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Revolutionizing radical prostatectomy - a comparative study of traditional and modern automated surgical techniques

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Abstract:

Introduction and purpose:

Prostate cancer is a common malignancy seen worldwide and second most common cancer among Polish men as well as globally. The symptoms of prostate cancer depend on severity of the cancer. Prostate cancer diagnosis is typically established through physical examination- digital rectal examination (DRE), PSA (prostate specific antigen) testing and confirmed by histopathological examination. The choice of treatment method depends on many factors: disease severity, risk assessment (based on PSA, TNM and Gleason score), age of the patient and

expected survival time. Treatment include surgery, hormone therapy, radiation therapy or chemotherapy. In some cases, the combination of methods can be used to achieve better outcomes.
One of available treatment option is radical prostatectomy which includes open radical prostatectomy (ORP), laparoscopic and laparoscopic robot assisted radical prostatectomy (RARP). We aimed at presenting various outcomes comparing open radical prostatectomy and robot assisted radical prostatectomy.
State of knowledge:
In order to carry out the review of the topic we began to collect information and comprehensive research in PubMed database. The analysis focused on the treatment of prostate cancer especially radical prostatectomy methods, the course of surgical procedure, postoperative care, oncological results, intraoperative and postoperative complications.
Conclusion:
ORP and RARP ae two surgical procedures used in prostate cancer treatment. Both of them involve removal of the prostate gland but also have a multiplicity of differences. RARP is safe and less invasive alternative to ORP with shorter postoperative hospitalization. However, ORP is known for no necessity for expensive specialized equipment such as Da Vinci or Versius robot surgery system and shorter operative time.

Keywords: Prostatectomy, Radical prostatectomy, Prostate cancer, Surgery, Robot assisted radical prostatectomy, Open radical prostatectomy, Robot

Background:

Prostate cancer is the most common in men over 50 years old and should be suspected during presenting lower urinary tracts symptoms (LUTS) which include increase of urination frequency, poor and intermittent stream, nocturia, urination difficulties, incomplete emptying, post-micturition dribble, pain and discomfort during ejaculation, hematuria [1]. Studies estimating that LUTS appears at greater than 50% men at age of 50 years old and above [2]. Difficulties of prostate cancer diagnosis include occurring LUTS during benign prostate hyperplasia (BHP) moreover symptoms like visible hematuria may also suggest possible urological cancer including prostate cancer [3]. Significant differences between prostate cancer and BPH can be distinguished during DRE and/or PSA [4]. Raise of PSA levels is present by a numerous condition such as BPH, prostatitis, ejaculation and physical exercises and also can be at normal range for up to 25% of men with prostate cancer [5]. Gold standard diagnostic test for prostate cancer is a transrectal ultrasound (TRUS) or transperineal approach guided by ultrasound prostate biopsy. Biopsy is performed after finding an elevated PSA result or assessing patient as prostate cancer susception [6]. Radical prostatectomy is treatment option for patients with high-risk prostate cancer. High-risk features include PSA > 20 ng/dl, Gleason ≥8 or TNM cT2c/T3 [7]. Radical prostatectomy is surgical treatment in which the prostate gland is removed with prostatic urethra and seminal vesicles. The best time for performing surgery is as least 6 weeks after prostate biopsy and not earlier than 3 months after transurethral resection due to possibility of hematoma, inflammation, periprostatic fibrosis that can increase the risk of surgical complications such as rectal injury or neurovascular bundle damage. The preoperative assessment includes past surgical and medical history, in particular, previous pelvic or abdominal surgeries, hernia repair with mesh, pelvic radiotherapy and transurethral surgeries. Multiparametric magnetic resonance imaging (mpMRI) is crucial to exact depiction a tumor location, tumor's clinical stage, the lent of the urethral sphincter and its proximity to neurovascular bundle which may come useful for concerning eventual postoperative urinary incontinence and potency loss [8].

Open radical prostatectomy- surgical procedure:

The patient's position is supine with suprapubic area exposed. Positions such subtle hyperextension, Trendelenburg position are occasionally used by some surgeons to improve exposure of the pelvis. After sterile skin preparation and draping the insertion of 16 or 18 French (Fr) indwelling catheter takes place. Surgeon makes a lower midline of Pfannensteil incision which allows for an extraperitoneal approach of the space of Retzius. After preservation and superior displacing of the vas deferens the access to the bifurcation of the common iliac vein is possible and the lymph node dissection may be performed. Bladder and peritoneum cephalad are displaced by the retractors. Next step contains opening the endopelvic fascia at both sides by lateral

incision what results access to the apex of the prostate [9]. At this point incisions on the prostatic fascia are performed with as much of periprostatic neurovascular tissue as possible preservation to initiate the apical dissection in preparation for nerve-sparing [10]. Then the apical dissection takes place with the gentle traction to preserve neurovascular bundles intact. The striated external sphincter fibers are attached to the surface of the distal prostatic apex and they are pushed away to visualize the longitudinal smooth muscle fibers which are running into the prostate gland [11]. Then the incision of the anterior urethra is done distal to apex with the maximal possible length of the membranous urethra preservation [12]. The posterior urethra should not be damaged to avoid retraction of the urethral stump and permit the anastomotic sutures placement of the anterior part within the exploded ventral edge. Surgeons control the dorsal venous complex to minimalize blood loss and injuries of the prostatic apex and the straited sphincter. Bleeding is controlled with absorbable sutures [13]. The posterior urethra and recto-urethialis are divided to expose the Denonvilliers' fascia which allows access and removal of the seminal vesicles and ductus deferens. In the next stage of the operation, the bladder neck is cut and the prostate gland is removed. The continuity of the urinary tract is restored by narrowing and suturing the bladder neck to the stump of the membranous part of the urethra. To keep urine continence and erectile function the neurovascular bundle in tissue between the peri-prostatic fascia and the endopelvic fascia should be preserved [14]. After performing the radical prostatectomy wound should be closed in layers after placing the drain into the pelvis.

Robot assisted radical prostatectomy- surgical procedure:

The da Vinci Surgical System and Versius Surgical Robotic System are two robotic surgical systems available for clinical use in Poland. The main procedural advantages of using the robotic system are improved dexterity, its precision, three-dimensional imaging, and its ergonomic design for surgeons [15]. During the procedure, the surgeon manipulates robotic arms attached to a console that provides high-definition visualization of the surgical site. Patient is placed in the Trendelenburg position. To insert trocars, camera and assistant instruments surgeon makes 6 incisions for 6 ports: 3 for the robotic arms, 2 for an assistant instruments and 1 for the camera. After Retzius space dissection the bladder is dropped and bladder wall is fixed to the abdominal wall to provide the best vision of the operation field. Then prostatectomy may take place. After removing the prostate gland, urethral stump is suturing to the bladder neck what provides the urinary tract community [16]. During whole procedure nerve sparing is crucial for the continence and erectile function.

Results:

Patients after RARP demonstrated a lower estimated blood loss and postoperative blood transfusions comparing to ORP. Moreover, ORP takes a shorter operative time but hospitalization time is longer as well as time to catheter removal than RARP. A higher rate of postoperative complications as well as postoperative blood transfusions was demonstrated for ORP [17]. In all approaches, small abdominal incision translates into low pain scores [18]. Although robotic surgery costs more and demands specialistic equipment the decreased blood loss, fewer transfusions and complications, shorter hospitalization and rapid convalescence may justify the additional expense of the robotic approach [19].

Perioperative and postoperative possible complications:

Regardless of the surgical method mortality with radical prostatectomy is low. The most common perioperative complication is bleeding. Advantage of RARP is fewer blood loss, perioperative complications and deaths [20]. The most important functional outcomes are continence and potency. The recovery of continence is associated with prostate volume [21], surgical techniques [22], bladder neck preservation [23] and nerve sparing [24]. Studies shows that time to reach full continence is shorter for RARP. Moreover the 12-month continence recovery is better following RARP and ranged up to 100% [25]. The recovery of erectile function depends on age [26], pretreatment potency [27], nerve sparing [28] and BMI [29]. RARP characterized with shorter time to potency recovery versus ORP [30]. In the prostate cancer treatment combining of satisfying functional outcomes and quality of life with good oncological outcomes is the most challenging [31]. The life expectancy following to the surgical treatment for prostate cancer is optimistic and the median is greater than 10 years [32]. Research shows that RARP has less positive surgical margin comparing to ORP [33]. Although surgical margins are not reliably point for prostate cancer mortality, positive surgical margins may be associated with raise for biochemical recurrence and necessity for salvage treatment [34]. Positive margin rate is another method of assessment of oncologic outcomes that is readily available giving a prediction for long-term oncologic outcome. Pathological tumor grade and nodal status are significant predictors of biochemical progression, clinical progression-free survival and 10-year cancer specific survival [35]. PSA > 20ng/ml and biopsy Gleason score ≤7 resulted in 10-year PCa-specific mortality of 5% [36]. However, RARP represents less perioperative

complications and shorter hospitalization, the economic issues are important. The robotic systems and its maintenance are more expensive than open surgery [37]. Price of Da Vinci Surgical system is about 14,5 million PLN which constitutes the robot price only without disposable parts and other maintenance components.

Conclusion:

For patients suffering from localized high-risk prostate cancer surgical treatment is one of the best options. Era of the laparoscopic and robot assisted surgeries is here and now and it is unlikely that open surgeries return and replace those minimally invasive treatment [38]. Despite to differences between RARP and ORP current available data shows achieving similar oncological and functional outcomes. Despite of shorter surgery time during ORP and lowers costs of the procedure, RARP technique holds shorter hospital stay, less blood loss as well as postoperative blood transfusions. To sum up ORP remains well-established approach for the prostate cancer treatment and surely will continue to be used in financial limited areas. Therefor training in ORP should not be desisted in order to assist and teaching other pelvic surgeries such as radical cystectomy. After follow-up RARP as well as laparoscopic radical prostatectomy have potential to became the gold standard in the treatment of localized prostate cancer worldwide.

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