



# Laparoscopic surgery for colorectal carcinoma: an overnight victory?

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## Abstract

Laparoscopic surgery became popular in the early 1990s. Cholecystectomy was the first ‘victim’ conquered by the new technique and laparoscopic cholecystectomy became the gold standard operation for gallbladder stones. Laparoscopic colorectal surgery was then attempted, for both benign and malignant disorders. After a short period of enthusiasm, alarming reports were published on laparoscopic surgery for malignant disease. The occurrence of so called ‘port-site’ metastases (PSM) led to a reduction in the use of the minimal invasive technique. In addition, the duration of the operations was criticised, as well as the limited beneficial effects (if any) and the possible violation of oncological surgical principles. The pros and cons of this new technique during its introduction are discussed, with focus on problem areas such as port-site metastases, surgical learning curve as well as beneficial effects. The current status of several comparative studies evaluating the laparoscopic technique is discussed leading to the conclusion that a basis for further research exists and therefore cautious progress is warranted. © 2002 Published by Elsevier Science Ltd.

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## 1. Introduction

In the late 1980s, laparoscopic surgery was embraced enthusiastically by part of the surgical community. Although the technique already existed for more than a century, only gynaecologists had incorporated the minimal invasive approach into their surgical armamentarium, mainly using it for diagnostic procedures and sterilisations. The surgical community only started to show an interest in this technique after the development of the charged coupled device (CCD) camera and the availability of more sophisticated instruments, which rendered the laparoscopic technique more suitable for more complex surgical procedures. At first, the technique was used for cholecystectomy, which led to the method becoming very popular (both with surgeons and the general public). This remains a curious development, because until today the benefits of laparoscopic cholecystectomy over open surgery are scientifically unproven, but the

method was so widely accepted in an extremely short time (an ‘overnight victory’) that it is now considered to be the ‘gold standard’. Of course, following this, every organ in the abdomen or abdominal wall was ‘fair game’ for the laparoscopist and numerous publications on the possibility of performing a procedure laparoscopically and ‘how I do it’ were produced. The first articles of this nature on colonic procedures were published in 1991 [1–4] and almost every known operation concerning the colon was performed using minimal invasive techniques, addressing both benign and malignant disease. Following the initial outburst of publications that were merely dealing with the technical possibility of a laparoscopic colorectal resection, more cautious members of the surgical community issued warnings about the indiscriminate use of the new technique and advocated the use of scientific methods (randomised trials) for its evaluation and possible validation [5,6].

The history behind the development of laparoscopic surgery for colorectal malignancies:

The first laparoscopic procedure for a colonic malignancy was reported in 1991 by Jacobs and colleagues [4] in an article describing a miscellaneous series of laparoscopic colonic resections. The 20 cases presented were

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according to the authors suggestive of a beneficial effect of laparoscopic surgery in colonic resections. The first authors on this subject also mentioned a number of problems like high conversion rate, long operating time, a higher chance of iatrogenic lesions and an unclear cost-effectiveness, prompting them to urge future laparoscopic surgeons to select only cases that were suitable for the minimal invasive approach [7]. There was also genuine concern over the probability of a violation of oncological principles in laparoscopic surgery. To account for the start-up problems and in part to answer sceptical questions from the surgical community, several explanations were put forward. The high conversion rates, longer operating time and iatrogenic lesions were attributed to the learning curve of a new technique and were expected to diminish with growing experience [6,8,9]. The violation of oncological principles could, of course, not be accepted, but was clearly a consequence of the aforementioned learning curve. These explanations were put forward to account for the possible negative aspects of minimal invasive surgery. The possible beneficial aspects of the technique were described as a shorter hospital stay, less pain, shorter postoperative ileus and improved cosmesis. Criteria for selecting appropriate cases were scarce and general agreement was reached only on the expected adhesions, tumour size and cardiovascular ability to undergo laparoscopy.

Wexner and colleagues [10] published an article in 1993 reporting on 74 laparoscopic (or lap-assisted) colonic procedures. A number of problems, as mentioned above, were addressed and tips for solving them were given. In addition, a number of objectives for the implementation of laparoscopic surgery were discussed. The most important objectives (comparing laparoscopic and open surgery) were similarity in complications, morbidity and mortality, complying with existing oncological principles, similarity in outcome and achievement of the postulated benefits. They argued that the technique was possibly feasible, but were very uncertain if the postulated beneficial effects could be achieved, as their study did not show any of them.

Already in January 1993, Alexander and colleagues [11] reported on the first port-site metastasis (PSM) following a laparoscopic colonic resection for malignancy. The port-site where the metastasis was located was not the one used for extraction of the specimen, so another mechanism of transmission had to be responsible. Shortly after this, several other reports on PSM were published [12,13]. In 1994, Wexner and Cohen [14] reviewed this problem and found reports of 30 PSM in literature, accounting for 4% of all published laparoscopic oncological colorectal procedures. This staggering rate of PSM prompted them to issue a warning pointing out the first line of the Hippocratic oath '*primum non nocere*' (first do no harm) and the authors

advised that the laparoscopic technique be used for colorectal oncology only in randomised trials.

In the following years, a large number of publications was produced, mainly addressing feasibility and the learning curve and most authors showed great improvements in the complication rate, operating room time and conversion rate. Agachan and colleagues [15] found a long learning curve, longer than 50 cases, for safely performing this type of surgery with a plateau phase after 70 cases. In the course of this learning curve, complications decreased from 29 to 11 to 7%. Agachan and colleagues [16] showed operating room time decreasing from 201 to 141 min, despite an increasing number of difficult cases. These results were confirmed by Larach and colleagues [17], who showed a further decrease in the complication rate from 7.3 to 1.4%. In addition, attention was given to technical aspects considering the oncological principles and the specific challenges of laparoscopic colorectal surgery. However, alongside these clinical evaluations, a substantial effort was made by several research groups to set up animal models to evaluate and possibly explain the occurrence of PSM. A number of sometimes conflicting results and theories were put forward. Possible explanations for PSM were the chimney effect due to aeration of tumour cells, suppression of the immunological response due to the pneumoperitoneum, biological properties of the tumour and excessive tumour handling as a result of an inadequate technique [18–21]. Different gases were tried, as well as rinsing the abdominal cavity with tumour cell killing substances, without a clearly demonstrated positive effect. On the other hand, several authors could not demonstrate a difference in the rate of tumour seeding in operation wounds between open and laparoscopic surgery or even found higher implantation rates in open surgery [22,23]. In 1997, Bonjer and colleagues [24] found after studying the literature that the reported prevalence of PSM was between 0 and 1.9% for laparoscopy and 0.8 and 3.3% for laparotomy. They concluded, that PSM was not a typical laparoscopic problem and felt justified to start a randomised multi-centre trial (COLOR trial) comparing laparoscopic and open surgery for colorectal malignancies.

As most published studies in the early 1990s on laparoscopic colorectal surgery were focused on feasibility, information concerning the comparison of open and laparoscopic surgery was scarce. Several authors used historical controls to compare the open with the laparoscopic approach and reported on a number of the abovementioned issues, like complications, hospital stay, etc. Laparoscopy produced fewer wound infections, earlier first bowel movement, better cosmesis and, in one study, showed a lower mortality rate for abdominal perineal resection [25]. Open surgery resulted in significantly shorter operating room time and possibly better cost-effectiveness (although specific calculations

were not produced). Equal outcome was reported for hypothermia, overall complication rate, morbidity, resection margins and number of lymph nodes, anastomotic leaks and short follow-up recurrence rate. However, neither of the abovementioned publications described a prospective randomised trial, so these conclusions can only be considered preliminary. The first prospective randomised trial was performed in Copenhagen [26] and described by Stage and colleagues. Although the studied group was relatively small (29

patients after exclusions), the Danish group was able to conclude that laparoscopy matched open surgery for factors such as pathological resection parameters and did significantly better for hospital stay and post-operative pain. Two randomised studies [27,28] (Cleveland and Barcelona trials) with more than 300 patients enrolled reported no PSM after an interim analysis over a follow-up period of 2 years. Franklin and colleagues in 1996 [29] described a prospective study comparing 224 open and 191 laparoscopic colon resections.

Table 1  
Studies comparing laparoscopic and open surgery for colon malignancies

Study	Design	No. patients	Follow-up	End-points	Results	Status
Texas Franklin and colleagues 1990–1995	Comparative	Total 415 Lapsc. 191 Open 224	?	Post op. hospitalisation Wound problems Pathological resection parameters Disease-free survival Recurrence rate	Lapsc.: Better N.S. N.S. N.S. N.S.	Finished
Copenhagen Stage and colleagues 1995–1996	Prospective randomised	Total 34  Excl. 5  Incl. 29	?	Post op. hospitalisation  Post op. pain  Pathological resection parameters Operative blood loss Post op. pulmonary infection Immuno-depression	Lapsc.: Better $P < 0.05$ Lapsc. Better $P < 0.01$ N.S. N.S. N.S. Open less $P < 0.01$	Finished
Barcelona Lacy and colleagues 1993–1996	Prospective randomised	Total 91	21.4 months	Port site metastasis Wound recurrence Recurrence rate	Lapsc. = 0 Open = 0 Lapsc. = 16.1% Open = 15.0%	Accrual closed
Cleveland Milsom and colleagues 1995–1997	Prospective randomised	Total 109  Cancer 90  Adenoma 19	18 months	Pulmonary function  Post op. pain  Post op. bowel movement  Pathological resection parameters Port site metastasis	Lapsc. Better $P = 0.01$ Lapsc. Better $P = 0.02$ Lapsc. Better $P = 0.006$ N.S. Lapsc. = 0	Accrual closed
COLOR trial Wittich and colleagues 1997–	Prospective randomised multicentre international	1500	60 months	Disease free 3-year survival Pathological resection parameters Operative morbidity and mortality Quality of life Cost-effectiveness	No report	Accrual open
NCCTG-934653 O'Connell and colleagues 1996–1999	Prospective randomised multicentre	900	?	Disease-free survival Pathological resection parameters Operative morbidity and mortality Quality of life Cost-effectiveness	No report	Accrual closed
MRC-CLASICC Guillou and colleagues	Prospective randomised multicentre	1200	?	Disease-free survival  Pathological resection parameters Operative morbidity and mortality Quality of life Cost-effectiveness Loco-regional and distant metastasis Eligibility factors for laparoscopy	No report	Accrual open

excl., excluding; incl., including; lapsc., laparoscopy; post op., post-operative; N.S., non-significant.

No PSM was found in this study and the overall results were equal or better for the laparoscopic approach. It is obvious that the aforementioned trials are very important for the introduction of laparoscopic colorectal surgery, because they show that at least similar results to open surgery might be expected. They paved the way for the larger prospective randomised multicentre trials [30–32], which are currently running and that will hopefully provide us with more definite answers on the applicability of minimal invasive surgery for colorectal malignancies. An overview of all the mentioned studies and the currently running multicentre trials is given in Table 1.

## 2. Conclusions and discussion

The available literature does not provide a clear picture of the incidence of PSM. After the initial alarm was raised, several publications suggest that there is no real difference in the incidence of PSM/wound recurrences between open and laparoscopic surgery. A number of causative factors have been postulated, but a consensus is only reached with regard to the importance of surgical expertise, blaming most of the initial rate of PSM on the learning curve accompanying the introduction of a new surgical technique. It is obvious that a large prospective randomised trial is necessary to prove the existence or absence of the phenomenon of PSM.

It is far more clear that a lot of the requirements put forward by Wexner and colleagues, amongst others are being met by today's laparoscopic colorectal surgery. Oncological standards are met, operating room time is being reduced significantly and the conversion rate is acceptable. The complication rate is comparable to open surgery. This shows that the technique is at least feasible and can be safely executed by an experienced laparoscopic surgeon. Notwithstanding the enormous technical progression that has been achieved, the case for laparoscopic colorectal surgery cannot be won if the beneficial effects of the procedure are not addressed. Although the rate of wound infections and cosmesis appears to be better for the minimal invasive procedure, less certain are the postulated benefits like a shorter recovery period and hospital stay, as well as reduced postoperative pain. These benefits should be clearly demonstrable, as it would not make much sense to introduce an initially difficult and expensive surgical technique if there was hardly any or no gain for the patient.

At this moment, it is clear that the introduction of laparoscopic colorectal surgery for cancer has not led to an 'overnight victory'. However, neither is it defeated and, although several major setbacks had to be overcome, the minimal invasive approach is still viable. Hopefully, the currently performed prospective randomised trials

will more clearly show the pros and cons of laparoscopic and open colorectal surgery for cancer, so that we can eventually make an evidence-based decision on the use of either technique.

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