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Standards for Local Recurrence Rates in Both Open and Laparoscopic Rectal Cancer Surgery. How do you Measure Up?

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Abstract

Local recurrence of rectal cancer is the result either of potentially removable tumor cells left in situ or cells already disseminated to areas where surgery cannot reach them. The first scenario infers inadequate surgery, the second implies unfavorable biology. Surgeons who operate for rectal cancer must know local recurrence rates in their patients, and be able to relate them to outcomes achieved by others. We have performed this study to facilitate such a comparison.

Methods: Systematic review of the literature from 1990 to 2010 was performed for publications which reported local recurrence after proctectomy for rectal cancer. Inclusion criteria were: studies of more than 80 patients and local recurrence stratified by histopathologic stage. Pooled local recurrence rates were tabulated by 5 percentile levels, stratified according to TNM stage (I,II,III) and surgical technique (total mesorectal excision or standard), as well as laparoscopic versus open.

Results: Thirty-six studies comprising 16425 patients were pooled for final analysis: Mean follow-up is 40.9 months (1.3-188mths). The table shows local recurrence stratified by tumor biology (stage), operative technique (total mesorectal excision vs. standard) and operative approach (open vs. laparoscopic). The percentiles provide standards against which surgeons can compare their own outcomes

Conclusion: Oncologic outcome of the treatment of rectal cancer is the result of interaction of therapeutic expertise and tumor biology. The percentile tables allow the use of local recurrence rates as an indirect parameter of surgical quality.

Keywords: Laparoscopic surgery

Introduction

Excellent surgical technique is of particular relevance in the treatment of rectal cancers where clinicians have the greatest impact on the survival outcomes. Cancer recurrence, viewed simply, can be the result of either potentially removable tumour cells that are left in situ at time of surgery or these cells have already disseminated to areas where even the best surgery cannot reach them. The first scenario infers that surgery has been inadequate; the second that biology is unfavorable. The first scenario is likely to lead to potentially resectable local recurrence while the later will lead to unresectable local recurrence unless prevented by appropriate neo adjuvant or adjuvant therapy. The oncologic outcome of treatment of low rectal cancer is therefore the result of the interaction of therapeutic expertise and tumor biology. If treatment is good and biology is good, the result should be a cure. If treatment is good but biology is aggressive, there will be local recurrence but also distant recurrence as cells escape surgery, radiation and chemotherapy. If treatment of good biology tumors is inadequate there will be local recurrence but minimal distant spread. If there is inadequate treatment of aggressive tumors the outcome will be disastrous; high rates of local and distant recurrence with patients dying a terrible death. Fulfilling this responsibility involves knowing the local and distant recurrence rates in their patients, and being able to relate them to outcomes achieved by others. We have performed this study to facilitate such a comparison.

Methods

A systematic review of the literature using MEDLINE and pubmed databases was performed for original papers published between 1990 to 2010 reporting results of local recurrence from rectal cancer surgery. The aim was not to achieve a complete coverage of all the literature but to provide a pool of local recurrence data from large series. Two main inclusion criteria were: studies of more than 80 patients and that local recurrence from these studies had to be stratified into histopathological stages which paralleled tumour's aggressiveness. Different staging systems were aggregated according to the AJCC Classification system (Table 1).

TNM	AJCC	Dukes	Astler-Coller
I	I	A	A,B1
II	IIA	B	B2
II	IIB	B	B3
III	IIIA	C	C1
III	IIIB	C	C, C3

III	IIIC	C	C, C, C3
IV	IV		D

Table1: Comparison of TNM, AJCC, Dukes, and Astler-Coller Stages.

Surgical techniques were divided into total mesorectal excision (TME) or standard resection (STD) based on the authors' descriptions. The use of neo-adjuvant or adjuvant therapy was considered to be part of surgical decision making and there for not an inclusion or exclusion criteria. Relevant articles were reviewed and the extracted data include: author, year of publication, study design, number of patients, surgical procedure, laparoscopic or open, length of follow-up, overall LR and DR as well as LR and DR by TNM stage (Table 2).

Good surgery		**Bad surgery**	
Good biology	Bad biology	Good biology	Bad biology
Low local recurrence	Low local recurrence	High local recurrence	High local recurrence
Low distal spread	High distal spread	Low distal spread	High distal spread
Cure	Adjuvant therapy	Salvage surgery	Death

Table 2: Determinants of oncologic outcome of rectal cancer surgery.

Results

Data from 38 studies comprising of 16425 patients were pooled for final analysis. Twenty-eight were open surgeries only, eight were laparoscopic studies only and two studies included both. 28 retrospective, 7 prospective and 3 randomised controlled trials. The overall laparoscopy conversion rate was 7.5%. Mean follow-up is 40.89 months (1.3-188mths): 58 months (24-120mths) for open surgery and 39 months (26-57mths) for laparoscopic surgery. Type of surgery was described in all of the studies apart from one (72% AR, 33% APR and 2% others) and only 14 studies specified the tumour grade (85% well differentiated and 15% poorly differentiated) (Table 3).

The data were tabulated in order of LR and stratified by AJCC stage (I-III), surgical technique (Table 4) as well as laparoscopic versus open (Table 5). Percentiles were derived. Stage IV was eliminated from the analysis secondary to paucity of data. Local recurrence rates were then distributed in five percentiles: P10, P25, P50, P75 and P90. This allowed us to develop a simple reference table using LR as an indirect parameter of surgical quality, graded as excellent, very good, good, fair and poor according to each percentile. The 10th percentile represents the top 10% with excellent results and the 90th percentile is the bottom 10% with the poorest surgical results.

The overall pooled recurrence rate is 11.3% for stage I to III (range 2-35%) and overall distant recurrence rate is 19.5% (range 8.1-39.3%). The median overall LR for stage I was 2.4% (IQ 0-10%), 9% (IQ 4.1-16.6%) for stage II and 16.1% (IQ10-24.1%) for stage III rectal cancers. For open surgeries, 7583 patients had TME while 7129 patients had standard resection. TME was associated with lower LR for all cancer stages when compared to the STD surgical technique. There is a significant more patients in the open group when compared to the laparoscopic group (14172 patients vs 1713 patients, respectively. While open approach seemed to be associated with higher LR in comparison with laparoscopic surgery at all TNM stage, bear in mind that the open group comprises both TME and STD resection while all patients in the laparoscopic group had TME.

Percentiles	**Stage I**	**Stage II**	**Stage III**
10 (Excellent)	0%	3.60%	6.80%
25 (Very good)	0%	4.10%	10%
50 (Good)	2.40%	9%	16.10%
75 (Fair)	5.50%	16.80%	24.70%
90 (Poor)	11.60%	24.30%	35.60%

Table 3: Overall local recurrence for lap and open by AJCC Stage

Percentiles	**Stage I**		**Stage II**		**Stage III**	
	TME	**STD**	**TME**	**STD**	**TME**	**STD**
10 (Excellent)	0%	1.40%	0.90%	7%	3%	10.90%
25 (Very good)	0%	2.90%	4%	9.80%	8.10%	18.50%
50 (Good)	0.50%	5.50%	5.30%	16.30%	10.30%	26.90%
75 (Fair)	2.70%	11.60%	9.50%	24%	18%	35.60%
90 (Poor)	4.60%	14.70%	16.20%	31.20%	21%	39%

Table 4: Local Recurrence for Lap and Open by AJCC Stage and Technique.

Percentiles	**Stage I**		**Stage II**		**Stage III**	
	Open	**Lap**	**Open**	**Lap**	**Open**	**Lap**
10 (Excellent)	0%	0%	4%	0%	3%	0%
25 (Very good)	0.50%	0%	4.50%	1.10%	11.50%	6.10%
50 (Good)	3%	0%	10%	5.40%	19%	8.50%
75 (Fair)	6.80%	2%	18%	8.30%	27.20%	10.20%
90 (Poor)	12.80%	5%	24.30%	17.60%	36.40%	11.30%

Table 5: Local recurrence by surgical approach and AJCC stage.

Discussion

The oncologic outcome is of the utmost importance following rectal cancer surgery, whilst the determinants of local recurrence are multi-factorial they are closely associated with tumour biology and surgical technique. Local recurrence is seldom curable and carries poor prognosis, it also produces incapacitating symptoms which are difficult to palliate [1-6]. Numerous approaches have been used in an attempt to reduce local recurrence rate such as total mesorectal excision (TME) [7], total pelvic lymphadenectomy [8,9], rectal stump irrigation with cytocidal agents, pre and post-operative radiotherapy and adjuvant chemotherapy [10-12]. However, technical ability alone is not the only factor in improving outcome, other components such as knowledge, judgment, training and volume are also crucial. In a multivariate analysis of surgeon-related factors and their effect on the outcomes in rectal cancer, Porter et al. has demonstrated that the risk of local recurrence is lessened with subspecialty training and higher

volume of operations performed. Non-colorectal surgeons had a higher local recurrence rate (hazard ratio 2.49, 95% CI 1.43-4.33,p<0.001) and significantly higher risk for local recurrence is demonstrated in surgeons who performed less than 21 resections (hazard ratio 1.80, 95% CI 1.36-2.40, p<0.001) [13].

There is a shift in paradigm in rectal surgery in the last century, abdominoperineal resection, once the gold standard, is now regarded as unnecessary in most patients. The anatomico-pathological studies have showed that the majority of lymph nodes are found parallel to or proximal to the level of primary rectal tumour [14] and distal margins of 2 cm does not compromise survival or local control [15). The allowance of a close distal margin has led to an increase incidence of sphincter-saving surgery. This has been reflected in our 38 pooled studies where anterior resection is performed at a higher frequency when compared to abdominoperineal resection (72% vs 33% respectively).

Conventional rectal mobilization in either APR or AR by blunt dissection is associated with a high local recurrence. To highlight the importance of surgeon as an independent prognostic factor, the introduction of total mesorectal excision (TME) by Heald in 1982 have significantly reduced the local recurrence rate from approximately 12-20% to 4% [7,16]. Our results have also confirmed such findings, lower local recurrence rates have been seen universally across all AJCC stages when TME is performed. Furthermore, mesorectal excision has been translated into an improvement in overall survival [7,17-19]. Assessment of the quality of TME is done by determining the involvement of tumour at the radial/circumferential margin and distal margin.

The concept of TME involves sharp dissection in the avascular mesorectal plane to keep the visceral layer of the pelvic fascia intact, theoratically it should reduce blood loss and specimen should contain all potential routes of metastatic tumour spread. Deviation from the principle may lead to incomplete TME and may jeopardize oncologic outcome. Moreover, recent studies have suggested TME can be modified according to the tumor distance from the anal verge. For upper rectal cancer, partial mesorectal excision does not compromise oncologic outcomes. However, for middle and low rectal cancer, the complete excision of the mesorectum is deemed necessary [20-24].

In the early development phase of laparoscopic surgery for colorectal cancer, serious concerns are raised regarding the adequacy of oncologic clearance and a high port site recurrence rate of 21% [25]. These concerns have been addressed by results of major comparative studies and randomized controlled trials that have reported no difference in resection margin, lymph node collection, tumor recurrence, and mid- to long-term survival between the open and laparoscopic approach [26]. Port site recurrence is now found to be 2.4% for laparoscopic colorectal cancer cases with 5 years follow up [27] and 1.3% in a more recent randomized controlled trial [28]. Published data from Cochrane review [29], showed there is no difference in recurrence at the site of the primary cancer 7.2% vs 7.7%; OR (fixed) 0.81 (95% CI 0.45 to 1.43) (P = 0.46). Similar cancer-related mortality was found after laparoscopic surgery compared to open surgery, 9.2% vs 10.0%; OR (fixed) 0.66 (95% CI 0.37 to 1.19) (P=0.16). However, Laurent et al. has shown a better 5-year survival in the laparoscopic group, the exact mechanism remains unknown but the author has suggested that mediators of immunologic response (TNF alpha, IL1-6, CRP) are decreased after laparoscopic surgery leading to less immunosuppression in the post operative period [30]. Another possible reason is better exposure and hence better surgery. During laparoscopic surgery, the positive pressure of the pneumoperitoneum can open up the alveolar plane that separates the parietal and visceral fascia of the mesorectum. The optics of laparoscopy provides a clear and magnified view of the pelvis to facilitates sharp TME and identification of important pelvis structures, including blood vessels, pelvic nerves, seminal vesicles, or the posterior vaginal wall.

In contrast to Laurent et al. [30], our data suggested similar local recurrence rates was seen between the laparoscopic TME group when compared to open TME group, this is however limited by a much smaller numbers of patients in the laparoscopic group and a shorter follow-up. Laparoscopic technique is a relatively new entity, the length of follow-up may not be adequate to detect all local recurrences yet.

Tumor biology strongly correlates to tumor stage. The widely used AJCC staging system is a reliable prognostic indicator and lymph node metastasis is an independent risk factor for recurrence and survival in rectal cancer patients [31]. For correct nodal staging, postoperative specimens must be examined thoroughly, and an adequate number of lymph nodes must be obtained. Experts now recommends the use of at least 12 lymph nodes for diagnosis of node-negative disease in colorectal cancer [32-35]. An insufficient number of retrieved nodes from a TME specimen can cause understaging of nodal status which can affect the use of adjuvant therapy.

Incomplete resection, local spillage of tumor cells or just bad technique may compromise the chance of local control of the rectal tumor. Salvage surgery represents a difficult clinical problem and the success rates are not very encouraging, but approximately 30% of patients may benefit from the procedure [36]. Recently Boyle et al. reports that 51% of patients whom has had a potentially curative excision of the local recurrence does not develop a second recurrence during the follow up period. This can be used as an indirect evidence that in approximately half of the patients local failure is related to the primary surgical treatment itself. In the other half, tumor biology is an important prognostic factor that no matter how skilful the surgeon is, it is impossible to eliminate all microscopic spread and local recurrence is inevitable [37].

Under these circumstances, the use neo adjuvant or adjuvant therapy may be more of use to eliminate the microscopic disease. For clinical T3 or T4 or node-positive disease, preoperative chemoradiotherapy is superior to postoperative chemoradiotherapy in reducing local recurrence rates and enhancing anal sphincter preservation. However, chemotherapy is expensive and can cause significant morbidity such as haemorrhagic proctitis, cystitis, radiation enteritis with fistula and tenesmus and severe dermatitis. Kuster et al. [38] has randomized 713 patients into RT+ TME and 704 into TME alone. The overall 5-year local recurrence is 4.6% in the RT+TME group and 11% in the TME group. Knowing one's own local recurrence rate for various AJCC stage is of particular importance here, because if local recurrence rate of 10% or less can be achieved with surgery alone, pre-operative radiotherapy or adjuvant chemotherapy may not greatly extend eventual outcome. On the other hand, if such result is not consistently achievable, the judicious use of neo-adjuvant and adjuvant therapy lies with the surgeon's own knowledge of their limitation.

Finally we would like to acknowledge the lack of methodological uniformity and the variability in the definition of curative surgery and local recurrence among rectal cancer studies, which may play a role of the wide variation of local recurrence rates present in the literature. The diversity in patients' inclusion/exclusion criteria with possible

patient or tumor selection bias, and different protocols for the selection of patients for neo or adjuvant therapy may also influences our results. The intention of this study was not to address methodological issues in reporting local recurrence rates but the aim is to provide standards of acceptable rates that one should aim for. However, since these rates are from large series therefore results may not be achievable in lower volume cetres.

Apart from local recurrence rates, other parameters of good surgery such as anastomotic leak rates, urinary bladder and sexual dysfunction need to be addressed. Despite serious efforts to preserve nerves during open TME approximately, prospective study has demonstrated that 10% of patients continued to have bladder dysfunction beyond 6 months and 30% of the preoperatively potent men had sexual dysfunction postoperatively [39].

Before trying to set new standards for local control in rectal cancer it is important to have in mind that the goal of every surgeon is to overcome the tumor biology and surgical technical issues to achieve the lowest local recurrence possible. Therefore, the 10% benchmark for local recurrence, commonly used today, seems to underestimate our capacity to achieve better results especially in early stage rectal cancer. With the use of the reference table we challenge that surgeons to push their limits and strive to achieve LR rates at least in the lower 50th percentile [Table 6].

Conclusion

Oncologic outcome of the treatment of rectal cancer is the result of interaction of therapeutic expertise and tumor biology. The percentile tables allow the use of local recurrence rates as an indirect parameter of surgical quality [Table 6].

Open Operations	Year	Type	Design
Amato et al. [40]	1991	Open	Retrospective
Bisset et al. [41]	2000	Open	Retrospective
Bokey et al. [21]	1999	Open	Retrospective
Bonadeo et al. [42]	2001	Open	Retrospective
Cecil et al. [43]	2004	Open	Prospective
Dehni et al. [44]	2003	Open	Retrospective
Enker et al. [17]	1995	Open	Retrospective
Ferulano et al. [45]	2000	Open	Prospective
Havenga et al. [46]	1999	Open	Retrospective
Jatzko et al. [47]	1999	Open	Retrospective
Kapiteijn et al. [48]	1998	Open	Retrospective
Kapiteijn et al. [49]	2001	Open	Retrospective
Killingback et al. [50]	2001	Open	Retrospective
Lavery et al. [51]	1997	Open	Retrospective
Law et al. [52]	2002	Open	Retrospective
Manfredi et al. [53]	2001	Open	Retrospective
Morino et al. [54]	2005	Open	Prospective
Nesbakken et al. [55]	2002	Open	Retrospective
Park et al. [56]	2009	Open	Prospective
Paty et al. [57]	1994	Open	Retrospective
Read et al. [58]	2001	Open	Retrospective
Ross et al. [59]	1999	Open	Retrospective
Rubbini et al. [60]	1990	Open	Prospective
Rullier et al. [61]	1997	Open	Retrospective
Sauer et al. [62]	2002	Open	Retrospective
Stockholm Rectal Cancer Study Group [63]	1990	Open	Randomised
Swedish Rectal Cancer Trial. [64]	1997	Open	Randomised
van Lingen et al. [65]	2003	Open	Retrospective
Wibe et al. [66]	2002	Open	Retrospective
Zaheer et al. [20]	1998	Open	Retrospective
Total no			30
Laparoscopic Operations	Year	Type	Design
Park et al. [56]	2009	Lap	Prospective
Ng et al. [67]	2009	Lap	Retrospective
Fukunaga et al. [68]	2010	Lap	Retrospective
Tsang et al. [69]	2006	Lap	Prospective
Morino et al. [70]	2003	Lap	Prospective
Morino et al. [54]	2005	Lap	Prospective
Pugliese et al. [71]	2008	Lap	Retrospective
Anthuber et al. [72]	2002	Lap	Retrospective
Poulin et al. [73]	2002	Lap	Prospective
Agha et al. [74]	2008	Lap	Retrospective
Total no			10

Table 6: Design of laparoscopic operations.

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