tracheotomy or endotracheal intubation, whether or not MRSA is isolated from the respiratory tract. The NSPEI&C that was practiced in period B was thoroughly performed during period D, and the use of recovery rooms was strictly controlled. Furthermore, for the countermeasures against MRSA to be completed, it was deemed necessary to complete the dosage of perioperative prophylactic antibiotics within 24 h from the day of surgery pursuant to the guidelines of the US Centers for Disease Control and Prevention. However, although the rate of MRSA isolation from the patients was reduced to approximately 2% following the application of NSPEI&C, and, although NSPEI&C had an effect, the isolation rate could not be reduced as much as during period B.[7]

Therefore, prophylactic antibiotics were administered within 72 h, including the day of surgery in period E, and as a result the cases where MRSA was isolated were approximately 0.3% for the number of patients who received surgery, and the isolation rate was similar to period B.

We have reported that the duration of treatment with the antibacterial drugs CEZ and CTM for the prevention of postoperative infections for 3 days after surgery reduced the isolation rate of MRSA in a previous study.[7] In that study, the patients in the present study with gastric cancer and colorectal cancer were partly represented. We previously reported that although there were no differences in the incidence of SSI between the single-day dosage and the 3-day dosages of CEZ and CTM, the isolation rates of both methicillin-sensitive *Staphylococcus aureus* (MSSA) and MRSA from the infection focus showed that developed SSIs were higher in a single-day dosage, and MRSA was considered to be induced from MSSA by postoperative prophylactic antibiotics.

In periods B and E, when the number of cases of MRSA isolation was small, there were no cases in which MRSA was contracted from incisional SSIs. During these periods, all cases from which MRSA was isolated were those of the patients with organ/space SSIs that were present at a longer time period after surgery. All of these cases excluded those patients who suffered intraperitoneal abscesses caused by the leakage of a sutured digestive tract, and as a result of various treatment methods desperately performed, the patients barely survived. These patients represent cases in which MRSA infection could not be either avoided or prevented.

Our countermeasures against hospital infections were thought to be universal, because throughout these periods of research the infection rates of MDR *P. aeruginosa* and IPM-resistant *P. aeruginosa* were less than the incidence of MRSA. Although this study was not a randomized controlled trial, we investigated a large number of cases, and no differences were observed that were found to affect the demographics of patients during each period. However, the present results only reflected the patients in our institution. Future research will involve a collaborative investigation with other institutions.

Limitations

The study period was particularly long, so that the patient population, surgical procedures, and other factors were not always consistent between the periods. The success of eliminating MRSA infection is multifactorial, and several issues, such as the duration of prophylactic antibiotics, should certainly be further investigated by prospective randomized studies.

Conclusions

The results of various countermeasures against infection revealed that the rate of MRSA infection changed from 0.3% to 0.4% for surgical cases, which was the lowest incidence reported worldwide. Comprehensive management, including the countermeasures to fight infection, preoperative management, training, and introduction of superior surgical techniques and NSPEI&C are necessary, and the administration of prophylactic antibacterial drugs for 3 days was also effective.

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原　著 II

TNM第7版による結腸癌Stage III細分類の妥当性の検証

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TNM第7版（以下TNM7）による結腸癌Stage III細分類の妥当性を当院データで検討する．

対象と方法：根治度A手術を施行したStage III結腸癌症例を対象としてTNM7，TNM第6版（以下TNM6），大腸癌取扱規約第7版（以下JGR7）別に無再発生存を検討した．またTNM7に基づいたT因子とN因子を組み合わせ，それぞれのグループの無再発生存を検討した．

結果：対象は217例．TNM7 Stage IIIA，Stage IIIB，Stage IIICでは3年無再発生存率（以下3y-RFS）がそれぞれ95%，82%，74%と有意差を持って層別化されたが（p＝0.0468），JGR7とTNM6では有意差を認めなかった．この主な要因としてはT4b N1群（3yRFS＝50%）をTNM7ではStage IIICと予後不良群に分類したことであると考えられた．

結語：TNM7による結腸癌Stage III細分類は予後をよく層別化し，その妥当性が示された．

索引用語：結腸癌，Stage III，大腸癌取り扱い規約，TNM第7版

はじめに

大腸癌Stage分類は治療の選択や予後の予測などに用いられている．本邦では大腸癌取り扱い規約が，欧米ではTNM分類が主にstagingに使われ，各国の治療ガイドラインに適用されている[1,2]．TNM分類は2002年に第6版（以下TNM6）[4]が出版された．本邦でも国際的な討論の場で使用できるようTNM分類との整合性を考慮した大腸癌取り扱い規約第7版（以下JGR7）が2006年に出版された[3]．そして今回2009年にTNM第7版（以下TNM7）に改訂された．TNM7では大腸癌における所属リンパ節転移個数をN1a（n＝1個），N1b（n＝2，3個），N2a（n＝4～6個），N2b（n＝7個以上）と4分類とし，深達度もT4をT4a（SE），T4b（SI）に分類している．特に変更の大きかったStage IIIではこれらを組み合わせた階段状の分類となっている[5]．そのstagingの妥当性はSEERデータベースの109,953人の結腸癌症例を使用し，検証された[6]．しかしこれは米国の症例のみでの検証であるため，手術だけでなく術前診断や病理評価，標本整理方法，術後補助化学療法など，異なる点が多数ある本邦でのTNM7の妥当性は不明である．結腸癌に対する術後補助化学療法は2009年8月にFOLFOX療法が本邦でも承認された．5FU/LV療法なども含めると，レジメンを決定する最適なstaging，特にStage IIIに関しては議論の余地がある．そこで今回当院データベースを用いて，TNM7における結腸癌Stage IIIの細分類に関して検討した．

対象と方法

2002年10月から2007年12月までに当院で根治度Aの手術を施行したStage IIおよびStage III結腸癌（C～RS）患者を対象とした．活動性重複癌合併例は除外した．

以下の項目に関し，無再発生存を検討した．

1. Stage III患者に関してJGR7，TNM6，TNM7の各規約別
2. 術後補助化学療法を施行していない群に関してTNM7 Stage II/Stage IIIA（以下Stage II*/Stage IIIA*）の比較
3. Stage III患者に関してTNM7に基づいたリンパ節転移個数と深達度の組み合わせ別（以下TN category）

Table 1　Stage Ⅲ Grouping

JGR7	N1	N2a	N2b
T1	Ⅲa	Ⅲb	
T2			
T3			
T4a			
T4b			

TNM6	N1	N2a	N2b
T1	ⅢA	ⅢC	
T2			
T3	ⅢB		
T4a			
T4b			

TNM7	N1	N2a	N2b
T1	ⅢA	ⅢB	ⅢC
T2			
T3			
T4a			
T4b			

T1　SM　　N1b　n=1-3
T2　MP　　N2a　n=4-6
T3　SS　　N2b　n=7-
T4a　SE
T4b　SI

Table 2　Patients characteristics

Factors	No. of patients (%)
Gender	
male	123 (57)
female	94 (43)
Histological differentiation	
tubl or tub2	198 (91)
por or muc or others	19 (9)
Operation	
Open surgery	113 (52)
Laparoscopic surgery	104 (48)
Adjuvant chemotherapy	
(+)	117 (54)
(−)	100 (46)
Factors	Median (Min ～ Max)
Age (years)	66 (30 ～ 90)
Follow time (months)	42.8 (5.1 ～ 84.4)
Examination of lymph nodes (number)	27 (5 ～ 74)

4. Stage III 患者に関して JGR7 に基づいた主リンパ節転移の有無別

検討は Kaplan-Meier 法を用いて行い，有意差検定には Logrank test を使用した．なお JGR7, TNM6, TNM7 Stage III の詳細を Table 1 に示す．

結　果

対象は Stage II 253 例，Stage III 217 例であった．Stage III 患者背景を Table 2 に示す．

1. 規約別検討

規約別の無再発生存曲線を Fig. 1～3 に示す．

Stage 別の patients at risk，3 年無再発生存率は

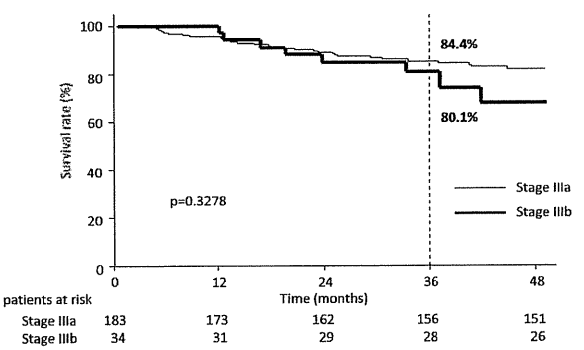

Fig. 1　Cumulative survival curves in patients comparing between Stage IIIa and Stage IIIb according to the Japanese General Rules for Clinical and Pathological Studies on Cancer of the Colon, Rectum and Anus the 7th edition

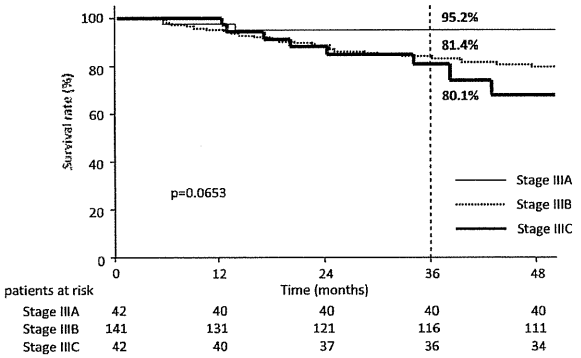

Fig. 2 Cumulative survival curves in patients comparing between Stage IIIA and Stage IIIB and Stage IIIC according to the TNM classification 6th edition

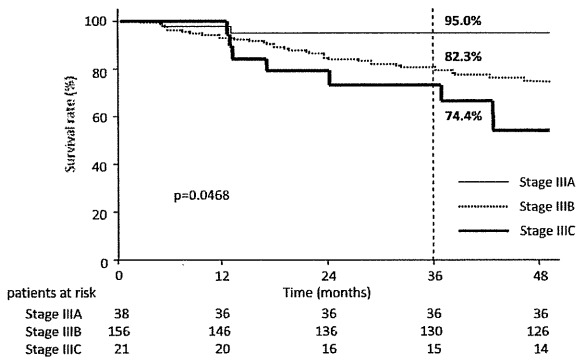

Fig. 3 Cumulative survival curves in patients comparing between Stage IIIA and Stage IIIB and Stage IIIC according to the TNM classification 7th edition

Fig. 内に示す.

全体ではTNM7のみ有意差を認めた（p=0.0468）.

2. Stage II*/Stage IIIA*の比較

TNM7 Stage II*とStage IIIA*の無再発生存曲線をFig. 4に示す. 3y-RFSはStage II*：92%, Stage IIIA*：90%で有意差を認めなかった(p=0.7680).

3. TN category検討

TN categoryの症例数と3y-RFSをTable 3に示す. TNM7に当てはめると, Stage IIIAは91～100%, Stage IIIBは65～84%, Stage IIICは0～80%と層別化された.

4. 主リンパ節転移の有無別検討

主リンパ節転移症例は4例(T3 N2a 2例, T3 N2b 2例). 各症例の術後の無再発生存期間は, 12カ月, 55カ月, 17カ月, 21カ月であり, 主リンパ節転移無し症例と比較して有意差を認めた（p=0.0340）.

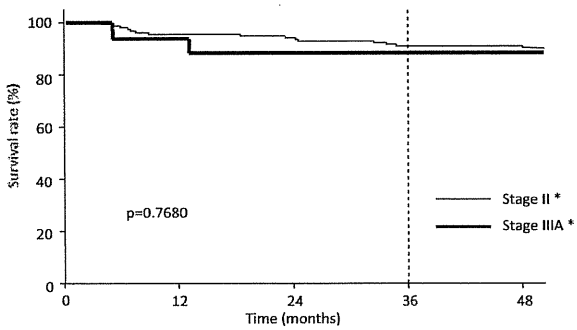

Fig. 4 Cumulative survival curves in patients comparing between Stage II* and Stage IIIA* [adjuvant chemotherapy (−) Stage II and Stage IIIA] according to the TNM classification 7th edition

考　察

TNM分類は世界で最も使われている悪性腫瘍の病期分類であり, 悪性腫瘍治療の選択や予後の予測などに用いられる. TNMの改訂は悪性腫瘍の治療に大きな影響を及ぼす. 第6版までの改訂に関してQuirkeらはエビデンスが不足していることや閉鎖的な委員会で決められているなど問題点を指摘している[7]. 今回のTNM7への改訂にはweb上での事前の公表があり, その妥当性もSEERの約10万人のデータで検証されている[6]. しかしすべて米国のデータでの解析であり, 本邦での妥当性に関しては不明である. そこで当院症例の検討を行った. なお直腸癌に関しては術前化学放射線療法や側方郭清の影響が大きく, 比較は困難であると考え今回は除外した. また生存解析として5年全生存率とほぼ同等である3年無再発生存率を使用した[8].

Stage IIIの細分類に関しては, TNM7で有意差を認めたが, JGR7やTNM6での有意差を認めなかった. この要因について検討するため, リンパ節転移個数と深達度を組み合わせたTN categoryの結果(Table 3)を参照すると, JGR7ではStage IIIaであるT4b N1群をTNM7ではStage IIICと予後不良群に分類していること, JGR7ではStage IIIbであるT2-3 N2a群をTNM7ではStage IIIBと分類していること, が有意差を認めた一因であると考えられた.

一方でTNM7 Stage IIICであるT3 N2bは予後良好であった. SEERデータの解析結果とはこの点で乖離がある[6]. 深達度とリンパ節転移個数を加味した階段状のstagingは有用であるものの, 本邦での結腸癌治療に関して今後どのような線引きをする

Table 3　No. of patients and 3y-RFS according to TN category

No. of patients (%)	N1	N2a	N2b
T1	17 (7.8)	0 (0)	0 (0)
T2	23 (10.6)	4 (1.8)	0 (0)
T3	120 (55.3)	16 (7.4)	10 (4.6)
T4a	16 (7.4)	1 (0.5)	2 (0.9)
T4b	7 (3.2)	0 (0)	1 (0.5)
3y-RFS	N1	N2a	N2b
T1	100.0%		
T2	91.3%	100.0%	
T3	84.1%	78.7%	80.0%
T4a	65.2%	100.0%	50.0%
T4b	53.6%		0.0%

stagingが妥当であるかは検討の必要があると考えられた．

結腸癌術後補助化学療法に関して本邦と米国のガイドラインでは違いがある[1,9,10]．2009年8月には結腸癌術後補助化学療法として本邦でもFOLFOX療法が保険承認となったが，その適応についてはまだ議論の余地がある．本邦での良好な手術成績，FOLFOX療法の有害事象やその費用を考えると，FOLFOX療法の術後補助化学療法としての適応はStage IIIのうち再発危険群に限定すべきだと我々は考えており，新たなStage IIIの細分類が必要と思われる．そこで各規約の予後不良群を比較すると，JGR7ではStage IIIb 34例で3y-RFS＝80.1%，TNM7はStage IIIC 21例で3y-RFS＝74.4%であった．TNM7はJGR7と比べて予後不良群をより選別している点で有用であると考えられた．

また，術後補助化学療法を行っていない群に関してTNM7に基づいたStage IIとStage IIIAに再発予後の差は認めなかった．本邦での良好な手術成績を考えると結腸癌Stage IIIでも補助化学療法を省略できる可能性が考えられた．2009年度版大腸癌治療ガイドラインで推奨される術後補助化学療法である治療(5FU/LV療法，UFT/LV療法，capecitabine療法)を行う群にFOLFOX療法を行う群を加え，さらに術後補助化学療法のない群を設定することを考慮すると，結腸癌Stage IIIの細分類は3分類が有用である可能性が考えられた．

JGR7への改訂によりTNM6との整合性はある程度達成されたが，現在のTNM分類になく本邦に残る概念として主リンパ節がある．その転移症例の5年生存率は30～40%と予後不良であることが報告されている[11-13]．今回の検討でも主リンパ節転移症例は3y-RFSが50%と予後不良であり，Stage IIIで考えると予後不良群に分類するのが妥当と考えられた．本邦のリンパ節分類は予後予測だけでなくリンパ節群を同定し手術時のリンパ節郭清の指標とする目的も含まれているとの意見もある[14]．予後予測の観点からも手術時の郭清指標の観点からも本邦の主リンパ節の検討は今後も重要であると考えられた．

今回はデータ数が少ないこと，全生存の検討でないこと，単施設の検討であることがこの研究の限界と考えられる．今後本邦の大規模データでの検証が望まれる．

結　語

結腸癌において深達度とリンパ節転移個数を組み合わせたTNM第7版のStage III細分類は予後不良群と良好群をよく選別し，有用であると考えられた．TNM第7版に基づいたStage IIIAは術後補助化学療法を省略できる可能性が考えられた．

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Validation of Patients with Stage III Colon Cancer According to the TNM, 7th Edition

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Purpose: This study assessed the validation of patients with Stage III colon cancer according to the TNM, 7th edition (TNM7).

Patients and Methods: Patients with Stage III colon cancer who underwent curative surgery were investigated. We compared the relapse-free survival of these patients according to TNM7, the TNM 6th edition (TNM6) and Japanese General Rules (JGR7). We verified the relapse-free survival of these patients which we divided into subgroups according to the combination of T factor and N factor on TNM7.

Results: We reviewed 217 patients. The rates of 3-year relapse-free survival (3y-RFS) of the patients on TNM7 Stage IIIA, Stage IIIB and Stage IIIC were 95%, 82% and 74%. There was a significant difference in relapse-free survival of these patients in TNM7 ($p = 0.0468$), but no significant differences in TNM6 or JGR7. The main reason for the clear stratification in TNM7 was the up-staging of the patients with T4bN1 tumors (3y-RFS = 50%) from stage IIIB in TNM6 or JPG7 to Stage IIIC in TNM7.

Conclusion: The prognosis of patients with Stage III colon cancer on TNM7 was stratified, and was shown to be valid.

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原　著

腹膜播種を伴う原発性大腸癌に対する外科的治療の成績

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はじめに：腹膜播種を伴う原発性大腸癌手術症例における予後規定因子を明らかにすることを目的とした．**方法**：2002年から2010年まで当院で手術施行した原発性大腸癌2,024例のうち，手術時に腹膜播種を認めた71例（3.5%）を対象とした．**結果**：腹膜播種の内訳はP1：19例，P2：20例，P3：32例であった．それらの3年生存率（生存期間中央値）はそれぞれ，P1：50.0%（34.6か月），P2：48.2%（22.3か月），P3：9.6%（13.3か月）でP1 vs. P3（$P<0.01$），P2 vs. P3（$P<0.05$）で有意な差を認めた（観察期間中央値14.4か月）．予後規定因子に関する多変量解析では，手術根治度（HR，3.91：$P<0.05$）が有意な予後規定因子として抽出された．手術根治度B（N＝16）と手術根治度C（N＝55）の3年生存率は，それぞれ78.4%，15.9%であった（$P<0.01$）．手術根治度B 15例（P3 1例除く）における腹膜播種程度別の無再発生存率，全生存率は有意な差を認めなかった（$P=0.37$，$P=0.82$）．**考察**：腹膜播種を伴う原発性大腸癌における予後規定因子は，手術根治度であった．P1，P2では，腹膜播種の程度によらず，手術根治度Bを目指すことによって生存期間の延長が期待できる可能性が示唆された．

はじめに

大腸癌治療ガイドライン[1]では，限局性播種で，他に切除不能な遠隔転移がなく，過大侵襲とならない切除であれば，原発巣切除と同時に腹膜播種巣を切除することが望ましいと記載されている．しかし，腹膜播種を伴った症例の予後は不良で[2)~5)]，腹膜播種巣切除の有効性を証明する大規模臨床試験もない．

そこで，腹膜播種を伴う原発性大腸癌手術症例における予後規定因子について後ろ向きに解析を行い，外科的治療の有用性を検討することを目的とした．

対象と方法

2002年9月から2010年2月まで，当院で手術施行した原発性大腸癌2,024例（単発または多発を含む）のうち，手術時に腹膜播種を認めた71例（3.5%）を対象とした．予後規定因子を抽出するにあたり，臨床病理学的因子および治療関連因子についてそれぞれ2群に分けてCoxの比例ハザードモデルにて単変量解析を行い，$P<0.1$であった因子を共変量としてCoxの比例ハザードモデル（Step-Wise regressionによる変数減少法）にて多変量解析を行った．累積生存率はKaplan-Meier法で算出し，有意差はlog-rank検定で判定した．いずれの場合もP値0.05未満を有意差ありとした．本稿における用語はすべて「大腸癌取扱い規約（第7版）」[1]に従った．

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Table 1 Clinicopathological features of 71 patients with peritoneal dissemination

	Peritoneal Dissemination			
	P1 (N = 19)	P2 (N = 20)	P3 (N = 32)	Total (N = 71)
Median age (range) years	64 (35–76)	68 (43–85)	64 (37–90)	64 (35–90)
Sex				
Male	13	3	16	32
Female	6	17	16	39
Median carcinoembryonic antigen (range) ng/ml	15.9 (0.7–1,797)	22.5 (2.7–1,153)	21.4 (0.7–1,489)	20.5 (0.7–1,797)
Tumor location				
Proximal colon	6	11	20	37
Distal colon and rectum	13	9	12	34
Macroscopic type				
Type 1, 2	15	18	24	57
Type 3, 4	4	2	8	14
Median tumor size (range) mm	55 (40–190)	54 (55–100)	57 (54–90)	55 (30–190)
Tumor annularity				
＜90 percent	8	5	7	20
≥90 percent	11	15	25	51
Histopathological grading				
Well/Mod	15	18	27	60
Poor/Sig	4	2	5	11
Distant metastasis excluding peritoneal dissemination				
Positive	12	12	23	47
Non-regional lymph node metastasis	4	5	12	21
Liver metastasis	10	9	18	37
Lung metastasis	4	2	2	8
Other organ	0	3	1	4
Negative	7	8	9	24
Resection of primary lesion	17	15	19	51
Resection of peritoneal dissemination	17	11	1	29
Curativity				
Cur B	8	7	1	16
Cur C	11	13	31	55
Additional chemotherapy				
Positive	14	15	20	49
Negative	5	5	12	22

結　果

1. 患者背景

腹膜播種を伴った71例全例と，腹膜播種程度別の患者背景をTable 1に示す．年齢の中央値は64歳，男性32例，女性39例であった．大動脈周囲リンパ節転移を含めた遠隔リンパ節転移は21例，肝転移は37例，肺転移は8例に認められた．腹膜播種程度別の遠隔転移の比率はそれぞれ差を認めなかった．腹膜播種程度別の手術根治度Bの割合は，P1 8/19例(42%)，P2 7/20例(35%)，P3 1/32例(3%)であった．化学療法は49例に施行し，その内訳はFOLFOXまたはFOLFIRI 26例（うち1例は＋bevacizumab），5-FU/LVまたはUFT/LV 15例，IFL 5例，TS-1＋L-OHP＋bevacizumab 1例，capecitabine 1

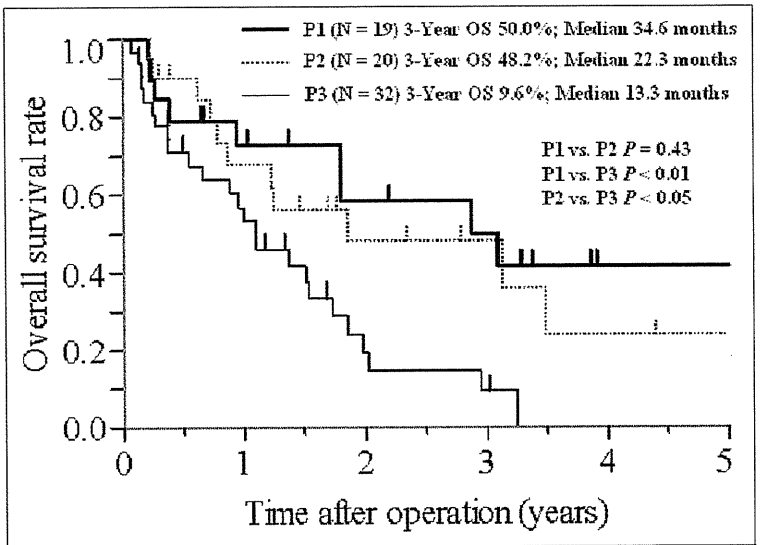

Fig. 1 Overall survival rate for all patients according to the degree of peritoneal dissemination. OS, Overall survival.

Table 2 Univariate analysis of clinicopathological factors affecting overall survival

Variable	Hazard ratio	95% C.I.	*P* value
Age (<65 years vs. ≥65 years)	1.12	0.62–2.02	0.706
Sex (Female vs. Male)	1.28	0.71–2.28	0.413
Tumor location (Distal colon and rectum vs. Proximal colon)	1.24	0.69–2.42	0.474
Macroscopic type (Type 1, 2 vs. Type 3, 4)	1.07	0.48–2.14	0.850
Tumor size (<50 mm vs. ≥50 mm)	1.95	0.99–4.19	0.054
Tumor annularity (<90 percent vs. ≥90 percent)	1.31	0.70–2.65	0.410
CEA (<100 vs. ≥100) (ng/ml)	1.86	0.91–3.57	0.087
Depth of tumor invasion (SS, SE, A vs. Si, Ai)	1.20	0.64–2.20	0.558
Lymphnode metastasis (pN0, pN1, pN2 vs. pN3)	2.16	1.07–4.09	0.034
Peritoneal dissemination (P1, P2 vs. P3)	2.56	1.39–4.79	0.003
Distant metastasis excluding peritoneal dissemination (Negative vs. Positive)	2.73	1.36–6.07	0.004
Histopathological grading (Poor/Sig vs. Well/Mod)	2.17	0.87–7.24	0.102
Curativity (cur B vs. cur C)	4.97	2.10–14.64	<0.001
Additional chemotherapy (Positive vs. Negative)	1.36	0.71–2.49	0.339

CEA, carcinoembryonic antigen; C.I., confidence interval.

例，肝動注1例であった．術前術後に化学療法施行例が1例，そのほかは術後に化学療法施行症例であった．

2．臨床病理学的因子・治療関連因子と予後

腹膜播種を伴った71例全例の観察期間中央値は14.4か月（0.9～69.5か月），3年と5年の全生存率はそれぞれ30.7%，18.6%であった．腹膜播種程度別の3年生存率（生存期間中央値）はそれぞれ，P1：50.0%（34.6か月），P2：48.2%（22.3か月），P3：9.6%（13.3か月）で，P1 vs. P2では生存期間に有意な差を認めなかったが，P1 vs. P3（$P<0.01$），P2 vs. P3（$P<0.05$）では有意な差を認めた（Fig. 1）．

Coxの比例ハザードモデルにて単変量解析を行ったところ，腫瘍最大径・術前CEA値・リンパ節転移・腹膜播種の程度・腹膜播種以外の遠隔転移有無（肝転移を含む）・手術根治度が$P<0.1$として抽出

Table 3 Multivariate analysis of clinicopathological factors affecting overall survival			
Variable	Hazard ratio	95% C.I.	*P* value
Tumor size (<50 mm vs. ≥50 mm)	1.97	0.93–4.17	0.077
Lymphnode metastasis (pN0, pN1, pN2 vs. pN3)	1.92	0.98–3.87	0.059
Peritoneal dissemination (P1, P2 vs. P3)	1.84	0.96–3.51	0.066
Curativity (cur B vs. cur C)	3.91	1.38–11.03	0.010
C.I., confidence interval.			

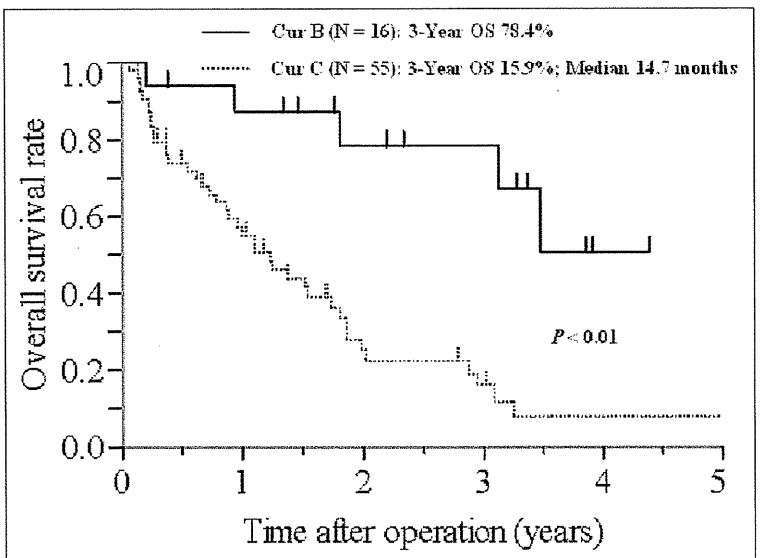

Fig. 2 Overall survival rate for patients with peritoneal dissemination according to curativity. OS, Overall survival.

された（Table 2）．これらの因子を共変量とし，Coxの比例ハザードモデル（Step-Wise regressionによる変数減少法）にて多変量解析を行ったところ，手術根治度が独立した予後規定因子として抽出された（Table 3）．手術根治度B（16例），手術根治度C（55例）の3年生存率はそれぞれ，78.4%，15.9%と有意に手術根治度Bで良好であった（$P<0.01$）（Fig. 2）．手術根治度B 16例のなかで，P3は1例であったため，それを除きP1，P2における無再発生存率（Fig. 3），全生存率を検討すると腹膜播種程度別では有意な差を認めなかった（$P=0.37$，$P=0.82$）．

手術根治度Bが得られた症例で腹膜播種以外の遠隔転移を認めた症例は2例のみであった．1例はP1，大動脈周囲リンパ節転移を認め，それらを切除後，16か月で側方リンパ節再発を認めたが，47か月生存中である．もう1例はP2，脾転移を認め，それらを切除後，7か月で肝再発を認め38か月で原病死した．

3．非治癒因子数別の予後

手術根治度C 55例のうち，非治癒因子数別の3年生存率は，1つ（9例），2つ以上（46例）でそれぞれ52.5%，9.3%と1つのみ有する症例において有意に予後が良好であった（$P<0.01$）（Fig. 4）．非治癒因子数が1つであった症例における非治癒因子の内訳は，肝転移6例，腹膜播種2例，大動脈周囲リンパ節転移1例であった（いずれも原発巣切除）．肝転移6例のうち，2例で異時性肝切除を行い，生存期間はそれぞれ22か月，70か月であった（いずれも死亡）．

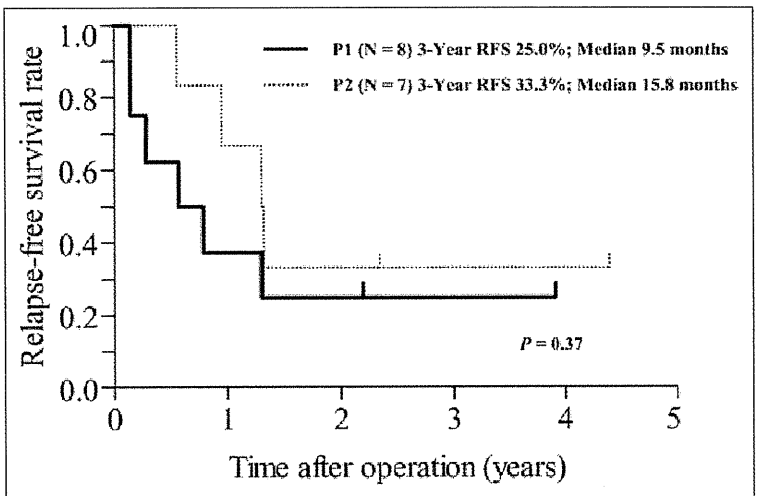

Fig. 3 Relapse-free survival rate for patients with curativity B according to the degree of peritoneal dissemination. RFS, Relapse-free survival.

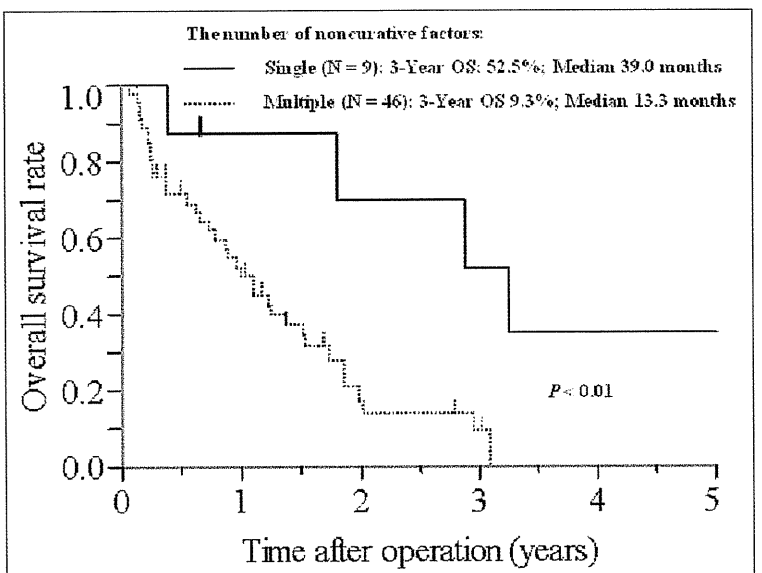

Fig. 4 Overall survival rate for non-curative patients according to the number of non-curative factors. OS, Overall survival.

考　察

大腸癌腹膜播種の頻度は4.3～7.3%と必ずしも多くないが，その予後は不良である[2)-5)]．その要因の一つとして，腹膜播種を来した症例は，同時に他臓器への転移を来していることがあげられる．我々の検討では，手術時に腹膜播種以外の遠隔転移（肝転移を含む）を47例（66.2%）に認め，そのうち手術根治度Bが得られたのは2例のみであった．このように腹膜播種は同時に他の遠隔転移を伴うことが多く，予後が不良な因子の一つであるが，原発および転移巣の完全切除が得られれば比較的良好な予後が期待できる症例も報告されている[3)4)]．

当院における腹膜播種症例の3年生存率，生存期間中央値はそれぞれ30.7%，20.7か月，腹膜播種程度

別の3年生存率（生存期間中央値）はそれぞれ，P1：50.0%（34.6か月），P2：48.2%（22.3か月），P3：9.6%（13.3か月）であった．平井ら[4]は生存期間中央値が，P1：17.7か月，P2：13.8か月，P3：6.6か月と報告し，横溝ら[3]は3年生存率，生存期間中央値はそれぞれ12.4%，5.4か月と報告している．さらに，高橋ら[6]は3年生存率がP1：15.0%，P2：13.2%，P3：4.8%と報告している．手術根治度Bが得られた症例の割合は，横溝ら[3]は21%，高橋ら[6]は31%で，当院の23%（16/71例）と同等またはそれ以上にもかかわらず，当院の成績が良好であった要因としては，対象症例が開院以来の2002年から2010年の比較的新しい症例であったため，奏効率の高い新規化学療法レジメンや分子標的治療薬が使用され，生存期間が改善した可能性がある．また，観察期間中央値が14.4か月と比較的短かったことも要因と考えられる．

予後規定因子についてはこれまで，占居部位[4]，組織型[2]，リンパ節転移の有無[2]，肝転移の有無[2]，原発巣切除の有無[3]，化学療法の有無[3]，手術根治度[3][4]，非治癒因子の数[4]などが報告されている．我々の検討では，多変量解析の結果，予後規定因子として手術根治度が抽出された．手術根治度に関しては，手術根治度Bが得られた症例において，P1とP2の転帰は有意な差を認めなかった．さらに，手術根治度Bは，手術根治度Cよりも有意に転帰が良好であった．つまり，P1とP2では，手術所見で完全切除が得られると判断すれば，それらの病巣を積極的に切除し，手術根治度Bを目指した手術を行うことで予後の改善が得られる可能性があると考えられる．腹膜播種の程度は転帰を反映していなかったことより，今後は諸家の報告にある予後不良因子[2]~[4]を組み合わせた分類を作成する必要があると思われる．ただし，P3で手術根治度Bが得られたのは1例のみなので，今回の検討からはP3における手術根治度Bを目指した手術療法の有効性を示すことはできない．少なくともP3で手術根治度Bを目指すことは，大腸癌治療ガイドライン[1]における「過大侵襲」となることがほとんどであると思われる．

このように手術根治度Bが得られれば転帰の改善が期待できるが，実際には多くの場合手術根治度Cとなり，その転帰は非常に悪い．自験例では，77.5%の症例が手術根治度Cとなった．そこで，主に海外では，以前からより強力な治療戦略として，腹膜播種巣の完全切除＋腹腔内化学療法の有効性が報告されている[7][8]．特に2003年にオランダで行われた大腸癌腹膜播種のランダム化比較試験では，減量手術＋術中温熱化学療法群が有意に減量手術＋標準的化学療法群より生存率が高いことが報告された[9]．我々の検討において，手術根治度Bが予後規定因子として抽出されたということは，減量手術の有効性を示唆している可能性がある．しかし，本治療法のエビデンスは十分ではなく，また腹腔内温熱化学療法に関連した合併症や治療の煩雑さを考慮すると，本邦で導入するには適正に計画された臨床試験として本治療法の有効性と安全性を確認していく必要があると思われる[1]．

肝転移に関して，肝転移の多くは他の遠隔転移を同時に伴うため切除不能となることが多く，我々の検討でも肝切除を行えた症例は2例のみであった．それらの症例は，同時性肝転移に対して原発巣および腹膜播種切除後に，異時性に肝切除を行い22か月，70か月生存した症例であった．症例数は少ないが，このように原発巣，腹膜播種，肝転移を切除可能であれば，それらを切除することによって転帰が改善する可能性があると考えられた．また，非治癒因子数が1つでそれが肝転移であれば，本症例のように異時性に切除が行え，長期生存例の可能性もあると考えられた．

診断に関しては，術前に腹膜播種を診断することは容易ではない．de Breeら[10]は，CTの場合，5cm以上の感度は59–67%であるが，1cm以下の病変であれば9–24%であると報告している．また，Tanakaら[11]はCTよりFDG-PETの方が正診率が高く，特に15mm以上であれば診断が可能であると報告している．しかし，粟粒大の播種性病変を手術時に認めることも多く，それらを手術前に診断することは困難である．よって，画像で腹膜結節を認めなくとも，腹水や腹膜脂肪織濃度の上昇および腸管壁の造影効果の上昇，腸間膜の肥厚，大網の血管の拡張など[5]を認める場合は，腹膜播種を疑い，手術時に注意深く観察することが重要である．

今回の検討では，手術根治度が予後規定因子として抽出されたが，当院での過去のデータから解析し

た後ろ向きの検討であるため，腹膜播種症例の選択自体にある程度の bias があることは否めない．しかし，後ろ向き検討ではあるが Stage IV 大腸癌において外科的治療の有効性が示唆されたことの意義は大きいと考える．

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Original Paper

Solo Surgery in Laparoscopic Colectomy: A Case-matched Study Comparing Robotic and Human Scopist

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KEY WORDS: Laparoscopic-assisted colectomy, Solo-surgery, Voice-control-led robotic arm, Colon-lifting method

ABSTRACT

Background/Aims: Recent technical developments have enabled solo surgery in laparoscopic surgery. Our experience of solo surgery using the voice-guided robotic arm in laparoscopic colectomy for colorectal cancer was analyzed.

Methodology: The colon-lifting method was used in this study. The laparoscope was handled by AESOP3000™. The colon was retracted anteriorly by the thread that passed through the mesocolon. This method enables lymphadenectomy by stretching of feeding vessels and obviates the need for an assistant. The short-term outcomes and survival between robotic arm and human scopist in a series of laparoscopic colectomies were compared with a case-matched control study.

Results: The numbers of both group patients were 11 respectively. There was no conversion to open surgery in both groups. The operation time (Robotic *vs.* Human=269 min. *vs.* 265) and laparoscopic time (209 *vs.* 212) were not significant differences. There were also no significant differences in the bleeding, the morbidity rate and the numbers of dissected lymph nodes between the two groups. The five-year overall (81.8% *vs.* 72.7%) and disease-free (72.7% *vs.* 62.3%) survivals showed no significant differences.

Conclusions: Laparoscopic solo-surgery in colectomy is safe and feasible, without any deterioration of the curative potential of the procedure.

INTRODUCTION

We have developed a new technique of colon lifting method using a thread in laparoscopic-assisted colectomy (LAC) for colorectal cancer (1). In this method, the colon is fixed to the abdominal wall; eliminating the need for a first surgical assistant and hence enabling the performance of solo surgery LAC by using a robot arm instead of a scopist. The aim of this study was to report on our experience of laparoscopic colorectal surgery by the colon lifting-method using a voice-controlled robotic arm (AESOP 3000 TM; Computer Motion, Inc., Santa Barbara, CA, U.S.A.), as "solo surgery". The use of a robotic arm during laparoscopic surgery is becoming more and more popular with laparoscopic surgeons. However, there are few published reports documenting the advantages and disadvantages of the use of a robotic arm, except for some that have documented its efficacy and beneficial influence on the operative outcomes, maintenance of a good operative view, and good cost effectiveness (2-6).

We used the robotic arm system as the scopist for laparoscopic colectomy using the colon-lifting method for colorectal cancer. A case-matched control study was performed in order to compare with the same conditions. Safety, quality of lymph node dissection, and the medical costs saving in solo surgery were analyzed.

METHODOLOGY

From June 2002 to January 2004, a series of 11 patients with adenocarcinoma of the colon and upper rectal cancer underwent LAC with the aid of a robotic arm. Patients with inability to withstand pneumoperitoneum with 10cm H_2O pressure due to cardio respiratory insufficiency were excluded. LAC is currently indicated for colorectal cancer cases with a tumor less than 5cm in diameter and classified into a stage lower than T3N1M0. The operative procedure with the aid of the robotic arm was only performed in patients who gave their informed consent and when the robotic arm system was available for use. Since our hospital owns only one robotic arm, we were not able to use it for all of our cases undergoing LAC. During the same period indicated above, 67 patients underwent LAC by the same surgeon with the assistance of a human scopist; that is, all of the operations were performed by the same surgeon. In order to compare outcomes with same

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conditions, the robotic arm and human scopist groups were matched in terms of the following variables: gender; age (within 10 years); American Society of Anesthesiologists (ASA) score (within one point); operative year; tumor location (right-side and transverse colon, left-side of the colon, rectosigmoid and rectum) and International Union Against Cancer Tumor-Node-Metastasis (TNM) stage (0, I, II or III). We compared the operative outcomes between the surgery conducted with the aid of robotic arm and that conducted with the assistance of a human scopist. The outcome data measured included the type and incidence complications, the operative time, the severity of intraoperative bleeding, the number of dissected lymph nodes, the length of postoperative hospital stay, and the survival.

Operative technique

The operative steps were guided by an identified operator's voice over the microphone. The orders being given, namely, the menu and the moving direction, were displayed on the monitor. All patients underwent LAC by the colon-lifting method. The mesocolon was pierced near the line of transection with the dissecting forceps, and a 2-0 Nylon thread was passed through it. The pulling site of the mesocolon was set at a distance of 10 cm or more from the tumor in order to prevent dissemination of the cancer cells. The colon was retracted anteriorly by slowly pulling the thread, and fixed to the abdominal wall with a pair of forceps. The main nutrient artery was stretched in the mesocolon, so as to enable the lymph node dissection to be performed easily. In the laparoscopic procedure using this method, therefore, the first surgical assistant was not required, because the colon was fixed to the abdominal wall without having to be held by an assistant; in addition, there was little risk of careless handling of the tumor. Retroperitoneal dissection was performed from the medial side; resulting in a non-touch technique. When conducted with the assistance of a human scopist, the procedure is a two-person method (**Figure 1**), while when performed with the aid of the robotic arm, only the primary surgeon is needed to perform the surgery (**Figure 2**). In both methods, however, an assistant is required at the time of the small laparotomy and the extracorporeally anastomotic procedure.

Statistical Analysis

The statistical analysis was performed with the SPSS software package (version 11.0J for Windows; SPSS Inc., Chicago, IL). The continuous variables were compared between groups using the Student's t-test. The Pearson's Chi-squared test or the Fisher's exact test was used to compare discrete variables. Survival curves were produced using the Kaplan-Meier method. Statistically significant differences between the groups were determined by the log-rank test. A p value <0.05 was considered statistically significant (two-tailed test).

RESULTS

Patient characteristics and short-term outcomes

There was no conversion to open surgery in both groups. There were no significant differences in the patient characteristics between the two groups due to a case-matched control study (**Table 1**). There was no significant difference in the follow-up period between the two groups (63.4±21.4 *vs.* 61.7±21.8, p=0.8615). There was no significant difference in the total operation time, laparoscopic time and the severity of intraoperative bleeding. Further, there was no significant difference in the number of dissected lymph nodes, proximal and distal margin. None of the patients in either group required a blood transfusion. The morbidity rates between the two groups were equal. There was 1 rectal cancer case of anastmotic leakage in the robotic arm group. The postoperative duration of hospital stay was longer in the robotic arm group than in the human scopist group due to the anastmotic leakage case, but the difference was not significant (**Table 2**).

The long-term outcomes

The five-year overall (81.8% *vs.* 72.7%, p=0.6562) and disease-free (72.7% *vs.* 62.3%, p=7918) survivals were no significant differences (**Figure 3**). Three patients in the robotic arm group had recurrence, one each in the bone, liver and peritoneum, and

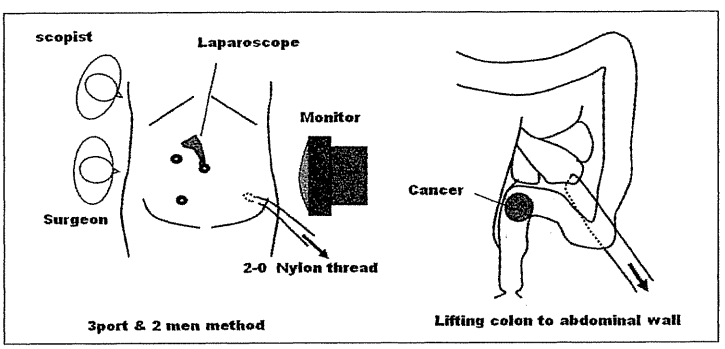

FIGURE 1 Human scopist with the colon lifting method. This figure shows the sigmoid colectomy. A Nylon thread was passed through the site of oral transected mesocolon and the colon was fixed at the left lower abdominal wall. The operative field was stable and this method enabled 3–port & 2– man method.

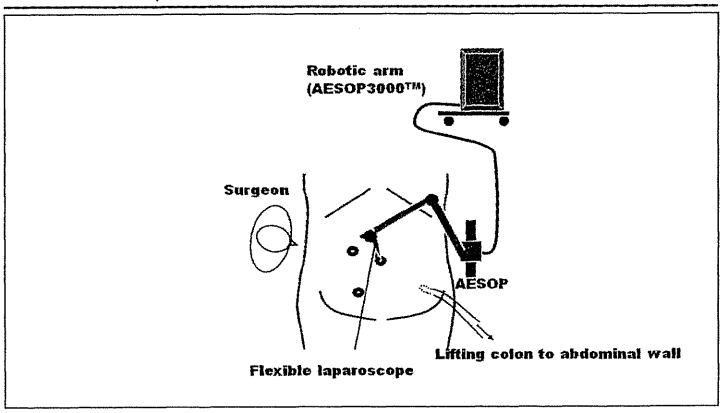

FIGURE 3 The overall and disease–free survival curves in both groups. There were no significant differences in the overall and disease–free survivals.

TABLE 1 Patient Characteristics in Both Groups

	Robotic group	Human group	*p*-Value
Gender			
Male/Female	7/4	7/4	1.0000
Age (years)	64.4 + 9.2	62.5 + 12.9	0.6928
ASA score*	1.4 + 0.5	1.6 + 0.5	0.2195
Operative year			1.0000
2002	5	5	
2003	5	5	
2004	1	1	
Site of tumor			
Right & Transverse colon	2	2	
Left colon	4	4	1.000
Rectosigmid & Rectum	5	5	
pTNM stage			
0	1	1	
I	4	4	1.0000
II	4	4	
III	2	2	
Follow-up period (months)	63.4 + 21.4	61.7 + 21.8	0.8615

*: American Society of Anesthesiologists score

one patient had peritoneal and lung metastases in the human scopist group. The patients with peritoneal and bone recurrence died 22 and 21 months, respectively, after the operation in the robotic arm group. The patients with hepatic recurrence underwent hepatectomy 13 months after the resection of primary lesion, and were alive up to 53 months after hepatectomy. The patients with peritoneal and lung metastases died 47 months after the operation in the human scopist group. One patient suffered with esophageal cancer and 2 patients died of other diseases in the human scopist group. The local recurrence was absent among the two groups.

Medical cost saving

In Japan, the personal charges of the surgeon are very low; being about 6,000 yen (about 61 US dollars) per hour at our hospital. The cost of using disposable instruments per operation were 4,000 yen for the surgery conducted with the assistance of the human scopist and 1,000 yen for that conducted with the aid of the robotic arm. Therefore, the saving of medical cost of one operation using the robotic arm, considering that the duration of assistance by the human laparoscopist necessary was 3 hours, was about 21,000 yen (6,000yen×3hours +1,000 yen; about 214 US dollars).

DISCUSSION

We have previously reported on the benefits of the colon-lifting method for laparoscopic colectomy, namely that it requires fewer operating staff and trocars, and can be performed without any decrease of the curative potential of the procedure. In this method, the colon is retracted anteriorly by pulling a thread fixed to the abdominal wall during the dissecting maneuvers (1). Since the colon is thus fixed to the abdominal wall, a first surgical assistant, besides the laparoscopist, is not required. With the aid of the robotic arm, therefore, we were able to perform solo surgery using this method.

We have reported on the advantages of the robotic arm in thoracoscopic surgery for esophageal cancer (7). The surgeons using the robotic arm system could obtain a more stable, close-up, and longer-lasting operative view during HALS and VATS for esophageal cancer than the open surgery group. In the current study, we compared the advantages of the robotic arm over the assistance of a human laparoscopist in LAC for colorectal cancer. With respect to the steadiness of holding the scope, the robotic arm provided excellent steadiness of handling. One of the most important advantages of the robotic arm, which unfortunately does not lend itself easily to quantitative analysis, is that it is a tremor-free technique. This has been reported to be especially significant during internal mammary artery harvesting (8). Baca *et al.* reported that the benefits

TABLE 2 Comparison of the Operative Procedure and Short-term Outcomes

	Robotic group	Human group	*p*-Value
Total Operation time (min)	268.7 + 60.8	264.7 + 53.8	0.8720
Laparoscopic time (min)	208.7 + 54.2	212.0 + 45.3	0.8794
Intraoperative bleeding (mL)	129.7 + 97.7	108.1 + 94.2	0.6028
Number of dissected lymph nodes	25.9 + 17.5	23.3 + 13.6	0.6969
Proximal margin (mm)	157.7 + 103.5	151.9 + 81.0	0.8847
Distal margin (mm)	93.8 + 70.1	73.1 + 41.4	0.6928
Morbidity (%)	2 (18.2)	2 (18.2%)	1.0000
Anastomotic leakage	1	0	
Surgical wound infection	1	2	
Postoperative hospital stay (days)	11.7 + 5.9	9.3 + 2.8	0.2258

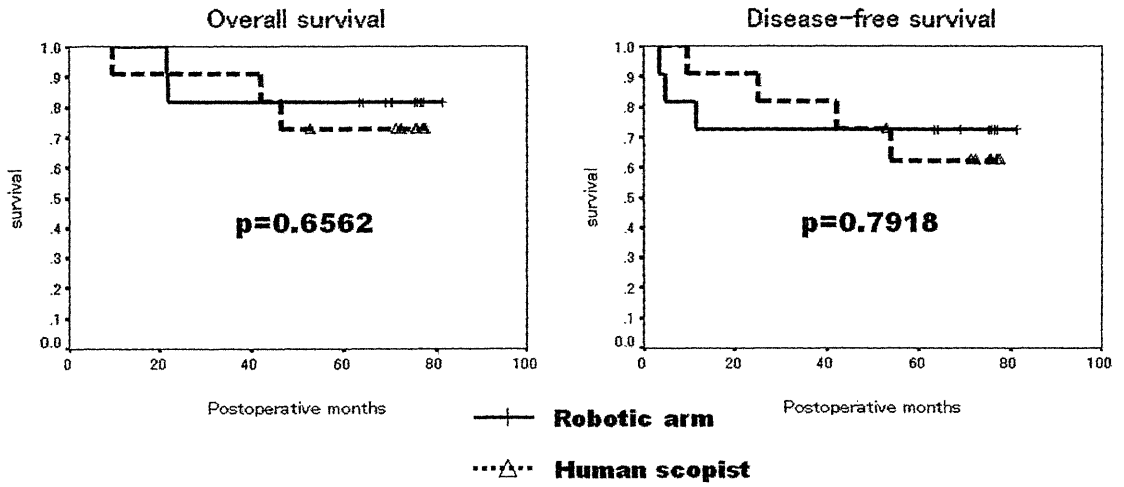

FIGURE 2 Schema of the access ports and the voice–controlled robotic arm site. This figure shows the set–up of the robotic arm. It was set at the opposite side of a surgeon.

that accrue from the use of robotic assistance are a greater stability of view, less inadvertent smearing of the lens, and the absence of fatigue, based on his experience of 200 laparoscopic procedures for various indications (9). It would also appear that the operative environment is highly satisfactory for the surgeon, because a wide operative field can be maintained.

The differences of the total and laparoscopic operation times in the robotic arm group were longer than those in the human scopist group, but were not significant. However, the operative time for laparoscopic surgery could be shortened by about 60 minutes through learning and experience. According to the literature, the time taken for solo surgery with the aid of a robotic scope holder was shorter than that for surgery with human assistance in a large control group of over 400 cholecystectomies on phantoms containing animal organs (10). Besides, the operative cost of surgery with robotic assistance was also lower than that incurred for surgery conducted with the assistance of a human scopist (11).

The robotic arm movements of the robotic arm system were fine-tuned and rigid under proper pronunciation of the orders in most of the cases. However, sometimes, the movements were slow and limited in range. In cases with unexpected bleeding or injury, slow movements of the robotic arm could prove to be an obstacle to the surgeon. In this context, some experiences with other types of robots have been reported (12-15). Nebot reported that the EndoAssist robot was significantly quicker for most of the tasks examined than the AESOP (13). However, numerous reports have shown that the movements of the AESOP system are quicker and more accurate than those of other robots (12, 15).

Some benefits of the robotic arm for laparoscopic procedures involving various organs have been reported, however, there are no clinical reports that can be considered as providing a high level of evidence, except for the randomized study of laparoscopic Nissen fundoplication with either human- or AESOP- assisted camera control in pigs (16). We reported that there were no significant differences between the two groups in terms of the operative time or surgeon's movements, except for the setup and breakdown times, which take about 10 minutes for set-up. In our view, the advantages of the robotic arm system for laparoscopic surgery are the improved stability of view and the absence of surgeon fatigue.

However, the current study was limited because it was not a randomized trial. A high-quality large-scale RCT is necessary to obtain stronger evidence. Well- randomized clinical studies with quantitative analysis to compare parameters between robotic and human camera control in a series of laparoscopic procedures are essential to endorse this contention.

CONCLUSION

Laparoscopic colectomy for colorectal cancer by the colon-lifting method conducted with the aid of the robotic arm permits solo laparoscopic surgery for colorectal cancer, without any decrease of the curative potential of the procedure. Some of the benefits that can accrue from the use of robotics are that it saves human resources and provides greater stability of view, and allows curative maneuvers by the non-touch technique. Thus, the use of the robotic arm is advantageous in terms of saving on the medical costs and maintaining a high quality of the laparoscopic procedure.

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ORIGINAL ARTICLE

Novel procedure, SILSOID colectomy, is a bridge between conventional and single-incisional laparoscopic colectomy

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Keywords
Colectomy; single-incisional laparoscopic surgery; transumbilical incision

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Abstract

Introduction: Laparoscopic colectomy (LC) is a widely accepted treatment for various diseases of the colon. Transumbilical single-incisional laparoscopic surgery (SILS) offers excellent cosmetic results compared with standard multiport laparoscopic surgery. We describe a new hybrid laparoscopic procedure, SILSOID colectomy, which combines conventional LC with SILS.
Methods: We performed SILSOID colectomy to treat four patients with colorectal disease. Three ports were inserted through the single transumbilical incision, and an additional port was inserted in the flank at a site that depended on the location of the lesion. Division and anastomosis of the colon were performed extracorporeally.
Results: SILSOID colectomy was carried out uneventfully in all four cases. The median operation time was 220 minutes (range, 179–320 min), and the median blood loss was negligible (range, negligible–285 mL), respectively. Although one patient experienced a postoperative wound infection, no other postoperative complications occurred.
Conclusion: SILSOID colectomy is safe and feasible and it can be used as an alternative to conventional LC. We consider this procedure to be a bridge between conventional LC and more advanced laparoscopic procedures, such as SILS.

Introduction

Laparoscopic colectomy (LC) is less invasive and more cosmetic than open colectomy (OC), and recently it has been used to treat patients with cancerous lesions as well as patients with benign lesions. In fact, several randomized controlled trials demonstrated that even in patients with advanced colon cancer, LC resulted in an oncological outcome that was similar to the outcome after OC (1–5).

Transumbilical single-incisional laparoscopic surgery (SILS) (6) and natural orifice transluminal endoscopic surgery (NOTES) (7) have recently been developed as new, more cosmetic approaches, and they have been applied to appendectomy and cholecystectomy (6,7). However, very specialized techniques are required to perform both procedures, and it takes a long time to acquire those specialized techniques. We developed a hybrid procedure, SILSOID colectomy, which is a more cosmetic approach that combines conventional LC and SILS. "SILSOID" means a procedure that is similar to SILS because it requires one additional port other than the umbilicus incision. In this article we report our initial experience with SILSOID colectomy in four cases and provide a detailed description of the procedure.

Materials and Methods

Indications and Patients

SILSOID colectomy is indicated for the treatment of patients with lesions located in the cecum, ascending colon, and sigmoid colon. In cancer patients, the indications for SILSOID colectomy are limited to preoperative diagnosis of T1 carcinoma. We limited the location of lesions because it was thought to be difficult to perform anastomosis using the double stapling technique in SILSOID colectomy. The details regarding all four patients are shown in Tables 1 and 2. We used this procedure to

Table 1 Clinical and operative data on four patients

Case	Age/sex	BMI (kg/m^2)	Reason for previous laparotomy	Disease	Procedure	Operative time (min)	Blood loss (mL)	Hospital stay (days)
1	72/M	21.5	Gastric cancer (distal gastrectomy)	Sigmoid colon cancer	Sigmoidectomy	225	Negligible	8
2	76/F	23.2	None	Ascending colon cancer	RHC	179	Negligible	7
3	58/M	24.7	HCC (partial resection of liver)	Sigmoid colon cancer	Sigmoidectomy	320	285	14
4	32/F	17.4	None	Crohn's disease	ICR stricture plasty	215	Negligible	11

BMI, body mass index; ICR, ileocecal resection; HCC, hepatocellular carcinoma; RHC, right hemi-colectomy.

Table 2 Histological data on four patients

Case	Histology	Size (mm)	Depth of invasion	Involvement of lymph nodes (metastatic/harvested)	Length of resected bowel (mm)
1	Well-differentiated tubular adenocarcinoma	35	pMP	6/18	115
2	Well-differentiated tubular adenocarcinoma	20	pSM	0/22	260
3	Moderately differentiated tubular adenocarcinoma	40	pSS	0/10	225
4	Crohn's disease	–	–	–	600

treat four patients with colorectal disease. Three of them had colon cancer: cancer of the ascending colon in one, and cancer of the sigmoid colon in two. The remaining patient had Crohn's disease with ileocecal stricture. Both patients with sigmoid colon cancer had a history of laparotomy for other cancerous lesions.

Surgical technique

The patient was placed in the modified lithotomy position. A 4-cm incision was made in the umbilicus, and the rectus abdominis fascia was fully exposed. It was easy to access the abdominal cavity by the open laparotomy approach because there was not the rectus abdominis fascia and the peritoneum was easily recognized around the umbilicus region. First, a 5-mm port was inserted under direct vision. When a left-sided colectomy was planned, a second 5-mm port was inserted in the left flank, whereas when a right-sided colectomy was planned, the second 5-mm port was inserted in the right flank. Two additional 5-mm ports were then inserted beside the first port through the single incision under laparoscopic guidance (Figure 1a and b). Thus, SILSOID colectomy was performed by using a total of four ports.

The pedicle of the mesenteric artery was retracted with forceps inserted through the flank, and the colon was fully mobilized by the medial approach (Figure 1c and d). These procedures were performed by parallel technique using conventional rigid forceps. The incision in the rectus abdominis fascia was extended and a lap protector mini (Hakko Medical, Tokyo, Japan) was applied to avoid wound infection and seeding of cancer cells. The affected colon was pulled out and divided extracorporeally. The anastomosis was performed extracorporeally by a functional end-to-end technique using a linear stapler. Finally, a 19-Fr Blake drain was inserted through the port in the flank.

Results

SILSOID colectomy was successfully completed in all four patients without any unanticipated extension of the umbilical skin incision or conversion to open or conventional laparoscopic surgery. The details regarding each patient are shown in Table 1. Median operation time was 220 min (range, 179–320 min), and median blood loss was negligible (range, neglibible–285 mL). In three patients with cancer, the median number of harvested lymph nodes was 18 (10–22), and median length of resected bowel was 242.5 (115–600) mm. One patient developed a postoperative wound infection, but there were no other postoperative complications. Clear liquids were allowed on postoperative day (POD) 2, and a diet was resumed on POD 3. All patients were discharged after an uneventful postoperative course and median hospital stay was 9.5 (7–14) days. The patients' wounds were more cosmetic than those of the conventional LC (Figure 2).

Discussion

More than 18 years have passed since Jacobs *et al.* first reported LC in 1991 (8). Today, LC has become the mainstay of operative procedures in colorectal surgery. In