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SURGICAL ENDOSCOPY
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Do elderly patients benefit from laparoscopic colorectal surgery?

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Abstract
Background: The steadily increasing age of the population mandates that potential benefits of new techniques and technologies be considered for older patients.
Aim: To analyze the short-term outcomes of laparoscopic (LAP) colorectal surgery in elderly compared to younger patients, and to patients who underwent laparotomy (OP).
Methods: A retrospective analysis of patients who underwent elective sigmoid colectomies for diverticular disease or ileo-colic resections for benign disorders; patients with stomas were excluded. There were two groups: age < 65 years (A) and age ≥ 65 years (B). Parameters included demographics, body mass index (BMI), length of operation (LO), incision length (LI), length of hospitalization (LOS), morbidity and mortality.
Results: 641 patients (M/F – 292/349) were included between July 1991 and June 2006; 407 in group A and 234 in group B. There were significantly more LAP procedures in group A (244/407 – 60%) than in group B (106/234 – 45%) – $p = 0.0003$. Conversion rates were similar: 61/244 (25%) in group A, and 25/106 (24%) in group B ($p = 0.78$). There was no difference in LO between the groups in any type of operation. LOS was shorter in patients in group A who underwent OP: 7.1 (3–17) days versus 8.7 (4–22) days in group B ($p < 0.0001$), and LAP: 5.3 (2–19) days versus 6.4 (2–34) days in group B ($p = 0.01$). In both groups LOS in the LAP group was significantly shorter than in OP group. There were no significant differences in major complications or mortality between the two groups; however, the complication rates in the OP groups were significantly higher than in LAP and CON combined ($p = 0.003$).
Conclusions: Elderly patients who undergo LAP have a significantly shorter LOS and fewer complications compared to elderly patients who undergo OP. Laparoscopy should be considered in all patients in whom ileo-colic or sigmoid resection is planned regardless of age.

Key words: Elderly — Laparoscopy — Colorectal surgery

With the steadily increasing age of the population it is critical that the potential benefit of new techniques and technologies be offered to older patients. Unfortunately, many trials of new technologies are limited to young patients. The most important advance in abdominal surgery in the last few decades is laparoscopy. It gradually extended to every field in surgery including colorectal surgery. At first it was employed only for benign disorders such as inflammatory bowel disease and diverticulitis, and later for colorectal cancer. Nowadays, most colorectal procedures may be laparoscopically accomplished. It has consistently been demonstrated that patients who undergo laparoscopic surgery have shorter convalescence, shorter length of hospitalization, and better cosmetic results compared with patients who undergo standard laparotomy [1–7].

The aim of this study was to compare the short-term outcomes of laparoscopic colorectal surgery in elderly compared to younger patients, and to patients who underwent matched procedures by standard laparotomy.

Methods

A retrospective analysis of a prospectively entered database of all the patients who underwent elective sigmoid colectomies for diverticular disease and patients who underwent elective ileo-colic resections for benign diseases [inflammatory bowel disease (IBD) and benign polyps] was undertaken. Elective resections by both laparoscopy and laparotomy were included; patients in whom a stoma was created or who underwent an emergency operation were excluded from the analysis. Patients were divided into two groups by their age: patients younger than 65 years (group A), and patients age 65 years or older (group B). In each group the patients were divided into three sub-groups according to the nature of the procedure: laparoscopic (LAP), open

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Table 1. Characteristics of group A compared to group B: demographics and type of procedure

	Group A, age < 65	Group B, age ≥ 65	*p*
Patients	407	234	
Male	207 (51%)	85 (36%)	0.0004
Female	200 (49%)	149 (64%)	
Age (years)	46 (14–64)	74 (65–91)	–
OP	163 (40%)	128 (55%)	0.0003
LAP	183 (45%)	81 (35%)	0.0003
CON	61 (15%) (25% of all laparoscopic)	25 (10%) (24% of all laparoscopic)	0.78*

OP – Open procedures; LAP – Laparoscopically completed procedures; CON – Laparoscopic converted procedures
* Difference in the conversion rates between the 2 groups

(OP), and converted (CON) procedures. Hand-assisted procedures were included in the LAP subgroup. Analyzed parameters included demographics, body mass index (BMI), length of operation (LO), length of incision (LI), length of hospital stay (LOS), morbidity and mortality. Statistical analysis was performed using GraphPad Instat™, GraphPad software V2.04 (San-Diego, CA), using Student's *t*-test and analysis of variations (ANOVA) when appropriate.

Results

Between July 1991 and June 2006, 641 patients met the inclusion criteria and were included in the analysis. There were 331 patients who had elective sigmoid colectomies for diverticular diseases, and 310 patients who had elective ileo-colic resections for benign diseases. The characteristics of groups A and B, and the categories of procedures are summarized in Table 1. Hand-assisted procedures (total of 35 in both groups) were included in the LAP sub-group, but specific sub-group analysis for this subset of patients was not performed due to the small number of patients in that group. There were significantly more male patients in group A compared to group B (51% vs. 36% respectively; $p = 0.0004$), and significantly more laparoscopic procedures were undertaken in group A compared to group B (60% vs. 45% respectively; $p = 0.0003$). There was no statistically significant difference in the conversion rates between the two groups – 25% in group A and 24% in group B ($p = 0.78$). Factors that were analyzed – body mass index (BMI), length of operation (LO), length of incision (LI) and length of hospital stay (LOS), and the differences between the groups in each factor are summarized in Tables 2 and 3. The statistically significant differences between the two groups were the LI that was significantly shorter in patients in group B who had LAP, and LOS that was significantly shorter in patients in group A who had OP and LAP. The LO in both groups was significantly longer in patients who had LAP and even CON compared to OP. In group A, the LOS in patients who had LAP was significantly shorter than the LOS in patients who had OP and CON ($p < 0.0001$ for both) and there was no difference in the LOS between patients who had OP and CON; in group B, the LOS for patients who had LAP was significantly shorter than the LOS in patients who had OP ($p = 0.0002$), but it was not different from the LOS in patients who had CON

Table 2. Summary of the factors that were analyzed in groups A and B

	Group A			Group B		
	OP	LAP	CON	OP	LAP	CON
BMI kg/m^2	26.1 ± 6.1 (16–46.9)	25.3 ± 4.8 (15.4–44.4)	27 ± 5.4 (13.4–41.8)	26.1 ± 4.1 (16.9–41.1)	25.7 ± 4.2 (17.5–37.9)	27.3 ± 6.1 (18.3–46.9)
LO (minutes)	143 ± 55 (40–320)	174 ± 59 (70–410)	217 ± 66 (100–415)	138 ± 65 (45–420)	175 ± 56 (45–300)	203 ± 63 (120–390)
LI (cm)	21.6 ± 6.9 (8–45)	6.4 ± 2.1 (3–12)	18.8 ± 8.6 (7–42)	23.3 ± 6.1 (10–42)	5.8 ± 2.1 (3–12)	15.3 ± 7.5 (6–30)
LOS (days)	7.1 ± 2.8 (3–17)	5.3 ± 2.2 (2–19)	7.1 ± 3.3 (3–22)	8.7 ± 3.9 (4–22)	6.4 ± 4.8 (2–34)	7.3 ± 3.3 (3–15)

BMI – body mass index; LO – length of operation; LI – length of incision; LOS – length of hospital stay

Table 3. Differences between groups A and B

	A OP vs. B OP	A LAP vs. B LAP	A CON vs. B CON
BMI	0.95	0.53	0.88
LO	0.57	0.88	0.38
LI	0.06	0.04	0.09
LOS	< 0.0001	0.01	0.83

* The numbers are p values demonstrating the differences in each factor between groups A and B

($p = 0.4$). There was a tendency, albeit not significant, towards a shorter LOS in patients who had CON compared to patients who had OP in group B ($p = 0.09$). Complications are summarized in Table 4. One patient from group B who had a LAP died from a myocardial infarction in the early postoperative period, which was the only mortality in the entire cohort; otherwise, there was no significant difference in the major complication rates between the two groups – 0.7% in group A and 1.7% in group B (p = NS). The rate of minor complications was higher in group B compared to group A (18.8% vs. 11%, respectively; $p = 0.004$). However, the overall complication rate in patients who had OP procedures in groups A and B combined (57/291 – 19.6%) was significantly higher than in patients who had both LAP and CON procedures combined in both groups (39/350 – 11.1%) – $p = 0.003$. When this comparison was performed in only group B, the results were similar: in the OP group the complication rate was 32/128 (25%), and in the LAP and CON groups combined it was 16/106 (14.1%) – $p = 0.04$. The overall complication rate in our series was 15%.

Table 4. Complications

Complication by type of procedure	Group A *n* (%)	Group B *n* (%)
OP		
Postoperative ileus	13	10
Wound infection	10	12
Anastomotic leak/re-laparotomy	1	1
Line sepsis	0	2
UTI	0	2
Infectious colitis	0	1
DVT/PE	1	4
Total	25 (15.3)	32 (25)
LAP		
Postoperative ileus	7	3
MI	0	2
Intraabdominal bleeding-conservative management	0	1
Anastomotic leak/re-laparotomy	0	1
Wound infection	1	0
UTI	2	1
Pneumonia	1	0
Total	11 (6)	8 (9.9)
CON		
Postoperative ileus	4	4
Anastomotic leak/re-laparotomy	2	0
Wound infection	5	3
Line sepsis	0	1
Pneumonia	1	0
Total	12 (19.7)	8 (32)
Total*		
Major complications	3 (0.7)	4 (1.7)
Minor complications	45 **(11)**	44 **(18.8)**

* Rates of major complications in group A compared to group B – p = NS
LAP – laparoscopy, OP – open, CON – converted, UTI – urinary tract infection; DVT – deep venous thrombosis; PE – pulmonary embolism; MI – myocardial infarction

Discussion

As defined by the US Census Bureau, older Americans are individuals over 65 years of age; while the oldest old are defined as over the age of 85 years. The growth of the population of older Americans has affected every aspect of our society, presenting challenges as well as opportunities to policymakers, families, businesses, and health care providers. While the average life expectancy in 1900 was 47 years, today's life expectancy is more than 76 years. Similarly, Americans over the age of 65 represented only 4% of the population in 1900, while in 2000, they accounted for nearly 13%; by 2030, it is projected that one in five Americans will be age 65 or older. The size of the older population is projected to double over the next 30 years, growing to 70 million by 2030. Florida, Pennsylvania, Iowa, West Virginia, and North Dakota have the highest proportion of older Americans - approximately 15% or more [8]. Since the population in the Western world is getting progressively older, and health care resources are limited, there is a need for critical evaluations of the short-term surgical outcome in the elderly. It has already been established in other surgical disciplines that elderly patients may benefit from various surgical procedures such as cardiothoracic [9] or anti-reflux [10] procedures. The purpose of the current study was to assess the short-term outcomes of laparoscopic colorectal procedures performed in the elderly compared to younger patients, and compared to traditional, open surgery.

In order to avoid confounding factors such as outcomes of emergency as opposed to elective procedures, procedures performed for colorectal cancer and the effects of radiotherapy and chemotherapy, and stoma-related issues (longer operative time, stoma-related complications and extra time required for stoma education), only elective procedures performed for benign diseases without construction of a stoma were included in the analysis. Furthermore, only elective segmental resections for these limited indications were included: sigmoid colectomy for diverticular disease and ileo-colic resection for IBD and benign cecal polyps in order to minimize diversity. Hand-assisted laparoscopic procedures (HALS) were considered as laparoscopic and included in the LAP group; however, the fact that this group included only 35 cases, it was too small for performing a specific sub-group analysis.

There were significantly more male patients in group A; a possible explanation for this finding may be that younger male patients usually present with complicated diverticular disease that necessitates elective surgical intervention more frequently than do younger females [11].

Significantly more laparoscopic procedures were performed in younger patients which may represent a

tendency of surgeons to offer innovative techniques to younger patients, however older patients had similar postoperative morbidity and similar conversion rates as younger patients, but duration of surgery, stay in the intensive care unit, and postoperative hospitalization, were significantly prolonged in patients older than 70 years [12]. These differences were explained by the higher incidence of significant co-morbidities in the elderly population. The LOS was significantly shorter in younger patients who had both OP and LAP procedures, but not in patients whose operations were converted to open procedures. This finding also may be explained by the incidence of co-morbidities in the elderly, and probably also by non-medical factors such as need for placement in nursing homes and the extra time needed for making the appropriate arrangements. Interestingly, in elderly patients who had LAP procedures, LOS was significantly shorter than in patients who had OP procedures, but there was no difference in the LOS between patients who had LAP or CON procedures. Conversely, in younger patients LOS was similar in patients who had OP and CON procedures, and that was significantly longer than the LOS in younger patients who had LAP. Even when the laparoscopic procedure was converted to an open operation, in elderly patients the LOS remained the same as in patients who had a completed laparoscopic procedure; contrary to younger patients in whom the LOS in patients whose operations were converted was prolonged and similar to patients who had open procedures. In some practices, reactive conversions are made as a response to intraoperative problems such as hemorrhage or organ injury. In our institution, most conversions are made as preemptive conversions to avoid intraoperative problems, especially in the elderly whose tolerance to complications is significantly lower. Preemptive conversions might be undertaken for dense adhesions or failure to identify the ureter or unclear anatomy. Another possible explanation for this finding could be that patients in group CON-B had a shorter convalescence compared to patients in group CON-A due to reduced pain resulting from smaller incisions. The difference in LI between groups CON-B and OP-B was 8 cm on average compared to less than 3 cm between groups CON-A and OP-A. Even though the reasons for this finding are not completely clear, it is a clear demonstration of the benefit of laparoscopy in the elderly that even conversion to open surgery did not result in a prolonged LOS.

The only other difference between group A and B was the length of the incision, which was significantly shorter in elderly patients compared to young patients who had LAP procedures. The explanation for this finding may be that over the last few years some surgeons have performed elective sigmoid colectomies utilizing HALS, and since a substantial percentage of these procedures are performed in younger patients, the incisions in this group are longer. However, even with HALS, the mean LI in the younger patients in group A who had LAP procedures was only 6.4 cm which had no impact whatsoever on any aspect of convalescence.

The overall conversion rate in our entire cohort was approximately 25% which is somewhat higher then the previously reported rate [13]. The independent predictors of conversion of laparoscopic to open surgery in that study [13] were BMI, type of resection (low rectal, left colorectal, right colonic vs. small and other bowel procedures), presence of intra-operative abscess or fistula, and surgeon seniority. This department is a tertiary and quaternary referral center for colorectal surgery; consequently, the volume of complicated cases with intra-abdominal abscesses, enteric fistulas (including to urinary and gynecologic organs), and bulky phlegmons are relatively high. All of these factors translate to higher conversion rates; however, as mentioned above, in the elderly group, conversion in itself did not result in a significant increase in complications or a prolonged LOS.

Complications were significantly more common in patients who had traditional open procedures compared to both laparoscopic and converted procedures combined in both groups of patients. Most complications were minor, while the overall incidence of major complications (anastomotic leaks requiring re-laparotomy, myocardial infarction and mortality) was 1.1% (7/641 patients) with no difference between the two groups; however, minor complications were more common in the elderly population, a finding that may be explained by the significantly higher prevalence of comorbidity in these patients.

Two previous reports assessed various outcomes of laparoscopic colorectal surgery in elderly compared to younger patients [14, 15] and demonstrated that there were no significant differences in factors such as incidence of complications, conversion rates, length of ileus, LOS and length of postoperative disability; other studies concurred with our findings [16, 17]. In the current study the outcome of laparoscopic to open procedures was stratified by patient's age, and demonstrated a clear advantage of laparoscopy over laparotomy in both age groups in every aspect except the length of the operative time.

Conclusion

Laparoscopy offers clear benefits to elderly patients; advanced age should not be considered as a contraindication to performing laparoscopic surgery. Thus, laparoscopy should be considered in all patients in whom either ileo-colic or sigmoid resection is planned regardless of the patient's age.

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