

Modifiable risk factors in colorectal surgery: central role of surgeon's volume



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Modifiable risk factors in colorectal surgery: central role of surgeon's volume

BACKGROUND: *Our objective was to inform the ongoing debate regarding selective referral of colorectal cancer patients to high-volume surgeons in order to improve outcomes.*

PATIENTS AND METHOD: *We evaluated data on patients treated by colorectal-dedicated surgeons (first study-group) and non specialized surgeons (second study-group). Particular attention has been paid to patients selection in order to collect two study-groups with similar demographic and clinical characteristics, differing only as regards providers' surgical experience in the colorectal field. We focused on postoperative mortality and 5-year overall and cancer-specific survival. We also analyzed resection rates of the primary tumor and colostomy rates for patients with stage I to III rectal cancer, and use of (neo)adjuvant (chemo)radiation therapy for patients with stage II-III rectal cancer by surgeon's volume.*

RESULTS: *The analysis of these 2 study-groups shows better results for patients treated by colorectal-trained surgeons (high-volume surgeons) for each parameter taken into account: lower postoperative mortality (OR 0.32; 95% CI:0.7-0.1; $p=0.04$), increased 5-year overall and cancer specific survival (rising from 41.2% and 46.4% to 56% and 61.2% respectively; OR 1.8; 95% CI:1.3-2.6; $p<0.005$). Patient treated by non specialized surgeons are more likely to receive a permanent colostomy (abdominoperineal resection: APR) (OR 5.9; 95% CI:3.3-10.7) and to undergo a non-resective procedure (OR 4.8; 95% CI:1.9-12)($p<0.005$). No difference was found between the 2 study-groups in the use of (neo)adjuvant (chemo)radiation therapy for patients with stage II-III rectal cancer.*

CONCLUSIONS: *Our analysis suggests that surgeon's volume does impact on outcomes for patients undergoing surgery due to colorectal cancer.*

KEY WORDS: Colorectal cancer, Surgeon's volume.

Introduction

The association between a surgeon's caseload and the surgical outcomes for cancer care have been shown in numerous studies¹.

This relationship has been pointed out for several specialized surgical branches.

High surgeon's operative volume contributes to decreased

surgical morbidity and mortality in high-risk procedures, such as cardiovascular operations and cancer resections². Oesophagectomy³⁻⁷ and pancreatectomy⁸ have vastly superior outcomes when performed by high volume clinicians and/or in high volume hospitals.

The relationship between outcomes for patients with colorectal cancer⁹⁻¹³ and, in particular, for those with rectal cancer¹⁴⁻²⁰, and volume of procedures performed, is significant. Harmon et al.²¹, Hannan et al.²² and Ko et al.²³ found that higher surgeon volume is associated with lower in-hospital mortality. In a broader population-based study, including patients of all ages from the California Cancer Registry, Hodgson et al. found that rectal cancer patients who received care in high-volume hospitals had lower colostomy rates and better survival¹⁹.

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To assess the contribution of surgeon's caseload to colorectal cancer outcomes and to verify whether the surgeon can be considered an influential factor on the prognosis of the colorectal cancer patients, we analyzed post-operative mortality, 5-year overall and cancer specific survival using data on patients operated on by colorectal-dedicated surgeons (first study-group) and non specialized surgeons (second study-group). In addition to these previously observed parameters¹⁴⁻²³, we also evaluated resection rates of the primary tumor and colostomy rates (APR) for patients with stage I to III rectal cancer, and the use of (neo)adjuvant radiation therapy for patients with stage II-III rectal cancer by surgeon's volume. Our objective was to inform the ongoing debate regarding selective referral of colorectal cancer patients to high-volume surgeons in order to improve outcomes.

Patients and method

We retrospectively analyzed data regarding patients who had undergone surgical operation due to stage I, II, or III colorectal cancer in the same institute over two different ten-year periods: the first study-group includes patients operated on during the 1995-2004 period by colorectal dedicated surgeons, whereas the second study group includes patients operated on during 1975 to 1984 by surgeons not trained in colorectal surgery. We classified surgeons into general or colorectal in dependence on the total number of surgical procedures yearly performed in colorectal cancer field (surgeon's volume): we defined colorectal those surgeons who performed more than 21 of such procedures *per year*. In this study individual surgeons performed 6 to 13 operations *per year* (mean 9) in the first study group (general surgeons) and 22 to 37 operations *per year* (mean 24) in the second study-group (colorectal-dedicated surgeons).

Patients characteristics in each study group were similar as regards age, sex, ASA score and cancer stage. Resections were deemed curative where no gross residual disease was evident at the time of the operation in the absence of distant spread. Patients with locally advanced (T4) carcinoma, as well as in case of lymph nodal involvement, were referred for consideration for adjuvant therapy. Exclusion criteria from this study included recurrent disease at presentation, metastatic disease at presentation (stage IV), primary treatment elsewhere, local excision by the transanal or perineal approach, carcinoma in situ or large polyps, and unspecified operative procedures. Cases lost to follow-up or with incomplete follow-up documentation were also excluded from analysis. Patients were followed-up routinely at six month intervals for the first two years and yearly thereafter. Patients who did not present for follow-up appointments were rescheduled through telephone reminders. Our primary analyses focused on the ratio of surgeon's volume to postoperative mortality (within 30 days after

operation) and to 5-year overall and cancer-specific survival for patients who survived at least 30 days after surgery. We also analyzed resection rates of the primary tumor and colostomy rates (APR) for patients with stage I, II, or III rectal cancer, and the use of chemo-radiation therapy for patients with stage II-III rectal cancer in each study group.

Statistical analysis

chi-square tests were used for categorical variables and student's t test was used for age. Survival in each study group was estimated with the Kaplan-Meier method and compared with the log-rank test. To examine the associations of surgeon's volume with 30-day mortality, we used logistic regression. We used similar models to assess the associations of surgeon's volume with permanent colostomies for patients with stage I to III rectal cancer and use of adjuvant radiation therapy for patients with stage II-III rectal cancer. We also assessed separately the effect of surgeon's volume on 30-day mortality for patients with colon cancer and rectal cancer, after recalculating the volume separately in each group. All analyses were performed with SAS software. Results are presented with two-tailed *P* values or 95% confidence intervals (95% CI).

Results

During 1975 to 1984, 407 patients underwent surgery for I, II, or III colorectal cancer, whereas 372 patients were operated on during the 1995-2004 period. From the initial cohort of patients, 250 patients were selected from the first study-group and 250 patients from the second one in order to achieve 2 groups of patients with similar characteristics of age, sex, ASA score and cancer stage. A 5-year follow-up was available for each patient included in the study. Demographic and clinical characteristics of the 500 patients who underwent surgery during these 2 study-periods are shown in Table I. There was a significant inverse association between surgeon's volume and 30-day mortality: 1.2 % for patients undergoing surgery by the highest-volume surgeons, rising to 4.4 % with the lowest-volume surgeons ($p = 0.03$). Low surgeon's volume (<21 operations per year) remained a statistically significant predictor of 30-day mortality in the multivariable analysis (OR 3.8; 95% CI 1.1 to 13.8) (Table II).

Likewise, for rectal cancer (112 and 106 cases in the first and second study-group respectively) adjusted 30-day mortality was significantly higher for patients operated on by low-volume surgeons (OR 5; 95% CI 1.1-5.8; $p = 0.03$) (Table III).

Five-year overall and cancer-related survival after surgery ranged from 56 % and 61.2 % respectively for patients

TABLE I – Demographic and clinical characteristics of the 500 patients who underwent surgery due to colorectal cancer during the 2 study periods.

	Surgeon's specialization		
	Non specialists	Specialists	
N patients	250	250	P: n.s.
Sex			P: n.s.
M	133	141	
F	117	109	
Mean age	63	66	P: n.s.
Stage			P: n.s.
I	67	70	
II	91	94	
III	92	86	
ASA score			P: n.s.
I	12	16	
II	74	82	
III	127	121	
IV/V	37	31	

TABLE II – Outcomes of the 500 patients who underwent surgery due to colorectal cancer during the 2 study periods.

	Surgeon's specialization		
	Non specialists	Specialists	
N Patients	250	250	P: n.s.
30-day mortality	11	3	P = 0.03
5-year overall survival	103	140	P < 0.005
5-year cancer specific survival	116	153	P < 0.005

treated by high-volume surgeons to 41.2 % and 46.4 % respectively for those treated by low-volume surgeons ($p < 0.005$) (Tables I, II). Patients treated by low-volume surgeons had a significantly higher adjusted overall and cancer-specific mortality rate than those treated by high-volume surgeons (OR 1.8; 95% CI 1.3 to 2.6) (Table II).

As regards colostomy rates following rectal resection with curative intent (APR) for stage I to III rectal cancer, in adjusted analyses, patients of low-volume surgeons were more likely to receive permanent colostomies than patients of high-volume surgeons (OR 5.9; 95% CI 3.3 to 10.7; $p < 0.005$) (Table III).

Similar results have appeared for resection rates of the primary tumor for stage I to III rectal cancer: patients treated by first study-group surgeons more frequently underwent non-resective procedure than patients operated on by second study-group surgeons (OR 4.8; 95% CI 1.9 to 12; $p < 0.005$).

Five-years overall and cancer specific survival for rectal-

TABLE III – Procedures undertaken and outcomes for the 218 patients who underwent surgery due to rectal cancer during the 2 study periods.

	Surgeon's specialization		
	Non specialists	Specialists	
N patients	112	106	P: n.s.
Surgical procedure			P < 0.005
Abdominoperineal resection (APR)	75	27	
Anterior resection	12	73	
Non resective procedure	25	6	
CHT-RT	68	67	P: n.s.
30-day mortality	5	1	P = 0.03
5-year overall survival	43	59	P = 0.01
5-year cancer specific survival	49	65	P = 0.01

cancer patients also highlighted the significant difference in outcomes between these 2 study-groups, with better results for the high-volume surgeons group ($p = 0.01$; OR 0.5; 95% CI 0.3 to 0.8) (table III).

Use of adjuvant radiation therapy for stage II to III rectal cancer was evaluated too: in contrast to results previously reported for 30-day mortality and 5-year survival, surgeon's volume was not significantly associated with adjusted rates of radiation therapy (Table III).

Discussion

This study provides further evidence that case volume is an important surgeon-related factor that affects short-term outcomes, including postoperative mortality and the likelihood of performing sphincter-saving surgery. Higher surgeon volume was demonstrated by Harmon and colleagues⁽²¹⁾ to be associated with significantly fewer in-hospital deaths following resection of colorectal cancer.

Furthermore, several studies²⁴⁻²⁶ noted that the risk of local recurrence was increased in patients treated by surgeons not trained in colorectal surgery and after procedures carried out by surgeons who performed only small numbers of resections, resulting in a reduction in disease-specific survival.

Analysis of outcomes other than survival and operative mortality, including resection of the primary tumor, avoidance of a permanent stoma and anastomotic leakage, has indicated that the surgeon may be a prognostic factor in the treatment of colorectal cancer.

It was found that patients treated by high-volume surgeons are more likely to undergo safer anastomoses, with minor risk of anastomotic leakage²⁷.

A large caseload in rectal surgery also results in a significant reduction in permanent stoma formation and postoperative morbidity²⁸.

In a study from the USA, subspecialty training in colonic and rectal surgery was associated with better disease-free

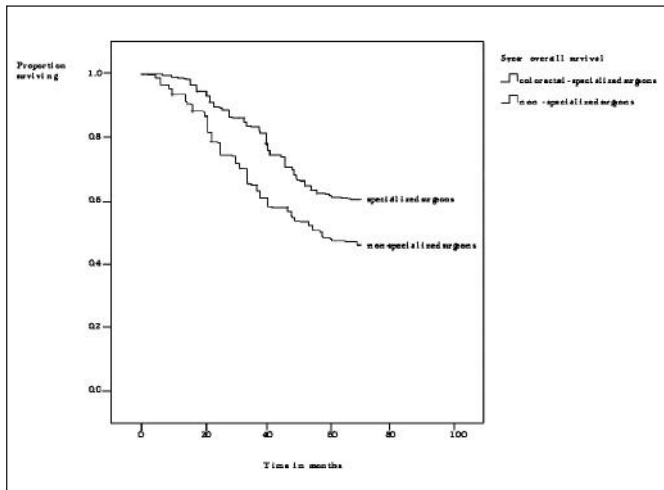


Fig. 1: Kaplan - Meier curves comparing the 5-year overall survival for high-volume surgeons (colorectal-specialized surgeons) and low-volume surgeons (non-specialized surgeons). (Proportion surviving/time in months).

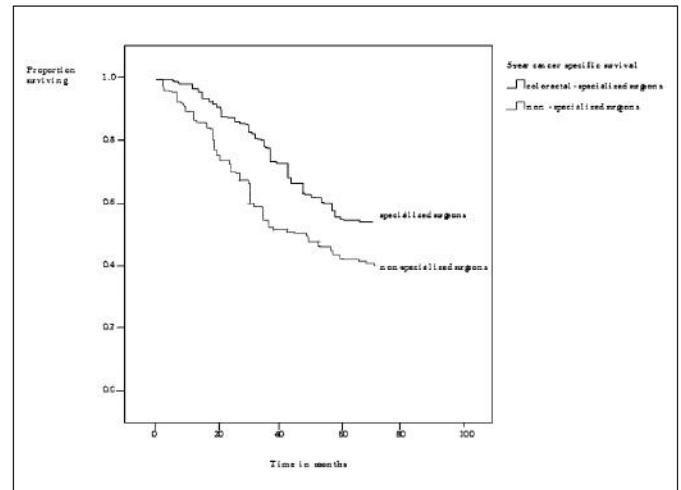


Fig. 2: Kaplan - Meier curves comparing the 5-year cancer-specific survival for high-volume surgeons (colorectal-specialized surgeons) and low-volume surgeons (non-specialized surgeons). (Proportion surviving/time in months).

survival and local control rates in surgery for rectal cancer, and sphincter preservation was more often achieved by colorectal than non-colorectal surgeons¹⁷.

This paper reports the results of the surgical management of colorectal cancer in patients treated by 2 different categories of surgeons: colorectal vs non-colorectal surgeons. The main aim of this study was to examine the impact of surgeon volume and specialization on postoperative mortality and 5 year-survival following colorectal cancer surgery. The effect of these surgeon-related factors on resection of the primary tumor, restoration of bowel continuity following resection of rectal cancer and use of chemo-radiation therapy for patients with stage II-III rectal cancer was also analyzed. Particular attention has been paid to patients selection in order to collect 2 study-groups with similar demographic and clinical characteristics, differing only as regards providers' surgical experience in colorectal field.

The analysis of these 2 study-groups shows better results for patients treated by colorectal-trained surgeons for each parameter taken into account: lower postoperative mortality, increased 5-year overall and cancer specific survival.

Data gathered from this study highlight, in particular, the crucial role of provider's specialization in rectal cancer treatment. A lower recurrence rate and a better 5-year survival in the colorectal-specialized surgeons group are strictly related to the more radical management of such tumors by surgeons trained in the colorectal field, since no difference was found in the use of adjuvant (chemo)radiation therapy for patients with stage II-III rectal cancer.

A Swedish trial evaluated the effects of provider's case-load on the local recurrence after rectal cancer surgery and noted a decrease in local recurrence that was parallel with the increase in operations/year: surgeons with

1-6 operations/year had 16%, surgeons with 7-12 operations/year had 9%, surgeons with more than 12 operations/year had 4%²⁹.

In our experience the growing specialization in rectal cancer management had also led to major employment of anterior resection with sphincter-sparing surgery to the prejudice of permanent colostomy (APR) and palliative operations.

There may also be other factors involved in accounting for the improved survival rates achieved by high-volume surgeons. These could be related to technical factors such as decreased requirements for blood transfusions or a decreased incidence of septic complications. Decreased surgical time may also influence the outcome^{30,31}. In the present study such improvements were observed in direct proportionality to the surgical experience of the operator, although their real impact on outcome was not evaluated.

Conclusion

In the light of such results our analysis suggests that surgeon's volume does impact on outcomes, particularly following rectal cancer surgery.

Armed with these data, a patient might choose his surgeon more rigorously; a view expressed with increasing strength in the literature^{32,33}.

Riassunto

Diversi studi hanno riportato un'associazione significativa fra l'esperienza del chirurgo e i risultati postoperatori nei pazienti affetti da patologia neoplastica.

Al fine di verificare la rilevanza dell'esperienza dell'ope-

ratore nei risultati dopo chirurgia oncologica coloretale, e valutare se il chirurgo possa essere considerato quale fattore in grado di condizionare la prognosi dei pazienti, sono stati posti a confronto i dati inerenti i pazienti operati da chirurghi colo rettali dedicati (primo gruppo in studio) e quelli trattati da chirurghi generali (secondo gruppo in studio). Particolare attenzione è stata posta nella selezione dei pazienti, in modo tale da avere a disposizione 2 gruppi di studio con caratteristiche cliniche e demografiche simili, differenti solamente riguardo all'esperienza dell'operatore (surgeon's volume) in ambito colo rettale.

E' stata inoltre valutata l'incidenza di procedure resettive con intento radicale e il ricorso ad amputazioni addominoperineali per pazienti con cancro del retto in stadio I-III, e l'impiego della (chemio)radioterapia (neo)adiuvante per pazienti con neoplasia rettale in stadio II-III, in funzione del volume operatorio annuo dell'operatore.

Obiettivo dello studio è fornire ulteriori dati riguardo l'opportunità di indirizzare i pazienti con neoplasia colo rettale verso chirurghi con maggiore esperienza in questo campo, al fine di migliorare i risultati conseguibili. L'analisi dei 2 gruppi di pazienti in studio ha evidenziato migliori risultati per i casi operati da chirurghi con maggiore esperienza in ambito coloretale (high-volume surgeons) riguardo ciascun parametro preso in considerazione: minore mortalità postoperatoria (OR 0.32; 95% CI 0.7-0.1; $p = 0.04$), miglioramento della sopravvivenza globale e cancro-specifica a 5 anni (con incremento da 41.2% e 46.4% a 56% e 61.2% rispettivamente; OR 1.8; 95% CI 1.3-2.6; $p < 0.005$).

I dati emergenti da questo studio enfatizzano il ruolo cruciale della specializzazione del chirurgo nel trattamento del carcinoma rettale: la minore incidenza di recidiva e la migliore sopravvivenza a 5 anni osservate nel gruppo di pazienti operati da chirurghi coloretali sono infatti da attribuire al trattamento oncologicamente più radicale di questi tumori fornito da chirurghi specializzati, dal momento che non è stata trovata alcuna differenza fra i 2 gruppi riguardo all'impiego della (chemio)radioterapia (neo)adiuvante nei casi di carcinoma rettale in stadio II-III. Inoltre, i pazienti trattati da chirurghi generali sono stati sottoposti più frequentemente ad amputazione addominoperineale (OR 5.9; 95% CI 3.3-10.7) e ad intervento non resettivo (OR 4.8; 95% CI 1.9-12; $p < 0.005$).

I risultati forniti suggeriscono che l'esperienza del chirurgo condiziona i risultati dopo chirurgia oncologica coloretale.

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Commento e Commentary

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La conclusione abbastanza ovvia di questo studio, come quella degli altri analoghi reperibili in letteratura, conferma che i migliori risultati statisticamente conseguibili in termini di morbilità e di mortalità provengono da centri chirurgici specificamente dedicati al trattamento del cancro del colon-retto, la cui chirurgia è obiettivamente più esposta a rischio. Per conseguire una eccellenza di risultati nel settore della chirurgia del cancro colon-rettale è sicuramente di primaria importanza l'alto numero di interventi eseguiti nella stessa istituzione chirurgica specificamente dedicata a questa chirurgia, anche se ciò si dovesse riferire ad una pluralità di chirurghi operativi nello stesso ambito sulle stesse problematiche tecniche e fisiopatologiche.

Le classiche regole anatomo-chirurgiche delle resezioni coliche sono ben consolidate e confermate dal tempo, ma vari sono i tipi di ricostruzione che si offrono alle scelte del chirurgo, al di quella tra tecnica manuale di sutura e quella meccanica.

Il materiale di sutura da impiegare, la stessa tecnica della sutura, le scelte da adottare per la protezione e la profilassi delle complicazioni possibili, attualmente abbastanza ben definite, offrono ciononostante elementi di cui riflettere, meglio se in condivisione in un gruppo di chirurghi dedicati a questi stessi problemi, ed ancor più se le loro esperienze non sono occasionali ma sono ripetute settimanalmente se non quotidianamente.

Non è strettamente necessario che una singola squadra chirurgica raccolga direttamente un più ampio numero di interventi chirurgici della stessa natura, ma anche la possibilità che differenti gruppi di chirurghi condividano nella stessa istituzione ed in modo concentrato nel tempo le soluzioni ed i risultati di problemi simili, sia nel caso di chirurgia da elezione che di urgenza, rappresenta la chiave per ottenere i migliori risultati nei loro pazienti. La conseguenza logica è che la chirurgia colon-rettale andrebbe fatta solo in queste istituzioni.

Ma questa affermazione introduce importanti elementi di forte critica: se accettata come priorità imprescindibile ne conseguirebbe direttamente la messa in discussione della legittimità di trattare il cancro del colon-retto, al di fuori di situazioni di emergenza, da parte di tutti i gruppi chirurgici non facenti parte di unità chirurgiche specificamente dedicate a questa patologia.

Questa supposta illegittimità come conclusione radicale determinerebbe una altrettanto illegittima e reciproca conseguenza, perché verrebbe ad ostacolare la possibilità per le giovani leve di chirurghi di accrescere la loro esperienza e la loro capacità se operano al di fuori di centri specializzati e dequalificando molti ospedali chirurgici della periferia.

Quindi vi è il massimo interesse di mediare un compromesso valido per i pazienti e per i chirurghi, per permettere a questi di accrescere le loro capacità e per quelli la possibilità di recuperare la loro salute in sicurezza.

La proposta è quella di procedere ad un confronto analitico e sistematico delle esperienze dei vari centri di eccellenza specificamente dedicati alla chirurgia del cancro colon-rettale sia per quanto riguarda i punti di strategia e di tecnica, di considerare i risultati e di definire con sufficiente accuratezza delle linee guida, lasciando infine il resto alle esperienze delle singole squadre chirurgiche.

A questo proposito sarebbe probabilmente utile riconsiderare l'apparente ridondanza delle variabili analizzate nel presente studio.

Anche se non è necessario attenersi strettamente ai dettami delle linee guida esse dovrebbero rappresentare una sorta di "guida didattica" per tutti i chirurghi operanti nell'ambito del cancro colon-rettale, per raggiungere i migliori risultati facendo riferimento ai punti di tecnica e strategia riconosciuti e confermati dalla migliore esperienza collettiva.

Dunque profonda cultura come prima cosa e poi a seguire esperienza diretta.

The rather obvious conclusion of this paper, like that of the similar ones you can find in the literature, confirm that the statistically better results for reduction of morbidity and mortality in colo-rectal surgery is met in surgical centres specifically dedicated to the treatment of these tumours, whose surgery is objectively more exposed to risks.

To obtain results of excellence in this field of surgery the high number of procedures carried out in a same surgical institution specifically dedicated is surely of primary importance, although were performed by a plurality of surgeons, provided operating in the same structure and on the same technical and pathophysiological topics.

The classical anatomic and surgical rules of colon resections are well consolidated and time honoured, but various are the possible options for reconstruction offered to the surgeon, besides those obvious between the manual or mechanical suture.

The suture material to employ, the suture technique itself, the choices of protection and prophylactic strategies to adopt against the possible complications, actually enough well defined, nevertheless offer still elements to reflect on, more useful if shared in a group of surgeons dedicated to these same problems, and moreover if their surgical experiences are not fortuitous but are repeated at least weekly if not every day.

It is not strictly necessary that a single staff collect a larger number of surgical procedure of the same kind, but also the possibility for different groups of surgeons share in the same institution and concentrated in the time the solution and the results of similar problems, both in elective that in emergency situations, is the key to obtain the better outcome of their patients. The logical consequence is that only in these institutions colon-rectal surgery should be done.

This assertion nevertheless introduces important elements of deep criticism: if accepted as an unavoidable priority the consequences of these statements put in discussion outright the legitimacy to treat the colo-rectal cancer, with the exclusion of the emergency circumstances, for all surgical team outside a specifically dedicated surgical unit.

This supposed illegitimacy as a radical conclusion is reciprocating an equally illegitimacy for its opposition against the possibility of the younger levies of surgeons to increase their experience and skill if operating outside this specialized centres, and disempowering many surgical hospitals of the periphery.

Therefore a mediation compromise is of the higher interest for the patients as for the surgeons, to permit an increasing skill for the latter without endanger the possibility to restore in safety their health of the former.

A proposal is that of an analytical and systematic confrontation of the experience of various excellence centres specifically dedicated to colon-rectal cancer surgery as for strategy and technical surgical points, considering the results and stating guides lines sufficiently demonstrated, and leaving the rest to the experience of the individual equipes.

At this propos probably could be useful to reconsider the apparent redundancy of the variables evaluated in the present study.

Although not necessarily to conform oneself to them, the guide lines should represent a sort of "didactical guides" for all surgeons operating on colon-rectal cancer, to reach all together the best results referring to technical points recognized and confirmed from the best collective experience.

Deep cultural education therefore at first and direct experience to follow.