.6% (430/833)	32.0% (872/2722)	32.7% (223/681)	30.7% (555/1807)	24.1% (314/1302)	A vs B, C, D, E $P < 0.001$; B, C, D vs E $P < 0.001$

Eso., esophageal; ca., cancer; Gast., gastric; per., perforation; Panc., pancreas; Gb, gall bladder; gbs, gallbladder stone; App., appendicitis; emerg., emergency surgery; n.s., not significant

Table 3. Demographics of cases with gastric cancer

	A	B	C	D	E	Statistics
Cases	194	428	120	265	112	
Male/Female	117/77	268/160	85/35	166/99	86/26	n.s.
Years	61.3	62.857	66.908	65.9848	68.2	n.s.
Procedures						
Total gastrectomy	31.4% (61)	30.4% (130)	28.3% (34)	29.8% (79)	28.6% (32)	n.s.
Combined resection[a]	12.4% (24)	12.6% (54)	10.8% (13)	8.3% (22)	5.4% (6)	n.s.
Stage						
IA	39.7% (77)	44.2% (189)	40.0% (48)	40.5% (107)	41.9% (47)	n.s.
IB	16.0% (31)	15.4% (66)	16.7% (20)	14.7% (39)	15.2% (17)	n.s.
II	12.9% (25)	14.7% (63)	10.7% (13)	11.7% (31)	10.7% (12)	n.s.
IIIA	7.2% (14)	8.6% (37)	5.0% (6)	7.5% (20)	5.4% (6)	n.s.
IIIB	4.1% (8)	3.5% (15)	4.2% (5)	4.9% (13)	5.4% (6)	n.s.
IV	12.4% (24)	12.4% (53)	21.7% (26)	18.1% (48)	18.7% (21)	n.s.
Unclassified	7.7% (15)	1.2% (5)	1.7% (2)	2.6% (7)	2.7% (3)	n.s.

[a] Combined resection: combined resection of pancreas tail and spleen

significantly decreased (Table 3). There were no significant differences in gender, age, the rate of total gastrectomy, or clinical stages as background factors for stomach cancer surgery. Since period B, the number of cases of laparoscopic cholecystectomy has significantly increased (Table 4). There were no significant differences in the incidence of liver and pancreatic cancer surgical procedures that affected the frequency of postoperative infections. In addition, no significant differences were seen in the frequencies of colon cancer patients undergoing colectomy (Table 5). Regarding operative methods, the rate of laparoscopic surgeries was significantly higher in periods C, D, and E than in periods A and B. The rate of Miles' operation was significantly lower in period A. In contrast, however, the rate of low anterior resection was significantly higher than in period B, and there have been no significant differences in the clinical stages of cancer concerning the cancer treatment regulations in Japan.

In period A, of the 22 cases in which the incidence of organ/space SSIs occurred, 19 patients who underwent endotracheal intubation or tracheotomy because of respiratory failure after surgery exhibited improvement under respiratory control. Twelve of 14 patients who developed ventilator-associated pneumonia and 8 of 10 patients who developed MRSA enteritis were admitted and treated in the recovery room. The number of patients who developed postoperative infections and were admitted to recovery rooms was 6 patients for 16.2 h on average in period B, 8 patients for 20.3 h on

Table 4. Demographics of cases with gallbladder stone

	A	B	C	D	E	Statistics
Cases	137	244	121	361	597	
Sex, Male/Female: OC/LC	56/81:0/0	49/59:46/90	11/5:47/58	38/24:147/152	30/40:226/301	
Procedure						
LC rate	0	43.4% (136)	86.8% (105)	82.8% (299)	88.3% (527)	A, B vs C, D, E $P < 0.001$
Incidence of postoperative infection						
OC	14.6% (21/137)	7.4% (8/108)	6.3% (1/16)	4.8% (3/62)	9.1% (4/70)	A vs B, C, D, E $P < 0.001$
LC	No case	0%	1.0% (1/105)	1.0% (3/299)	1.7% (9/527)	n.s.
Total cases	14.6% (21/137)	3.3% (88/244)	1.7% (2/121)	1.7% (6/361)	2.2% (13/597)	A vs B, C, D, E $P < 0.001$
MRSA isolate	0.7% (1/137)	0	0	0	0	n.s.

LC, laparoscopic cholecystectomy; OC, open laparotomic cholecystectomy; MRSA, methicillin-resistant *Staphylococcus aureus*

average in period D, and 4 patients for 19.7 h on average in period E. However, 28 patients contracted pneumonia and SSIs after surgery; the patients who developed community-acquired pneumonia unrelated to the surgeries and those who developed hospital-acquired pneumonia caused by underlying cranial nerve disease managed by the departments other than the surgical department were admitted in the recovery rooms for an average of 156.3 h in period C.

With respect to the observance rate of I&C in period A, NSPEI&C was ultimately applied to 14 patients with postoperative respiratory failure managed by endotracheal intubation or tracheotomy, but MRSA was contracted an average of 11.6 days after surgery. In periods B, D, and E, all patients who were on respiratory support because of postoperative respiratory failure were treated with NSPEI&C from the beginning, regardless of whether MRSA and *Pseudomonas aeruginosa* were isolated. In period C, the patients undergoing endotracheal intubation and tracheotomy were treated with I&C after the isolation of MRSA or imipenem (IPM)-resistant *P. aeruginosa* was confirmed.

There were no significant differences in the total incidence of postoperative infections for all patients during all of the periods (Table 6). In addition, there were no significant differences in the incidence of SSIs during the periods. Although there were no significant differences in the incidence of RIs throughout the periods, the incidence of respiratory infections after surgery was significantly higher in period A than in other periods.

The frequency of the cases in which MRSA was isolated from postoperative infectious sites was significantly higher in periods A, C, and D, and there was a significant difference between periods B and E. There were no significant differences in the cases of emergency surgery with the incidence of MRSA contracted in all periods, but MRSA was contracted significantly more often in the patients undergoing elective surgery in periods A, C, and D than in periods B and E. The cases in which MRSA was isolated from incisional SSIs were significantly higher in period D than in periods A, B, C, and E. The length of time when MRSA was isolated for the first time after surgery was significantly longer during periods B and E than in periods A, C, and D. The isolation rate of IPM-resistant *P. aeruginosa* was significantly higher in period C. There were no significant differences in the isolation rates of MDR *P. aeruginosa* throughout all the examined periods.

Discussion

Because all Japanese citizens are covered under the public insurance system, anyone can receive high-quality medicine and postoperative treatments. In addition, medical and hospital expenses are relatively inexpensive in Japan, and only 30% of medical fees are paid for by the patients themselves. However, when the total medical expenses of a family exceed $1000 per year, the excess amount is tax-deductible.

Due to lower medical fees, Japanese surgeons can perform any treatment options from examinations without strict evidence in a regulated manner. The reimbursement of the medical fee to hospitals in Japan is determined by strict rules. Therefore, the majority of treatments thought to be effective are applied in cases of severe infections after surgery. These treatments include endotoxin hemofiltration with polymyxin B-immobilized fiber column and continuous hemofiltration to remove several cytokines from the blood. In

Table 5. Demographics of cases with colorectal cancer

	A	B	C	D	E	Statistics
Cases	135	524	164	502	214	
Male/Female	72:63	291:233	90:74	293:209	127:87	n.s.
Years	65.1	66.9	66.5	67.3	70.2	n.s.
Over 80 years old (%)	4.4% (6/135)	12.4% (65/524)	10.3% (17/164)	13.3% (67/502)	15.9% (34/214)	n.s.
Laparoscopic colectomy	0	3.1% (16)	10.4% (17)	26.1% (131)	36.6% (77)	A, B vs C, D, E $P < 0.001$
Abdominoperineal resection	14.8% (20/135)	3.4% (18)	6.1% (10)	4.6% (23)	5.1% (11)	A vs B, C, D, E $P < 0.001$
Low anterior resection	5.2% (7/135)	17.6% (92)	18.3% (30)	14.5% (73)	15.9% (34)	A vs B, C, D, E $P < 0.001$
Stage						
0	0.7% (1)	2.1% (11)	1.9% (3)	4.4% (22)	1.9% (4)	n.s.
I	22.2% (30)	24.0% (126)	23.2% (38)	21.7% (109)	27.6% (59)	n.s.
II	26.7% (36)	26.1% (136)	32.9% (54)	27.5% (138)	27.1% (58)	n.s.
IIIA	23.0% (31)	24.0% (126)	23.2% (38)	22.5% (113)	20.1% (43)	n.s.
IIIB	6.7% (9)	5.9% (31)	11.0% (18)	8.0% (40)	9.8% (21)	n.s.
IV	11.1% (15)	12.0% (63)	3.0% (5)	12.0% (60)	15.0% (32)	n.s.
Unclassified	9.6% (13)	5.9% (31)	4.9% (8)	4.0% (20)	4.7% (10)	n.s.

addition, we conducted a cultivation of bacterial tests for patients with SSIs and RIs at least once every week, even if they were generally not administered antibacterial agents and were aware of bacterial isolates. Surgeons have conducted the appropriate preoperative management through trial and error. As a result, it has been reported that the mortality rate caused by various surgeries in Japan is only one-third of that in the United States and United Kingdom.[3–5]

We are recording the number of onsets of postoperative infection every day, and are seeking new countermeasures to protect against these infections. In the present study, after we began a new countermeasure based on the knowledge that MRSA was on the increase, we examined the cases that are considered to be in the next period. We had not previously defined the period.

The basic policy for the countermeasures against MRSA infection that we have conducted was applied during period B, and as already reported, CEZ and CTM were used as antibacterial agents after surgery.[1] NSPEI&C was applied to the patients undergoing tracheotomy or endotracheal intubation, regardless of whether MRSA was contracted, and the patients with infection and high-risk patients were not admitted in the recovery rooms of the surgical ward. As a result, in period B the incidence of MRSA isolated from the sites of infection was 0.3% for all targeted patients of digestive tract surgery.

In period C, emergency room patients with infection from nonsurgical causes were admitted to the recovery room, and we stopped performing NSPEI&C on patients undergoing either tracheotomy or endotracheal intubation and on patients from whom respiratory tract MRSA was contracted, due to a lack of clear evidence.

The patients with either tracheotomy or endotracheal intubation often spread bacteria from their respiratory tract. Therefore, these patients were a source of hospital infections and required countermeasures to fight cross-infection. NSPEI&C is conducted as a countermeasure against infection from highly-infectious pathogenic microorganisms. To select the patients for whom I&C should be conducted, an active surveillance culture (ASC) and active surveillance test (AST) using the polymerase chain reaction method are performed.[6] However, even if these tests are performed every day, highly infectious pathogenic microorganisms cannot always be detected in real time. Therefore, it may be too late to determine the application of I&C after the result of the AST is confirmed. All of the patients who had complications and were undergoing tracheotomy or endotracheal intubation after surgery were carrying highly infectious microorganisms, such as MRSA. For the appropriate countermeasures to be promptly taken for patients carrying the bacteria at any time, NSPEI&C should be applied to the patients undergoing

Table 6. Incidence of postoperative infections

	A Sep.'87–Feb.'90	B Mar.'90–Aug.'97	C Sep.'97–Mar.'99	D Apr.'99–Oct.'04	E Nov.'04–Jul.'07	Statistics
Total postoperative infection	12.9% (108/833)	11.4% (309/2722)	12.8% (87/681)	10.9% (197/1807)	10.8% (141/1302)	n.s.
SSIs	8.9% (74/833)	8.8% (239/2722)	9.4% (64/681)	9.8% (177/1807)	9.3% (121/1302)	n.s.
Sup/deep in. SSI	6.4% (53)	6.4% (174)	7.2% (49)	6.8% (123)	6.5% (85)	n.s.
Organ/space SSI	2.6% (22)	2.4% (65)	2.9% (20)	3.3% (59)	3.1% (41)	n.s.
(leakage)	2.4% (20)	2.3% (62)	2.5% (17)	2.3% (42)	2.2% (28)	n.s.
Remote infections	5.3% (44/833)	3.7% (102/2722)	4.8% (33/681)	3.9% (70/1807)	3.6% (47/1302)	n.s.
Pneumonia	1.7% (14)	0.8% (23)	1.0% (7)	1.0% (18)	0.8% (11)	A vs B, C, D, E $P < 0.003$
Catheter-related infection	2.0% (17)	2.0% (55)	2.5% (17)	1.7% (30)	2.2% (29)	n.s.
Urinary tract infection	1.2% (10)	1.2% (32)	2.1% (14)	1.6% (29)	2.2% (29)	n.s.
Enterocolitis	1.2% (10)	0	0	0	0.1% (1)	A vs B, C, D, E $P < 0.003$
MRSA enteritis	1.2% (10)	0	0	0		A vs B, C, D, E $P < 0.003$
Clostridium difficile enteritis	0	0	0	0	0.1% (1)	n.s.
Resistant bacteria						
MRSA-total	4.1% (34/833)	0.3% (8/2722)	3.4% (23/681)	2.2% (40/1807)	0.4% (5/1302)	A, C, D vs B, E $P < 0.05$
MRSA-Emer.	1.6% (5/315)	2.3% (2/871)	3.3% (8/244)	1.4% (8/555)	1.0% (3/314)	n.s.
MRSA-Pl.	5.8% (30/518)	0.3% (6/1851)	3.4% (15/437)	2.6% (32/1252)	0.2% (2/988)	A, C, D vs B, E $P < 0.05$
MRSA-SSI/Pl.	0.4% (2/518)	0	0.2% (1/437)	1.2% (15/1252)	0	n.s.
Postoperative initial isolate day	4.3	31.8	4.4	4.9	28.5	A, C, D vs B, E $P < 0.05$
IPM-R/P.a	0	0.3% (7/2702)	1.3% (9/681)	0.3% (6/1807)	0.2% (2/1302)	C vs B, D, E $P < 0.001$

SSI, surgical site infection; Sup/deep in. SSI, superficial/deep incisional SSI; Emer, emergency operation; Pl., planned operation; IPM-R/P.a, imipenem-resistant *Pseudomonas aeruginosa*