

# Bladder and sexual dysfunction following laparoscopically assisted and conventional open mesorectal resection for cancer

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**Background:** Bladder and sexual dysfunction, secondary to pelvic nerve injury, are recognized complications of rectal resection. This study investigated the frequency of these complications following laparoscopically assisted and conventional open mesorectal resection for cancer.

**Methods:** A total of 170 patients with rectal cancer was identified from a previous randomized trial of laparoscopic *versus* open resection. A retrospective analysis of bladder and sexual function before and after operation was performed by means of postal questionnaires and telephone interviews.

**Results:** At the time of the study, 111 (65 per cent) of the 170 patients were alive, of whom 80 (72 per cent) responded. Of the responders, 40 patients had undergone laparoscopically assisted resection and 40 had had an open operation. No significant deterioration in bladder function following operation was observed, although two patients in the laparoscopic group required long-term intermittent self-catheterization. A significant difference in male, but not female, sexual function was noted, with seven of 15 sexually active men in the laparoscopic group reporting impotence or impaired ejaculation, compared with only one of 22 patients having an open operation ( $P = 0.004$ ). All patients with bladder or sexual dysfunction in the laparoscopic group had resection of either bulky or low rectal cancers.

**Conclusion:** Laparoscopically assisted rectal resection is associated with a higher rate of male sexual dysfunction, but not bladder dysfunction, compared with the open approach. This has implications, particularly for sexually active males with bulky or low rectal cancers, when deciding the best operative approach.

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## Introduction

Bladder and sexual dysfunction are recognized complications following surgical resection of the rectum. The incidence varies greatly, with reported values of 8–54 per cent for bladder dysfunction<sup>1–3</sup> and 18–59 per cent for sexual dysfunction<sup>4–11</sup>. The incidence is dependent on the extent of resection<sup>12</sup> and the surgical technique employed.

Total mesorectal excision (TME) is the preferred method for oncological resection of low rectal cancers. It achieves complete excision of the rectum together with its draining lymphatics, and results in low rates of local recurrence<sup>13,14</sup>. For cancers of the mid and upper rectum, wide mesorectal excision (WME) is often preferred to TME, with preservation of the uninvolved lower rectum. Both techniques employ dissection in the tissue plane that separates the mesorectal fascial envelope from the presacral fascia<sup>13</sup>.

However, care must be exercised because excessive traction during the dissection or lateral dissection outside this plane may lead to neuropraxia or permanent injury to the sympathetic and parasympathetic nerves that course along the lateral pelvic side-walls. Inadvertent damage to these nerves will result in postoperative bladder and sexual dysfunction, the severity of which will be dependent on the extent of the injury and the relative components of the autonomic supply affected<sup>10,15,16</sup>.

Laparoscopic resection of the rectum has been shown to achieve oncological tumour clearance equivalent to that of conventional open operation, with the potential benefits of reduced pain, shorter hospital stay and earlier return to normal function<sup>17–20</sup>. The results of large randomized multicentre trials<sup>21–23</sup> are eagerly awaited to determine the cost-effectiveness of laparoscopic surgery in malignant disease<sup>24</sup> and its influence on local recurrence rates and

long-term survival. Although technically more demanding and associated with a long learning curve<sup>25</sup>, the magnified view of the pelvis afforded by the laparoscope<sup>26</sup> may facilitate identification of the autonomic nerves and thus prevent inadvertent injury. The rates of bladder and sexual dysfunction following laparoscopic rectal resection have not been reported previously. The authors therefore conducted a retrospective analysis of bladder and sexual function in patients who had undergone rectal resection as part of a previous randomized trial of laparoscopically assisted *versus* conventional open operation for colorectal malignancy<sup>27</sup>.

### Patients and methods

One hundred and seventy patients with a diagnosis of rectal cancer were identified from a database of 250 patients previously enrolled in a randomized trial of laparoscopically assisted *versus* open operation for colorectal cancer<sup>27</sup>. The medical records and histological reports of all patients were scrutinized for details of patient demographics, operative technique, postoperative complications and follow-up progress.

Within the confines of the trial, patients had been randomized to either laparoscopic or open operation by means of computer generation. All patients had been prepared for operation, as per the trial protocol, with oral osmotic bowel preparation, low molecular weight heparin and prophylactic antibiotics.

Patients randomized to open operation underwent resection according to standard oncological practice. This included sharp diathermy mobilization of the left colon, and if necessary of the splenic flexure, high ligation of the inferior mesenteric pedicle, *en bloc* resection of involved adjacent organs and sharp diathermy mobilization of the rectum within the mesorectal plane. TME or WME was dictated by the height of the tumour. Anastomoses were performed using established stapling techniques and defunctioned at the discretion of the surgeon. Patients with low tumours (less than 5 cm from the anal verge), in whom oncological resection was not possible without compromise of the sphincter complex, underwent abdominoperineal resection.

Patients randomized to the laparoscopic group underwent rectal resection according to the same oncological principles outlined for open surgery. Generally, a four-port technique was employed, supplemented by an additional fifth port as necessary, with pneumoperitoneum not exceeding a pressure of 12 mmHg. Sharp diathermy mobilization of the left colon, and if necessary of the splenic flexure, was followed by intracorporeal ligation of the inferior mesenteric pedicle using an endovascular stapler.

Mobilization of the rectum in the mesorectal plane was performed to a level below the distal edge of the tumour. A small suprapubic incision was made, the dissection completed, and the rectum divided. Anastomoses were performed using similar stapling techniques to those used in the open procedure, and defunctioned at the discretion of the surgeon. For laparoscopically assisted abdominoperineal resections, the abdominal operation was carried out in a similar fashion but with intracorporeal division of the proximal colon, formation of an end-colostomy, and delivery of the specimen through the perineal wound.

Structured postal questionnaires based on previously validated instruments were utilized to assess patients' bladder and sexual function before and at least 1 year after operation. The international prostatic symptom score (I-PSS)<sup>28</sup>, with minor modification, was used to assess bladder function, with additional questions to assess urinary incontinence and the need for intermittent self-catheterization. The international index of erectile function<sup>29</sup> was used to assess male sexual function, with emphasis on domains to evaluate erectile function, ejaculatory function, sexual desire and overall sexual satisfaction. Female sexual function was assessed by evaluation of sexual desire, dyspareunia and sexual satisfaction<sup>30</sup>. The postal survey was supplemented by follow-up telephone interviews to validate the information retrieved and clarify any areas of discrepancy.

### Statistical analysis

Data on patient demographics, operative details, histological details, and preoperative and postoperative bladder and sexual function were entered into a statistical software package (Statistical Package for the Social Sciences version 9.0; SPSS®, Chicago, Illinois, USA), and analysed using the Mann-Whitney *U* test or Wilcoxon signed ranks test for continuous variables and the  $\chi^2$  test or Fisher's exact test for categorical variables. Differences in preoperative and postoperative bladder and sexual dysfunction between the two groups were analysed on an intention-to-treat basis.

### Results

Of the 170 patients analysed, 86 (51 per cent) were randomized to the laparoscopic group and 84 (49 per cent) to open operation. Patient demographics, operative details and histological data are shown in *Table 1*. There was no statistically significant difference between the groups in terms of age, sex distribution, the number and types of operative procedures performed, or the tumour (T) and nodal (N) stages of the resected specimens. In total, 47 per cent of patients underwent high anterior resection, 41 per cent had low anterior resection, and 9 per cent had

**Table 1** Demographic and clinical characteristics of patients undergoing laparoscopically assisted or conventional open resection of rectal cancer

|   | Laparoscopic approach<br>(n = 86) | Open operation<br>(n = 84) |
|---|-----------------------------------|----------------------------|
| Median (i.q.r.) age (years)                           | 64 (53–69)                        | 62 (55–69)                 |
| Sex ratio (M : F)                                     | 42 : 44                           | 52 : 32                    |
| Operation   |                                   |                            |
| High anterior resection                               | 42 (49)                           | 38 (45)                    |
| Low anterior resection                                | 31 (36)                           | 38 (45)                    |
| Abdominoperineal resection                            | 9 (10)                            | 6 (7)                      |
| Hartmann procedure                                    | 3 (3)                             | 1 (1)                      |
| Other   | 1 (1)                             | 1 (1)                      |
| Tumour stage*   |                                   |                            |
| T1  | 4 (5)                             | 3 (4)                      |
| T2  | 5 (6)                             | 12 (15)                    |
| T3  | 71 (85)                           | 65 (79)                    |
| T4  | 4 (5)                             | 2 (2)                      |
| Nodal stage*  |                                   |                            |
| N0  | 43 (51)                           | 45 (55)                    |
| N1  | 13 (16)                           | 15 (18)                    |
| N2  | 21 (25)                           | 18 (22)                    |
| N3  | 7 (8)                             | 4 (5)                      |
| Median (i.q.r.) height of tumour from anal verge (cm) | 10 (7–14)                         | 8 (6–13)                   |
| Adjuvant treatment                                    |                                   |                            |
| Radiotherapy  | 4 (5)                             | 6 (7)                      |
| Chemotherapy  | 11 (13)                           | 16 (19)                    |

Values in parentheses are percentages unless otherwise indicated. \*Histopathological staging was not performed in four patients because of non-malignancy or resection not carried out. i.q.r., Interquartile range

abdominoperineal resection. Ten patients (12 per cent) in the laparoscopic group were converted to open resection (bleeding, three; excessive adhesions, four; anatomical uncertainty, one; technical difficulties, two). Three patients (3 per cent) in the laparoscopic group and one (1 per cent) in the open operation group underwent a Hartmann procedure. One patient in each group underwent formation of a defunctioning loop colostomy for locally advanced cancer. The majority of tumours were stage T3 (82 per cent). Two patients (one laparoscopic, one open operation) were subsequently discovered to have benign pathology on histological examination.

One hundred and eleven patients (65 per cent) were alive at the time of the survey, of whom 80 (72 per cent) responded to the postal questionnaire. The median interval between operation and questionnaire assessment was 3 (interquartile range (i.q.r.) 2–4) years. Among responders, there was an exact 50 per cent split, with 40 patients in each of the two groups.

### Bladder function

Most patients had minimal urinary symptoms before operation, which was reflected in the median I-PSS score of 3 (i.q.r. 2–4) out of a possible score of 35. On follow-up

there was no significant deterioration in median I-PSS symptom score in either the laparoscopic or the open group for men or women. Two patients in the laparoscopic group and none who had an open operation required long-term intermittent self-catheterization ( $P = 0.49$ ). One was a 57-year-old man who underwent abdominoperineal resection for a T3 N2 low rectal cancer, the other a 41-year-old woman who had low anterior resection for a T3 N1 tumour. Both had normal preoperative bladder function.

### Sexual function

Of the 21 patients in the laparoscopic group who were sexually active before operation, the majority (15 of 21) were male. At a median of 3 years' follow-up, 16 of the 21 patients remained sexually active. The corresponding figures for patients having open operation were 28 (22 men) sexually active before operation, with 25 of the 28 patients remaining sexually active on follow-up. This reduction in sexual activity observed in the laparoscopic group was not statistically different from that observed for open operation ( $P = 0.26$ , Fisher's exact test).

In the laparoscopic group, five of 15 men who were previously sexually active became impotent after operation, with a further patient reporting moderately impaired

erectile function (Table 2). Among these five men, two had undergone a resection for a locally advanced rectal tumour (T3 N2), one had an abdominoperineal resection, one an ultra-low anterior resection, and the other a high anterior resection. In comparison, only one of 22 men in the open surgery group became impotent after operation, with two patients reporting a moderate impairment in erectile function. Similarly there was a significant difference between the two groups in terms of ejaculatory function, with six of 15 men in the laparoscopic group reporting inability to ejaculate after operation, compared with one of 22 in the open group. In the laparoscopic group, of the six men with inability to ejaculate, four were impotent, one had reduction in erectile function, and one had normal erection. In the open operation group, the only patient affected had both erectile and ejaculatory dysfunction. Hence, the overall rate of male sexual dysfunction after operation was seven of 15 in the laparoscopic group compared with one of 22 men having an open operation. This was reflected in the sexual satisfaction score, with a one-point median deterioration in the laparoscopic group, compared with no deterioration in the open group ( $P = 0.06$ ).

Six women in each group were sexually active before operation, and all but one in the open operation group remained sexually active on follow-up. One patient reported increased dyspareunia after the laparoscopic approach, but remained sexually active.

## Discussion

The regulation of normal bladder and sexual function is dependent on an intact parasympathetic and sympathetic nerve supply. Sympathetic nerves emerge from the thoracic and lumbar spinal cord, synapse in the sympathetic ganglion, and send postganglionic hypogastric fibres to join the preganglionic parasympathetic nervi erigentes in the pelvic plexuses. It is along the pelvic side-walls and anteriorly

where they enter their end-organs that these autonomic nerves are susceptible to injury during rectal resection. The pattern of injury depends not only on the extent of nerve trauma (e.g. unilateral *versus* bilateral), but also on the relative components of the autonomic supply injured, giving rise to variable symptoms of bladder and sexual dysfunction. In simple terms, the parasympathetic supply controls bladder contraction and normal erectile function, with injury resulting in detrusor areflexia and impotence, while the sympathetic supply controls bladder relaxation and ejaculation, with injury resulting in bladder instability and retrograde ejaculation or anejaculation.

The authors have attempted to document for the first time the rates of bladder and sexual dysfunction following laparoscopically assisted resection of rectal cancer and compared them with dysfunction following the conventional open operation. This was done by means of postal questionnaires sent to patients previously randomized within the context of a clinical trial. While postal questionnaires are subject to inherent biases, the authors consider their use to be justified when dealing with sensitive subject matter such as sexual and bladder function, especially when supported by telephone interviews<sup>31</sup>. The high response rate (72 per cent) achieved in this study minimized the effects of any response biases, which in any event should have been similar for both groups.

The incidence of bladder dysfunction was low following both laparoscopic and conventional open approaches, with no difference between the two groups in terms of change in median I-PSS scores. Only two patients (both in the laparoscopic group) reported significant bladder dysfunction necessitating intermittent catheterization, giving an overall incidence of 2.5 per cent. This value compares favourably with the findings in previous studies, which have reported the incidence of bladder denervation following rectal resection as ranging from 8 to 54 per cent<sup>1-3</sup>. Many of these earlier studies did not employ present-day techniques

**Table 2** Male sexual dysfunction after resection of rectal cancer

|   | Laparoscopic approach<br>( <i>n</i> = 15) | Open operation<br>( <i>n</i> = 22) | <i>P</i> |
|---|---|------------------------------------|----------|
| Erectile function                             |   |                                    | 0.03†    |
| No difference                                 | 9   | 19                                 |          |
| Reduced                                       | 1   | 2                                  |          |
| Impotent                                      | 5   | 1                                  |          |
| Able to ejaculate                             |   |                                    | 0.01†    |
| Yes   | 9   | 21                                 |          |
| No  | 6   | 1                                  |          |
| Overall sexual dysfunction*                   | 7   | 1                                  | 0.004‡   |
| Median (i.q.r.) change in sexual satisfaction | -1 (-3, 0)                                | 0 (-0.25, 0)                       | 0.06‡    |

\*Some patients were both impotent and unable to ejaculate. i.q.r., Interquartile range. †Fisher's exact test; ‡Mann-Whitney *U* test

of TME. Since the introduction of TME and the recognized need for autonomic nerve preservation, the incidence of bladder complications appears to have diminished to a level of 0–4 per cent<sup>7,16</sup>.

In comparison, sexual dysfunction remains a significant problem following rectal resection. This was particularly so for the 37 sexually active men in the present study, of whom eight experienced sexual dysfunction, compared with only one of 12 sexually active women. These figures compare favourably with those of older studies that reported rates of male impotence of 18–34 per cent and ejaculatory problems in 19–59 per cent<sup>4–11</sup>, and are similar to recent studies utilizing TME in which impotence is reported as 11–25 per cent<sup>15,16,32</sup>.

A significant difference in male sexual dysfunction was observed between the two groups. Interestingly, the rates of impotence and ejaculatory problems were similar, suggesting that both parasympathetic and sympathetic nerves are equally at risk of injury, and indicate that the most likely site of damage is at the lateral pelvic plexus where both autonomic systems converge.

As the stage of the tumours and the types of operation performed were similar between the two groups, the difference in sexual dysfunction must relate to technical differences between the two surgical approaches. It is accepted that laparoscopic surgery is technically more demanding than the open counterpart, and this is reflected in its protracted learning curve<sup>18,25,33–35</sup>. However, all the surgeons performing laparoscopically assisted rectal resection in the present study were experienced laparoscopic surgeons proficient in TME. The high incidence of sexual dysfunction in the laparoscopic group is particularly surprising given that completion of the rectal dissection and specimen delivery were in the main performed via a small suprapubic wound incision rather than by a totally intracorporeal technique. However, it should be noted that of the two patients requiring intermittent catheterization and the five patients with impotence in the laparoscopic group, all were operated on for either locally advanced cancers (T3 N1–2) or had low or abdominoperineal resections. The high incidence of bladder and sexual dysfunction therefore appears to be related to technical difficulties in resecting these particular types of tumour by means of a laparoscopic approach. This may be due to the increased difficulties in achieving adequate anterior rectal retraction within the confines of the male pelvis and a closed abdomen, particularly when the tumour is bulky or sited distally. However, as the rate of bladder denervation was low, the nerve damage must have occurred after the nerve to the bladder has branched off in the deep narrow pelvis of the male, where precise visualization and dissection may be more difficult. The proposed advantages of the laparoscopic

technique, namely the improved visibility afforded by a magnified, well illuminated field of view, appear to be more than offset by these technical difficulties.

The high incidence of male sexual dysfunction translated into a significant difference in patient-reported satisfaction with sex life between the two groups. It is appreciated that the assessment of sexual function is a complex issue, dependent on both physical and psychological factors, with the definition of an adequate sex life varying from individual to individual. These difficulties are compounded in patients with rectal cancer, many of whom are elderly and not sexually active. However, the fact remains that the authors have observed an increased frequency of sexual dysfunction following laparoscopic resection. This fact should guide the surgical approach to this disease, particularly in sexually active males with bulky or low rectal cancers.

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