

Case Analysis

Laparoscopic Colectomy for Nonagenarians, Preliminary Experience in National Taiwan University Hospital

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Key Words

Colorectal neoplasm;
Nonagenarians;
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Purpose. Over the past decade, laparoscopic colectomy has been widely used for patients with colorectal neoplasm. However, there is little data about laparoscopic surgery among nonagenarians. This study discusses our clinical experience of laparoscopic colectomy for nonagenarians in a single institute.

Methods. From January 2000 to July 2009, we performed a retrospective case control study of patients who underwent laparoscopic or open colectomy due to a primary colon tumor. Thirty-five patients were older than 90 years old. The demographics, tumor characteristics, surgical methods, lab data, morbidity, mortality, and survival were investigated and analyzed.

Results. Eleven patients underwent laparoscopic colectomy and eleven underwent open colectomy were enrolled. The mean age entering surgery was 92.3 versus 93.3. The most common operation procedure was a laparoscopic anterior resection (45%) versus open right hemicolectomy (27.3%). The average of hospital stay was 16.9 (8-39) days versus 23.9 (10-69) days. Four patients in laparoscopic group (36.4%) and five in open group (45.5%) suffered complications. There was one 30 days-mortality (9.1%) in laparoscopic group. The median follow-up interval was 19 versus 13 months and the five year survival rate was 54.6% versus 33.8%.

Conclusion. The short-term and long-term result of laparoscopic group are not worse than open group. The mortality and morbidity rates in our study are not higher than octogenarians or septuagenarians of other studies. For nonagenarians with colorectal neoplasm, laparoscopic colectomy is a feasible and safe option for selective patients.

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Since the 1990's, laparoscopic surgery has revolutionized the thinking around major operations, substituting traditional large incisions with modern minimally invasive surgery. Its success has been confirmed by good cosmetic results and early recovery times, whether for laparoscopic appendectomies or

cholecystectomies. Several reports described laparoscopic appendectomy being adapted for patients who were pregnant, received previous abdominal surgery, or suffered perforated appendicitis.¹⁻³ T. R. Scott et al., reported a review of 12397 patients and indicated laparoscopic cholecystectomy to be a safe and effective

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procedure that is a viable alternative to conventional cholecystectomies.⁴

Some have asked whether laparoscopic surgery is suitable for older patients. This is a controversial matter still under being discussed. Guller et al., reported that laparoscopic appendectomy offers significant advantages over open appendectomy with respect to length of hospital stays as well as postoperative morbidity and mortality for patients older than 65 years old.⁵ Malik et al., reported on a prospective series of laparoscopic cholecystectomies involving 173 patients over 65 years old, concluding it was as safe as for patients below 65 years old.⁶ And Lopez et al., presented their experiences from 1992 to 1997, also concluding that laparoscopic surgery for the elderly was safe, and associating it with short hospital stays and lower morbidity and mortality.⁷ However, some aspects of laparoscopic surgery for older patients remains in doubt. Some reports described that the pneumoperitoneum may overload the cardiopulmonary system of elderly patients, especially during extended operating times.⁸

The elderly segment of Taiwan's population has grown rapidly. And their health care needs have also grown in importance to society because they often involve critical care and cancer treatment.⁹ Number of nonagenarians is much greater today in Taiwan and they present new medical challenges. Meanwhile, since 2006, the report from Bureau of Health Promotion, Department of Health, Executive Yuan revealed that colorectal cancer has become the malignant disease with the highest incidence in Taiwan. Lately, laparoscopic colectomy has become the major surgical treatment of colon neoplasms. Zheng and Wang et al., had reported their successful experience of laparoscopic colectomy in elderly in Taiwan.¹⁰ Several reports confirmed that laparoscopic colectomies were safe and beneficial to the elderly when compared to open colectomies.¹¹

There is some data specifically about laparoscopic surgery for neoplasm among the elder patients. Santos et al., described a case report of a nonagenarian with advanced gynecologic malignancy who underwent a laparoscopic colostomy for palliative fecal diversion.¹² And Hsu and Gill reported on 11 patients – octogenarians and nonagenarians – with urologic malig-

nancy who underwent retroperitoneal laparoscopic radical nephrectomies and nephroureterectomies; they concluded that laparoscopy surgery was an excellent alternative to open surgery for excisions of selected renal malignancies among octogenarians and nonagenarians.¹³ However, there are few reports about consecutive laparoscopic colectomies for nonagenarians in the literature. This study discusses our preliminary clinical experience, and seeks to determine characteristics of major laparoscopic surgery for nonagenarians.

Materials and Methods

We retrospectively collected the medical data of all patients diagnosed with a primary colon neoplasm – including adenocarcinoma, carcinoma *in situ*, adenoma with severe dysplasia, and colon stromal tumor – at the National Taiwan University Hospital between January 2000 and July 2009. Among patients older than 90 years-old, 35 patients underwent surgery. One of them received a transanal excision for early lower rectal cancer, and we excluded this patient. Eleven of these patients received laparoscopic colectomies. Twenty three patients received open colectomy, and 6 of them was excluded because of emergent surgery, 2 patients excluded due to combine with other major surgery like hepatectomy; one of them was excluded because she was older than hundred years old, and two patients were excluded for lack of medical data. We designed a case control retrospective study and compare the 11 patients underwent laparoscopic colectomies (laparoscopy group, n = 11) with the 11 underwent open colectomies (open group, n = 11).

We collected and analyzed the patient demographics, characteristics of the neoplasms, surgical methods, preoperative lab data (including carcinoembryonic antigen [CEA] levels and American Society of Anesthesiology classification [ASA] scores), intraoperative blood transfusions and estimated blood loss, operation times, postoperative lab data, courses in the intensive care unit, 30-day morbidities and mortalities, chemotherapy treatments, disease-free survival rates, and overall survival rates. The stage of neoplasm was classified as the AJCC cancer staging, seventh edition. Preoperative co-morbidities included

pulmonary problems like emphysema, obstructive lung disease, cardiovascular problems like coronary artery disease, arrhythmia and heart failure, renal problems definite as serum creatinine > 2 mg/dl or need artificial dialysis, and diabetes mellitus or hypertension under medication treatment were all collected and analyzed. Complications were graded on a scale of 1-5 according to the Clavien-Dindo Classification of Surgical Complications, and are summarized in Table 3.

Categorical variables were compared using the Chi-squared test or Fisher's exact test ($n \leq 5$), when appropriate. The student's *t*-test or Mann-Whitney *U*-test was used to compare normally distributed variables. Survival was analyzed using the Kaplan-Meier method, and comparisons were made with the log-rank test; *p*-values less than 0.05 were considered statistically significant.

Results

The clinical demographic characteristics at presentation of the 11 nonagenarians who underwent laparoscopic surgery are shown in Table 1. The average age was 92.3 years old, ranging from 90 to 98 years old. There were 7 male and 4 female patients. The most common preoperative co-morbidities were hypertension in 4 patients (36.4%), and diabetes

mellitus in 2 patients (18.2%). Only 1 patient had cardiac or pulmonary disease while undergoing surgery. The distribution of co-morbidities is described in Table 2. The locations of the tumors and operating methods are shown in Table 1, with the most common site being the sigmoid colon in 6 patients (54.5%). No synchronous or metachronous tumors were found at the time of operation. Three patients underwent enterostomies, and no combined operations like hepatectomy or small bowel resection were performed at the same time. All operations were elective surgeries; none were on an emergency basis. The average operating time was 224.5 min (SD \pm 51.1 min); average blood loss was 172.2 ml (SD \pm 83.3 mL). No patients required intra-operative component therapy because of massive blood loss.

The distribution of TNM stages is shown in Table 1, with Stage I and Stage II patients exceeding half (63.7%) of the total. The average longest-diameter of the tumors was 4.48 cm (\pm 2.21 cm); and the most common was T3 (6 patients, 54.5%). The number of lymph node dissections was described at Table 2, with the average of 10.0 (\pm 4.8); only 2 patients had lymph node metastases and were limited at N1b (both were 2 node metastases). No patients had peritoneal seeding or malignant ascites. Only 1 patient with liver metastasis was discovered before the operation, and no patients received neo-adjuvant chemotherapy. There were 9 patients with characteristics of moderate dif-

Table 1. General characteristics of colorectal neoplasm patients 90 years age or older with laparoscopic surgery

Case	Age/sex	ASA	Location of tumor	Operation method (Laparoscopic)	Tumor largest length (cm)	LN metastasis/ dissection number	TNM Stage	enterostomy
1	92M	3	Sigmoid colon	Anterior resection	3	2/10	T3N1M0	
2	93M	2	Sigmoid colon	Anterior resection	3	0/10	T1N0M0	
3	90M	3	Sigmoid colon	Anterior resection	2.5	0/8	T2N0M0	
4	91M	4	Recto-sigmoid junction	Hartmann's procedure	4	0/7	T3N0M0	End colostomy
5	90F	2	Sigmoid colon	Anterior resection	4.8	0/11	T1N0M0	
6	90M	2	Transverse colon	Left hemicolectomy	2.5	2/13	T3N1M0	
7	90M	3	Ascending colon	Right hemicolectomy	6	0/12	T3N0M0	
8	90F	2	Sigmoid colon	Anterior resection	5	0/4	-	Protective ileostomy
9	94M	4	Sigmoid colon	Lower anterior resection	5.5	0/11	T3N0M0	
10	97F	3	Rectum	Lower anterior resection	3	0/12	T2N0M0	Protective ileostomy
11	98F	3	Ascending colon	Right hemicolectomy	10	0/12	T3N0M1	

TNM refers to the Tumor, Node, Metastasis system used in the TNM Classification of Malignant Tumours.

• ASA: American Society of Anesthesiology classification score.

Table 2. Comparison of demographic data, tumor-related characteristics and mean perioperative parameters of colorectal neoplasm patients aged 90 years or older with laparoscopic and open surgery

Characteristic	Laparoscopy group (n = 11)	Open group (n = 11)	p value
Age, year	92.3 ± 2.8	93.3 ± 2.9	0.423
Sex, male	7 (63.6%)	6 (54.5%)	0.665
ASA	2.8±0.8	3.0 ± 0.8	0.582
Co-morbidity number/per patient	1.0	1.5	0.205
Pulmonary problems	0	1	
Cardiovascular problems	2	5	
Renal problems	1	1	
Diabetes mellitus	2	2	
Hypertension	4	5	
Tumor size, cm	4.48 ± 2.51	5.40 ± 2.69	0.393
CEA	5.05	3.14	0.499
Cancer stage			0.817
0	1 (9.1%)	0 (0%)	
I	3 (27.3%)	4 (36.4%)	
II	4 (36.4%)	5 (45.5%)	
III	2 (18.2%)	2 (18.2%)	
IV	1 (9.1%)	0 (9.1%)	
Enterostomy	3 (27.3%)	3 (27.3%)	1.000
Lymph node dissection number	10.0 ± 4.8	9.6 ± 5.1	0.866
Length of hospital stay, day	16.9 ± 8.5	23.9 ± 12.3	0.343
Post-op complication, patient number	4 (36.4%)	5 (45.5%)	0.682
Minor complication	3 (27.3%)	1 (9.1%)	0.291
Major complication	1 (9.1%)	4 (36.4%)	0.139
One-month mortality	1 (9.1%)	0 (0.0%)	0.329
One-year mortality	2 (18.2%)	3 (27.3%)	0.631
Recurrence	1 (9.1%)	2 (18.2%)	0.557
Length of survival, month	47.5 ± 12.1	37.6 ± 11.6	0.969
Disease-free survival, month	41.8 ± 12.0	35.2 ± 12.2	0.944

- The all data are presented a mean (± standard deviation) or number and percentage.
- ASA: American Society of Anesthesiology classification score.
- Minor complication is classified as Clavien-dindo classification grade I and II, and major complication is classified as grade III, IV and V.

Table 3. Clavien-Dindo classifications of surgical complications.²⁰

Grade	Recommended treatment or results
Grade I complication	Only requires antiemetics, antipyretics, analgetics, diuretics and physiotherapy without any invasive intervention
Grade II complications	Requires further pharmacological treatment with drugs like antibiotics, transfusions, prolonged tube feedings, or total parenteral nutrition
Grade III complications	Requires interventional radiology, reoperation, endoscopy, or intubation
Grade IV complications	Life-threatening situations that require ICU admission
Grade V complications	Results in patient death

ferentiated adenocarcinoma, one with well-differentiated adenocarcinoma, and 1 with villous adenoma with severe dysplasia.

Complications of laparoscopy group were found among 4 patients. One 90 year-old male suffered from

paraxymal atrial fibrillation at ICU course and resolved spontaneously (grade II). One 97 year-old female received packed Red Blood Cells two unit transfusion due to dropped hemoglobin to 7.9 g/dL without any sign of massive internal bleeding (grade II). One

98 year-old female delayed discharge at post-operative day 39 due to urinary tract infection under intravenous antibiotics treatment for 20 days (grade II). One 90 year-old female suffered from wound infection and ventral hernia and received exploratory laparotomy for debridement and herniorrhaphy at post-operative day 18; however, bowel perforation was induced during adhesionolysis and complicated with enterocutaneous fistula. Intra-abdominal infection and sepsis induced death at post-operative day 25 due to multiple organ failure. She was the only one 30 days mortality in our series (grade V).

Among the laparoscopy group, except for the patient diagnosed with liver metastasis before the operation, there was only one case of liver metastasis, which was reported in the 31st month after the operation with no observed local recurrence. Two patients received postoperative adjuvant chemotherapy. One of them suffered from poor appetite and repeated vomiting at postoperative day 47 after chemotherapy with oral Fluorouracil since postoperative day 27; neutropenic fever and upper gastrointestinal bleeding followed and he died at postoperative day 105 because of sepsis and multiple organ failure.

Three patients in laparoscopy group and six in open group died at the end of study. There was one patient in each group died because of complications related to the operation, and one in each group died related to chemotherapy. One patient in laparoscopy group and two in open group died after cancer recurrence, and three in open group died because of other reason which had no relationship to colorectal cancer.

The comparisons between laparoscopy and open group were described in Table 2. There is no difference between two groups in age, sex, ASA, co-morbidities, tumor size, CEA level, cancer stage, enterostomy, lymph node dissection, length of hospital stay, postoperative complications, one month and one year mortality rate and recurrence rate. The average hospital stay was 16.9 days (8-39 days) in laparoscopy group versus 23.9 days (10-69 days) in open group without statistically significant differences. The average survival was 47.5 versus 37.6 months and the average disease-free survival was 41.8 versus 35.2 months. The five year survival was 54.6% versus 33.8% and the five-year disease-free survival was

48.5% versus 33.8%. The survival curve and disease-free survival curve are shown in Figs. 1 and 2. Even though the survival of laparoscopy group seems better, but no statistically significant difference was found.

Discussion

Most people in Taiwan used to believe that surgery in elderly patients was much riskier to them than it is to younger patients, leading many mature patients

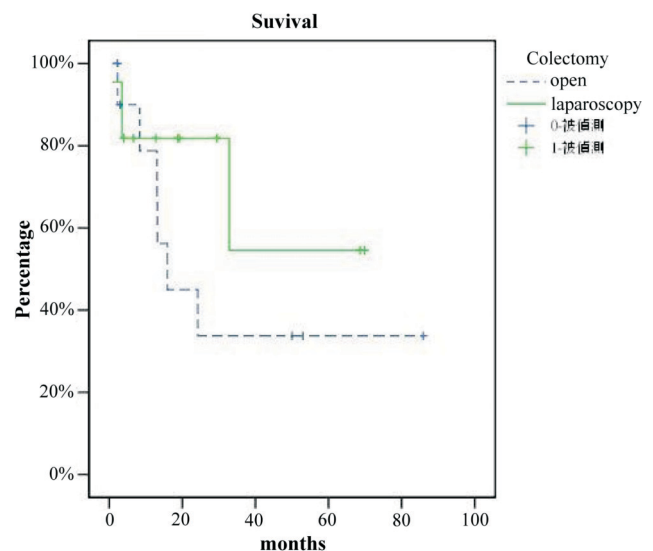


Fig. 1. Survival of two groups.

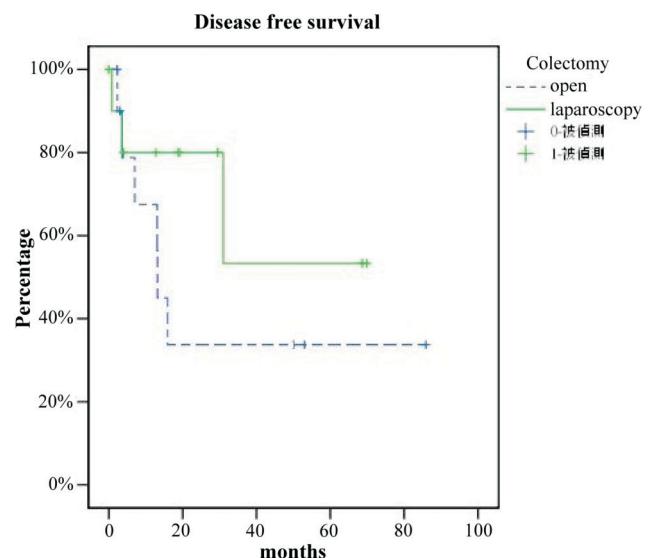


Fig. 2. Disease free survival of two groups.

to reject major operations, particularly resections of neoplasms. Such limited experience was compounded by the lack of data in oncological results, prognoses, and complications in the surgery of elderly patients. Meanwhile, according to the report from Bureau of Health Promotion, Department of Health, Executive Yuan, the average life-span in Taiwan has increased to 78.5 years old in 2008, with the population of nonagenarians increasing 4 times from 1991 to 2007. Surgery on nonagenarians has become a more common challenge for surgeons because of the prevalence of colorectal cancer and advancements in laparoscopy. There have been few reports about laparoscopic surgery for nonagenarians with colorectal neoplasm, and we wish our preliminary experience contribute to the research of colorectal neoplasm and geriatrics.

Mortality and morbidity in colorectal surgery are indeed higher among the elderly versus younger patients. Some reports presented perioperative mortality rates to be about 8%-18% in patients older than 80 years who underwent colorectal surgery,¹⁴ with death usually resulting from complications of coexisting medical disorders or anastomotic leakage. The rate of pneumonia or respiratory failure after colorectal surgery in the elderly has been reported to be 12% in 75-to-85 year-olds and 15% in patients older than 85 years, with conclusions that advanced age did affect the surgical outcome, particularly short-term morbidity and mortality.¹⁵

Originally considered a risky procedure for the elderly, laparoscopy has more recently been described as safe and beneficial for them.¹⁶ Laparoscopic surgery may decrease the size and continuity of abdominal wounds, cause less pain, and having less influence on the respiratory system, despite early mobilization; this may ultimately lower the risk of postoperative pneumonia and ileus.

Unlike perioperative risk, the postoperative complication rate has decreased recently because of advanced techniques and experiences in laparoscopic surgery. Many references reported that the rate of complications in patients older than 80 years is lower in laparoscopic colectomy cases than in open colectomy cases, especially pulmonary and cardiovascular complications.^{17,18} Minimal invasive surgery might offer greater benefits such as short hospital

stays, lower costs, or even better oncological results.¹⁹

In our study, the perioperative mortality of laparoscopic colectomy was 9.1% (only one patient), not dramatically higher than other studies which evaluated elderly patients, which ranged from 4%-7.6%.²⁰⁻²² Postoperative morbidity of laparoscopic colectomy in our study was 36.4%, and 3/4 were limited to minor grade II complications. Law et al., encountered overall surgical morbidities of 36.8% in patients older than 75 years-old;²² Hesterberg et al., also reported morbidity of 12.2% in elective surgery in the same age group;²³ while Marks et al., reported result in 368 consecutive laparoscopic colorectal resections, including a mortality rate of 5%-7% and a morbidity of 17%-31%.¹⁶ In our study, the mortality and morbidity rates of laparoscopic colectomy in nonagenarians was not obviously higher than those of octogenarians or septagenarians in other studies. The low rates of complications and mortality may be a result of progress made in intensive care for the elderly in our medical center as well as the advanced techniques used in laparoscopic surgery.

In our series, 9 of 22 patients in both groups died before the study ended. Only two patients died due to operation related complications. The elderly are more susceptible to die from cardiovascular or respiratory diseases, even though they may have survived major surgery for malignant diseases. Their quality of life and early recovery might be of greater value to these patients.

Preoperative co-morbidity is also an important factor in the postoperative morbidity and mortality of colorectal surgery patients who are nonagenarians. Hesterberg et al., reported that elder patients with 1 or more co-morbidities had a 10%-15% morbidity rate after an operation.²³ In a population-based study, the incidences of hypertension and heart disease are about 43.8% and 38.4 %, respectively, in patients older than 75 years.²⁴ In our study, the proportion of hypertension was 36.4% in laparoscopy group and 45.5% in open group, consistent with other references. Marks et al., demonstrated a close association between advancing age and increasing ASA scores.¹⁶ It is very hard to avoid competition with comorbidities in major operations for elderly patients, especially nonagenarians. Our study indicated that high ASA score

among nonagenarians (median = 3). It was very difficult to address the relatively high risk to elderly patients, but selective patients may be suitable for laparoscopic surgery if well-prepared. Preoperative colon preparation, the quality of anesthesia, minimally invasive surgery, and flawless postoperative care are the best ways to reduce mortality and morbidity among such elderly patients.²⁵ We compare our result of laparoscopic colectomy with other studies and described it in Table 4.²⁶⁻²⁸ We now recognize that laparoscopic surgery is safe and feasible for nonagenarians under well-prepared conditions, and it may even become a routine approach for colorectal neoplasms in the elderly over time.

In the laparoscopy group of our series, anterior resection and Hartmann's procedure occupied the

early five cases. We performed laparoscopic lower anterior resections and right hemicolectomies for nonagenarians in four of the last five cases. In our concern, lower anterior resection is difficult for surgeon with less experience. Lai et al., reported that colorectal surgeons with laparoscopic experienced achieve proficiency at 16 cases.²⁹ We considered that laparoscopic anterior resection is adapted to the surgeon under learning curve of laparoscopic colectomy, and laparoscopic lower anterior resection had better been performed by an experienced surgeon.

Two patients in our series died from adverse events of chemotherapy. Actually adjuvant chemotherapy is still controversial for colorectal cancer of nonagenarians. Kahn et al., reported that older patients tolerated adjuvant chemotherapy with less-toxic

Table 4. Compare with other series of the elder patients with laparoscopic colectomies

	Our series	L.Lian et al. ⁴³	Seshadri et al. ⁴⁴	Cheung et al. ⁴⁵
Cases number	11	97	62	101
Age (years)	92.27 ± 2.80	82.8 ± 3.3	85	83
Gender (male)	7(63.6%)	46(47.4%)	30(48.4%)	
Operation method				
Right hemicolectomy	2(18.2%)	58(59.8%)	22(35.5%)	16(16%)
Left hemicolectomy	1(9.1%)	34(35.1%)	8(12.9%)	6(6%)
Anterior resection	5(45.5%)		9(14.5%)	26(26%)
Low anterior resection	2(18.2%)	0	0	44(44%)
APR	0(0%)	0	4(6.5%)	8(8%)
Hartmann's operation	1(9.1%)	0	2(3.2%)	1(1%)
Segmental resection	0(0%)	0	13(21.0%)	0
Subtotal colectomy	0(0%)	4(4.1%)	3(4.8%)	0
Conversion rate	0	14.4%	7(11%)	1(1%)
ASA score				
1	0	17(17.5%)		0
2	4(36.4%)			62(61%)
3	5(45.5%)	71(73.2%)		36(36%)
4	2(18.2%)	9(9.3%)		3(3%)
Stage				
I	3(27.3%)			23(23%)
II	4(36.4%)			30(30%)
III	2(18.2%)			38(38%)
IV	1(9.1%)			9(9%)
Two or more co-morbidities	2(18.2%)		11(17.7%)	
Outcome				
30-day complication	4(36.4%)	36(37.1%)	19(31%)	17(17%)
30-day mortality	1(9.1%)	5(5.2%)	3(4.8%)	3(3%)
Hospital stay (days)	16.9	6	10	8
Median follow-up (months)	19			24
Recurrence	1(9.1%)			22(22%)
Five year survival	54.6%			51%
Five year disease-free survival	48.5%			49%

agents although more often with earlier discontinuation of treatment, which resulted in fewer adverse events than younger patients.³⁰ Our patients were older than Kahn's series which were just older than 75 year-old. Further study of adjuvant chemotherapy for nonagenarians is needed to reveal the issue.

Our study was limited to a retrospective case control study because there the number of nonagenarians with colorectal neoplasm who received laparoscopic surgery in Taiwan is still rare. We were also limited to a single institute. A prospective, randomized (or even multi-center) study that investigates patient quality of life or satisfaction with the operation will be considered for future research.

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病例分析

九十歲以上病人的腹腔鏡大腸切除手術 – 台大醫院之初始經驗

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目的 近十年來，腹腔鏡大腸切除手術已經廣泛應用於大腸直腸腫瘤之治療。然而，對於九十歲以上的老年人，腹腔鏡手術的資料仍然相當缺乏。本研究主要是探討單一醫院腹腔鏡大腸切除手術用於九十歲以上病人的經驗。

方法 從 2001 年 1 月到 2009 年 7 月，我們進行了回溯病例控制研究，收集所有因為原發大腸直腸腫瘤而在本院接受腹腔鏡或剖腹大腸切除手術的病人資料，有 35 個病人在接受手術時超過 90 歲，他們的身體狀況，腫瘤狀況，手術方法，實驗室檢查，致病及致死率，以及存活皆加以分析。

結果 腹腔鏡大腸切除以及剖腹大腸切除兩組分別各收集了十一個病人。平均年齡為 92.3 歲對 93.3 歲；最常見的術式分別為腹腔鏡前方切除手術 (45%) 及右側結腸切除手術 (27.3%)。平均手術時間為 224.5 分鐘而平均失血量則為 172.2 毫升。平均住院天數為 16.9 天。有三個病人產生輕微併發症 (27.3%)，一個病人因為嚴重併發症而死亡 (9.1%)。平均追蹤時間是 19 個月而五年存活率則是 54.6%，腹腔鏡組和剖腹組相比沒有統計上的差異。

結論 腹腔鏡組的短期及長期成績和剖腹組相比起來並沒有差別。本研究的手術後致病率及致死率和其他研究的七十歲或八十歲以上病人比較，並沒有顯著差異。因此，慎選九十歲以上患有大腸直腸腫瘤的病人，腹腔鏡大腸切除手術是個安全而有效的治療方式。

關鍵詞 大腸直腸腫瘤、九十歲老人、腹腔鏡手術。