World Journal of Urology
https://doi.org/10.1007/s00345-020-03350-5

ORIGINAL ARTICLE

# How radical prostatectomy procedures have changed over the last 10 years in Italy: a comparative analysis based on more than 1500 patients participating in the MIRROR-SIU/LUNA and the Pros-IT CNR study

**Mauro Gacci[1] · Walter Artibani[2] · Pierfrancesco Bassi[3] · Filippo Bertoni[4] · Sergio Bracarda[5] · Alberto Briganti[6] · Giorgio Carmignani[7] · Luca Carmignani[8] · Giario Conti[9] · Renzo Corvò[10] · Cosimo De Nunzio[11] · Ferdinando Fusco[12] · Pierpaolo Graziotti[13] · Isabella Greco[1] · Stefania Maggi[14] · Stefano Maria Magrini[15] · Vincenzo Mirone[12] · Rodolfo Montironi[16] · Giuseppe Morgia[17] · Giovanni Muto[18] · Marianna Noale[14] · Stefano Pecoraro[19] · Angelo Porreca[20] · Umberto Ricardi[21] · Elvio Russi[22] · Giorgio Russo[17] · Andrea Salonia[23] · Alchiede Simonato[24] · Sergio Serni[1] · Davide Tomasini[15] · Andrea Tubaro[11] · Vittorina Zagonel[25] · Gaetano Crepaldi[14] · The MIRROR-SIU/LUNA Study Group and the Pros-IT CNR Study Group**

Received: 22 April 2020 / Accepted: 7 July 2020


## Abstract

**Purpose** Therapeutic strategies for prostate cancer (PCa) have been evolving dramatically worldwide. The current article reports on the evolution of surgical management strategies for PCa in Italy.

**Methods** The data from two independent Italian multicenter projects, the MIRROR-SIU/LUNA (started in 2007, holding data of 890 patients) and the Pros-IT-CNR project (started in 2014, with data of 692 patients), were compared. Differences in patients' characteristics were evaluated. Multivariable logistic regression models were used to identify characteristics associated with robot-assisted (RA) procedure, nerve sparing (NS) approach, and lymph node dissection (LND).

**Results** The two cohorts did not differ in terms of age and prostate-specific antigen (PSA) levels at biopsy. Patients enrolled in the Pros-IT-CNR project more frequently were submitted to RA (58.8% vs 27.6%, $p<0.001$) and NS prostatectomy (58.4% vs. 52.9%, $p=0.04$), but received LND less frequently (47.7% vs. 76.7%, $p<0.001$), as compared to the MIRROR-SIU/LUNA patients.

At multivariate logistic models, Lower Gleason Scores (GS) and PSA levels were significantly associated with RA prostatectomy in both cohorts. As for the MIRROR-SIU/LUNA data, clinical T-stage was a predictor for NS (OR = 0.07 for T3, T4) and LND (OR = 2.41 for T2) procedures. As for Pros-IT CNR data, GS ≥ (4 + 3) and positive cancer cores ≥ 50% were decisive factors both for NS (OR 0.29 and 0.30) and LND (OR 7.53 and 2.31) strategies.

**Conclusions** PCa management has changed over the last decade in Italian centers: RA and NS procedures without LND have become the methods of choice to treat newly medium–high risk diagnosed PCa.

**Keywords** Prostate cancer · Pros-IT CNR study · MIRROR SIU/LUNA study · Robotic procedures · Nerve sparing · Lymph node dissection

## Introduction

Treatment pathways for prostate cancer (PCa) patients have been evolving dramatically over recent years worldwide, leading to different patterns of surgical strategies throughout the development and improvement of diagnostic and staging tools, such as preoperative nomograms, multidisciplinary guidelines, and the advent of robotic technology.

Members of The MIRROR-SIU/LUNA Study Group and the Pros-IT CNR Study Group are listed in Acknowledgements section.

**Electronic supplementary material** The online version of this article (https://doi.org/10.1007/s00345-020-03350-5) contains supplementary material, which is available to authorized users.

✉ Mauro Gacci
maurogacci@yahoo.it

Extended author information available on the last page of the article

Published online: 01 August 2020

Intensifying prostate-specific antigen (PSA) screening efforts, lowering PSA threshold for prostate biopsy and the ever-growing number of samples taken have contributed to the rising incidence rates of PCa [1].

Despite these changes, radical prostatectomy (RP) remains the surgical standard treatment for patients with organ confined PCa [2, 3]. Moreover, throughout time, available evidence focused on general topics regarding RP, including the role of robot assisted (RA) procedures, nerve sparing (NS) approach and/or lymph node dissection (LND). Likewise, Internet has become an important source of information for patients on waiting lists for RP, but only 36% of the information provided about PCa treatment is in accordance with the guidelines of the European Association of Urology (EAU) [4]. In addition, there seems to be a low compliance with guidelines by Italian urologists [5].

In 2007, the Italian Urological Association (SIU) with the Leading Urological No-profit Foundation for advanced Research (LUNA—Fondazione SIU Onlus) instituted the Multicenter Italian Report on Radical prostatectomy Outcome and Research (MIRROR), involving 136 Urology Departments located throughout the country [6]. In 2014, the PROState cancer monitoring in Italy, from the National Research Council (Pros-IT CNR) study, prospective, multicenter project monitoring PCa patients attending 97 Urology, Radiation therapy, and Oncology Departments located throughout Italy, was instituted [7].

The aim of this retrospective observational study was to analyze and compare data from the two PCa patients' cohorts, mostly in terms of RA, NS, and LND rates observed over the 7-year time frame.

## Materials and methods

The MIRROR, an independent prospective observational study started in Italy in 2007, aimed to create a register of patient surgically treated for PCa [6]. Overall, consecutive patients, from 2007 to 2011, underwent RP in 136 participating centers. The following information was gathered from all participating patients: age, calculated body mass index (BMI), preoperative tumor characteristics (i.e., serum PSA value, clinical T-stage, and GS at biopsy, number and percent of positive cancer cores). Likewise, patients' preoperative general quality of life (QoL) was evaluated using the validated translation of the Short Form Health Survey (SF-12) [8]; their PCa-specific QoL was evaluated using the validated translation of the University of California Los Angeles-Prostate Cancer Index (UCLA-PCI) [9]. The surgical data (RA vs. non-RA RP; NS vs. non-NS; LND vs. no LND) have also been collected.

The Pros-IT CNR is an ongoing, prospective, multicenter study, aimed at monitoring the QoL of a sample of Italian treatment-naïve males diagnosed with biopsy-verified PCa after September 1th 2014. Overall, patients who met study's eligibility criteria were enrolled in the 97 participating centers (51 Urology, 39 Radiation Oncology, 7 Medical Oncology) [7]. Baseline questionnaire was administered at the time of PCa diagnosis, and follow-up evaluations were planned for a 60-months period [10, 11]. The data on patients' demographics, BMI, comorbidities, initial diagnosis, and cancer staging (i.e., PSA levels, clinical T-stage, biopsy GS, details regarding the prostate biopsy) were collected. Patients' general and PCa-specific QoL at diagnosis were evaluated using the SF-12 and UCLA-PCI questionnaires. Only data from patients who underwent RP and whose QoL records were complete entered this analysis. The surgical data (robot-assisted vs. non-robot assisted RP; NS vs. non-NS; LND vs. no LND) have also been collected and eventually analyzed.

Both projects, in accordance with the principles of the Declaration of Helsinki, were approved by the Ethic Committee of both coordinating centers and of each participating center. All participants provided their informed consent.

RA RP was performed using either the Si or Xi da Vinci robotic platform in a four-arm configuration, according to centers availability. Trendelenburg tilt was set at 30° in all cases. All procedures were performed according to general principles and surgical details, previously described [12].

Both Pros-IT CNR and MIRROR data were analyzed without imputation of missing data. The normality of distributions was tested using the Shapiro–Wilk test. The data are presented as either means and standard deviation (SD) of the mean, or medians and interquartile ranges for quantitative variables, and as frequencies and percentages for categorical variables. The differences in terms of patients' characteristics between the two cohorts were assessed using the Chi-square or the Fisher's exact test and the Wilcoxon rank-sum test.

Multivariable logistic regression models were applied to identify the characteristics associated with the use of (a) RA, (b) NS approach, and (c) LND in both cohorts. Each model was adjusted for age at diagnosis (years), BMI (obesity vs normal weight, underweight or overweight), T staging at diagnosis (T1 vs T2 or T3-T4), GS at diagnosis (3 + 3 vs 3 + 4, 4 + 3, 8+), serum PSA at diagnosis (< 10 vs 10–20 or > 20 ng/mL), the percentage of positive cores, and D'Amico risk classification (low vs intermediate or high risk) [13]. The models were also adjusted for general and PCa-specific QoL scores at diagnosis, dichotomized with respect to the third quartile (Q3) of their distribution. Significance was set for a $p$ value < 0.05. Analyses were performed using SAS 9.4 statistical software.

## Results

Overall, the data of 890 patients (37%) for the MIRROR and 692 (40.6%) for the Pros-IT CNR cohort, respectively, who underwent RP and whose QoL information were recorded, were finally analyzed.

Patients' age at diagnosis, median PSA level at biopsy, mean BMI and waist circumference value were not different between the two groups (Table 1). Conversely, Pros-IT CNR cohort had a lower clinical T-stage in a greater rate of patients compared to MIRROR cohort (cT1 for 54.3% vs 45%; $p < 0.0001$, respectively), but higher biopsy GS (GS 8–10 in 14.2% vs 10.1%; $p < 0.0001$, respectively). Similarly, Pros-IT CNR cohort had a higher mean number of cores at biopsy ($14.3 \pm 4.6$ vs $12.6 \pm 4.1$, $p < 0.0001$, respectively, with a median of 12 for each cohort) and higher median percentage of positive cores (33 vs 29; $p = 0.0123$, respectively) as compared to MIRROR cohort.

Pros-IT CNR patients showed higher mean scores on the physical component summary (PCS) of the SF-12 and on the urinary function (UF) ($p < 0.0001$), the bowel

**Table 1** Patient data and disease characteristics

| | MIRROR ($n = 890$) | Pros-IT CNR ($n = 692$) | $p$ |
|---|---|---|---|
| Patient's characteristics | | | |
| Age (years) (mean ± SD) | 64.9 ± 6.5 | 64.6 ± 6.7 | 0.3316 |
| BMI (kg/m$^2$) | | | |
| Mean ± SD | 26.4 ± 3.2 | 26.5 ± 3.2 | 0.4869 |
| Underweight[a] (*n*, %) | 0 (0.0) | 2 (0.3) | 0.3966 |
| Normal weight[a] (*n*, %) | 252 (35.1) | 226 (32.9) | |
| Overweight[a] (*n*, %) | 383 (53.3) | 368 (53.6) | |
| Obese[a] (*n*, %) | 83 (11.6) | 90 (13.1) | |
| Waist circumference (cm) (mean ± SD) | 94.3 ± 14.9 | 93.0 ± 12.1 | 0.2358 |
| Preoperative tumor features | | | |
| Clinical stage (*n*, %) | < 0.0001 | | |
| cT1 | 385 (45.0) | 371 (54.3) | |
| cT2 | 418 (48.8) | 259 (37.9) | |
| cT3, cT4 | 45 (5.3) | 35 (5.1) | |
| PSA at biopsy (ng/mL) | | | |
| Median, IQR | 7.0 (5.1–9.9) | 6.9 (5.2–9.9) | 0.9375 |
| < 10, *n* (%) | 669 (75.2) | 522 (76.3) | 0.6176 |
| 10–20, *n* (%) | 158 (17.8) | 122 (17.8) | |
| > 20, *n* (%) | 63 (7.1) | 40 (5.9) | |
| Gleason Grade Groups at biopsy (*n*, %) | < 0.0001 | | |
| 1 | 554 (62.7) | 334 (48.7) | |
| 2 | 163 (18.5) | 160 (23.3) | |
| 3 | 77 (8.6) | 95 (13.8) | |
| 4 | 66 (7.5) | 67 (9.8) | |
| 5 | 23 (2.6) | 30 (4.4) | |
| D'Amico risk class (*n*, %) | 0.1580 | | |
| Low | 276 (33.3) | 209 (34.0) | |
| Intermediate | 374 (45.2) | 251 (40.8) | |
| High | 178 (21.5) | 155 (25.2) | |
| Bioptical features | | | |
| Number of biopsy cores (mean ± SD) | 12.6 ± 4.1 | 14.3 ± 4.6 | < 0.0001 |
| Percentage of positive cores | 0.0123 | | |
| Mean ± SD | 34.7 ± 24.9 | 36.1 ± 23.9 | |
| Median, IQR | 29 (17–50) | 33 (17–50) | |
| Min, max | 0, 100 | 0, 100 | |

*BMI* body mass index, *PSA* prostate-specific antigen

[a]Underweight: < 18.5 kg/m$^2$, normal weight 18.5–24.9 kg/m$^2$; overweight: 25.0–29.9 kg/m$^2$; obese: ≥ 30.0 kg/m$^2$

function (BF) ($p = 0.0002$) and the bowel bother (BB) components ($p = 0.0008$) of the UCLA-PCI at diagnosis (Table S1). Conversely, the two cohorts did not differ as far as the mental component summary (MCS) of the SF-12 and the urinary bother (UB), the sexual function (SF) and the sexual bother (SB) components of the UCLA-PCI were concerned.

More robotic procedures were carried out in the Pros-IT CNR than in the MIRROR cohort (58.8% vs 27.6%; $p < 0.0001$; respectively). Nerve sparing approach was more common in the Pros-IT CNR group (57.8% vs 52.9%, $p = 0.0449$): bilateral NS prostatectomy was performed in 42.6% and 36.3% of the Pros-IT CNR and MIRROR cohort, respectively. Less patients in the Pros-IT CNR were submitted to LND than in the MIRROR group (47.7% vs. 76.7%; $p < 0.0001$, respectively).

At logistic regression models (Table S2), the higher was the age at diagnosis, the lower was the probability of being submitted to RA and NS strategies in both cohorts. Advanced age was associated with higher odds of LND procedures only in the MIRROR population. Obesity and the D'Amico risk class were not associated with any outcomes taken into consideration.

Gleason score > 4 + 3 at biopsy showed, at multivariable analysis, a value of 0.29 (95% CI 0.13–0.68) for the MIRROR and 0.37 (95% CI 0.18–0.78) for the Pros-IT CNR cohort, respectively. Moreover, the OR related to a serum PSA ≥ 20 ng/mL at diagnosis was 0.20 (95% CI 0.06–0.69) for the MIRROR and 0.40 (95% CI 0.16–1.03) for the Pros-IT CNR cohort, respectively (Table S2). The clinical T-stage did not emerge to be relevant in Pros-IT population as well as the RA strategy was concerned (OR = 1.47, 95% CI 0.50–4.31). Conversely, clinical T-stage was associated with the decision to perform both NS and LND in the MIRROR cohort respect to the Pros-IT group (OR = 0.07, 95% CI 0.01–0.58 for T3–T4 and OR = 2.41, 95% CI 1.36–4.27 for T2) (Table S2). Biopsy GS ≥ 4 + 3 and a ≥ 50% percentage of positive cores was associated with the decision to perform NS (OR = 0.29, 95% CI 0.14–0.62 and OR = 0.37, 95% CI 0.23–0.59, respectively) as well as LND (OR = 7.53, 95% CI 3.40–16.7 and OR = 2.31, 95% CI 1.45–3.69, respectively) in the Pros-IT CNR cohort of patients.

Regarding the QoL, lower score on the physical component of the SF-12 scale emerged to be a protective factor against RA only in the MIRROR population (OR = 0.53, 95% CI 0.31–0.92). Scores for the SF and SB components of the UCLA-PCI at diagnosis below the third quartile were associated with RA RP in the MIRROR cohort (SF OR = 2.17, 95% CI 1.13–4.16) and with the LND in the Pros-IT CNR one (SB OR = 2.14, 95% CI 1.24–3.69).

## Discussion

It is well established that PCa should be managed on a personalized basis [3] and that the surgical strategy and approach should be determined on the basis of the patient's demographic and clinical characteristics. The frequency of minimally invasive approaches reflects all the important technological advancements that have recently taken place in the field of urology [14, 15] and dramatically changed the management of PCa patients. In fact, 3D magnification, Endowrist technology and the use of RA surgery have enabled surgeons to develop improved techniques in Urology.

The analysis of our data showed that both cohort of patients shared similar characteristics (i.e., age, BMI, waist circumference, and median serum PSA value) (Table1). Therefore, we sought to investigate whether some preoperative variables could have been differently associated with the surgical decision over the 7-year time frame that separated patients' enrollment between the two studies. In this context, parallel multivariate analyses were carried out (Table S2).

A first relevant finding was that the number of RA and NS procedures increased (27.6–53.4% and from 52.9 to 57.8%, in the two cohorts, respectively), whereas the frequency of the LND fell down (76.7% vs. 47.7%, respectively). A further analysis also uncovered that selection criteria for robotic surgery were mainly based on tumor-related (i.e.; GS and PSA) rather than patient-related characteristics (i.e.; SF-12 PCS and age). In this context, surgeons' experience, skill, and confidence with the RA approach seemed to be important factors when intermediate and high-risk patients were considered.

Furthermore, the comparison between the two projects (separated by a 7-year time lag) showed that clinical T-stage, once considered a crucial step for choosing both RA and NS approaches, is no longer relevant; in contrast GS at biopsy, once ignored when the NS and LND strategies were being contemplated, is now one of the main determinants.

As for LND procedures, GS at biopsy and the percentage of positive cores seemed to be the most important factors considered. Of clinical relevance, the most recent project (i.e., Pros-IT CNR) depicted that patient's age was no longer a determinant for LND compared to seven years before [16, 17].

Our findings are in in agreement with evidence currently available. Although the decision to perform LND was not based on a validated nomogram [18, 19], the single elements considered by our multivariable models are all included in the most popular nomograms available. Indeed, the decision to consider single elements rather

than a nomogram seemed particularly appropriate given the long study period (7 years), the many changes made in those nomograms and the different weight of each factor [16, 17, 20]. This feeling can be further illustrated by referring to the Briganti nomogram which predicts lymph node involvement in prostate cancer patients. According to that model, if a 5–10 ng/ml PSA range predicts an increase of only 10 points, the clinical T-stage and GS at biopsy are both considered important elements in predicting lymph node involvement.

Our data have confirmed the results of the Martini-Clinic database that showed that GS, serum PSA levels, and the number of positive biopsy cores were independent predictors for LND in both open and RA RP in high-volume centers [21]. Moreover, even if PSA has kept its importance in terms of surgical decision, the percentage of positive cores at biopsy has become even more relevant both for NS and LND.

These results could be linked to advancements in the technical accuracy of robotic surgery and the more precise preoperative imaging assessment tools—including magnetic resonance [22], fusion biopsy [23], 3D technology [24], etc.—that are increasingly being used to evaluate patients with PCa.

It should be noted that the significantly higher mean number of biopsy cores in Pros-IT CNR population might be related to the wide time period of the studies, during which methods and number of cores significantly changed.

Despite the significant reduction in palpable tumors (cT2: 48.8% vs. 37.9%) found by the most recent survey (Pros-IT CNR), men at the same age and with the same PSA value showed the comparable median number of positive cores at biopsy (i.e., 12), although they presented different percentages of positive cores (33% vs. 29%). The changes occurred over time in the guidelines about prostate biopsies (namely, indications, procedures, and interpretation of results) have led to a dramatic increase in high grade PCa in the latter as compared to the former cohort of patients (GS $\geq$ 8: 14.2% vs.10.1%, respectively) and a concomitant reduction in the number of indolent or low grade PCa (GS = 6: 48.7% vs 62.7%, respectively).

Of further clinical relevance the finding that the D'Amico risk class was not associated with the surgical decisions at multivariate analyses in both cohorts. This quite unexpected result might be linked to the higher impact of single oncologic features (such as grade, stage, and PSA) with respect to risk classes referring to a combination of variables [25]. In addition, criteria for RA procedures have probably changed over the last 10 years. In fact, general and cancer-specific QoL analyses have demonstrated that nowadays candidates for RA RP seem to be more fit and to have better urinary and bowel control. On the contrary, patients with urinary and/or bowel dysfunction are being offered other treatment options [6, 26–28]. Similarly, it is also possible that patients' expectations in terms of urinary function after RP are currently higher than those reported only 10 years ago [6, 26–28].

Finally, while none of the projects seemed to take obesity into consideration during preoperative assessments, in accordance with current literature reports, the Pros-IT study found a further reduction in terms of the OR for the obese patients to be finally considered for RA, NS prostatectomy and LND compared to the MIRROR cohort (1.0 vs. 1.8, 0.6 vs. 0.8 and 0.7 vs. 2.0, respectively) [29, 30].

The present study is not devoid of limitations. First of all, we compared the populations of two different studies with dissimilar designs, number of patients per center, proposed objectives and methods. Second, since PCa patients in the two groups were treated both at referral as well as at minor urologic centers, current findings may not be considered generalizable. Nevertheless, both used the same tests to evaluate patients' general and PCa-related QoL. Moreover, selection criteria for robotic surgery are based on tumor-, patient-, center- and surgeon-related factors. Owing to the primary aims of the studies, these data are not totally available, and they are not considered in our analysis. However, the selection criteria listed above, are partially related to surgeon decision-making and maybe they are not entirely generalizable. Key factor for the specific purpose of the analyses, the studies referred to two different time frames, an important issue when robotic technology is being discussed. These limitations may have affected data's homogeneity and generalizability. Finally, the lack of information on long-term outcomes can be considered a further methodological bias.

Despite these limitations, the multi-institutional experiences outlined here provide a revealing snapshot of the Italian trend to use RA RP in case of organ-confided PCa, highlighting patient and tumor related factors that continue to be considered relevant when surgical options (RA, NS and LND) are contemplated.

Overall, the current findings confirm that PCa management has dramatically changed over the past single decade, mostly because of newly developed therapeutic technologies [31]. Our study presents a picture of surgical treatments of PCa in a specific country over a specific timeframe. Future studies will be able to: assess the impact of the surgeon's experience and skill; evaluate very long-term functional and oncological outcomes after robotic vs. open surgery; pinpoint criteria for selecting candidates who most could benefit from a minimally invasive approach; and compare various therapeutic options for PCa and the differences attained in low and high volume centers.

To conclude, major technological advancements have been fully incorporated in the practice of Italian urologists, aiming at reducing the toxicity of the surgical treatment and possibly ameliorating outcomes; hopefully, future breakthroughs in surgical techniques and preoperative assessment

tools will lead to even better outcomes for patients underwent RP.

**Acknowledgements** Pros-IT CNR is a non-profit observational study. Takeda Italia S.p.A. will furnish CNR with a non-conditional grant to cover the cost of developing a web platform for data entry and the travel expenses of the Steering Committee, the Working Group and the Scientific Committee. The MIRROR study was promoted by Leading Urological No profit foundation Advanced research (LUNA), the research foundation of the Italian Urological Association (SIU) which supported the study with an unrestricted grant. The Pros-IT CNR Group: *Steering Committee*: Walter Artibani, Pierfrancesco Bassi, Sergio Bracarda, Giario Natale Conti, Renzo Corvò, Gaetano Crepaldi, Angelo Porreca, Pierpaolo Graziotti, Stefania Maggi, Vincenzo Mirone, Rodolfo Montironi, Marianna Noale, Elvio Russi. *Scientific Committee*: Filippo Bertoni, Mauro Gacci, Stefano Maria Magrini, Giovanni Muto, Stefano Pecoraro, Umberto Ricardi, Andrea Tubaro, Vittorina Zagonel. *Working Group:* Anna Rita Alitto, Enrica Ambrosi, Alessandro Antonelli, Cynthia Aristei, Franco Bardari, Lilia Bardoscia, Salvina Barra, Sara Bartoncini, Umberto Basso, Carlotta Becherini, Rita Bellavita, Franco Bergamaschi, Stefania Berlingheri, Alfredo Berruti, Marco Borghesi, Roberto Bortolus, Valentina Borzillo, Davide Bosetti, Giuseppe Bove, Pierluigi Bove, Maurizio Brausi, Alessio Bruni, Giorgio Bruno, Eugenio Brunocilla, Alberto Buffoli, Michela Buglione, Consuelo Buttigliero, Giovanni Cacciamani, Michela Caldiroli, Giuseppe Cardo, Giorgio Carmignani, Giuseppe Carrieri, Emanuele Castelli, Elisabetta Castrezzati, Gianpiero Catalano, Susanna Cattarino, Francesco Catucci, Dario Cavallini Francolini, Ofelia Ceccarini, Antonio Celia, Francesco Chiancone, Tommaso Chini, Claudia Cianci, Antonio Cisternino, Devis Collura, Franco Corbella, Matteo Corinti, Paolo Corsi, Fiorenza Cortese, Luigi Corti, Nunzio de Cosimo, Olga Cristiano, D'Angelillo Rolando, Luigi Da Pozzo, Daniele D'Agostino, Carolina D'Elia, Matteo Dandrea, Micheles De Angelis, Paolo De Angelis, Ottavio De Cobelli, Bernardino De Concilio, Antonello De Lisa, Stefano De Luca, Agostina De Stefani, Chiara Lucrezia Deantoni, Claudio Degli Esposti, Anna Destito, Beatrice Detti, Nadia Di Muzio, Andrea Di Stasio, Calogero Di Stefano, Danilo Di Trapani, Giuseppe Difino, Sara Falivene, Giuseppe Farullo, Paolo Fedelini, Ilaria Ferrari, Francesco Ferraù, Matteo Ferro, Andrei Fodor, Francesco Fontana, Francesco Francesca, Giulio Francolini, Paolo Frata, Giovanni Frezza, Pietro Gabriele, Maria Galeandro, Elisabetta Garibaldi, Pietro Giovanni Gennari, Alessandro Gentilucci, Alessandro Giacobbe, Laura Giussani, Giuseppe Giusti, Paolo Gontero, Alessia Guarneri, Cesare Guida, Alberto Gurioli, Dorijan Huqi, Ciro Imbimbo, Gianluca Ingrosso, Cinzia Iotti, Corrado Italia, Pierdaniele La Mattina, Roberto La Rocca, Enza Lamanna, Luciana Lastrucci, Grazia Lazzari, Fabiola Liberale, Giovanni Liguori, Roberto Lisi, Frank Lohr, Riccardo Lombardo, Jon AJ Lovisolo, Giuseppe Mario Ludovico, Nicola Macchione, Francesca Maggio, Michele Malizia, Gianluca Manasse, Giovanni Mandoliti, Giovanna Mantini, Luigi Marafioti, Luisa Marciello, Alberto Mario Marconi, Antonietta Martilotta, Salvino Marzano, Stefano Masciullo, Gloria Maso, Adele Massenzo, Ercole Mazzeo, Luigi Mearini, Serena Medoro, Rosa Molè, Giorgio Monesi, Emanuele Montanari, Franco Montefiore, Giampaolo Montesi, Giuseppe Morgia, Gregorio Moro, Giorgio Muscas, Daniela Musio, Paolo Muto, Giovanni Muzzonigro, Giorgio Napodano, Carlo Luigi Augusto Negro, Mattia Nidini, Maria Ntreta, Marco Orsatti, Carmela Palazzolo, Isabella Palumbo, Alessandro Parisi, Paolo Parma, Nicola Pavan, Martina Pericolini, Francesco Pinto, Antonio Pistone, Valerio Pizzuti, Angelo Platania, Caterina Polli, Giorgio Pomara, Elisabetta Ponti, Antonio Benito Porcaro, Francesco Porpiglia, Dario Pugliese, Armin Pycha, Giuseppe Raguso, Andrea Rampini, Donato Franco Randone, Valentina Roboldi, Marco Roscigno, Maria Paola Ruggieri, Giuseppe Ruoppo, Roberto Sanseverino, Anna Santacaterina, Michele Santarsieri, Riccardo Santoni, Sarah Scagliarini, Giorgio Vittorio Scagliotti, Mauro Scanzi, Marcello Scarcia, Riccardo Schiavina, Alessandro Sciarra, Carmine Sciorio, Tindaro Scolaro, Salvatore Scuzzarella, Oscar Selvaggio, Armando Serao, Sergio Serni, Marco Andrea Signor, Mauro Silvani, Giovanni Silvano, Franco Silvestris, Claudio Simeone, Valeria Simone, Girolamo Spagnoletti, Matteo Giulio Spinelli, Luigi Squillace, Vincenzo Tombolini, Mariastella Toninelli, Luca Triggiani, Alberto Trinchieri, Luca Trodella, Eolo Luca, Lucio Trodella, Carlo Trombetta, Lidia Tronnolone, Marcello Tucci, Daniele Urzì, Riccardo Valdagni, Maurizio Valeriani, Maurizio Vanoli, Elisabetta Vitali, Alessandro Volpe, Stefano Zaramella, Guglielmo Zeccolini, Giampaolo Zini. *The MIRROR-SIU/LUNA Group*: Ferdinando Acanfora, Ernesto Aiello, Simonato Alchiede, Vincenzo Altieri, Claudio Anceschi, Francesco Aragona, Walter Artibani, Filippo Balloni, Ezio Barasolo, Giuseppe Barba, Riccardo Bartoletti, Pierfrancesco Bassi, Barbara Bigazzi, Emanuele Belgrano, Siracusano Salvatore, Michele Battaglia, Luca Bellei, Attilio Bettin, Giampaolo Bianchi, Leonardo Bombieri, Tommaso Brancato, Guglielmo Breda, Alberto Briganti, Sergio Caggiano, Antonino Calabrò, Michela Caldironi, Biagio Campo, Sergio Capobianco, Francesco Capparelli, Antonio Carbone, Daniele Carlo, Giorgio Carmignani, Giuseppe Catalano, Francesco Catanzaro, Francesco Ciaraldi, Virgilio Cicalese, Antono Cisternino, Carlo Corbu, Sergio Cosciani Cunico, Vincenzo Cosentino, Aldo Crimi, Giuseppina Cucchiarale, Daniele Cuscunà, Rocco Damiano, Massimino D'Armiento, Ottavio De Cobelli, Carlo De Dominicis, Gaetano De Grande, Carlo Del Boca, Angelo D'Elia, Antonello De Lisa, Stefano De Luca, Emmanuel De Mayo, Michele De Martin, Luigi Di Clemente, Sergio Di Meo, Giovanni Di Monaco, Giuliano Di Nicola, Alessandro Di Silverio, Franco Di Silverio, Franco Fabri, Mario Falsaperla, Franco Fanciullacci, Giovanni Ferrari, Gaspare Fiaccavento, Antonio Filoni, Dario Fontana, Gabriele Fontana, Hassan Ghabin, Bruno Frea, Franco Gaboardi, Mauro Gacci, Vincenzo Gentile, Marco Giandotti, Paolo Gontero, Marco Grasso, Gaetano Grosso, Stefano Guazzieri, Antonino Isaia, Giuseppe Landi, Roberto Landolfi, Piero Larcher, Cesare Laurenti, Dino Lavelli, Gianni Lorenzo Leidi, Antonino Lembo, Sergio Leoni, Giuseppe Mario Ludovico, Nicola Maffei, Massimo Maffezzini, Carlo Martinengo, Carlo Manieri, Alberto Mario Marconi, Giuseppe Martorana, Rosaria Mazza, Mauro Medica, Darwin Melloni, Lucio Miano, Emanuele Micheli, Raffaella Milesi, Mauro Silvano Minervini, Danilo Minocci, Vincenzo Mirone, Angelo Molon, Emanuele Montanari, Patrizia Morello, Giuseppe Morgia, Mario Motta, Giovanni Muzzonigro, Federico Narcisi, Giulio Nicita, Salvatore Palermo, Mauro Paoluzzi, Paolo Parma, Paolo Pompa, Massimo Porena, Giovanni Raciti, Donato Franco Randone, Antonio Rizzotto, Francesco Rocco, Michele Romano, Leonardo Rossini, Gian Rosario Russo, Roberto Salvioni, Sandro Sandri, Gianfranco Savoca, Cesare Selli, Francesco Paolo Selvaggi, Fabio Sercia, Carlo Tallarigo, Marco Tanello, Andrea Tasca, Raffaello Tenaglia, Mario Tensi, Carlo Terrone, Luigi Tralce, Alberto Trinchieri, Alessandra Vagge, Primo Valenti, Marco Varaldo, Giuseppe Vespasiani, Carlo Vicentini, Francesco Vicirca, Paolo Viganò, Vincenzo Zaccone, Camil Zartar.

**Author contributions** MG project development, manuscript writing. WA data collection. PB data collection. FB data collection. SB data collection. AB data collection. GC data collection. LC data collection. GC data collection. RC data collection. CDN data collection. FF data collection. PG data collection. IG manuscript writing. SM statistical analysis. SMM data collection. VM data collection. RM data collection. GM data collection. GM data collection. MN data analysis, manuscript writing. SP data collection. AP data collection. UR data collection. ER data collection. GR data collection. AS data collection. AS data collection. SS data collection. DT data collection. AT data collection. VZ data collection. GC data collection. MIRROR-SIU/LUNA Study Group: data collection. Pros-IT CNR Study Group: data collection.

**Funding** Takeda, LUNA foundation.

## Compliance with ethical standards

**Conflict of interest** None.

**Research involving human participants** All researches involving human participants were in accordance with the principles of the Declaration of Helsinki and were approved by the Ethic Committee of both coordinating centers and of each participating center.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

**Availability of data and material** Pros-IT CNR data are available only to the collaborating scientists within the study.

**Code availability** Pros-IT CNR materials are available only to the collaborating scientists within the study.

## References


1. Ficarra V, Novara G, Artibani W et al (2009) Retropubic, laparoscopic, and robot-assisted radical prostatectomy: a systematic review and cumulative analysis of comparative studies. Eur Urol 55(5):1037–1063. https://doi.org/10.1016/j.eururo.2009.01.036
2. Heidenreich A, Aus G, Bolla M et al (2008) European Association of Urology. EAU guidelines on prostate cancer. Eur Urol 53(1):68–80. https://doi.org/10.1016/j.eururo.2007.09.002
3. Mottet N, Cornford P. van den Bergh RCN et al (2020) EAU—EANM—ESTRO—ESUR—SIOG Guidelines on Prostate Cancer. https://uroweb.org/guideline/prostate-cancer/
4. Bruendl J, Rothbauer C, Bn L et al (2018) Accordance of online health information on prostate cancer with the European Association of Urology Guidelines. Urol Int 100(3):288–293. https://doi.org/10.1159/000487146
5. Simonato A, Varca V, Gacci M et al (2012) Adherence to guidelines among italian urologists on imaging preoperative staging of low-risk prostate cancer: results from the MIRROR (Multicenter Italian Report on Radical Prostatectomy Outcomes and Research) Study. Adv Urol 2012:651061. https://doi.org/10.1155/2012/651061
6. Imbimbo C, Creta M, Gacci M et al (2011) Patients' desire to preserve sexual activity and final decision for a nerve-sparing approach: results from the MIRROR (Multicenter Italian Report on Radical Prostatectomy Outcomes and Research) Study. J Sex Med 8(5):1495–1502. https://doi.org/10.1111/j.1743-6109.2011.02213.x
7. Noale M, Maggi S, Artibani W et al (2017) Pros-IT CNR study group. Pros-IT CNR: an Italian prostate cancer monitoring project. Aging Clin Exp Res 29(2):165–172. https://doi.org/10.1007/s40520-017-0735-6
8. Apolone G, Mosconi P, Quattrociocchi L et al (2001) Questionario sullo stato di salute SF-12. Versione Italiana. Guerini e Associati Editore, Milano
9. Gacci M, Livi L, Paiar F et al (2005) Quality of life after radical treatment of prostate cancer: validation of the Italian version of the University of California Los Angeles-Prostate Cancer Index. Urology 66:338–343. https://doi.org/10.1016/j.urology.2005.02.027
10. Porreca A, Noale M, Artibani W et al (2018) Pros-IT CNR study group. Disease-specific and general health-related quality of life in newly diagnosed prostate cancer patients: the Pros-IT CNR study. Health Qual Life Outcomes 16(1):122. https://doi.org/10.1186/s12955-018-0952-5
11. Gacci M, Noale M, Artibani W et al (2017) Pros-IT CNR study group. Quality of life after prostate cancer diagnosis: data from the Pros-IT CNR. Eur Urol Focus 3(4–5):321–324. https://doi.org/10.1016/j.euf.2017.10.009
12. Leow JJ, Chang SL, Meyer CP et al (2016) Robot-assisted versus open radical prostatectomy: a contemporary analysis of an all-payer discharge database. Eur Urol 70(5):837–845. https://doi.org/10.1016/j.eururo.2016.01.044
13. D'Amico AV (2011) Risk-based management of prostate cancer. N Engl J Med 365(2):169–171. https://doi.org/10.1056/NEJMe1103829
14. Vignolini G, Campi R, Sessa F et al (2019) Development of a robot-assisted kidney transplantation programme from deceased donors in a referral academic centre: technical nuances and preliminary results. BJU Int 123(3):474–484. https://doi.org/10.1111/bju.14588
15. Vignolini G, Sessa F, Greco I et al (2019) Intraoperative assessment of ureteral and graft reperfusion during robotic kidney transplantation with indocyanine green fluorescence videography. Minerva Urol Nefrol 71(1):79–84. https://doi.org/10.23736/S0393-2249.18.03278-2
16. Mearini L, Gacci M, Saleh O et al (2014) Multicenter Italian Report on Radical Prostatectomy: Outcome and Research (MIRROR) Project-Leading Urological No-Profit Foundation for Advanced Research (LUNA) Foundation. External validation of nomogram predicting the probability of specimen-confined disease (pT2-3a, R0N0) in patients undergoing radical prostatectomy and pelvic lymph node dissection. Urol Int 93(3):262–268. https://doi.org/10.1159/000354430
17. Gacci M, Schiavina R, Lanciotti M et al (2013) External validation of the updated nomogram predicting lymph node invasion in patients with prostate cancer undergoing extended pelvic lymph node dissection. Urol Int 90(3):277–282. https://doi.org/10.1159/000343993
18. Briganti A, Larcher A, Abdollah F et al (2012) Updated nomogram predicting lymph node invasion in patients with prostate cancer undergoing extended pelvic lymph node dissection: the essential importance of percentage of positive cores. Eur Urol 61(3):480–487. https://doi.org/10.1016/j.eururo.2011.10.044
19. De Nunzio C, Lombardo R, Tema G et al (2018) External validation of Chun, PCPT, ERSPC, Kawakami, and Karakiewicz nomograms in the prediction of prostate cancer: a single center cohort-study. Urol Oncol 36(8):364.e1–364.e7. https://doi.org/10.1016/j.urolonc.2018.05.010
20. Briganti A, Joniau S, Gontero P et al (2012) Identifying the best candidate for radical prostatectomy among patients with high-risk prostate cancer. Eur Urol 61(3):584–592. https://doi.org/10.1016/j.eururo.2011.11.043
21. Schiffmann J, Haese A, Leyh-Bannurah SR et al (2015) Adherence of the indication to European Association of Urology guideline recommended pelvic lymph node dissection at a high-volume center: differences between open and robot-assisted radical prostatectomy. Eur J Surg Oncol 41(11):1547–1553. https://doi.org/10.1016/j.ejso.2015.05.008
22. Fütterer JJ, Briganti A, De Visschere P et al (2015) Can clinically significant prostate cancer be detected with multiparametric magnetic resonance imaging? A systematic review of the literature. Eur Urol 68(6):1045–1053. https://doi.org/10.1016/j.eururo.2015.01.013
23. Kasivisvanathan V, Rannikko AS, Borghi M et al (2018) MRI-targeted or standard biopsy for prostate-cancer diagnosis. N Engl J Med 378(19):1767–1777. https://doi.org/10.1056/NEJMoa1801993
24. Porpiglia F, Bertolo R, Checcucci E et al (2018) ESUT Research Group. Development and validation of 3D printed virtual models for robot-assisted radical prostatectomy and partial nephrectomy:

urologists' and patients' perception. World J Urol 36(2):201–207. https://doi.org/10.1007/s00345-017-2126-1
25. Leyh-Bannurah SR, Budäus L, Zaffuto E et al (2018) Adherence to pelvic lymph node dissection recommendations according to the National Comprehensive Cancer Network pelvic lymph node dissection guideline and the D'Amico lymph node invasion risk stratification. Urol Oncol 36(2):81.e17–81.e24. https://doi.org/10.1016/j.urolonc.2017.10.022
26. Porreca A, Noale M, Artibani W et al (2018) Disease-specific and general health-related quality of life in newly diagnosed prostate cancer patients: the Pros-IT CNR study. Health Qual Life Outcomes 16(1):122. https://doi.org/10.1186/s12955-018-0952-5
27. Gacci M, Carini M, Simonato A et al (2011) Factors predicting continence recovery 1 month after radical prostatectomy: results of a multicenter survey. Int J Urol 18(10):700–708. https://doi.org/10.1111/j.1442-2042.2011.02826.x
28. Gacci M, Simonato A, Masieri L et al (2009) Urinary and sexual outcomes in long-term (5+ years) prostate cancer disease free survivors after radical prostatectomy. Health Qual Life Outcomes 13(7):94. https://doi.org/10.1186/1477-7525-7-94
29. Limani K, Albisinni S, Aoun F et al (2017) Quality of life after robotic prostatectomy: Impact of BMI and age on urinary incontinence. Prog Urol 27(4):244–252. https://doi.org/10.1016/j.purol.2016.10.008
30. Schiffmann J, Salomon G, Tilki D et al (2017) Radical prostatectomy neutralizes obesity-driven risk of prostate cancer progression. Urol Oncol 35(5):243–249. https://doi.org/10.1016/j.urolonc.2016.12.014
31. Valerio M, Cerantola Y, Eggener SE et al (2017) New and established technology in focal ablation of the prostate: a systematic review. Eur Urol 71(1):17–34. https://doi.org/10.1016/j.eururo.2016.08.044



## Affiliations

**Mauro Gacci[1] · Walter Artibani[2] · Pierfrancesco Bassi[3] · Filippo Bertoni[4] · Sergio Bracarda[5] · Alberto Briganti[6] · Giorgio Carmignani[7] · Luca Carmignani[8] · Giario Conti[9] · Renzo Corvò[10] · Cosimo De Nunzio[11] · Ferdinando Fusco[12] · Pierpaolo Graziotti[13] · Isabella Greco[1] · Stefania Maggi[14] · Stefano Maria Magrini[15] · Vincenzo Mirone[12] · Rodolfo Montironi[16] · Giuseppe Morgia[17] · Giovanni Muto[18] · Marianna Noale[14] · Stefano Pecoraro[19] · Angelo Porreca[20] · Umberto Ricardi[21] · Elvio Russi[22] · Giorgio Russo[17] · Andrea Salonia[23] · Alchiede Simonato[24] · Sergio Serni[1] · Davide Tomasini[15] · Andrea Tubaro[11] · Vittorina Zagonel[25] · Gaetano Crepaldi[14] · The MIRROR-SIU/LUNA Study Group and the Pros-IT CNR Study Group**

1 Department of Urological minimally invasive and Robotic Surgery and kidney Transplantation, Careggi Hospital, University of Florence, Florence, Italy
2 Urologic Clinic, Department of Oncological and Surgical Sciences, AOU Integrata and University of Verona, Verona, Italy
3 Department of Urology, University of Rome La Cattolica, Rome, Italy
4 AIRO-Italian Association for Radiation Oncology, Rome, Italy
5 Department of Oncology, Santa Maria Hospital, Terni, Italy
6 Department of Urology, Vita-Salute San Raffaele University, Milan, Italy
7 Department of Urology, University of Genoa, Genoa, Italy
8 Department of Urology, San Donato Policlinic Hospital, Milan, Italy
9 Department of Urology, Sant' Anna Hospital, Como, Italy
10 Department of Radiation Oncology, AOU IRCCS San Martino-IST National Cancer Research Institute and University, Genoa, Italy
11 Department of Urology, Sant'Andrea Hospital, Sapienza University of Rome, Rome, Italy
12 Department of Urology, University Federico II, Naples, Italy
13 Department of Urology, San Giuseppe Hospital, Milan, Italy
14 Aging Branch, National Research Council (CNR), Neuroscience Institute, Padua, Italy
15 Radiation Oncology Unit, University of Brescia and Spedali Civili Hospital, Brescia, Italy
16 Section of Pathological Anatomy, Polytechnic University of the Marche Region, Ancona, Italy
17 Department of Urology, University of Catania, Catania, Italy
18 Department of Urology, Humanitas, Hospital Gradenigo, Turin, Italy
19 Department of Nephrourology, Malzoni Center, Avellino, Italy
20 Department of Urology, Abano Terme General Hospital, Padua, Italy
21 Department of Oncology, Radiation Oncology, University of Torino, Turin, Italy
22 Radiation Unit, San Croce e Carle Hospital, Cuneo, Italy
23 Division of Experimental Oncology/Unit of Urology, URI, IRCCS San Raffaele Hospital, Milan, Italy
24 Department of Surgical, Oncological and Stomatological Sciences, Section of Urology, University of Palermo, Palermo, Italy
25 Medical Oncology Unit, Oncological Institute, Veneto IOV-IRCCS, Padua, Italy