

Surgeon case volume and 5 years survival rate for colorectal cancer



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AIM: Many factors that influence patient outcome in colorectal surgery are not editable, and these are related either the tumor, the patient and the treatment. The surgeon- and hospital-related factors are independent predictors of outcome for colorectal cancer surgery and these are supervision, teaching/training, specialization in colorectal surgery, high caseload, high hospital caseload.

MATERIALS OF STUDY: We evaluated the impact of the experience of 4 surgeons on the 5 years survival rate of patients with colon and rectal cancer and we valued if the surgeons' experience plays an equal role in both.

RESULTS: Four experienced surgeons operated 384 patients with colorectal cancer. Surgeon with the major experience and colorectal-dedicated presented a slightly better total 5 years survival rate, comparing to other surgeons, although he had a considerably better 5 years survival rate in rectal operations.

CONCLUSIONS: We concluded that surgeon- and hospital-related factors directly influence the surgeon learning curve and are therefore rightly considered predictors of outcome in colorectal cancer surgery. A low surgeon or hospital caseload may be compensated by intensified supervision or by improved training and teaching.

KEY WORDS: Colon cancer, Colectomy, Surgeon volume

Introduction

The surgical world was, until recently, quite simple and straightforward. A patient suffering from colorectal cancer would undergo surgery and the only factors determining the patient's outcome would have been related either the tumor (e.g. TNM classification, tumor grading), the patient (e.g. age, sex, comorbidity) or the treatment (e.g. urgency of operation, type of resection,

chemo-radiotherapy) ¹. The surgeon or surgeon-related factors were not part of the equation. However, it is a long-standing and common perception of the general public as well as the medical community that there are good and not-so-good surgeons. The surgeon himself was later identified as an independent prognostic factor for the frequency of loco-regional recurrence and survival in rectal cancer patients ^{2,3}.

Most tumor-related, patient-related and treatment-related predictors of outcome cannot be modified. The majority of surgeon- and hospital-related factors, however, can be influenced positively. Herein lies great promise, since an enhancement of surgeon- and hospital-related factors will lead to a significant improvement in the patient outcome. ^{4,5}

Five surgeon- and hospital-related factors can be considered as significant and independent predictors of outcome in colorectal cancer surgery (supervision, teaching/training, specialization in colorectal surgery, high surgeon caseload, high hospital caseload).

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Materials and Methods

The aim of the study was to analyze the impact of the experience of surgeons on the 5 years survival rate of patients with colon and rectal cancer. We have considered the possible difference of survival between patients that suffered from colon cancer and rectal cancer and we valued if the experience of the surgeon plays an equal role in both.

Clinico-pathological characteristics of the patients were collected, such as sex, age, comorbidities and cancer site (Table I).

Dates of death were recorded in order to evaluate the 5 years survival rate of patients resected for colorectal cancer (right side colon cancer, transverse colon cancer, left side colon cancer, sigmoid cancer and rectal cancer).

In order to consider only patients with colorectal cancer as a reason of death or recurrence, we excluded from the study patients with more than one cancer at different sites (synchronous cancer), patients with different cancers at different time (metachronous cancers), patients with distant metastases at the time of surgery as well as patients dead for causes unrelated to the colorectal cancer.

Results were analyzed using OpenEpi, version 3, open source calculator, and Chi-squared test was applied. $P < 0.05$ was considered statistically significant.

Results

Four experienced surgeons (A-B-C-D) operated 384 patients with colorectal cancer. The results included the

TABLE I - Clinicopathological Characteristics

	No.	%
<i>Patients (Tot):</i>	384	
Male	247	64,3
Female	137	35,7
Median Age	66 Years	
(Range)	31-94 Years	
<i>Comorbidities:</i>		
Cardiac	146	38
Hypertension	116	
Ischemic Heart Disease	25	
Arrhythmia	18	
Diabetes Mellitus	43	11,2
Pulmonary Disease	39	10,2
Neurologic Disease	12	3,1
<i>Site Of Cancer:</i>		
Right Colon	136	35,4
Transverse Colon	19	4,9
Left Colon	45	11,7
Sigma	105	27,3
Rectum	80	20,8

number of patients treated by each surgeon, the type of cancer they treated (Table II) and the 5-years-survival per-year from 2006 to 2010 (Table III).

Surgeon A, who had a larger number of colorectal operations from January 2006 to December 2010 compared to other surgeons, presented a slightly better total 5-years-survival rate (78% versus 68%, 77% and 73%). Considering only rectal neoplasm, the survival rate for surgeon A is better than for others (72% versus 57%, 54% and 50%), which may indicate a greater influence of surgeon experience regarding rectal cancer operation. The overall 5-years-survival rate for colorectal cancer is always higher for all surgeons than the rectal one, because of the worst prognosis of rectal cancer.

Surgeons presented a decline in 5-years-survival rate, respectively in 2010 for surgeon A, in 2009 for surgeon B and in 2008 for surgeon C and D and this depends on a higher number of rectal cancers operated in that years, that consequently is reflected in a low percentage in survival rate.

Nevertheless, analyzing total and rectal neoplasm 5-years-survival rate data with Chi squared test, the results were not statistically significant ($p = 0,4862$ and $p = 0,4067$ respectively).

TABLE II - Number of patients operated by each surgeon from 2006 to 2010 and site of colorectal cancer treated.

	Surgeon A	Surgeon B	Surgeon C	Surgeon D
Nr Patients (Tot)	214	57	64	49
Site Of Cancer				
Right Colon	75	19	21	21
Transverse Colon	11	2	5	1
Left Colon	28	5	7	5
Sigma	60	14	20	11
Rectum	40	19	11	10

TABLE III - 5-years-survival rate for each surgeon and 5-years-survival rate per-year from 2006 to 2010.

	Surgeon A	Surgeon B	Surgeon C	Surgeon D
Total 5-Years-Survival %	78	68	77	73
Rectal Neoplasm				
5-Years Survival %	72	57	54	50
5-Years-Survival Per-Years %				
2006	86	80	83	92
2007	81	88	71	64
2008	81	50	68	33
2009	78	33	75	75
2010	71	63	86	83

Discussion

The individual surgeon is an independent prognostic factor in colorectal cancer surgery. Several surgeon- and hospital-related factors might positively influence the learning curve and therefore enhance patient outcome⁶. The learning curve^{7,8} is a two dimensional representation plotting the number of cases against the outcome for any given surgical procedure.

On the left-hand side we find the young and inexperienced surgeon just graduated in training, with increasing years of training and accumulating experience, the young trainee will eventually become an expert surgeon^{9,10}. Unfortunately, the exact shape of the learning curve is unknown and all factors that change the shape will alter the patient outcome. The surgical procedures are changing in the last years; the treatment quality /cost analysis is different if we analyze elective or urgent patient.¹¹ Several surgeon- and hospital-related characteristics are described as prognostic factors in colorectal cancer surgery. These predictors of outcome, in contrast to traditional prognostic factors, which are tumor- and patient-related, can be influenced positively. An improvement of these surgeon- and hospital-related factors leads to enhancement and acceleration of the surgeon's learning curve and, therefore, to an improvement in the patient outcome.

Supervision, training/teaching, specialization, surgeon caseload and hospital caseload are considered as the five main surgeon- and hospital-related confounding factors. In 1991 McArdle and Hole published a prospective study investigating inter-surgeon variability by looking at the outcomes of individual surgeons. Thirteen consultants, none of whom had a special interest in colorectal surgery, operated 645 patients with colorectal cancer. Outcome were completely different between surgeons. The rate of curative resection varied from 40% to 76%, postoperative mortality from 0% to 20%, local recurrence from 0% to 21%, anastomotic leakage from 0% to 25% and survival at 10 years from 20% to 63%. These important differences in outcome were not entirely explained by differences in patient population¹². The existence of a significant inter-surgeon variability was hereby proven. The individual surgeon was later identified as an independent prognostic factor for the frequency of loco-regional recurrence and survival in patients with rectal cancer. In our study we noticed that the surgeon experience has a higher importance in rectal surgery than in colon.

It is generally accepted that colorectal surgery performed by young surgeons in training will be less successful and effective than such surgery performed by experienced and well-trained senior surgeon¹³. Supervision of surgeons in training, however, may help to bridge this difference in experience and surgical expertise. A publication from Singh KK et al. reviewed the results of 245 consecutive patients with colorectal cancer undergone surgery by

either a consultant, a supervised surgical trainee or an independent surgical trainee. A supervised operation was one in which a consultant was scrubbed and actively assisting the surgical trainee. Any given operation was allocated to a junior or a senior surgical trainee, with or without supervision of a consultant. There was a comparatively high proportion of supervised operations, as 28,6% of all resections, and 51,1% of those undertaken by trainees¹⁴. This proportion was higher than that reported in the Lothian and Borders Large Bowel Cancer Project (13.9% and 31.5% respectively)¹⁵. The study showed no difference between operations by consultants, by supervised trainees and by independent trainees in terms of 30-days mortality (6.5%, 6% and 4% respectively), clinical anastomotic leakage rate (9%, 2% and 5%), local recurrence rate (2%, 3% and 7%) and adjusted 5-years disease-related survival rate. Therefore, it was concluded that, with careful patient selection and allocation, properly supervised, trainees could resect a high proportion of colorectal cancers without compromising immediate outcome or long-term survival. Taking into consideration the important improvement in outcome by supervision, it is likely that supervision will also improve outcomes of board-certified surgeons. Therefore, it may be desirable that even fully certified surgeons ask for assistance of a senior specialist surgeon, at least for the critical surgical steps of difficult operations.

The best illustration for the importance of training and teaching was the introduction of the total mesorectal excision (TME) technique for the treatment of rectal cancer, leading to an increase in the rate of sphincter preservation and enhanced preservation of male genital function as well as decrease in local recurrence and an increase in survival¹⁶. Different studies have documented the impact of training and teaching on patient outcome by the introduction of TME technique for rectal cancer surgery.

The Stockholm Colorectal Cancer Study Group more than 20 years ago introduced TME in Sweden in 1994 and surgeons were trained in workshops through videos, histopathology sessions and direct operative instructions by senior members of the Colorectal Research Unit from Basingstoke, UK. From 1995 to 1996, a total of 447 patients underwent TME. The outcomes at 2 years were compared to those from the Stockholm I (n=790) and II (n=542) trials, investigating the value of preoperative radiotherapy as historical controls. There were no differences in 30-days mortality rate, anastomotic leakage rate and overall postoperative morbidity, despite a decrease in the proportion of abdominoperitoneal resections from 55% and 60% (Stockholm I and II trials) to 27%(TME group). The rate of local recurrence at 2 years decreased significantly from 15% and 14% (Stockholm I and II trials) to 6% (TME group), as the 2-years cancer-related mortality rate (15% and 16% to 9%). They concluded that a surgical teaching initiative had a major effect on cancer outcomes¹⁷. The same

results were obtained with the introduction of TME technique in Netherlands by the Dutch Colorectal Cancer Group, where surgeons were trained in workshops and symposia and specially trained instructor-surgeons were used for local teaching and supervision¹⁸. Three different degrees of specialization in the treatment of colorectal cancer patients can be described: general surgeons with special interest in colorectal surgery and dedication to it, colorectal surgeon with subspecialty training and special board certification and colorectal surgeons working in specialized colorectal cancer units¹⁹. Iversen et al. studied the influence of surgical specialty on short-term and long-term outcome following surgery for colorectal cancer. The primary study was a pathology investigation reviewing the type of operation performed. Ten surgeons with four different specialty interest treated 116 patients for primary colorectal cancer. Surgeons with an interest in colorectal cancer resected twice as much colon (280 mm vs 130 mm) and were more likely to perform multivisceral resection in order to remove adjacent clinically involved organs (15% vs 0%) for left-sided colon and rectal cancer. Distal resection margins for sigmoid cancer (55 mm vs 20 mm) and the number of lymph nodes retrieved from the mesentery (13 nodes vs 7,5 nodes) were significantly greater in the group of surgeons with a special interest in colorectal surgery.²⁰ The subsequent study examined the long-term outcome, depending on the surgeons' specialty interest. Twelve surgeons, with different specialty interest, treated 378 patients for primary colorectal cancer over a 4-years period. There were six surgeons with a vascular or transplant emphasis, four surgeons with a general background and two surgeons with colorectal specialty interest. They operated on 126, 98 and 154 patients respectively. A significant association between colorectal specialty interest and a reduced local and overall recurrence rate was found. Patients operated by a surgeon with a general background were 3,42 times more likely to develop a local recurrence than those operated by a surgeon with colorectal interest²¹. However, it is important to notice the difference in the individual caseload for vascular/ transplant, general and colorectal surgery (21, 24,5 and 77 patients/study period respectively)- a difference that may have contributed to the differences in outcome. Surgeons with a special interest in and dedication to colorectal surgery seem to be more familiar with the guidelines for colorectal cancer surgery. This familiarity translates into a different kind of resection performed, resulting in enhanced radicality in accordance with the principles of surgical oncology, and eventually leads to an improvement in the patients outcome. Even in our study, the surgeon with a higher caseload had also a specific interest in colorectal surgery and with this specialty he obtained better surgical results, particularly with rectal cancer. The Royal College of Surgeons of England and the Association of Coloproctology of Great Britain and Ireland published

recommended treatment and outcomes for colorectal cancer surgery. These criteria demand an operative mortality of less than 5% for elective surgery, an anastomotic leak rate less than 8% after anterior rectal resection and less than 4% for other anastomoses, a wound infection rate below 10% after elective surgery and a local recurrence rate inferior to 10% after curative resection. Two publications considering nonspecialist surgeons reported results in accordance with the recommendations mentioned above. However, it is important to notice that in both studies the surgeons can be considered high-caseload surgeons. Whereas the surgeons in both studies considered themselves non specialists, it can be assumed that the good results achieved are partly explained by the high-caseload figures²². Surgery is becoming increasingly complex and subspecialization is therefore often considered necessary. Specialization in colorectal surgery led to a significant reduction in in-hospital mortality and an increase in sphincter preservation²³. Concerning long-term outcome, specialization led to a significant reduction in the rate of local recurrence and an increase in survival²⁴. The formation of specialized colorectal cancer units was the next logical step in an attempt to improve the patient outcome. Machado et al. compared the results for rectal cancer surgery before and after the formation of a specialized colorectal cancer unit. They performed a prospective and retrospective analysis of complications, stoma frequency, local recurrence rate and survival in 252 patients operated for rectal cancer before (1990-1992) and after (1994-1996) the creation of a specialized rectal cancer team. Specialization led to a significant decrease both in the need of permanent stomas (52% before vs 33% after specialization) and in frequency of local recurrence (18% vs 3%); more extensive surgery was used and the anastomotic level decreased from 8 to 4 cm. Cancer-specific survival at 2 years after operation was significantly higher in patients operated in 1994-1996 than in those operated in 1990-1992²⁵. Surgical expertise is acquired through practice. The more operations a surgeon is able to perform, the better outcome for the patients. A positive beneficial relationship between a higher individual surgeon caseload and better outcome is generally assumed^{26,27}. Moreover, the outcome for complex surgical procedures is not only dependent on the surgeon's skills and expertise but also on the experience of an interdisciplinary team²⁸. Therefore the outcome is considerably influenced by the hospital caseload²⁹⁻³². A multicenter trial from Kee F. et al. investigated the influence of surgeon and hospital caseload on mortality for colorectal cancer, analyzing the outcome of 3217 patients with a follow up period of 54 months after diagnosis. In multilevel model, surgeon caseload had no significant effect on mortality at 2 years. Hospital workload, however, had a significant impact on survival; survival of patients treated in hospital with caseload above 33 cases per year was slightly worse than for those

treated in hospital with fewer caseloads³³. On the contrary, another publication that examined the available literature for the effects of hospital volume, surgeon caseload and specialization on the outcomes of colorectal, colon and rectal cancer surgery concluded clearly the presence of a volume-outcome relationship in colorectal cancer surgery, based on hospital and surgeon caseload, and specialization. The volume-outcome relationship appears somewhat stronger for the individual surgeon than for the hospital; particularly for the overall 5-year survival and operative mortality, there were differences between US and non-US data, suggesting provider variability at hospital level between different countries, making it imperative that every country or healthcare system must establish audit systems to guide changes in the service provision based on local data, and facilitate centralization of services as required³⁴. Conventional surgical resection of rectal cancer is linked to a high rate of local recurrence and to an important inter-surgeon variability. It was reasonable to expect that through the introduction of the standardized TME technique, the intersurgeon variability would be substantially reduced. A study of Martling A et al. reviewed 652 patients with rectal cancer underwent TME in Stockholm. All surgeons were trained in the TME technique in workshop. Nevertheless, high-caseload surgeons (>12 operations/ years) had a reduced rate of local recurrence (4% vs 10%) and a reduced rate of rectal cancer death (11% vs 18%). Intersurgeon variability persisted even after the introduction of the standardized TME technique³⁵. Therefore, both training and caseload must be regarded as a prognostic factor for outcome, and it not sufficient to be only a well-trained surgeon but it is necessary to be a well-trained surgeon with a high annual caseload.

A low surgeon or hospital caseload may be compensated by intensified supervision or by improved training and teaching. However, most surgeon- and hospital-related factors are interdependent and neither supervision nor training/teaching nor specialization is possible without an adequate caseload. The caseload-outcome relationship has been discussed in an³⁶ commenting on a publication²⁷ linking hospital caseload to colostomy rate and survival for patients with rectal cancer in a large representative cohort identified from the California Cancer Registry. Smith et al. stressed the importance of the caseload-outcome relationship and provocatively wrote that "it's time for us to take our heads out of the colostomy bag, and take some action". Drolet et al. in a series of elective patients treated for colorectal cancer resection demonstrated a reduction in postoperative mortality if treated by medium/high volume surgeons³⁷.

In 2018 Yi et al. analyzed the impact of surgeon case volume on procedural time, total cost and LOS highlighting that "surgeons with high case volumes can deliver a higher value to patients than low volume surgeons"³⁸.

Conclusion

Five surgeon- and hospital-related factors directly influence the surgeon learning curve and are therefore rightly considered predictors of outcome in colorectal cancer surgery. Improvements in supervision, training/teaching, specialization, surgeon caseload and hospital caseload will therefore translate into enhanced patient outcome.

Riassunto

Molti fattori che influenzano l'esito del paziente operato per Chirurgia coloretale sono indipendenti, come correlati al chirurgo, al numero degli interventi dell'ospedale, all'addestramento chirurgico ed alla specializzazione in Chirurgia coloretale

Abbiamo valutato l'impatto dell'esperienza di 4 chirurghi seniors della nostra istituzione sulla sopravvivenza dei pazienti affetti da carcinoma coloretale valutando il ruolo dell'esperienza del singolo dedicato.

Come risultato quattro chirurghi seniors hanno trattato 384 casi affetti da carcinoma coloretale.

Il chirurgo con la maggior esperienza e dedicato a questa chirurgia ha avuto come risultato una migliore sopravvivenza a 5 anni, avendo trattato un maggior numero di carcinomi rettali.

In conclusione l'esperienza del chirurgo e della squadra chirurgica influenza direttamente la curva di apprendimento e possono essere considerati i fattori che influenzano l'esito.

Una minor esperienza può essere compensate da un programma di supervisione e di addestramento specifico..

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