# Impact of Robotic Surgery on Sexual and Urinary Functions After Fully Robotic Nerve-Sparing Total Mesorectal Excision for Rectal Cancer

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**Background:** Urinary and sexual dysfunctions are recognized complications of rectal cancer surgery. Their incidence after robotic surgery is as yet unknown. The aim of this study was to prospectively evaluate the impact of robotic surgery for rectal cancer on sexual and urinary functions in male and female patients.

**Methods and Procedures:** From April 2008 to December 2010, 74 patients undergoing fully robotic resection for rectal cancer were prospectively included in the study. Urinary and sexual dysfunctions affecting quality of life were assessed with specific self-administered questionnaires in all patients undergoing robotic total mesorectal excision (RTME). Results were calculated with validated scoring systems and statistically analyzed.

**Results:** The analyses of the questionnaires completed by the 74 patients who underwent RTME showed that sexual function and general sexual satisfaction decreased significantly 1 month after intervention: $19.1 \pm 8.7$ versus $11.9 \pm 10.2$ ($P < 0.05$) for erectile function and $6.9 \pm 2.4$ versus $5.3 \pm 2.5$ ($P < 0.05$) for general satisfaction in men; $2.6 \pm 3.3$ versus $0.8 \pm 1.4$ ($P < 0.05$) and $2.4 \pm 2.5$ versus $0.7 \pm 1.6$ ($P < 0.05$) for arousal and general satisfaction, respectively, in women. Subsequently, both parameters increased progressively, and 1 year after surgery, the values were comparable to those measured before surgery. Concerning urinary function, the grade of incontinence measured 1 year after the intervention was unchanged for both sexes.

**Conclusions:** RTME allows for preservation of urinary and sexual functions. This is probably due to the superior movements of the wristed instruments that facilitate fine dissection, coupled with a stable and magnified view that helps in recognizing the inferior hypogastric plexus.

**Keywords:** nerve-sparing surgery, rectal cancer, robotic surgery, sexual dysfunction, total mesorectal excision, urinary dysfunction

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Colorectal cancer is a major health problem in Europe and the United States: it is currently the third- and the second-most common cancer, respectively, both in males and in females.[1] The 5-year relative survival, for rectal cancer only, is 68%, with an estimated incidence for 2011 of around 40,000 new cases in the United States.[2,3] Over the past 3 decades, we have seen an increase in survival from rectal cancer, largely due to advances in surgical techniques such as total mesorectal excision (TME), earlier diagnosis, and the improvement in the efficacy of adjuvant radio- and chemotherapy.[4,5] In recent decades, the introduction of TME and the concept of nerve-sparing dissection has decreased urogenital dysfunction after pelvic surgery.[6] However, despite the fact that TME is currently considered the optimal technique for resection of rectal cancer, providing superior oncological outcomes, sexual and urinary dysfunctions remain well-recognized complications of rectal surgery, due to the proximity between the pelvic nerves and the mesorectum, and the difficulty in identifying small anatomical structures such as the nerves of the inferior hypogastric plexus, in a narrow space such as the pelvis.[7]

Moreover, it has been reported that pre- and postoperative radiotherapy (RT) is associated with significant long-term decreased sexual function.[8,9]

The first laparoscopic colorectal resection was performed almost 20 years ago, but despite the advantages of a minimally invasive approach, laparoscopic rectal surgery is associated with a rate of sexual dysfunction that is similar[10] or higher[11] when compared with the open approach.

In the context of minimally invasive surgery, the most recent innovation is represented by robotic surgery. The first robotic colorectal surgery was performed in 2002, and in the following years, many authors have demonstrated that robotic TME (RTME) is an oncologically safe and feasible procedure that may facilitate mesorectal excision.[12–14] The magnified vision, the superior dexterity, and the precision of movements of the robotic arms allow the surgeon a better view and greater ergonomic comfort for the dissection of the small anatomical structures.[15]

The incidence of urinary and sexual complications after robotic surgery is as yet unknown. The aim of this study was to prospectively evaluate, by means of validated self-administered questionnaires, whether the fully robotic technique may preserve sexual and urinary function complications in male and female patients undergoing surgery for rectal cancer.

## PATIENTS AND METHODS

Robotic surgery has been performed since January 2007 in the Division of Abdomino-Pelvic Surgery of the European Institute of Oncology (IEO), Milan, Italy. From April 2008 to December 2010, 74 consecutive patients undergoing fully robotic resection for rectal cancer were prospectively included in this study.

All rectal resections were performed for histologically proven adenocarcinoma, whose distance from the anal verge was less than or equal to 15 cm. Preoperative radiochemotherapy (RT-CT) was offered to all patients with a clinical tumor stage (T) $\geq 3$ or with node positive disease, according to international guidelines. Neoadjuvant

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radiochemotherapy consisted of 45–50-Gy dose over 4–5 weeks, together with systemic 5-fluouracil-based chemotherapy.

Patients were admitted to the study regardless of sex, age, AJCC/UICC (American Joint Cancer Committee/Union Internationale Contre le Cancer) stage, type of intervention performed, and history of previous abdominal surgery.

Exclusion criteria were: unwillingness to participate in the survey and patients undergoing robotic surgery for local recurrence. The study was approved by the IEO Ethics Committee, and all patients were asked to provide (written) informed consent.Urinary and sexual dysfunctions affecting quality of life (QoL) were assessed, by means of specific self-administered questionnaires, in all patients undergoing RTME. For evaluating urinary tract symptoms and the impact on QoL, the ICIQ-FLUTS and the ICIQ-MLUTS questionnaires were used, respectively (International Consultation on Incontinence–Male/Female Lower Urinary Tract Symptoms).[16]

Each module uses a common question format. Most questions use 5-point Likert scales to assess the presence or absence of a symptom and its severity, followed by a scale to assess the associated degree of bother, which is measured by a visual analog scale. The interpretation of these scoring systems is reported in Figure 1: the higher the numerical value indicated by the patient, the more severe the degree of urinary dysfunction or the decrease in QoL. Bother scales are not incorporated in the overall score, but they indicate the impact of individual symptoms for the patient.

For assessing male sexual function, the IIEF (International Index of Erectile Function) questionnaire[17] was adopted, and for female sexual function, the FSFI (Female Sexual Function Index) questionnaire[18] was adopted. These are 15-item, self-administered questionnaires that analyze 5 factors: erectile function (sexual function for female), orgasmic function, sexual desire, intercourse satisfaction, and overall satisfaction. The interpretation of the IIEF and FSFI scoring is represented in Figure 2. The maximum score (ie, 30 for erectile function and 10 for overall satisfaction) corresponds to the higher level of sexual function.

## Fully Robotic Rectal Cancer Resection

Since the introduction of the da Vinci Surgical System in the Division of Abdomino-Pelvic Surgery of the IEO, we have standardized a totally robotic technique that allows for the execution of all phases of the intervention from the same position of the robotic cart, for vessel ligation, splenic flexure mobilization, and the complete isolation of the mesorectum.[19] With this approach, the surgeon can extend the advantages of the enhanced dexterity offered by the da Vinci Surgical System during the entire intervention.

All surgical procedures were performed by 2 surgeons (FL and RB), and the inferior mesenteric artery was always exposed and divided at its origin between clips, without the use of monopolar instruments to prevent the risk of thermal injury to the superior hypogastric plexus.

| | |
|---|---|
| Male Scoring system | 0-20 voiding symptoms subscale<br>0-24 incontinence symptoms subscale |
| Female Scoring system | 0-15 filling symptoms subscale<br>0-12 voiding symptoms subscale<br>0-20 incontinence symptoms subscale |

**FIGURE 1.** ICIQ-MLUTS and FLUTS questionnaires scoring system.

IIEF

| Domain | Items | Range | Max score |
|---|---|---|---|
| Erectile Function | 1, 2, 3, 4, 5, 15 | 0-5 | 30 |
| Orgasmic Function | 9, 10 | 0-5 | 10 |
| Sexual Desire | 11, 12 | 0-5 | 10 |
| Intercourse Satisfaction | 6, 7, 8 | 0-5 | 15 |
| Overall Satisfaction | 13, 14 | 0-5 | 10 |

FSFI

| Domain | Questions | Range | Factor | Min score | Max score |
|---|---|---|---|---|---|
| Desire | 1, 2 | 1-5 | 0.6 | 1.2 | 6 |
| Arousal | 3, 4, 5, 6 | 0-5 | 0.3 | 0 | 6 |
| Lubrication | 7, 8, 9, 10 | 0-5 | 0.3 | 0 | 6 |
| Orgasm | 11, 12, 13 | 0-5 | 0.4 | 0 | 6 |
| Satisfaction | 14, 15, 16 | 0-5 | 0.4 | 0.8 | 6 |
| Pain | 17, 18, 19 | 0-5 | 0.4 | 0 | 6 |
| | | | Full Scale Score Range | 2 | 36 |

**FIGURE 2.** IIEF and FSFI questionnaires scoring systems.

Patients completed the questionnaires regarding their sexual and urinary function before surgery and at 1 month, 6 months, 1 year, and 2 years after surgery. Results were prospectively collected in a dedicated database, calculated with validated scoring systems and statistically analyzed.

## Statistical Analysis

Statistical analysis was conducted with IBM SPSS Statistics software. Descriptive statistics were calculated for all variables. Data are presented as mean, standard deviation (SD), range, and number of patients. The nonparametric Kruskal-Wallis test was employed to compare the qualitative variables. Overall survival was calculated using the Kaplan-Meir method. *P* values less than 0.05 were considered to indicate statistical significance.

# RESULTS

Seventy-four consecutive patients participated in this study, 38 (51.3%) men and 36 (48.7%) women. The mean age was 57.6 ± 10.4 years (range: 29–75). The mean body mass index (BMI) was 24.8 (15.8–36): 25.7 for men (19.2–34.3) and 23.9 for female (15.8–36).

Anterior resection was carried out in 49 patients, intersphincteric resection with colo-anal hand-sewn anastomosis in 20 patients, and 5 patients underwent abdomino-perineal resection (APR). A diverting stoma was fashioned in 44 cases (excluding APR).

In 23 patients (31.2%), the tumor was located in the upper rectum, with a distance from the anal margin greater than 11 cm; in 16 patients (21.6%), in the midrectum (between 7 and 11 cm); and in 35 cases (47.2%), in the lower rectum (less than 7 cm from the anal margin). Patients' demographic data are shown in Table 1.

The mean operative time was 276 ± 64 min (range: 155–448 min). The mean estimated intraoperative blood loss was 53 mL (0–400), intraoperative blood transfusions were 0 (0%), and postoperative blood transfusion was 1 (1.3%).

The mean postoperative hospital stay was 6.9 ± 5.6 days (range: 4–44). Two patients had a wound infection and 2 had a prolonged ileus. One patient had a symptomatic leakage and needed a reintervention, and 1 patient (1.3%) was readmitted for radiological drainage of a septic pelvic collection. No mortality during the first 30 postoperative days was recorded (Table 2 shows surgical data).

**TABLE 1.** Patients Data

| Characteristics | Value (n = 74) n (%) |
|---|---|
| Gender | |
| Male | 38 (51.3%) |
| Female | 36 (48.7%) |
| Age (years)* | 57.6 ± 10.4 (29–75) |
| BMI (kg/m$^2$)* | 24.8 (15.8–36) |
| History of abdominal surgery† | 36 (48.6%) |
| Comorbidity: | 38 (51.3%) |
| Cardiac | 7 (9.4%) |
| Diabetes | 4 (2.8%) |
| Others | 27 (36.5%) |
| ASA score | |
| I | 13 (17.5%) |
| II | 57 (77%) |
| III | 4 (5.5%) |

ASA indicates American Society of Anesthesiologists.
*Mean (range) value expressed.
†Inguinal herniorrhaphy was not considered as prior abdominal surgery.

**TABLE 2.** Surgical Data

| Characteristics | Value (n = 74) n (%) |
|---|---|
| Operative time (min)* | 276 ± 64 (155–448) |
| Estimated blood loss (mL)* | 53 (0–400) |
| Postoperative hospital stay (days)* | 6.9 ± 5.6 (4–44) |
| Blood transfusions (patients) | |
| Intraoperative transfusion | 0 (0%) |
| Postoperative transfusion | 1 (1.3%) |
| Complications† | |
| Prolonged ileus | 2 (2.7%) |
| Wound infection | 2 (2.7%) |
| Subclinical anastomotic leakage | 5 (6.7%) |
| Symptomatic anastomotic leakage | 1(1.3%) |
| Other | 3 (4%) |
| Overall | 13 (17.4%) |
| Reoperation† | 2 (2.7%) |
| Hospital readmission† | 1 (1.3%) |
| Mortality† | 0 (0%) |

*Mean (range) value expressed.
†During the first 30 postoperative days.

## AJCC/UICC Stage Distribution (Table 3)

The median number of lymph nodes retrieved was 20.5 ± 9.7 (range 15–44) and the circumferential margin (CMR) was negative in all cases. The distal margin (DRM) was 3.1 ± 1.8 cm (0.2–7.3). The quality of the mesorectum, according to Quirkes' criteria, was "complete" in 65 (87.8%) patients and "near complete" in 9 (12.2%). In no case was the mesorectum defined "incomplete" by the pathologist. Pathological data are summarized in Table 4.

Three recurrences of the disease were recorded to date (4%). After a median follow-up of 17.03 months, the 2-year cancer-specific survival rate was 98.7%, the disease free-survival rate was 93.3%, and the 2-year overall survival rate was 95.9%.

## Sexual and Urinary Functions

The analyses of the questionnaires completed by the 74 patients who underwent robotic nerve-sparing total mesorectal excision showed that sexual function and general sexual satisfaction decreased significantly 1 month and 6 months after intervention, respectively. In male patients, the scores for erectile function were 19.1 ± 8.7 (preop) versus 11.9 ± 10.2 ($P < 0.05$) at 1 month and 13.9 ± 10.6 ($P < 0.05$) at 6 months; for general satisfaction, 6.9 ± 2.4 (preop) versus 5.3 ± 2.5 ($P < 0.05$) at 1 month and 5.2 ± 2.8 ($P < 0.05$) at 6 months. In female patients, the values for sexual function were 2.6 ± 3.3 (preop) versus 0.8 ± 1.4 ($P < 0.05$) at 1 month and 1.8 ± 1.9 at 6 months for arousal, and 2.4 ± 2.5 (preop) versus 0.7 ± 1.6 ($P < 0.05$) at 1 month and 1.9 ± 2.9 at 6 months for general satisfaction. Both parameters then increased progressively, and 1 year after surgery, the values were comparable to those measured before surgery: 19.1 ± 8.7 (preop) versus 16.1 ± 10.9 for erectile function and 6.9 ± 2.4 (preop) versus 5.7 ± 2.8 for general satisfaction in men; 2.6 ± 3.3 (preop) versus 2.3 ± 2 for arousal and 2.4 ± 2.5 (preop) versus 2.5 ± 2.4 for overall satisfaction in women. These data are listed in Table 5.

**TABLE 3.** AJCC/UICC Stage

| AJCC/UICC Stage | (n = 74) n (%) |
|---|---|
| I | 31 (41.8%) |
| II | 8 (10.8%) |
| IIa | 5 (6.7%) |
| IIb | 3 (4.1%) |
| III | 26 (35.1%) |
| IIIa | 6 (8.1%) |
| IIIb | 16 (21.6%) |
| IIIc | 4 (5.4%) |
| IV | 9 (12.3%) |

**TABLE 4.** Pathological Data

| Characteristics | Value (n = 74) n (%) |
|---|---|
| Tumor location | |
| Upper rectum (>11 cm) | 23 (31.2%) |
| Mid rectum (7–11 cm) | 16 (21.6%) |
| Lower rectum (<7 cm) | 35 (47.2%) |
| Negative surgical margin | 73 (98.6%) |
| No. harvested lymph nodes* | 20.5 ± 9.7 (15–44) |
| Quality of mesorectum† | |
| Complete | 65 (87.8%) |
| Near complete | 9 (12.2%) |
| Incomplete | 0 (0%) |

*Mean (range) value expressed.
†According to Quirkes' criteria.

Concerning urinary function, the grade of incontinence measured 1 year after the intervention was statistically unchanged when compared with the preoperative status for both sexes; the data are summarized in Table 6. In particular, in male patients, we observed no significant deterioration of voiding and incontinence during the whole period of this study.

The grade of filling symptoms and incontinence function in women were both statistically worse 1 month after intervention, 2.6 ± 1.7 versus 4.1 ± 2.8 ($P < 0.05$) and 2.1 ± 2.2 versus 3.2 ± 2.7 ($P < 0.05$), respectively, whereas 1 year after surgery, all scores were comparable to preoperative values. Again, we observed the same results when comparing the total number of male and female patients with severe or moderate urinary incontinence (score ≥ 9) before and 1 year after surgery, as reported in Table 7.

As regards the impact of urinary symptoms on patient's QoL (Table 8), no difference was measured for both sexes at 1 year compared with the preoperative status. For example, the scores of incontinence QoL were 2.1 ± 2.7 (preop) versus 2.3 ± 3 (1 year) for male; 5.3 ± 6.7 (preop) versus 5.8 ± 8.4 (1 year) for female.

Forty-three patients (58.1%) underwent preoperative neoadjuvant combined chemoradiation therapy. In this group, erectile

**TABLE 5.** Sexual Function Data

| Male | IIEF (38 Pts.) | Range | Before Surgery* | 30 Days After Surgery* | 6 Months After Surgery* | 1 Year After Surgery* |
|---|---|---|---|---|---|---|
| | Erectile function | (0–30) | 19.1 ± 8.7 | 11.9 ± 10.2 | 13.9 ± 10.6 | 16.1 ± 10.9 |
| | Orgasmic function | (0–10) | 6.6 ± 3.1 | 4.1 ± 3.5 | 5.1 ± 3.7 | 5.7 ± 3.4 |
| | Sexual desire | (2–10) | 5.8 ± 2.3 | 4.8 ± 2.1 | 5.2 ± 2.9 | 5.8 ± 2.9 |
| | Intercourse satisfaction | (0–15) | 7.7 ± 4 | 4.1 ± 3.9 | 5.3 ± 4.4 | 6.8 ± 3 |
| | Overall satisfaction | (2–10) | 6.9 ± 2.4 | 5.3 ± 2.5 | 5.2 ± 2.8 | 5.7 ± 2.8 |
| **Female** | **FSFI (36 Pts.)** | **Range** | **Before Surgery[a]** | **30 Days After Surgery[a]** | **6 Months After Surgery[a]** | **1 Year After Surgery[a]** |
| | Desire | (1.2–6) | 2.4 ± 1.3 | 1.8 ± 1 | 2 ± 1 | 2.4 ± 2.1 |
| | Arousal | (0–6) | 2.6 ± 3.3 | 0.8 ± 1.4 | 1.8 ± 1.9 | 2.3 ± 2 |
| | Lubrication | (0–6) | 2.1 ± 2.1 | 0.8 ± 1.5 | 2.2 ± 2.2 | 2.2 ± 2.1 |
| | Orgasm | (0–6) | 2.5 ± 2.5 | 0.8 ± 1.6 | 2.1 ± 2.3 | 2.4 ± 2.3 |
| | Satisfaction | (0.8–6) | 2.4 ± 2.5 | 0.7 ± 1.6 | 1.9 ± 2.9 | 2.5 ± 2.4 |
| | Pain | (0–6) | 2.4 ± 2.6 | 0.8 ± 1.8 | 1.8 ± 2.1 | 2.4 ± 2.4 |

*Mean ± SD expressed.

**TABLE 6.** Male and Female Urinary Function Data

| Male | (38 Pts.) | Range | Before Surgery* | 30 Days After Surgery* | 6 Months After Surgery* | 1 Year After Surgery* |
|---|---|---|---|---|---|---|
| | VS | (0–20) | 3.6 ± 3.8 | 3.6 ± 3.3 | 2.5 ± 3 | 3 ± 3.2 |
| | IS | (0–20) | 2.4 ± 2.6 | 1.1 ± 1.2 | 0.9 ± 1.2 | 1.25 |
| **Female** | **(36 Pts.)** | **Range** | **Before Surgery*** | **30 Days After Surgery*** | **6 Months After Surgery*** | **1 Year After Surgery*** |
| | FS | (0–20) | 2.6 ± 1.7 | 4.1 ± 2.8 | 2.6 ± 2.5 | 2 ± 1.5 |
| | VS | (0–20) | 1.3 ± 1.8 | 2.8 ± 2.7 | 1.6 ± 2.3 | 2 ± 2.4 |
| | IS | (0–20) | 2.1 ± 2.2 | 3.2 ± 2.7 | 2.2 ± 2.5 | 2.8 ± 3.2 |

VS indicates voiding symptoms; IS, incontinence symptoms; FS, filling symptoms.
*Mean ± SD expressed.

**TABLE 7.** Male and Female Urinary Incontinence Data

| Male (38 Pts.) | Before Surgery | 6 Months After Surgery | 1 Year After Surgery |
|---|---|---|---|
| Urinary incontinence* | 1 (2.6%) | 0 (0%) | 0 (0%) |
| **Female (36 Pts.)** | **Before Surgery** | **6 Months After Surgery** | **1 Year After Surgery** |
| Urinary incontinence* | 2 (5.5%) | 1 (2.7%) | 1 (2.7%) |

Values in n (%).
*Score ≤12.

**TABLE 8.** Impact on QoL of Urinary Function in Male and Female Patients

| Male | (38 Pts.) | Range | Before Surgery* | 30 Days After Surgery* | 6 Months After Surgery* | 1 Year After Surgery* |
|---|---|---|---|---|---|---|
| | V QoL | (0–20) | 3.9 ± 4 | 5.6 ± 6.5 | 3.5 ± 5.5 | 3.2 ± 4.4 |
| | I QoL | (0–20) | 2.1 ± 2.7 | 1.2 ± 1.7 | 1.4 ± 2.4 | 2.3 ± 3 |
| **Female** | **(36 Pts.)** | **Range** | **Before Surgery*** | **30 Days After Surgery*** | **6 Months After Surgery*** | **1 Year After Surgery*** |
| | F QoL | (0–20) | 3.4 ± 3.5 | 5.3 ± 7.2 | 3.7 ± 5.4 | 4.1 ± 5.3 |
| | V QoL | (0–20) | 1.6 ± 2.9 | 2.8 ± 4.3 | 1.9 ± 3.8 | 3.8 ± 7.6 |
| | I QoL | (0–20) | 5.3 ± 6.7 | 7.1 ± 9.5 | 6.2 ± 9.1 | 5.8 ± 8.4 |

V QoL indicates voiding quality of life; I QoL, incontinence quality of life; F QoL, filling quality of life.
*Mean ± SD expressed.

function in men was significantly reduced at 1 month and 6 months after intervention: 20 ± 9 (preop) versus 11.2 ± 18.3 ($P < 0.05$) at 1 month versus 13.3 ± 11.1 at 6 months. One year after surgery, however, the score returned to a comparable level to the preoperative score: 17.1 ± 10.7. The values for overall satisfaction remained constant during the entire study period (Table 9). In female patients who underwent preoperative RT-CT, the values of arousal also dropped after surgery: 3 ± 2.4 (preop) versus 0.2 ± 0.5 ($P < 0.05$) at 1 month; also general satisfaction decreased significantly: 2.6 ± 2.5 (preop) versus 0.1 ± 0.7 ($P < 0.05$) at 1 month. One year after surgery, as observed in men, the values were equivalent to those measured before the operation (Table 9).

Regarding urinary function, the grade of incontinence in this subgroup of patients measured 1 year after the intervention was comparable with the preoperative status for both sexes, with a value for incontinence symptoms of 1.2 ± 1.2 (preop) versus 1.4 ± 1.1 (1 year) in men and 1.6 ± 1.9 (preop) versus 2.4 ± 2.6 (1 year) in women (Table 10).

A diverting stoma, excluding APR, was fashioned in 44 patients (59.4%). In this subgroup, the scores for sexual function in males did not differ from those measured in patients without a stoma at the same time interval (Table 11). In female patients, on the contrary, the presence of the stoma was associated with a conspicuous reduction in all the scores measured 1 month after

**TABLE 9.** Sexual Function After RT/CT

| Male | IIEF (19 Pts.) | Range | Before Surgery* | 30 Days After Surgery* | 6 Months After Surgery* | 1 Year After Surgery* |
|---|---|---|---|---|---|---|
| | Erectile function | (0–30) | 20 ± 9 | 11.2 ± 8.3 | 13.3 ± 11.1 | 17.1 ± 10.7 |
| | Orgasmic function | (0–10) | 6.8 ± 3.1 | 4.7 ± 2.5 | 5 ± 4.3 | 5.4 ± 3.7 |
| | Sexual desire | (2–10) | 5.5 ± 2.3 | 4.8 ± 2.1 | 5.3 ± 2.7 | 5.3 ± 2.5 |
| | Intercourse satisfaction | (0–15) | 4.1 ± 4.4 | 4.1 ± 4.1 | 5 ± 5.8 | 6.7 ± 4.5 |
| | Overall satisfaction | (2–10) | 5.2 ± 2.5 | 5.3 ± 1.9 | 5.2 ± 3 | 7 ± 2.6 |
| **Female** | **FSFI (24 Pts.)** | **Range** | **Before Surgery*** | **30 Days After Surgery*** | **6 Months After Surgery*** | **1 Year After Surgery*** |
| | Desire | (1.2–6) | 2.4 ± 1.3 | 1.5 ± 0.5 | 2.1 ± 1 | 2.2 ± 1.1 |
| | Arousal | (0–6) | 3 ± 2.4 | 0.2 ± 0.5 | 1.9 ± 2 | 1.9 ± 2.1 |
| | Lubrication | (0–6) | 2.7 ± 2.6 | 0.2 ± 0.7 | 2.2 ± 1.9 | 1.8 ± 2 |
| | Orgasm | (0–6) | 2.7 ± 2.6 | 0.1 ± 0.8 | 2.2 ± 5.8 | 2.1 ± 2.3 |
| | Satisfaction | (0.8–6) | 2.6 ± 2.5 | 0.1 ± 0.7 | 1.8 ± 2.3 | 2.1 ± 2.4 |
| | Pain | (0–6) | 2.6 ± 2.7 | 0.1 ± 0.6 | 1.8 ± 2 | 1.9 ± 2.3 |

*Mean ± SD expressed.

**TABLE 10.** Male and Female Urinary Function After RT/CT

| Male | (19 Pts.) | Range | Before Surgery* | 30 Days After Surgery* | 6 Months After Surgery* | 1 Year After Surgery* |
|---|---|---|---|---|---|---|
| | VS | (0–20) | 2.1 ± 2 | 3.8 ± 3.4 | 3.2 ± 3.2 | 2.8 ± 2.7 |
| | IS | (0–20) | 1.2 ± 1.2 | 1 ± 1.1 | 0.9 ± 1.2 | 1.4 ± 1.1 |
| **Female** | **(24 Pts.)** | **Range** | **Before Surgery*** | **30 Days After Surgery*** | **6 Months After Surgery*** | **1 Year After Surgery*** |
| | FS | (0–20) | 2.5 ± 1.9 | 4.2 ± 3.2 | 3 ± 2.7 | 2.1 ± 1.7 |
| | VS | (0–20) | 1.1 ± 1.7 | 2.8 ± 2.9 | 2.3 ± 2.4 | 2.3 ± 2.8 |
| | IS | (0–20) | 1.6 ± 1.9 | 2.2 ± 2.4 | 1.4 ± 1.9 | 2.4 ± 2.6 |

VS indicates voiding symptoms; IS, incontinence symptoms; FS, filling symptoms.
*Mean ± SD expressed.

**TABLE 11.** Sexual Function in Men With and Without Diverting Stoma

| Male With Diverting Stoma | IIEF (20 Pts.)* | Range | Before Surgery† | 30 Days After Surgery† | 6 Months After Surgery† | 1 Year After Surgery† |
|---|---|---|---|---|---|---|
| | Erectile function | (0–30) | 20.4 ± 9.7 | 13 ± 12.1 | 13.4 ± 9.3 | 18 ± 10.6 |
| | Orgasmic function | (0–10) | 5.4 ± 3.2 | 4 ± 4.1 | 5 ± 4 | 5.6 ± 3.7 |
| | Sexual desire | (2–10) | 5.3 ± 2.5 | 5 ± 2.5 | 5 ± 2.5 | 5.6 ± 2.6 |
| | Intercourse satisfaction | (0–15) | 7.4 ± 4.4 | 4.7 ± 5.5 | 5 ± 5.2 | 7.3 ± 5.1 |
| | Overall satisfaction | (2–10) | 6.2 ± 2.4 | 5.4 ± 3.2 | 5.1 ± 2.5 | 6.9 ± 2.2 |
| **Male Without Diverting Stoma** | **IIEF: (15 Pts.)** | **Range** | **Before Surgery†** | **30 Days After Surgery†** | **6 Months After Surgery†** | **1 Year After Surgery†** |
| | Erectile function | (0–30) | 20.8 ± 8.2 | 12.2 ± 10.8 | 17.4 ± 11.6 | 19.2 ± 12.5 |
| | Orgasmic function | (0–10) | 7.5 ± 3.5 | 4.7 ± 3.4 | 6.2 ± 4.6 | 6.3 ± 4.4 |
| | Sexual desire | (2–10) | 6.3 ± 0.8 | 5 ± 2.5 | 6.1 ± 3 | 7.2 ± 2.8 |
| | Intercourse satisfaction | (0–15) | 8.5 ± 5.2 | 5.3 ± 3.8 | 6.8 ± 5.2 | 7.5 ± 5.2 |
| | Overall satisfaction | (2–10) | 7.7 ± 2.2 | 5.6 ± 3.2 | 6 ± 3.2 | 7 ± 3.1 |

*Excluding APR.
†Mean ± SD expressed.

surgery when compared with patients without a stoma: 0.2 ± 0.5 versus 3 ± 1.5 ($P < 0.05$) for arousal and 0.1 ± 0.6 versus 3.3 ± 1.4 ($P < 0.05$) for general satisfaction. The same values measured at 6 months and 1 year (the stoma is surgically closed) were analogous in both groups of women. The data are summarized in Table 12.

## DISCUSSION

Over the past 2 decades, since the first laparoscopic segmental colectomy was carried out in 1991 by Jacobs and Fowler,[20] we have witnessed a progressive expansion of minimally invasive surgery. However, laparoscopic-assisted rectal surgery has not decreased urogenital complications and is associated with a rate of sexual and urinary dysfunctions higher than,[11,21–23] or comparable to[10,24,25] open surgery. The reason could be ascribed to the technical complexities of this type of surgery, such as the unstable 2-dimensional view of the operative field and the poor ergonomics of the surgical tools that render complex operation even more difficult with a higher degree of surgeon fatigue.

Robotic surgery, performed using the da Vinci Surgical System, represents a great improvement in minimally invasive surgery, as it offers the surgeon a 3-dimensional, magnified high-definition (HD) view of the operative field, a stable camera platform, and a precise, dexterous control of the wristed instruments. As we reported in previous studies, the technical characteristics of this system permits an extended lymph node dissection[12,19] and an accurate isolation of the smaller anatomical structures.

Despite recent advances in the oncologic treatment of rectal cancer, sexual and urinary dysfunctions remain among the major complications of rectal surgery, with implications that impact so much the

**TABLE 12.** Sexual Function in Women With and Without Diverting Stoma

| **Female With Diverting Stoma** | **FSFI (24 Pts.)*** | **Range** | **Before Surgery†** | **30 Days After Surgery†** | **6 Months After Surgery†** | **1 Year After Surgery†** |
|---|---|---|---|---|---|---|
| | Desire | (1.2–6) | 2.4 ± 1.3 | 1.5 ± 0.5 | 1.9 ± 0.9 | 2.1 ± 1 |
| | Arousal | (0–6) | 2.8 ± 2.3 | 0.2 ± 0.5 | 1.8 ± 2 | 1.8 ± 2 |
| | Lubrication | (0–6) | 2.5 ± 2.5 | 0.2 ± 0.7 | 1.9 ± 2 | 1.7 ± 2 |
| | Orgasm | (0–6) | 2.7 ± 2.7 | 0.1 ± 0.5 | 2 ± 2.4 | 2 ± 2.3 |
| | Satisfaction | (0.8–6) | 2.6 ± 2.1 | 0.1± 0.6 | 1.6 ± 2.1 | 2 ± 2.4 |
| | Pain | (0–6) | 2.5 ± 1.6 | 0.1 ± 0.5 | 1.6 ± 2 | 1.7 ± 2.3 |
| **Female Without Diverting Stoma** | **FSFI (10 Pts.)** | **Range** | **Before Surgery†** | **30 Days After Surgery†** | **6 Months After Surgery†** | **1 Year After Surgery†** |
| | Desire | (1.2–6) | 2.1 ± 1.1 | 3 ± 1.8 | 2.5 ± 1 | 3.3 ± 0.9 |
| | Arousal | (0–6) | 1.7 ± 2.3 | 3 ± 1.5 | 3.5 ± 1.3 | 3.7 ± 1.3 |
| | Lubrication | (0–6) | 1.7 ± 2.2 | 3.6 ± 1.3 | 4.8 ± 1.2 | 4.5 ± 1.4 |
| | Orgasm | (0–6) | 1.9 ± 2.5 | 3.4 ± 1.6 | 3.8 ± 1.4 | 4.4 ± 1.6 |
| | Satisfaction | (0.8–6) | 1.8 ± 3.2 | 3.3 ± 1.4 | 4.8 ± 1.5 | 4.7 ± 1.5 |
| | Pain | (0–6) | 2 ± 2.2 | 3.8 ± 1.3 | 4.8 ± 1.7 | 4.9 ± 1.3 |

*Excluding APR.
†Mean ± SD expressed.

QoL of patients that different authors claim they should be considered when deciding the best operative approach.[21,26]

The strict anatomical relationship between the neural structures of the pelvis and the mesorectum lies at the base of the vast majority of the damage to the hypogastric plexus. However, injuries can also occur during the ligation of the inferior mesenteric artery.

Damage to the superior hypogastric plexus can lead to disturbed ejaculation in males and to impaired lubrication in females, whereas a lesion in the pelvic splanchnic nerves or the pelvic plexus can determine erectile dysfunction in men and cause diminished labia-swelling response in women.

The better-magnified and 3-dimensional view of the small anatomical pelvic structures, together with the more precise and accurate dissection offered by the robotic system during mesorectal resection, can help reduce the risk of collateral damage to the pelvic autonomic nerves. However, despite the remarkable subjective experience of the surgeon at the console, to date, there are no prospective studies evaluating the influence of this technology on sexual and urinary complications after RTME for rectal cancer.

To our knowledge, the present study is the first study ever published to evaluate the impact of robotic rectal surgery on urogenital function preservation.

However, in this series, we recorded no difference in terms of incontinence, filling, or voiding symptoms at 1 year when compared with the preoperative status for both sexes. The same results were also obtained from the analyses of the incontinence QoL: the average values at 1 year, in fact, are equivalent to the preoperative values.

In relation to sexual function in males, we found a decrease for all the items in the IIEF questionnaires measured at 1 and 6 months after surgery, and we confirm[15] the degree of positive correlation between erectile function, and intercourse and general sexual satisfaction (Table 5). The progressive improvement recorded for erectile and sexual functions starting from 6 months after surgery is probably related to the resolution of postoperative inflammation of pelvic tissues and the repair of minimal nerve damage caused by the intraoperative tensions.

Besides intraoperative injury to the pelvic autonomic plexus, other risk factors have been associated with urogenital dysfunction after rectal resection: patient comorbidity such as arteriosclerosis, hypertensionm and diabetes; preoperative associated treatment; the presence of a temporary or definitive stoma; anastomotic leakage; and excessive blood loss.

The significant reduction in intraoperative blood loss and the shorter return to complete mobilization without a long-term catheterization may also contribute to the restoration of sexual and urinary functions after RTME.

## Chemoradiation Therapy

More than half of the patients (58.1%) received neoadjuvant combined chemoradiation therapy. It has been reported that RT of the pelvis is associated with significant long-term negative effects on sexual function in males[27,28] and in females,[29,30] and after TME for rectal cancer, the ability to have an erection or an orgasm disappears in up to 50% of male and female patients.[31,32] Moreover, voiding dysfunction and incontinence symptoms are reported to occur in 30% of men and 58% of women.[31,32] In our study, patients who received preoperative RT showed an identical trend, with a reduction in sexual function in the course of the first months and an average score for the different items at 1 year postoperative comparable with the preoperative score. In addition, neoadjuvant RT-CT did not worsen urinary results.

## Diverting Stoma

The presence of a stoma did not affect sexual function in male patients. However, in female patients, a stoma influenced sexual function deeply, causing a drop in sexual desire and overall satisfaction close to zero. After the surgical closure of the stoma, libido and sexual satisfaction increased and the scores returned to similar levels to those measured in women who did not had a temporary bowel diversion. These findings confirm that men and women experience sexual activity in different ways, but also suggest that behavioral, psychological, and cultural differences should be very carefully considered when analyzing the results of a study on sexual function.

Robotic surgery seems to increase dissection accuracy during TME, and this is confirmed by the quality of the mesorectum, analyzed by the pathologist, which was reported "complete" in 65 patients (87.8%) and "near complete" in 9 (12.2%), with no "incomplete" specimen.

We observed no difference in terms of function and QoL for the various types of intervention performed: high versus low anterior resection versus APR. However, due to the limited number of patients undergoing the Miles' procedure, this result should be treated with caution. Prospective controlled trials enrolling a larger number of patients should be conducted *to investigate this aspect.* It is reasonable

to suppose, in fact, that the extraelevator perineal excision implies a higher risk of damaging the nerves.

## CONCLUSION

This study confirms that RTME is a safe and adequate technique for the treatment of rectal cancer. Robotic nerve-sparing TME allows for better preservation of urinary and sexual functions when compared with the literature data on both open and laparoscopic surgery. This is probably due to the superior movements of the wristed instruments that facilitate fine dissection, especially in narrow spaces, minimizing the trauma to the surrounding tissues, and also due to the magnified view that makes it easier to identify the anatomical planes and the smaller neural component of the inferior hypogastric plexus during the dissection of the mesorectum.

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