Original Article

The Early Experience of a Novel Robotic Platform: A Pilot Study

Abstract

Introduction: Robotic platforms have been gradually adopted in the current surgical status quo. The aim of the pilot study is the presentation of our initial experience, using the newly introduced avatera robotic system. **Methods:** Two patients were included in the current study. One male patient underwent a robot-assisted radical prostatectomy and one female patient underwent a right radical nephrectomy. **Results:** Both of the surgeries were completed successfully, without major complications. The mean operative time was calculated to be 174 min. **Conclusion:** Radical procedures can be safely and effectively conducted, using the avatera robot platform.

Keywords: *Avateramedical, early experience, nephrectomy, radical prostatectomy, robot-assisted*

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Introduction

The introduction of robotic surgical systems to the options of surgical treatment was initiated 23 years ago. The surgical practice changed gradually and started to evolve, especially in the field of urology.[1] Intuitive surgical reported that in 2000 more than 1.2 million robot-assisted procedures were performed.[2] The steep learning curve and ergonomy during surgeries are some of the reasons of the increasing use of these platforms.[3-5] The increasing adoption of robotic platforms in everyday clinical practice has contributed to the creation of many different devices by different companies over the last years. The avatera robotic system (avateramedical GmbH, Jena, Germany) is a newly introduced robotic platform developed in Germany. The aim of the current study is the presentation of our initial experience, after completing two cases with this newly designed robotic platform.

Methods

The robotic system

The avatera robotic system consists of two basic units: the bedside unit including the 4 surgical arms for the placement and control of the instruments and the control unit. The surgeon performs the procedures sitting on the control unit. An endoscope, Metzenbaum scissors, an Atraumatic grasper, a Maryland dissector, and a Needle Holder can be connected to the 4 arms of the bedside unit. Bipolar energy can be incorporated by the Metzenbaum scissors and the Maryland dissector. During surgery, 3 arms can be controlled by the surgeon, while the 4th arm can be altered and used immediately by the panel of the control unit.[6]

The current study is a pilot study conducted at the Urology Department of the University Hospital of Patras. The institutional ethics committee approved the study, and informed consent was obtained from the patients.

Study design

The first two cases who underwent robotic-assisted procedures in our department, using the novel avatera system during July 2022 were included. The first case was a radical prostatectomy and the second was a radical nephrectomy. The surgeries were performed by one expert surgeon with great experience in robotic procedures. Past abdominal surgeries, increased body mass index (BMI >30), serious comorbidity, or hematologic disorders were considered exclusion criteria for the initial cases.

Patients' characteristics

Radical prostatectomy

The age of the male patient was 56 years old. From his history, he had high blood pressure, under control with medication.

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No previous abdominal surgeries had been conducted. His BMI was 24.6 kg/m^2. The patient's prostate-specific antigen was 5.7 ng/dL with Gleason score 6 (3 + 3) bilaterally. He was not eligible for lymph node dissection based on the Briganti nomogram calculations. The preoperative hemoglobin was 14.2 g/dL and creatinine was 0.9 mg/dL.

Radical nephrectomy

The age of the female patient was 43 years old. The patient did not have any medication or abdominal surgery history. Her BMI was 25.1 kg/m^2. A mass of the upper pole was diagnosed 3 months before her admission, during a routine ultrasonic check-up, which was measured at 5.2 cm based on her staging computed tomography reports. The preoperative hemoglobin was 14.7 g/dL and creatinine was 0.8 mg/dL.

Endpoints

The successful completion of the procedures and the operation time include the draping, docking, and console time. Draping time was defined as the time from the opening of the sterile drapes until the placement on the surgical arms. Docking time was defined as the time between the trocar and arms placement. Console time was considered the time between the insertion of the first instrument and the drainage placement. Hemoglobin and creatinine levels preoperatively and postoperatively were also evaluated.

Results

Both of the surgeries were successfully completed. One male patient underwent robot-assisted radical prostatectomy and one female patient underwent robot-assisted right radical nephrectomy. The draping of the robotic unit was completed in a mean time of 10.2 min. The average docking time was calculated to be 14.8 min, while the average console time was 149 min. An average hemoglobin drop of 1.2 g/dL was reported, while no changes were observed regarding creatinine levels [Table 1].

Discussion

The field of robot-assisted procedures is increasingly evolving and robotic systems are used more and more for several urological procedures.[7] The shorter learning curve and the quality of maneuverability in comparison to open and laparoscopic procedures contribute to the rapid expansion of the robot-assisted approach.[8] Different companies started the creation of licensed robotic platforms during the past 3 years. The increased production may make robotic systems accessible to more population due to cost decrease.[9] The avatera robotic system could play an important role in the following robotic surgery market reconstruction.[10]

Our first experience showed considerable reliability of the robotic system as both surgeries were successfully completed without any noticeable malfunctions of the robotic system. The feedback given by the surgeon in the current study underlined the great quality of the bipolar coagulation of the avatera robotic system. Besides the surgical technique, the bipolar energy contributed to the low blood loss in each case. In addition, the 4th arm was vital for prostate manipulation and anastomosis during the radical prostatectomy case [Figure 1]. In addition, robotic platforms allow the surgeon to perform long-lasting operations, from the comfort of their control unit.[11] Dai *et al*. underlined the importance of ergonomy offered by robotic systems, comparing the operative results between laparoscopic and robotic surgeries.[3] Our experience with the new avatera robotic system showed great ergonomy levels due to reduced physical strain, impressive precision, and control of the surgical instruments and great visualization of the surgical site. Berguer and Smith observed that robotic systems contribute to the completion of complex tasks with less stress in comparison to the use of laparoscopic tools.[4]

In the current study, our initial experience using the avatera robotic platform is presented. The early results of robot-assisted radical prostatectomies including 125 patients were presented by Bouchier-Hayes *et al*.[12] The authors conducted 125 procedures using the daVinci robot system (Intuitive Surgical, Sunnyvale, CA, USA).[13]

Table 1: Perioperative results

	Radical prostatectomy	Right nephrectomy
Preoperative hemoglobin (g/dL)	14.2	14.7
Postoperative hemoglobin (g/dL)	13.1	13.4
Hemoglobin drop (g/dL)	1.1	1.3
Preoperative creatinine (mg/dL)	0.9	0.8
Postoperative creatinine (mg/dL)	0.9	0.8
Creatinine change (mg/dL)	0	0
Draping time (min)	10.3	10.1
Docking time (min)	14.6	14.8
Console time (min)	153	145

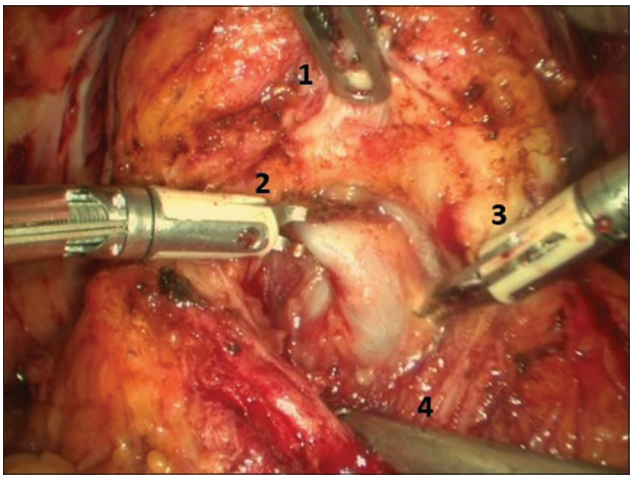

Figure 1: Endoscopic image from the dissection of the seminal vesicles during the first robotic-assisted radical prostatectomy. (1) Atraumatic grasper, (2) Maryland dissector, (3) Metzenbaum scissors, (4) Suction (assistant)

The mean operative time was 232.9 min while decreasing during the 25 last cases (183 min). The mean hemoglobin drop was 2.2 g/dL. The operative time reported by this pilot study can be compared with the operative time reported from the last 25 cases of Bouchier Hayes.[12] The experience of the surgeon in our department and the lowering of the learning curve of the participants presented by the authors can be the combination of the described results.

Klingler *et al*. presented the initial experience of their surgical team after completing 5 robot-assisted radical nephrectomies.[14] The authors used the daVinci robot system (Intuitive Surgical, Sunnyvale, CA, USA). The mean operative time was calculated to be 321 min (ranging from 246 to 437 min), while the mean hemoglobin drop was 1.4 g/dL. The draping, docking, and console time were not specified by the authors. Robot-assisted radical nephrectomy was found feasible and safe by the surgical team.

Finally, estimating the cost of each operation is not feasible in the current study. The surgical tools are single-use materials and are currently produced in limited numbers. The potential of using this robotic system on a worldwide scale and increasing massively the single-use equipment produced would most certainly reduce the cost. It should be noted also that each surgery requires a different kind of equipment and as a result different overall cost. Future studies with an increased number of patients could evaluate the overall cost more precisely.

Limitations

Our study presents many advantages and some limitations. First of all, the surgeon that conducted the surgeries is experienced and can adapt without difficulties to different operating systems. The number of procedures performed is extremely restricted. Future studies with increased number of patients and longer follow up could increase the significance of the presented findings. The selection of the cases might play an important role in the overall good results, as they did not present difficulties regarding the operative part. Thus, we believe that the presented data are important for the evaluation of a newly introduced robot system.

Conclusion

The initial experience of our surgical team after the use of a newly introduced robotic platform was presented. The safety and efficacy of the avatera robotic system for performing radical procedures were demonstrated.

Ethical standards

The study has been carried out in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Inform consent was obtained from all the included patients.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Original Article

Ureteral Stent Placement as a Treatment Option of Ureteral Stenosis in Comorbid Patients: A Single-Center Experience

Abstract

Background: Ureteral stenosis consist a medical condition characterized by high percentage of morbidity index causing refractory urinary tract infections, lithiasis as well as renal impairment and as a result, it is associated with poor outcomes regarding patients' quality of life. Cold-knife, electrocautery, laser incision as well as surgical reconstruction are different options of treatment. However, in comorbid patients unfit for surgery permanent ureteral stent placement should be an alternative approach. **Aims and Objectives:** Assessing success rate and safety profile of ureteral stenting in comorbid patients with ureteral stenosis. **Materials and Methods:** In this retrospective study data was collected from patients underwent ureteral stent placement in our department. Personal history, laboratory examination and frailty assessment was documented in each case. Meanwhile, complications and success rate of the procedurewere recorded. **Conclusion:** Ureteral stent placement consist a safe treatment approach in patients with ureteral stenosis and many comorbidities. However, urologists should inform patients about the risk of stent withdrawal.

Keywords: *Comorbid patients, ureteral stenosis, ureteral stent*

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Introduction

Ureteral stricture disease represents a chronic disease affecting seriously patients' quality of life. It is associated with a variety of causative factors including malignancies, trauma, and periureteral fibrosis. Symptomatic patients often complain about severe back pain while a variety of complications such as relapsing urinary tract infections and acute kidney injury usually accompany ureteral strictures.[1] Plenty of surgical procedures have been proposed as preferred treatment modalities. Among them, two widely used techniques include balloon ureteral dilation as well as endoureterotomy. However, frailty patients with high comorbidity index may be considered unfit for time-consuming surgery intervention.

Ureteral stents provide patients with a minimally invasive, low-risk surgical procedure. It is thought an effective approach in the decompressing upper urinary tract and at the same time, it is associated with low morbidity and mortality rates. Stent placement should be considered an effective alternative treatment of most ureteral strictures in patients with high frailty index. However, permanent stent placement is associated with a notable risk of stent withdrawal and patients should always be informed about its complications.[2]

Materials and Methods

In this retrospective study, single-center data were collected from patients who underwent ureteral permanent stent placement as a treatment modality of ureteral stenosis disease (USD), between the years 2019 and 2022. Personal history was recorded while all patients were submitted on frailty assessment. In addition, laboratory tests as well as computed tomography (CT) examination with intravenous contrast were applied in all cases.

Frailty assessment was supervised by an anesthesiologist specialized to preoperative screening and was based on the validated Clinical Frailty Scale (CFS), volume 2, to assess physical, mental, and social frailty. CFS consists of a frailty assessment index assessing the habitual health state of patients rather than the state of acute illness.[3] All patients were considered unfit for a time-consuming surgery and the permanent stent placement was decided as the preferred treatment.

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Results

A total of 12 patients were included in the analysis. The mean age was 76.8 years and the majority of patients were female (66.6%) while 4 patients were male (33.3%) with men-to-women ratio at 1:2. Nine patients (75%) complained of back pain while the last three (25%) diagnosed with persistent upper urinary tract dilation. Furthermore, personal history examination revealed that in 8 patients, the cause was previous ureteroscopy procedure, in 3, the stenosis was presented after surgery of gynecological malignancies, and the last patient was diagnosed after a colectomy procedure. All cases underwent imaging examination with CT urography illustrating narrowed ureters with intraluminal contrast deficit along with dilated upper urinary tract and hydronephrosis. Moreover, renal function assessment performed by blood creatine levels calculation concluded that 9 patients (75%) had abnormal creatine values. The mean creatine value was 2.4 mg/dl. Finally, all patients underwent frailty assessment based on CFS, version 2.0. Most of the patients (75%) were assessed as CFS 6 while two cases (16.6%) were included at a scale of 7 and the last patient (8.3%) at a scale of 8. Consequently, all patients were considered unfit for a time-consuming surgery and the permanent stent placement was decided.

Surgical intervention with permanent stent placement was successful in all patients and the whole procedure lasted among 15–30 min. Neither intraoperative nor immediate postoperative complications were recorded, and patients were discharged after a mean hospitalization time of 2 days. Among patients, nine have no complications recorded during a 6-month follow-up. However, three stents (25%) were eventually removed. The reasons for ureteral stent removal were stent migration in one case, contamination of the stent and persistent fever in another one, and severe hydronephrosis and persistent flank pain in the last patient. A change to nephrostomy tube was the treatment of choice in these cases except of the last patient who underwent radical nephrectomy. The former patient was diagnosed with pyonephrosis, unresponsive to antibiotic treatment, and open surgical intervention was decided.

Discussion

As far as quality of life is thought a cornerstone in medical care, treatment of USD should be considered a challenge in urology daily practice. Ureteral stenosis is a chronic disease characterized by the narrowing of the ureteral lumen and chronic increase of intraluminal pressure. Iatrogenic ureteral injuries, retroperitoneal fibrosis, as well as malignant conditions such as carcinoma of genitourinary system and pelvic lymphadenopathy consist of causative factors of stenosis of urinary tract. The lesions of ureteral stenosis can be broadly categorized as either intrinsic or extrinsic.[4] The incidence of USD varies by cause, as it can be seen in 1% of patients' postureteroscopy, 5%–24% with stone impaction >2 months, and 2%–3% postradiation. Patients with USD may or may not be symptomatic depending on both the degree of obstruction and the chronicity of the stricture. Clinical manifestations of stenosis include persisting side or back pain worsening with increased fluid or alcohol consumption, as well as an ipsilateral feeling of fullness, hematuria, and nausea. Meanwhile, USD is associated with a variety of complications such as chronic renal failure, obstructive pyelonephritis, and sepsis.[5]

As ureteral stenosis affects seriously patients everyday life, proper diagnostic evaluation of ureteral obstruction and underlying causes are essential to provide the preferred treatment option. Diagnosis is made by detailed history, physical examination, and basic laboratory tests including renal function estimation and urinary test analysis. CT urography is considered the imaging tool of the highest importance. Intraluminal contrast deficit along with dilated upper urinary tract and hydronephrosis are the most common signs at CT examination.[6] Imaging of the upper urinary tract will provide clinician information about stenosis etiology as well as the exact location and length of ureteral stricture. Other diagnostic tool includes diuretic renal scan, most commonly with 99 mTc-MAG3, and magnetic resonance-urography confer the advantage of identifying both renal function and degree of obstruction, which is an important aspect for surgical planning, especially if endoscopic management will be attempted.[7]

Once a ureteral stricture is diagnosed, recurrent pyelonephritis, pain associated with obstruction, and ongoing hydronephrosis consist of indications for intervention. Treatment options include a variety of surgical techniques such as balloon ureteral dilation, endoureterotomy, psoas hitch, Boari flap, ureteroureterostomy, intestine interposition, ureteroneocystostomy, and renal mobilization.[8,9] There are numerous factors to consider about the best approach including anatomic location, stricture length and etiology, incisional length and depth, preoperative renal function, and patient's comorbidity. Most of the aforementioned approaches require long hospitalization time and they are associated with a variety of complications. At the same time, frailty patients with high comorbidity index require a well-tolerable approach with low perioperative complications index and as a result, they cannot be considered candidates for such interventions.

Ureteral stent placement has the ability to decompress an obstructed renal unit and it can serve as both a temporary or permanent treatment modality. It is indicated for both intrinsic and extrinsic stenosis. Success rates for ureteral stent placement have been shown to be higher for intrinsic etiologies of USD while patients with malignant extrinsic ureteral compression are associated with higher failure rates. A prospective study by Yossepowitch *et al*. found that retrograde ureteral stent placement was successful in 94% and 73% of patients with intrinsic and extrinsic obstruction, respectively. Furthermore,

at 3-month follow-up, stent function was maintained in 100% of patients with intrinsic ureteral obstruction compared to 56.4% of patients with extrinsic cause, while in our study, 75% of patients maintained ureteral stent function during a 6-month follow-up.[2] Nonetheless, there are few side effects associated with stents. Bacterial colonization and encrustation over the stent surface are two of the most common causes of stent-related infections and obstruction, potentially resulting in its functional failure while stent migration and intolerance consist of other possible causes.[10] Regarding prognostic factors of ureteral stent failure, the extrinsic etiology of obstruction is considered of the utmost importance. In addition, a retrospective review at the University of Michigan concluded that male sex, increased creatinine level as a presenting symptom, and more severe preoperative hydronephrosis consist of predictors of failure in cases with intrinsic stenosis.[11]

Since the beginning of ureteral stent use, modifications in materials used to produce ureteral stents have helped to make this treatment modality more cost-efficient and more tolerable for the patient. In general, two main types of biocompatible materials exist for fabricating ureteral stents, polymers, and metals. Silicone is a widely employed synthetic polymer for manufacturing ureteral stents, thanks to its flexibility against bending and lubricious properties. However, the rigidity of this material can potentially become a disadvantage during the insertion of the stent within a guidewire.[12] Another widely used synthetic polymer is polyurethane. It is characterized as highly versatile and inexpensive biomaterial compared with other ureteral stent materials. However, polyurethane has been found to result in significantly more urothelial ulceration and erosion.[13] On the other hand, metallic stents were introduced to increase their ability to oppose deformation caused by extrinsic/intrinsic ureteric obstruction. However, they are associated with a high rate of migration, stone encrustation, and obstruction resulting from hyperplastic reactions.[14,15] Apart from constitute materials, stent design and coating consist of other variable parameters determining the stent's mechanical properties. Each of these characteristics aims to address specific causes of stent failure, especially encrustation and biofilm formation. As a result, combining the most appropriate material, design, and coating would allow the development of an optimal stent providing patients with USD an effective permanent treatment modality with low morbidity.[16]

The present study verified that ureteral stenting is a safe treatment in patients diagnosed with USD and many comorbidities. However, the retrospective nature of our investigation along with the limited number of patients included consists worth mentioning the limitations of our study. As a result, further investigation should be proposed and a multicenter prospective study should be designed.

Conclusion

The use of ureteroscopy has increased exponentially in the last two decades and has increased the number of tools in the urologists' armamentarium. Ureteral stent placement consists of a safe treatment alternative of USD in frailty patients. However, ureteral stenting is associated with various complications such as stent migration and contamination. Therefore, patients should be informed properly about the possibility of treatment failure.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Review Article

From "Micro-" Diagnosis to "Macro-" Treatment, a Road Full of Colors

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Abstract

Introduction: From 1878 when the first working cystoscope was presented to today's era of big data and artificial intelligence, colorful biomarkers remain one of the urologists' strongest allies. We hereby review the current research frontiers in "color" informatics and their clinical translation in urology through methodologies and applications of visual augmentation of molecular feedback and theragnostic. **Results:** The multi-dimensional data approach involves firstly lasers' rapid progress as an omnipresent part of modern urology in a variety of diseases, while color Doppler assists the depiction both of the urinary tract and the male genital tract. Both in molecular and systemic level screening, unique techniques using light, histochemical stain enabling color, and fluorescent tracers are improving morphological discrimination between malignant and benign cells, as well as providing anatomical and functional information preoperatively and intraoperatively. **Conclusion:** Technologies by exploiting the various lengths of the spectrum of light, which clinically it is translated, and it is evident as different color shades, have significantly toward improved our ability to both diagnose and treat urological entities. Thus, improving the management of light's and color's unique attributes could provide urologists with more effective clinical tools.

Keywords: *Color doppler, cystoscopy, fluorescence, light laser, ultrasound Doppler, urology*

Introduction

From the wheel of flasks in medieval books representing urine color-based diagnosis to today's diagnostic and therapeutic technology, color remains a valuable assistant in decision-making for urologists. This article is reviewing the existent technologies that use various wave lengths, that are clinically perceptible as different kind of "colors". These technologies are introduced for the diagnosis and treatments of complex upper and lower urinary tract diseases [Table 1].

Considering the novel and advanced instrumentation and visualization procedures, it is important to estimate their accuracy and reliability and to summarize the main trends of their utilization as markers, biosensors, or adjuvants to the current gold standards of cytology and cystoscopy.

The use of lasers in urology has been around for more than 40 years and constantly advancing to answer growing demands and reinvestigate the appropriateness of the use of a specific laser in a specific urological condition. On the other hand, Doppler ultrasonography for the assessment of both urinary tract and genital tract remains a safe noninvasive technique with pro-, peri-, and postoperative use.

The emergence of other less invasive diagnostic methods and predictor biomarkers based on fluorescence dyes or simply urine color is also discussed while also assessing their role in the process of understanding the mechanisms underlying the disease and consequently the identification of potential new therapeutic key targets [Table 2].

Materials and Methods

Our search was performed in PubMed and MEDLINE for English language literature for articles published from inception to April 2022. Any type of article that was considered relevant to the topic based on the title and the abstract was reviewed. The search strategy was: urology AND color, urology AND Doppler, urology AND fluorescence, "urine color," and "cystoscopy." We included articles with at least an abstract in English language.

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Table 1: Color technologies

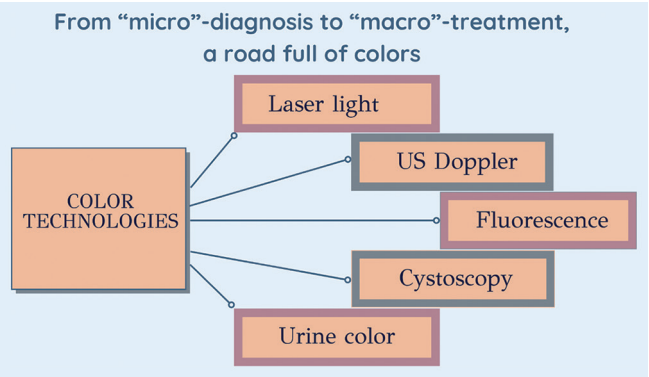

Table 2: The various technologies and their uses in urology

Type of technology	Uses in urology
Light laser	A. Benign prostatic hyperplasia
	B. Urolithiasis
	C. Strictures of the upper and lower urinary tract
	D. Bladder cancer
US Doppler	A. In genital tract disorders, to diagnose scrotal and testicular pathologies
	B. Minimally invasive procedures
	C. For
	D. postoperative evaluation
Fluorescence	A. Preoperative use for diagnosis and treatment planning
	B. Perioperative establishment of anatomical structure and pathologic entities
	C. Postoperative estimation of recurrence
Cystoscopy	For diagnostic purposes to evaluate the interior of the bladder in case of:
	A. Hematuria
	B. Benign diseases
	C. Tumors of the bladder
Urine color	A. As an indication of anastomotic leakage
	B. Intraoperatively to identify anatomical structures

Laser's applications in urology

Lasers are one of the most prestigious technological figures in the road of colors of urology. Today, lasers are most ordinarily employed in the surgical management of benign prostatic hyperplasia (BPH) and as intracorporeal lithotripters. Other uses include ablation of urologic tumors and incising strictures of the upper and lower urinary tract. In the case of BPH, two separate oppositions are to be proposed. The first juxtaposition applies to laser and other techniques, while the second segregation considers the distinctive characteristics of lasers.

Benign prostatic hyperplasia

Comparison with other techniques

Despite being the "gold standard" for treating BPH for over 20 years, traditional transurethral resection of the prostate (TURP) seems to be getting surpassed by new technologies. In 2016, a network meta-analysis attempted to establish a hierarchy among various techniques[1] and a series of meta-analyses under the same scope followed. The criteria used to elaborate the query included prostate volume, comorbidities, safety, efficacy, and required experience.

To address the abovementioned question, Chen *et al*. analyzed the International Prostate Symptom Score (IPSS), postvoid residual (PVR), maximal flow rate (Q_{max}) hemoglobin (Hb) loss, catheterization time, and length of hospitalization among TURP, endoscopic enucleation of the prostate (EEP), and open prostatectomy (OP). EEP displayed better efficacy regarding both functionality post-operatively (IPSS, PVR, and Q_{max}) and intraoperative risks (less Hb loss, shorter catheterization time, and shorter length of hospitalization) when compared to TURP, while her superiority against OP was established only in the aspect of intraoperative risks.[2] Consistent results were found by Zhang *et al*. who also noticed better outcomes in the series of enucleation rather than resection.[3] In terms of various EEP techniques, a meta-analysis showed better results in the short term with laser (L-EEP) rather than nonlaser (NL-EEP) procedures concerning tissue removal and Hb decrease. The follow-up of the surveys included in the meta-analysis was inadequate to provide information about the long-term effects.[4] In a similar framework was designed and conducted a network meta-analysis comparing nine techniques among which five involved laser. This meta-analysis found bipolar TURP to be superior to monopolar while enucleation approaches were safer than vaporization and resection methods.[5] Noticeably, another meta-analysis did not display a statistically significant difference when comparing endoscopic enucleation and vaporization and required further examination.[6]

Regarding the volume of prostates, a meta-analysis concluded that for volumes >60 ml, holmium laser enucleation of the prostate (HoLEP), diode laser enucleation of the prostate (diode LEP), bipolar enucleation of the prostate (bipolar EP), and laparoscopic simple prostatectomy (laparoscope SP) are superior in efficacy compared with OP and monopolar TURP.[7] On the other hand, according to Haibin *et al*., laser transurethral prostatectomy did not overthrow open simple prostatectomy in terms of safety and efficiency when used for large-volume prostates but could end up being the preferred approach because of a more favorable perioperative profile.[8]

A meta-analysis comparing TURP with GreenLight™ high-performance system (HPS) 120-W laser photoselective vaporization of the prostate (PVP) showed better intraoperative results (capsule perforation, transfusion requirements, shorter catheterization time, and shorter duration of hospital stay) in the latter, while TURP was associated with a lower risk of reoperation and a shorter operative time.[9] These findings were in alignment with the Zang *et al*. survey.[10] Likewise, Lai *et al*. demonstrated a possible long-term advantage with PVP over TURP while outlining the drawback of the absence of histological tissue examination.[11]

The outcomes of a meta-analysis conducted in 2020 evaluating diode laser enucleation of the prostate (DiLEP) versus bipolar plasma kinetic enucleation of the prostate (PKEP) showed a lower risk of blood loss, declined postoperative catheterization time, less postoperative irrigation time, and slighter postoperative irritative symptoms with DiLEP.[12] In accordance with the two aforementioned surveys, a meta-analysis of 2019 described better short-term results (smaller reduction in Hb, shorter catheterization duration, and shorter hospital stay) with lasers without, however, showing a long-term superiority over bipolar treatments.[13]

Regarding thulium laser and specifically thulium laser transurethral vaporesection of the prostate (ThuVARP), its effectiveness according to IPSS, quality of life (QoL), Q_{max}, and PVR scores appeared similar to TURP and plasmakinetic resection of the prostate (PKRP). Despite the longer operation time, ThuVaRP was associated with better serum Hb levels, catheterization time, and hospital stay.[14] Similar results were noticed in the case of holmium, with HoLEP requiring more time operationally, but less hemoglobulin reduction, transfusions, hospital stay, and catheterization time. The possibility of better results in Q_{max} at the 24-month follow-up and in PVR and IPSS at the 12-month follow-up was not ruled out.[15] Similar results were obtained when the volume of the prostate was also taken into consideration.[15] The network meta-analysis of 2016 pointed out that IPSS at 12 months and Q_{max} at 6 months and 12 months were better with HoLEP over traditional TURC.[1]

According to two meta-analysis in which ThuVARP[16] and HoLEP[17] were compared with bipolar TURP (B-TURP) respectively no statistical difference in efficacy was observed, although in the comparison between B-TURP with ThuVARP, the latter seems to be more effective in terms of less blood loss, hospitalization, and catheterization time.[16]

Regarding high-risk bleeding patients, many guidelines favor the use of lasers instead of TURP, without clarifying whether it is essential to discontinue pre- and perioperatively the therapy. Taking into consideration the abovementioned as well as the increasing requirement of anticoagulant (AC) or antiplatelet (AP) therapy among the elderly, Liang *et al*. conducted a meta-analysis regarding the optimum pre- and perioperative therapeutic strategy.[18] According to the results, patients on perioperative AC/AP therapy had a higher risk of hemorrhage in TURP treatment. Of notice, subgroup analysis indicated that the risk with laser (either HoLEP or PVP) was more similar to the control group, although still higher. Bridging treatment with low-molecular-weight heparin seemed to have more favorable results in both cases.

Another meta-analysis focused on PVP used ten criteria (operation time, laser time, blood transfusion, urethral stricture, urinary tract infection, reoperation, dysuria, capsule perforation, catheterization time, and re-catheterization) to compare two groups of patients. In one group patients continued on receiving AC therapy while in the other group. AC was discontinued a significant difference between the two groups was established only in the duration of catheterization needed time which was higher in those that received ACs.[19] Attention should be attained when comparing data from Asian and Western manuscripts due to different coagulation functions among these populations.

Although there are insufficient data regarding erectile function (EF) postoperatively for the various techniques of treating BPH, a recent meta-analysis showed favorable results in cases involving prostatic urethral lift over all other techniques including laser.[20] Moreover, EEP may be more beneficial for postoperative preservation of EF in the long term when compared to TURP.[21] Finally, in an attempt to rank surgical treatments according to EF, Li *et al*. observed the pro-erectile effect of HoLEP and PKEP even for patients with decreased baseline EF. In general, they concluded that out of nine procedures, only PVP led to a decrease in the postoperative five-item version of the International Index of EF score. Laparoscopic simple prostatectomy (LSP) and PKRP ranked first and second in the network analysis, correspondingly, and displayed encouraging results for a less negative effect on EF.[22]

Limited data are also available for another long-term complication, bladder neck stenosis, whose frequency does not seem to significantly defer among TURP, ablation, and enucleation.[23] Studies about the role of laser-related procedures in supporting and promoting outpatient treatment remain restricted but encouraging.[24]

Comparison among lasers

Among lasers, GreenLight (PVP) technology (532-nm wavelength) and holmium laser procedures have similar results regarding functionality as was noted in 1-year QoL scores and overall IPSS scores in a meta-analysis published in 2020.[25] However, significantly important differences were discovered in 1-, 3-, and 6-month peak flow rate (Q_{max}) in favor of holmium laser techniques, which

include holmium laser ablation of the prostate (HoLAP), holmium laser transurethral incision (Hol-TUIP), holmium laser resection of the prostate (HoLRP), and HoLEP. The latter demonstrated better results to all HoL-Ts. Less PVR urine volume (PVR) and lower conversion rate were also noticed with holmium.

On the other hand, a comparison made by Meng *et al*. between thulium and holmium lasers displayed that ThuLEP apart from greater safety was also linked to faster improvement of symptoms.[26] Similar results were presented by Xiao *et al*. meta-analysis which indicated superior results in enucleation time, efficacy, perioperative blood loss, Q_{max}, and PVR the 1st postoperative month and IPSS in the 12th postoperative month when comparing thulium laser enucleation of the prostate (ThuEP) against HoLEP.[27]

Several comparative studies among lasers showed that the QoL score is improved most by TmLRP, whereas in terms of IPSS and Q_{max}, diode laser vaporization of the prostate is the preferred choice. Finally, for PVR, HoLEP was ahead of the other techniques.[28] Problems and limitations encountered by most meta-analyses were the short-term follow-ups, variety in the capacity of different medical institutions, diversities in laser power, and the proficiency of surgeons. Both thulium and holmium laser enucleation appear to be size-independent methods.

Urolithiasis

Laser technology is also widely used in the management of urolithiasis. Specifically, regarding bladder stones (BSs), the latest international guidelines suggest conducting transurethral cystolithotripsy using an instrument with a continuous flow (e.g. a nephroscope or a resectoscope) to minimize operation time. However, regarding endoscopic management of BS, no difference was established among mechanical, pneumatic, and laser lithotripsy neither in adults nor in children.[29] Previous studies drew attention to a possible higher risk of early postoperative urinary incontinence with a complete resolution by 6 months when laser energy techniques are used in BS.[30]

In the case of proximal ureteral stones, a meta-analysis of 2020 indicated that laparoscopic ureterolithotomy despite the longer operation time and hospital stay of had a statistically significant higher stone-free rate and lower severe complications, particularly lower ureteral stricture rate, when compared to ureteroscopic lithotripsy.[31] A comparison among URSL with holmium laser technology and extracorporeal shock wave lithotripsy (ESWL) on ureteral calculi showed the latter's slight inferiority in efficiency.[32]

In terms of renal stone, an advantage of flexible ureterorenoscopy (F-URS) with holmium laser technique with a higher stone-free rate (SFR) in both renal stones <1 and 1–2 cm, as well as lower auxiliary procedure rate and lower retreatment rate (RR), appeared when compared to ESWL, while simultaneously F-URS technique had similar complication rate and operative time. The superiority of that F-URS was more evident with renal stone <2 cm, especially for lower pole stone, and followingly researchers suggested the translation of this knowledge into the corresponding clinical field.[33]

Regarding patients with bleeding diathesis ureteroscopy either with or without the holmium laser did not alter the bleeding risk.[34] Finally, in the case of percutaneous nephrolithotomy (PCNL), holmium laser is required to establish better perioperative outcomes and SFR before being adequate to replace nonlaser PCNL, which for the time being appears to be superior.[35]

Strictures of the upper and lower urinary tract

Moreover currently, lasers along with cold-knife techniques are the main suggestions regarding endoscopic urethrotomy for the treatment of strictures, but there is a lack of data regarding superiority. A meta-analysis published in 2017 based solely on randomized control trials but with the restriction of short-term follow-up of 6 and 12 months indicated that laser urethrotomy technique had a lower recurrence rate compared to the cold-knife urethrotomy.[36] A restriction that should be taken into consideration when examining the results of this study is of short-term follow up of the patients 6 and 12 months after. On the contrary, a survey in 2019 did not reach the same conclusion as the recurrence rate among the techniques was similar. Noticeably, the perioperative time was longer with laser, although the bleeding rate was less, while the cold-knife group had a better 6-month Q_{max}.[37]

Bladder cancer

Nonmuscle-invasive bladder cancer (NMIBC) comprises another field of conflict of whether laser could replace TURBT as the gold standard for NMIBC or only be used as a supplement to TURBT. Although the results of the study of Li *et al*. showed that holmium laser resection of the bladder tumor showed better results in perioperative complications, postoperative recovery, and 2 year recurrence when compared to standard transurethral resection of the bladder tumor (TURBT) there are some limitations that should be taken into consideration, such as that only one randomized control trial (RCT) was included and thus a lack of data led into nonevaluation of significant parameters such as bleeding. Subsequently because of those limitations the aforementioned study cannot be used as a stepping stone to encourage and promote the use of laser over the other technique.[38] Encouraging were the results for laser's feasibility in a meta-analysis focused on thulium laser resection of bladder tumor (TmLRBT) and TURBT. TmLRBT overcomes the problem of providing high-quality specimens for pathology diagnosis, a problem encountered with transurethral bladder tumor green laser selective vaporization,[39] while also having a better safety

profile, less intraoperative complications, and noninferior efficacy.[40]

Potential future applications of lasers with limited data

The uses of lasers in renal pathologies are limited but a great candidate for future use due to the coagulation profile. Limited data are available and controversial. One of the largest cases series including 29 patients undergoing laparoscopic laser-assisted partial nephrectomy pointed out some of the difficulties encountered with this technique, smoke building, and indistinct surgical margins, but could not encourage the application of this method out of a trial context.[41]

Ultrasonography Doppler

Another well-established and widely used technology utilizing color for both diagnostic and therapeutic purposes is color Doppler ultrasound. Ultrasonography is primarily employed in genital tract disorders, to diagnose scrotal and testicular pathologies. Likewise, ultrasonography is now applied in surgical procedures of the urinary tract, namely in minimally invasive PCNL and laparoscopic varicocelectomy and postoperatively for the evaluation of an open pyeloplasty.

Ultrasonography is the primary imaging modality for the testis. Grayscale ultrasound and color Doppler ultrasound are used in emergency units because of their availability and cost-effectiveness compared to magnetic resonance imaging. Scrotal swellings have a nonspecific clinical picture, and their clinical diagnosis can be challenging. Scrotal grayscale ultrasound and color Doppler ultrasound are noninvasive methods used for accurate screening and diagnostic modalities. Almassry *et al*. conducted a retrospective study including 181 patients, examined using grayscale and color Doppler ultrasound (Toshiba Nemio XG ultrasound machine with a high-frequency 7.5-MHz linear-array transducer). The diagnostic validity was estimated using surgical findings, histopathological results, and imaging and clinical follow-up as reference standards.[42]

On a lesion-based analysis, both grayscale and color Doppler were 100% sensitive and 100% specific for diagnosing varicocele, hydrocele, epididymal cyst, inguinoscrotal hernia, and torsion. As regards inflammatory lesions, the sensitivity and specificity of grayscale and color Doppler ultrasound were 100% and 98.3%, respectively. The sensitivity and specificity of grayscale and color Doppler ultrasound for diagnosing scrotal tumors were 84.6% and 76.2%, respectively. It is hence safe to assume that grayscale ultrasound and color Doppler ultrasound of the scrotum provide high diagnostic validity for the assessment of scrotal swellings.[42]

Considering that ultrasonography is mandatory for male infertility workups, more nonpalpable testicular lesions are now identified. It is yet to be determined the benefit of discovering such a lesion. Maxwell *et al*. examined preoperatively the features of testicular Leydig cell tumors, using ultrasound and color Doppler. Bilateral testicular ultrasonography was performed on a Toshiba ultrasound system. Both testicles were examined in B-mode with a 5–12 MHz linear array probe and in a B-mode color Doppler or power Doppler with a high-frequency 8–18 MHz linear array probe. The B-mode was used to assess the volume of the testicles, the echo texture of the testicular pulp, and the number and characteristics of the lesions. Typical sporadic Leydig cell tumors appeared as an isolated hypoechoic infracentimetric mass with a clear demarcation from the adjacent pulp. These characteristics could assist the surgeon to decide whether the testis can be spared.[43]

As to intraoperative use, Guo *et al*. conducted a prospective study to evaluate the benefits of employing laparoscopic Doppler ultrasound (LDU) during laparoscopic varicocelectomy for infertile patients with varicoceles. They compared the outcomes and complications between conventional varicocelectomy and Doppler-assisted varicocelectomy. In the conventional laparoscopic varicocelectomy, the spermatic vessels were clipped and ligated, while the LDU-assisted laparoscopic varicocelectomy had all the enlarged arteries and veins mobilized. During the LDU assisted varicocelectomy all spermatic veins were effectively ligated, the spermatic arteries and lymphatics were preserved, while the procedure didn't lead to high varicocele recurrence. However, the LDU-assisted varicocelectomy required extended operative time. However, the benefits of LDU-assisted varicocelectomy, such as increased sperm count and sperm motility, favorize the procedure for the treatment of varicoceles.[44]

Xu, Congcong, *et al*. conducted a randomized control trial using color Doppler in addition to single B-mode ultrasound guidance in minimally invasive PCNL (m-PCNL). Color Doppler ultrasound was used to avoid areas with dense vessels, since renal hemorrhage is one of the most common complications of the m-PCNL. The outcome of the trial indicated that using the color Doppler ultrasound decreased statistically significantly the incidence of hemorrhagic complications and postoperative infections.

Postoperative assessment could employ ultrasonography as well. Hamedanchi and Sedokani run a prospective study including patients with ureteropelvic junction obstruction, who underwent open pyeloplasty. Open pyeloplasty principles require a follow-up using ultrasound and isotope scans to determine the success rate of pyeloplasty. However, the results of the postoperative assessment with color Doppler ultrasonography compared to renal scan indicate that color Doppler ultrasonography should now be considered an adequate alternative to a nuclear scan or an intravenous pyelogram, although studies with a greater study population should be performed.[45]

Worth mentioning as an ascendent opponent for color Doppler seems to be the three-dimensional printing puncture guide, a lately developing technology still in need of further testing.[46]

Fluorescence

In this enumeration, the technique of fluorescence, a valuable assistant not only in new imaging modalities and diagnosis but also in treatment and prognosis, could not be absent. A multidimensional and broad field of microscopes, endoscopes, and administration for fluorescein-based dyes has being developed during the past years.

Applications in microscopic level

Their applicability for micro-diagnosis pre-, peri-, and postoperative is being implied by several studies such as a recent comprehensive comparison indicating that cytology is inferior to FISH in the case of upper urinary tract urothelial carcinoma (UUT-UC).[47] Of interest is a novel cell staining technique, CellDetect, that seems to have a similar diagnostic value to FISH.[48] Specifically, for NMIBC, the importance of FISH as a prognostic predictor of tumor recurrence in patients treated with BCG is under evaluation. The appropriate chronic point to predict recurrence seems to be 3 months after initial TURBT, but further investigation is needed.[49] Of importance is also to establish the apt time to conduct this prognostic test in order to facilitate the low sensitivity, especially when combined with other techniques such as cystoscopy or cytology.[50]

Meanwhile, ongoing trials are evaluating the possible advantage of *ex vivo* fluorescence confocal microscopy (FCM) over hematoxylin and eosin images for fast, "real-time" pathological examination of prostatic tissues, while an atlas of FCM images is being created.[51] A similar approach has been proposed for renal core biopsies by Mir *et al*.[52] A step further was the *in vivo* microscopy in the case of UUT-UC, in which confocal laser endomicroscopy (CLE), a fluorescence-based fiber-optic imaging technique, was used in real-time to estimate grade based on the score system introduced by Freund *et al*.[53]

Applications in macroscopic level

In macroscopic level, due to the constant and urgent need for a better diagnostic tool with high specificity and sensitivity for UUT-UC, urologists "borrowed" photodynamic technology used mostly in bladder cancer.[54,55] Several studies investigated the utility of this method and their results were used by Liu *et al*. in a meta-analysis approving photodynamic diagnostic (PDD) as a valid and more accurate than the white light ureterorenoscopy technique that improves the diagnostic accuracy of UUT-UC, by being able to differentiate among benign and malignant lesions.[56] In NMIBC, fluorescence used in cystoscopy was associated with better residual tumor rate and higher recurrence-free survival when compared to white light cystoscopy.[57] These results were in agreement with the previous meta-analysis showing a reduced risk of bladder cancer recurrence in the case of fluorescence-assisted cystoscopy instead of white light.[58]

The outcomes of another meta-analysis also focused on the available diagnostic methods for NMIBC supported existent guidelines purposing conducting TURBT combined either with PDD or with NBI for the diagnosis of dysplastic lesions,[59] as well as a predictor marker which will be mentioned in the next part of the manuscript. On the other hand, the results of Veeratterapillay *et al*., although in the favor of PDD, are more preservative regarding the clinical adaption of this methodology considering the short-term proven advantage in recurrence-free survival in NMIBC over the interval of 2 years of follow-up.[60] Ongoing randomized trials will provide further information in the comparison between fluorescent cystoscopy-assisted *en bloc* transurethral resection and conventional transurethral resection.[61] Another meta-analysis proposed the combination of PDD, narrow band imaging (NBI), and single immediate intravesical chemotherapy, since they had the most improved recurrence rate at 12 months when compared with just the single use of each of these methods, while all of the abovementioned overthrew WLC.[62] Attention should be provided to the study offering both physiochemical and clinical data to regard to the consolidation of three techniques: TURB, fluorescence diagnosis, and photodynamic therapy (PDT) for treating NMIBC.[63]

Vascular-targeted PDT, one of the choices for the minimally invasive approach to prostatic malignancy, needs further studies since the results of a meta-analysis showing a higher percentage of positive postablation biopsies raised questions regarding the benefit.[64]

Despite being an interesting approach, the use of fluorescence dies to detect lymph nodes has yet to prove superiority over pelvic lymph node dissection in prostate cancer patients, although it remains useful for drainage mapping.[65] The previous meta-analysis denoted that among urological cancers, sentinel lymph node mapping is more applicable in bladder and prostate cancers.[66] A broader meta-analysis including the malignancies of the whole pelvic region proposed the exploitation of indocyanine green (ICG) fluorescence tracer in robotic-assisted surgeries too.[67]

Potential uses in future

Worth mentioning although with limited data is the novel approach of partial nephrectomy combining both robotic and fluorescence technologies.[68-70] Potential exploitation of fluorescence imaging of nerves (and vessels) during surgeries could assist the concept of "maximal function-based resections" also in urological cases.[71] Taking

into consideration the aforementioned Mangano *et al*. conducted laparoscopic robot-assisted radical prostatectomy with the use of ICG with a near-infrared imaging system to preserve both benchmark artery and neurovascular bundle. Despite the encouraging results due to the limited number of cases further studies are needed to examine the results and efficacy of this technique.[72] Animal models are used to enhance nerve-targeted probes to reinforce the above conceptualization.[73] Novel probes targeting either specific types of cells according to their unique proteomic profile such as a ligand for prostate-specific membrane antigen[74] and the "do not eat me" CD47 protein[75] or tumor-associated biomarkers such as carbonic anhydrase IX[76] are also under development. Another novelty inheres in the concept of combining fluorescence with optical coherence tomography to more accurately differentiate benign from malignant lesions in the bladder.[77]

Cystoscopy

The compendium of color techniques incorporates the various type of cystoscopy commonly performed for diagnostic purposes to evaluate the interior of the bladder in the case of hematuria, benign diseases, and tumors of the bladder. To begin with the "debatable" use in hematuria, and specifically microhematuria, cystoscopy is proposed to be used in selected patients with high risk for UTC to avoid the complications linked to this invasive method in patients with no benefit.[78] Instead, noninvasive techniques are encouraged such as the Cxbladder urine test which assists the physician to estimate if a patient with asymptomatic microhematuria is of high risk for UC and in need of further workup.[79]

In regard to tumors, the question that arises is whether one technique is better than the other. Randomized perspective studies have been conducted to compare white light cystoscopy and NBI and although the results were not statistically important, a tendency in favor of NBI was observed.[80] All in all, results of a recent meta-analysis concluded no difference in recurrence in 1 year.[81]

Earlier in the manuscript was presented a comparison of PDD and white light cystoscopy, regarding their clinical use and efficiency.[57] Focusing here on the cost-effectiveness of exploiting PDD instead of white light or NBI cystoscopy, the results of Ontario's quality health assessment described an acceptable increased cost of PDD in exchange for quality-adjusted life year gained,[82] a cost that according to an independent previous RCT, the majority of patients were willing to cover themselves.[83]

Urine color

This manuscript could not omit urine color as an imaging technique. Researchers have aimed to use urine color intraoperatively to identify anatomical structures of the urinary tract as well as after surgery as an indication of anastomotic leakage. Given that ureteral orifices can be difficult to identify intraoperatively due to anatomical features, such as a large median lobe, an obstructing tumor, or even a previous surgery, methylene blue and indigo carmine have been previously administered to help with the localization of the ureteral orifices. Rehfuss *et al*. searched for an alternative substance for this purpose. Phenazopyridine, a urinary analgesic coloring the urine orange, is an alternative to identifying the ureteral orifices intraoperatively. It may be administered the evening before the procedure with a lasting effect of up to 18 h. It is safe, effective, widely available, easy to administer, and rapidly excreted in the urine and, as a result, can aid in the visualization of the ureteral orifices.[84]

Urine color can be used as an indicator of surgical complications. Riikonen *et al*. evaluated microscopic hematuria as a predicting factor for urethrovesical anastomotic leakage after robot-assisted laparoscopic radical prostatectomy (RALP). Urine color in the collection bag was classified according to a three-step scale, and leakages in the cystogram were graded with a four-step scale. The study estimated the predictive accuracy of macroscopic hematuria of any grade and showed that bloody urine color predicts urethrovesical anastomosis leakage with high specificity although low sensitivity. The sensitivity can be improved by considering other risk factors for leakage. Therefore, if the urine is clear, cystography can be omitted, especially if no leakage risk factors exist. However, a small proportion of leakages may be missed, especially in men with risk factors for leakage. A bloody urine color at 5–14 days after RALP is a predictor of urethrovesical anastomosis leakage.[85] Concluding, to reduce unnecessary imaging such as a cystogram, clear urine and the absence of risk factors for anastomotic leakage is adequate.

Conclusions

The role of new imaging technologies and tracers in urology is being actively investigated. Technological advancement and the development of new surgical methods and instruments have changed the methods used to treat upper and lower urinary tract diseases as well as genital tract. Long-term data will ultimately determine the efficiency of the colorful armamentarium.

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Conflicts of interest

There are no conflicts of interest.

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Review Article

The Role of Urologist in Ovarian Cancer Debulking Surgery

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Abstract

Although spread of advanced ovarian cancer (OC) into the urinary tract was considered a contraindication for surgery until the last decade, advancement of oncological centers tries to perform these radical surgeries. Urologist plays a significant role during these surgeries in order to obtain an optimal cytoreductive surgery (CRS). The aim of debulking surgeries is to achieve radical resection of involved organs by eliminating macroscopic disease. If urinary organs are involved, patients' survival depends on tumor resection with free postoperative margins and without residual disease and the incidence of postoperative obstruction. Preoperative evaluation of the extent of tumor into the urinary tract or dilation of the renal tract caused by ovarian spread is considered challenging. First, urologists should aim to the decompression of the lower urinary tract by placing either ureteral stents or nephrostomy tubes. After initial decompression of ureteral obstruction, urinary surgeries should follow aiming to initial identification of ureters and reconstruction of ureteral lesions. Optimal CRS in cases of OC invading the urinary bladder can be achieved either by radical or by bladder-sparing surgical procedures. Furthermore, urologists should aim to the surgical management, pre- and postoperative evaluation of patients with advanced OC involving the kidney. Due to restricted knowledge on this topic, there are no current guidelines concerning the surgical approach of urinary organs during debulking surgeries for OC, while surgical treatment of these patients should follow guidelines for the management of advanced OC invading other types of organs.

Keywords: *Cytoreductive surgery, debulking surgery, ovarian cancer, urinary tract, urologist*

Introduction

The extension of surgery during cytoreductive surgery (CRS) depends on various parameters, such as clinical stage of the disease, histological grade of tumors, clinical characteristics, and physical condition of patients.[1] The ultimate aim of CRS is to achieve a radical resection of involved organs by eliminating macroscopic disease, since the achievement of free postoperative margins is strongly related with increased overall survival and extended disease-free period of patients.[2] Performance of CRS is considered optimal when a maximum residual lesion with diameter <1 cm is achieved.[2] The combination of debulking surgery with the administration of chemotherapeutic regimens in patients with advanced tumor stages can contribute to enhance the surgical outcomes of CRS.[1] However, the ideal time for chemotherapy in relation with the subjection of debulking surgery has not been clearly delineated yet.

Multimodal Approach of Debulking Surgery

The involvement of ureters, bladder, and kidney in cases with advanced ovarian cancer (OC) was considered a contraindication for surgical interventions until the last decade.[3] The advancement in the management of these end stage tumors helped to change surgeons' mentality and perform these urological procedures in order to achieve an optimal CRS.[3] Although resectability of OC, defined by tumor advancement, patient's age, and physical conditions, is crucial in the outcome of debulking surgeries, effectiveness of CRS also depends on the ability of the operating team, including surgeon's training and experience, and availability of technical and personal resources.[4,5] However, subspecialty training in gynecologic oncology for the management of these elective cases has not been established in all countries, especially in Europe.[5] Their surgical management mainly relies on the contribution of specialized surgical teams

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consisted of surgeons of different specialties, in order to achieve a multimodal approach of widespread OC. As a result, in cases of disseminated OC with urinary tract involvement, the role of highly experienced urologists during debulking surgeries aiming to obtain optimal CRS is considered necessary.

Surgical Interventions of the Urinary Tract during Cytoreductive Surgery

Radical urinary interventions in advanced cancers of various origins were analyzed in a retrospective study conducted by Düzgün *et al*., including 44 cases of major urinary system resections.[3] Although OC was the primary cause of urological surgeries only in 9 cases (20.4%), aggressive surgical procedures of urinary organs, such as nephrectomy, partial and total cystectomy, and ureteral interventions, for other cancer types, were carried out with acceptable mortality rates and low incidence of complications.[3] Furthermore, similar promising postoperative results were reported in other large case series that recorded the incidence of complications after urinary interventions during CRS with hyperthermic intraperitoneal chemotherapy (HIIPEC) for advanced tumors. According to their findings, the incidence of perioperative mortality and postoperative complications was not increased in patients subjected to radical urologic interventions, whereas these patients presented with longer hospital stay.[6] As a result, currently published studies mainly suggest to perform major urinary system resections aiming R0 resection during CRS, independently from the origin of the primary tumor.

Surgical Interventions of the Urinary Tract during Cytoreductive Surgery for OC

Pelvic tumors originating outside the urinary tract can spread to urinary organs due to the close proximity of pelvic strictures. Invasion of advanced OC to the lower urinary tract may occur either by direct extension of the tumor around or into the bladder and ureters or indirectly by pressure from an enlarged ovarian mass developed in the pelvis.[7] However, metastasis or infiltration of ovarian tumors into the urinary organs is extremely rare and usually occurs in untreated patients with advanced disease. Interestingly, in autopsy series of 170 patients that died from disseminated OC, the involvement of urinary organs was rarely reported: kidney (3.5%), urinary bladder (22.4%), and ureters (11.8%), while the development of hydronephrosis was reported in 21.2% of the included patients.[8] Although debulking surgery plays a crucial role in the management of advanced OC, knowledge gained for urologic radical procedures and optimal techniques during CRS for the management of urinary involvement remains limited, due to the scarcity of urinary involvement in advanced OC.

In a retrospective study of 24 patients with advanced OC invading to the urinary tract, the role of urinary surgical procedures, including partial ureteral resection, partial cystectomy, and ureteral reimplantation, aiming to achieve an optimal CRS was studied.[7] Major and minor postoperative complications were reported in 25% of the patients, including unilateral renal atrophy, pyelonephritis, and anastomotic leak after ureteral resection or ureteroneocystostomy.[7] The mean postoperative survival was significantly lower in patients with nonoptimal CRS, R+ resection of primary tumor, and occurrence of postoperative urinary obstruction.[1] Despite the increased disease burden of these patients, they presented with low morbidity and mortality postoperative rates, suggesting that urinary tract surgeries are considered justified as part of debulking procedures in cases of disseminated OC.[7] The same promising results were also reported in another retrospective study that included 22 patients subjected to urinary interventions for advanced OC.[7] Incidence of complications was reported only in 31.8% of the included patients, while optimal CRS combined with radical urinary resection was associated with increased survival and acceptable morbidity rates.[9]

In addition, another retrospective study described the treatment outcomes of CRS along with HIIPEC in 81 patients with involvement of the urinary bladder or the ureters after peritoneal ovarian carcinomatosis.[10] After the subjection of aggressive urinary resections, postoperative urinary complications and obstruction of the lower urinary tract were reported only in 4.9% and 2.5% of the included patients, respectively.[10] Iatrogenic injuries of the urinary bladder were described only in two patients, suggesting that radical urinary interventions followed by HIIPEC present with low postoperative morbidity and should be thoroughly considered as part of optimal management for disseminated ovarian disease.[10]

Due to the absence of clinical trials or prospective studies published in the literature, there are no current guidelines or consensus strategies concerning the surgical approach of urinary organs during debulking surgeries for OC. However, our clinical experience shows that surgical procedures of the urinary tract in these patients should follow guidelines for the management of advanced OC invading other types of organs. Survival of patients that undergo urinary resections as part of debulking surgeries for OC depends on the achievement of optimal CRS without residual disease, optimal resection of primary ovarian tumors with free postoperative margins, and the incidence of postoperative urinary obstruction.[7] In addition, several poor prognostic indicators for advanced epithelial OC, irrespective of the type of involved organs, have also been reported in the literature; increased patient's age, poor patient's performance status, advanced initial International Federation of Gynecology and Obstetrics (FIGO) stage of tumor, tumor histological grade, the presence of large volume of ascites (>500 mL), and mucinous histological subtype of OC are significantly related with shorter overall and free survival of patients. Importantly, patients subjected

to more aggressive surgical procedures present with better survival outcomes compared to patients with nonradical procedures.[1] Interventions of the urinary tract as part of CRS seem not to affect surgical outcomes and incidence of complications, while only extensive peritoneum resection has been recognized as a poor prognostic factor for these surgeries.[1,3] Poor prognostic indicators of debulking surgeries for advanced OC are summarized in Table 1.

Ureteral Procedures during Cytoreductive Surgery for OC

Disseminated ovarian disease in the pelvis can cause ureteral obstruction presented with either hydronephrosis or hydroureters.[11] Dilation of the renal tract occurs either with direct compression of the ureters from an enlarged ovarian tumor or indirectly by tumor infiltration into the periureteric tissues.[11] The incidence of ureteral obstruction should be suspected clinically and confirmed by imaging techniques.[12] However, preoperative evaluation of the extent of lower urinary tract involvement can be really difficult. Although low abdominal ultrasonography and computed tomography constitute the most commonly used imaging techniques, they can recognize only gross masses developed in the urinary tract.[13]

Due to the poor physical condition and dismal prognosis of patients with advanced OC, initial therapeutic approach, urinary surgical procedures during CRS, and follow-up of these patients can be really challenging and should be performed from highly experienced urologists. Initial approach of these patients should aim to the decompression of the lower urinary tract by placing either ureteral stents or nephrostomy tubes.[12] The stents can be inserted either retrogradely, with the assistance of a cystoscope, or transureterically, through a longitudinal incision in the ureter near the pelvic brim. In cases of advanced OC, placement of retrograde ureteral stents comprises a better therapeutic option for the management of urinary obstruction compared to nephrostomy tubes.[14] However, transurethral stent placement should be preferred, since they are placed intraoperatively, in one surgical period, with no need for further reposition of the patient or prolongation of other interventions.[14] Failure of initial stent placement can occur due to the difficulty of the surgeon to identify the location of ureteral orifices. Furthermore, the presence of severe hydronephrosis, peritoneal carcinomatosis of OC, and poor patient's general condition constitute other independent predictors of stent failure.[15] Ureteral stents should not be left for longer than 6 weeks and should be replaced every 3 months in order to avoid stent blockage, infection, or dislocation.[11] However, in cases of uncertain ureteral vascularity, severe postoperative injury, ureteral strictures, or need for adjuvant therapy, stents can be left for periods longer than 6 weeks.[11] Of note, placement of metallic stents should be favored, since they provide long-term urinary drainage leading to decreased incidence of stent failure and encrustation.[15]

Although placement of ureteral stents is preferred in order to achieve urinary decompression in cases of advanced OC, nephrostomy tubes constitute an alternative option after consecutive failures of stent placement.[15] More specifically, nephrostomy tubes should comprise the first treatment choice in patients with poor physical condition, severe hydronephrosis, and peritoneal carcinomatosis.[15] A proposed algorithm for the optimal decompression of patients with urinary tract obstruction is described in Figure 1.

After initial decompression of ureteral obstruction, urinary surgical procedures should follow in order to achieve an optimal CRS. The initial identification of ureters during debulking surgery can be really challenging and mainly depends on patient size, tumor dimension, extension of disseminated disease, and

Table 1: Poor prognostic factors of debulking surgeries for advanced ovarian cancer

Surgical procedures during CRS	Prognostic factors
Urological interventions	Debulking surgery with residual disease
	Tumor resection (R+) without free margins
	Postoperative urinary obstruction
Surgical procedures for various organs (including urological interventions)	Increased age
	Poor performance status
	Advanced FIGO
	Poor histological grade
	Large volume of ascites (>500 mL)
	Mucinous histological subtype

CRS: Cytoreductive surgery, FIGO: Federation of Gynecology and Obstetrics

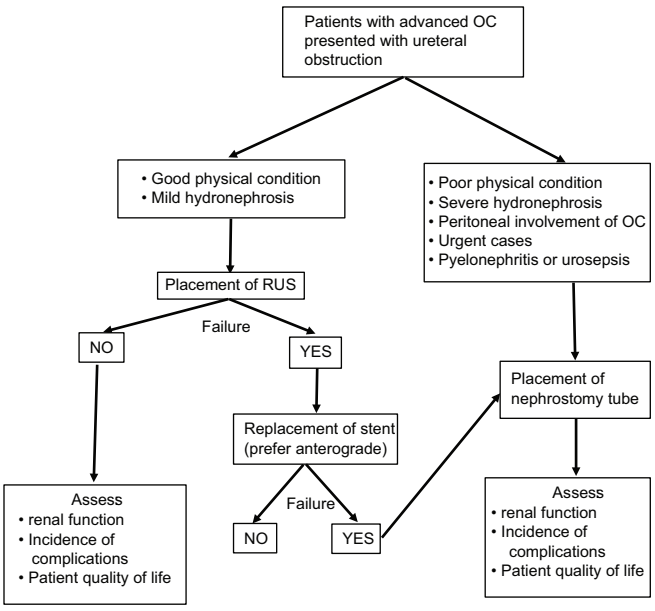

Figure 1: Algorithm for the management of patients with urinary tract obstruction

patient's surgical history.[12] Based on our experience, the optimal method to avoid ureteral injuries consists of a careful exploration of the retroperitoneum aiming to direct visualization of the ureters. Of note, placement of a ureteral stent can also help for better identification of the ureters.[12] However, other urologists strongly support that preoperative ureteral stent placement is associated with increased risk of ureteral injury due to dislocation and decreased pliability of the ureters.[12] In addition, due to the anatomic proximity and embryologic relationship between the reproductive system and lower urinary tract, debulking surgeries for OC present with increased risk of postoperative urinary injuries.[12] The most commonly reported locations for ureteral injuries during these procedures are found in the level of infundibulopelvic ligament, uterine artery, and angles of the vagina.[16] In addition, management of ureteral obstruction during debulking surgeries can be really challenging and require the participation of highly experienced urologists, since they should aim inpatient renal preservation and avoid the occurrence of complications along with assessing patients' quality of life.

Ureteral lesions, caused either by immediate spread of OC or by injuries during debulking surgeries, should be reconstructed in order to preserve renal function and ensure urinary continuity.[17] In cases of ureteric defects, an intravenous urogram is needed to identify the site of the urinary leak.[17] If this modality presents with ambiguous results, a cystoscopy or retrograde pyelogram should follow.[17] The principles of ureteric reconstruction include the establishment of sufficient blood supply, complete excision of the tumor, and tension-free anastomosis from mucosa to mucosa.[17] For ureteral injuries discovered during debulking surgery, immediate repair comprises the optimal approach.[18] Concerning ureteral lesions diagnosed postoperatively, drainage with nephrostomy tubes or placement of ureteral stents (retrograde or anterograde), can be used if the ureteral defect is short (<2.5 cm).[19] In patients with unresolved ureteric leaks, an open surgical procedure for definitive reconstruction is considered mandatory.[17]

Urinary Bladder Procedures during Cytoreductive Surgery for OC

Although invasion of OC in the urinary bladder is rarely reported, enlarged masses of disseminated disease can result in mechanical compression or direct invasion around or into the bladder.[20] Therefore, a dissection of ovarian tumors adjacent to the bladder is considered necessary.

An optimal resection of the mass can be accomplished either by radical surgical procedures, such as total cystectomy, or by bladder-sparing procedures, such as partial cystectomy, aiming to preserve any residual bladder capacity and sexual function and achieve better quality of patient's life.[21] The subjection of a total cystectomy is associated with considerable increase in surgical stress and decrease in postoperative quality of patient's life.[21] Consequently, surgical procedures of the bladder during CRS should not be radical and should aim to spare the bladder by resecting the seminal vesicle or to preserve a residual function of the resected bladder.[21] Partial cystectomy should be offered in selected patients with solitary tumors without concomitant carcinoma *in situ* that can achieve 1–2-cm postoperative margins in a normally functioning bladder.[22] During bladder-sparing procedures, the identification of the extent of tumors truly infiltrating into the bladder can be really challenging, due to dense fibrous reaction caused by cancer spread.[13] Separation and dissection of involved adjacent structures should be performed thoroughly, since it can cause tumor spillage and local recurrence of the disease.[13]

Concerning patients with advanced disease that cannot be subjected to bladder-sparing procedures, total cystectomy should comprise the treatment of choice in order to decrease cancer burden and incidence of tumor's recurrence. Reconstructive surgeries of the urinary tract, including ileal neobladder and ileal or colon conduit, should follow radical bladder procedures, aiming to restore bladder's function.[21] Interestingly, Gilad *et al*. proposed the implication of cystotomy in order to achieve optimal resection of ovarian tumors adherent to the bladder.[23] More specifically, cystotomy enables safe resection of the pelvic tumors and assists to prevent bladder injuries caused by more radical procedures.[23] Thus, urologists can play a crucial role both in the preoperative design of these elective surgical interventions and the intraoperative care of involved patients.[21]

Renal Procedures during Cytoreductive Surgery for OC

Metastatic tumors of the kidney originated from the ovaries are extremely rare, since they usually spread throughout the peritoneum and the pelvic or abdominal cavities.[20] However, similarities concerning histology and embryologic development of the ovary and kidney imply the existence of a renal-ovarian axis as a possible route for metastasis of ovarian tumors to the kidney.[24] Poor understanding of this interrelationship contributes to missed or delayed diagnosis of the primary malignancy. Only ten case reports have been published in the literature reporting ovarian metastases to the kidney, with 40% of them to concern advanced stages of OC, and therefore, knowledge for their optimal surgical approach remains restricted.[20] As mentioned before, debulking surgery for the management of disseminated ovarian disease that involves kidney, should follow the principles of CRS for other organs, aiming to reduce the burden of the disease and achieve free postoperative margins.

The role of urologists should not only be restricted in the surgical management of cases with advanced OC that involve kidney but also in the pre- and postoperative assessment of these patients. Although the incidence of acute kidney injury (AKI) in patients treated with debulking surgery followed by HIIPEC for various cancer types ranges from 0% to 40%, postoperative occurrence of AKI in patients that underwent CRS-HIIPEC for advanced OC is higher, varying from 40.4% to 48.4%.[25,26] Thus, careful evaluation of these patients from highly experienced urologists is considered necessary. Interestingly, medical history of hypertension and antihypertension treatment, low intraoperative diuresis, and administration of crystalloids have been related with increased risk of AKI.[25] Furthermore, patients with increased preoperative levels of baseline creatinine or estimated glomerular filtration rate also present with increased risk to develop AKI, and thus, an adequate perioperative hydration is needed in order to achieve sufficient intravascular volume.[26] Hydration is considered an effective strategy to prevent nephrotoxicity, since it increases renal clearance and prevents extended contact of the drug with renal tubules.[26] Urologists should have in mind to recess the administration of antihypertension regimens during the day of debulking surgery and avoid the usage of nephrotoxic agents, such as nonsteroidal anti-inflammatory agents.[25,26]

Conclusion

Although urinary tract involvement is considered an uncommon finding in patients with disseminated ovarian disease, urinary surgical procedures seem necessary to achieve an optimal debulking effort. It has also been demonstrated that these radical urinary interventions can be performed with acceptable rates of morbidity and postoperative complications, while a significant benefit in terms of survival is expected when debulking surgeries with no residual disease are carried out. Further well-designed studies are needed to further elucidate the role of urologists during debulking surgeries for the management of advanced OC.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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An Adult Patient with Bladder Exstrophy

Abstract

Bladder exstrophy is a rare congenital malformation. The incidence of this rare condition is calculated between 1 in 10,000 and 1 in 50,000 live births. The reconstruction of this malformation is one of the most challenging conditions managed by pediatric urologists. The exact incidence of patients with bladder exstrophy seeking treatment in adulthood is not documented adequately in the literature. The aim of this study is to present a 24-year-old female with bladder exstrophy who was referred to the emergency department of our hospital due to a high fever. The diagnosis of acute right pyelonephritis was determined after physical examination and computed tomography. The patient was hospitalized for intravenous antibiotics. She decided that she did not want any reconstructive intervention besides the opposite consultation.

Keywords: *Adult, bladder exstrophy, untreated*

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Introduction

Bladder exstrophy is a rare malformation that consists of the lack of the anterior subumbilical abdominal wall and the front wall of the bladder. The urethra, pelvic floor, external genital organs, and the perineum are also affected.[1] The incidence of this rare condition is calculated between 1 in 10,000 and 1 in 50,000 live births.[2] Numerous series demonstrated that male-to-female ratio is estimated 2.3:1, while it does not differ by race and region.[3,4] The reconstruction of the malformation is one of the most challenging conditions managed by pediatric urologists. The malignant potential of bladder exstrophy is one of the reasons that it should be treated during infancy.[5] Moreover, the functional and physical impact of this condition can be evolved into social, psychological, and professional disability during adulthood.[1] The exact incidence of patients with bladder exstrophy seeking treatment in adulthood is not documented adequately in literature. The aim of the study is to present one case of an adult patient with untreated bladder exstrophy and acute right pyelonephritis.

Case Report

Our case is a 24-year-old female from Somalia who was referred to the emergency department of our hospital due to high fever (38.2°C) and chills with onset 24 h before the admission. The patient had a history of urinary tract infections (UTIs) in the past. The exstrophy of the bladder was obvious by the initial clinical evaluation [Figure 1]. The patient did not present abdominal tenderness, while the Giordano's sign was found to be positive to her right side. Blood sample and urine culture were sent for examination. The blood test did not reveal any significant increase of inflammation markers, and the patient underwent a contrast computed tomography for the investigation of the fever origin. The examination demonstrated a right kidney with decreased size, probably due to recurrent UTIs, while the left kidney was normal. Hydroureteronephrosis was also detected on the right side until the level of ureterovesical junction. The images confirmed the diagnosis of the congenital condition of bladder exstrophy [Figure 2].

After discussing the treatment options with the patient, it was mutually decided that she should remain in the hospital for intravenous wide-range antibiotics (ceftriaxone 2 g × 1 and amikacin 1 g × 1/day). The patient did not have any fever after the 1st day of hospitalization. Nevertheless, 2 days after her admission, the urine cultures demonstrated the existence of *Proteus mirabilis* and *Klebsiella pneumoniae*. The combination of antibiotics was changed according to the antibiogram, after the consultation of the infectious diseases'

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treatment team of the hospital. The 3rd day of the hospital stay, the patient underwent a magnetic resonance imaging examination, as the possibility of transferring her to a different center that could conduct the reconstructive surgery was still an option [Figure 3]. The patient decided not to have reconstructive surgery after discussing the options with our consultant and her family. She was discharged on the 4th day with oral antibiotics, without fever, and with normal physical examination.

Discussion

Reconstructive surgeries of bladder exstrophy are challenging and rare procedures. Primary reconstruction by pediatric urologists is increasingly performed with good results. The treatment should be conducted during infancy due to the increased possibility of bladder malignancy and the challenging management of the abdominal wall deficit that are associated with adult patients with untreated malformation.[6,7] Recurrent pyelonephritis and gradual renal function decrease can also be the result of untreated bladder exstrophy.[8] In addition, the sociopsychological factors accompanying the syndrome have led to a very rare presentation of adult patients with bladder exstrophy.

Historically, ureterosigmoidostomy was one of the first surgical approaches for the treatment of bladder exstrophy regarding patients after adolescence. The evolution of reimplantation techniques demonstrated some improvement regarding metabolic anomalies that occurred after the surgery.[9] The absence of abdominal stoma is one of the advantages of ureterosigmoidostomy. Nevertheless, recurrent pyelonephritis and the possibility of fecal incontinence, ureteral obstruction, and delayed neoplasia of the colon are some of the milestones of this technique.[10,11] The treatment of the malformation with cystectomy, construction of a Kock's continent ileal reservoir, and closure of the abdominal fascial defect using alloplastic material was reported by Matsuda *et al*.[12] The authors reported that the patient was continent after the procedure. This type of surgery is not associated with recurrent UTIs, rectal incontinence, and the possibility of malignancy.[11] The treatment of adult patients with bladder exstrophy was reported by Gulati *et al*.[13] The authors conducted cystectomy and modified the Mainz pouch and the lack of the abdominal wall was closed in the same procedure. Both of the patients reported improvement of quality of life. D'Elia *et al*. conducted Mainz pouch II ureterosigmoidostomy on 26 patients with bladder exstrophy and/or incontinent epispadias.[14] The authors reported no severe complications and excellent continence rates for this series of cases.

A 39-year-old male from Mali presented with bladder exstrophy was reported by Ouattara *et al*.[15] The patient was fully functional and the father of four children. Another 49-year-old female patient with bladder exstrophy was reported by Ozdiler *et al*.[8] The patient did not have any severe complications due to the disease. Savalia *et al*. presented a rare case of a 63-year-old patient with untreated

Figure 1: The phenotype of bladder exstrophy. Lack of the anterior subumbilical abdominal wall and the front wall of the bladder. The external genital organs are exposed

Figure 2: Computed tomography image of the pelvis. The malformation of the lack of the anterior subumbilical abdominal wall and the front wall of the bladder can be observed

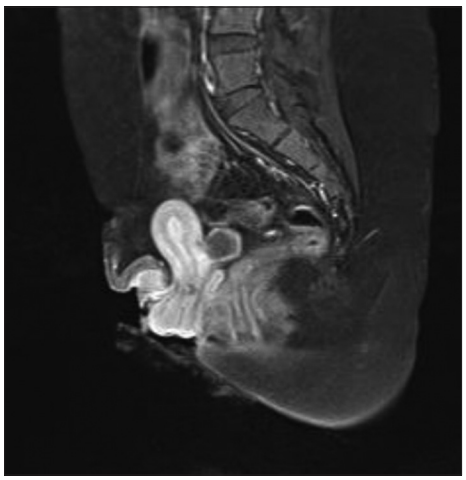

Figure 3: MRI imaging (sagittal reconstruction). The lack of the abdominal wall and the grade of exposition of the organs can be observed. MRI: Magnetic resonance imaging

bladder exstrophy that was admitted due to hematuria. The patient was diagnosed with signet-ring cell adenocarcinoma of the bladder.[6]

Conclusion

Bladder exstrophy is a rare congenital malformation that can be easily recognized. The importance of early treatment is associated with the lower possibility. In addition, recurrent UTIs and gradual renal function decrease can be avoided, ameliorating the quality of life of the patients.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Blunt Injury Abdomen with Complete Vesico-Urethral Transection in a Female Child

Abstract

Traumatic bladder neck distraction injury in children is an uncommon but potentially dangerous occurrence. Straddle injuries produced by a hit to the perineum as a result of striking an outside object with the power of one's body weight, as well as significant urethral trauma caused by a pelvic fracture, occur in both sexes. Urethral injuries in females are infrequent and are typically associated with pelvic fractures and anterior vaginal wall laceration. We offer a case report of a girl who had a full vesicourethral transection following a traumatic injury to the abdomen, as well as a rupture of the dome of the urinary bladder, and was treated with early urethro-vesical anastomosis and bladder closure. Patient recovered well after surgery, was continent, and had excellent urine flow rates.

Keywords: *Bladder neck injury, blunt injury abdomen, pediatric injury, urethral injury, vesicourethral transaction*

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Introduction

Complete bladder neck distraction damage is a very well side effect of pelvic fracture-related trauma, especially in children.[1,2] Female urethral trauma is a poorly known condition that has only been documented occasionally in the literature. It is thought to affect 4.6%–6% of female pelvic fractures, and it is more prevalent in youngsters than adults.[3,4] The bladder's mobile and smaller intra-abdominal position, as well as the cranially located, immobile prostate, may all contribute to bladder neck disruption in babies. When the urinary sphincter mechanism is damaged, it might result in severe incontinence and/or urethral stricture development.[5] The muscular components of the urinary sphincter can be injured as a result of acute or penetrating pelvic trauma, as well as surgery. The pubic symphysis, which is hanging in the pelvic floor, protects the urinary sphincter. Longitudinal rips in the sphincter system from the bladder wall to the bladder neck may form in patients who have full bladders at the moment of impact. Damage to the sphincteric urethra, whether severe or direct, can result in full muscle breakdown. Bladder neck transection can be treated by primary realignment or suprapubic cystostomy alone, as well as delayed repair.[6,7] We present a case of full vesicourethral transection with dome rupture in a 4-year-old girl treated with primary vesicourethral anastomosis and closure of the perforation over the dome of the urinary bladder.

Case Report

A 4-year-old female was brought to the emergency room with a history of lower abdominal traumatic injuries, genitoperineal pain, hematuria, and lower abdominal tenderness. The patient's hemodynamics was steady. An ultrasound of the abdomen revealed free fluid in the peritoneal cavity. A transurethral catheter was inserted to empty the bladder of hematuria. After stabilizing the patient, the abdomen and pelvis were scanned with a contrast-enhanced computerized tomography scan, which revealed a ruptured urinary bladder with a Foley bulb outside the bladder. There was contrast extravasation and free fluid in the peritoneal cavity, and a definite urethral contour could not be observed. There was also a comminuted fracture of the bilateral superior pubic rami [Figure 1]. An exploratory laparotomy was performed as a last resort. We discovered total vesico-urethral transection as well as a rupture of the urine bladder at the dome

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during our inspection [Figure 2]. There was no further visible harm to the abdominal viscera. It was possible to see the urethral mucosa and sphincter's edges. For the initial vesicourethral anastomosis, six conventional intermittent through and through sutures were employed, which were knotted loosely to properly approach the borders while not strangling the tissues, and then perforation closure over the dome of the urinary bladder. The suprapubic and transurethral catheters were left in place for 3 weeks before being withdrawn during a micturition cystogram [Figure 3]. After 3 years of follow-up, the patient was continent and voiding with excellent urine flow.

Discussion

Female urethral injury resulting in total disruption is a highly unusual appearance.[8] In females, urethral injuries are more typically observed in conjunction with pelvic trauma, and treatment involves urine diversion via a suprapubic cystostomy and delayed repair for severe lesions.[9] A partial rupture of the proximal anterior wall is the most common female urethral injury but complete disruption is unusual and typically linked with severe vaginal lacerations.[10] Males have a substantially greater incidence of urethral injuries than females, with 10% versus 4%–6%, respectively.[11,12] Simple urethral disturbances have been rectified on occasion. The management of traumatic urethral damage in females is developing, with a debate raging over whether primary repair is preferable to subsequent delayed anastomosis and repair.[13] Primary vesicourethral anastomosis was performed in our instance to achieve full vesicourethral transection. The treatment of urethral injuries is still debatable, owing to the inadequate knowledge of most pediatric urologists. The goal of therapy should be to reduce distant harms including urethrocutaneous fistula, periurethral diverticula, urethral stricture, and incontinence. Despite a higher incontinence rate of up to 75%, Husmann and Routh JC discovered that early bladder neck repair reduces the risk of acute complications such urine extravasation, which can develop to pelvic urinoma, abscess, osteomyelitis, or necrotizing fasciitis.[2] Balkan *et al*. reported that pediatric patients with posterior urethral injury who got early repair had a stricture rate of 16.6% versus 37.5% in those who received delayed repair.[14] Our patient, who was treated with an immediate repair, had no problems. Because there is a risk of ureteric or bladder damage, an abdominal route is suggested. In the acute setting, Voelzke *et al*. recommended for early repair of bladder neck damage to reduce complications by insertion of a urethral catheter over the injured site with attached urethral sutures for tissue approximation as well as the placement of a suprapubic tube.[15] Urinary incontinence is a typical postoperative complication linked with pelvic fracture.[16] Despite undergoing a full transection of the bladder neck, our patient had no postoperative incontinence or stricture after 3 years of follow-up.

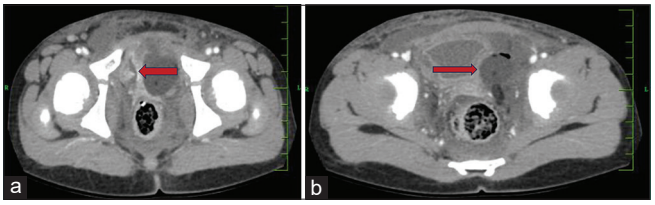

Figure 1: (a) CECT scan abdomen showing Bladder rupture extravasation of the contrast (b) CECT scan abdomen showing Bladder rupture with foley catheter outside the bladder

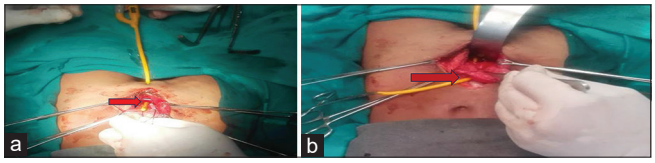

Figure 2: (a) Intraoperative photographs showing Complete Vesico-Urethral transection (b) Intraoperative photographs showing rupture of the Dome of the urinary bladder along with Complete Vesico-Urethral transection

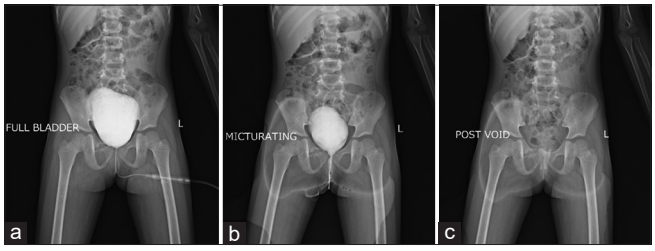

Figure 3: Postoperative micturating cystourethrogram, (a) Full bladder, (b) Micturating phase, (c) Post-void Cystourethrogram shows no residual urine

Conclusion

Given the rarity of bladder neck distraction damage in pediatric children, we believe that early urethro-vesical anastomosis can provide satisfactory long-term outcomes.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Case Report

Congenital Urethral Polyp as Cause of Urinary Retention in the Pediatric Population. Presentation of a Rare Case

Abstract

Urethral polyps (UPs) constitute a rare congenital disease in the pediatric population. They are benign lesions that are associated with a great variety of symptoms including dysuria, decreased urine stream, urinary retention, urinary tract infections, vesicourethral reflux, and even enuresis. The aim of this study was to present one case of a UP in a 20-month-old boy. The boy was referred to the emergency department of a pediatric hospital due to acute urinary retention. The performed ultrasound detected an increased bladder wall and the presence of a bladder diverticulum. In addition, in the voiding cystourethrogram, a filling defect in the posterior urethra was noticed. The performed urethrocystoscopy detected one polypoid lesion of about 1 cm in length which was excised using an 11F resectoscope. The patient was followed up for 6 years without recurrence or additional symptoms.

Keywords: *Bladder outlet obstruction, urethral polyps, urinary retention in children*

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Introduction

Urethral polyps (UPs) constitute a rare congenital disease in the pediatric population. UPs are fibroepithelial lesions that are located mainly in the posterior urethra. They are commonly presented in boys at preschool age. The incidence of UP in the anterior urethra or in the urethra of girls is extremely rare.[1]

The UPs are benign lesions and they are associated with a great variety of symptoms. The most common are dysuria, decreased urine stream, and hesitancy. UPs could also constitute the cause of urinary retention and they could be associated with urinary tract infections, vesicourethral reflux, and even enuresis.[2] The diagnostic pathway includes the ultrasound and the voiding cystourethrogram, while the diagnosis is confirmed by urethroscopy.[3]

The aim of this study is to present one case of a UP in a 20-month-old boy.

Case Report

Our case is a 20-month-old boy who was referred to the emergency department of a pediatric hospital due to symptoms compatible with acute urinary retention. After the performance of an ultrasound, the diagnosis of urinary retention was confirmed and a urethral Foley catheter was placed. The urethral Foley was removed on the 7th day and the boy was able to urine. The performed ultrasound detected an increased bladder wall of 10 mm [Figure 1] and the presence of a bladder diverticulum on the right side [Figure 2]. As the suspicion of bladder outlet obstruction was raised, the patient underwent a voiding cystourethrogram. The presence of the bladder diverticulum and a filling defect in the posterior urethra were noticed [Figure 3]. Thus, the urethrocystoscopy was determined to be the next step in the diagnostic pathway.

At the age of 21 months, the patient underwent urethrocystoscopy under general anesthesia. The operation was performed by an 11F pediatric cystoscope. One polypoid lesion of about 1 cm in length was detected posterior to the verumontanum. The polypoid lesion was excised using an 11F resectoscope and was removed utilizing biopsy forceps [Figure 4]. A urethral Foley catheter was placed and it was removed on the 3rd postoperative day. Histopathology examination showed that the lesion was a congenital UP, which was covered by urothelium. In addition, edema of the

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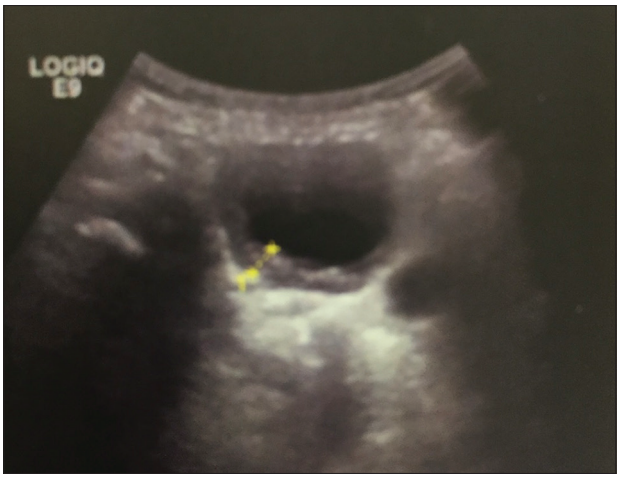

Figure 1: Thickened bladder wall in ultrasound

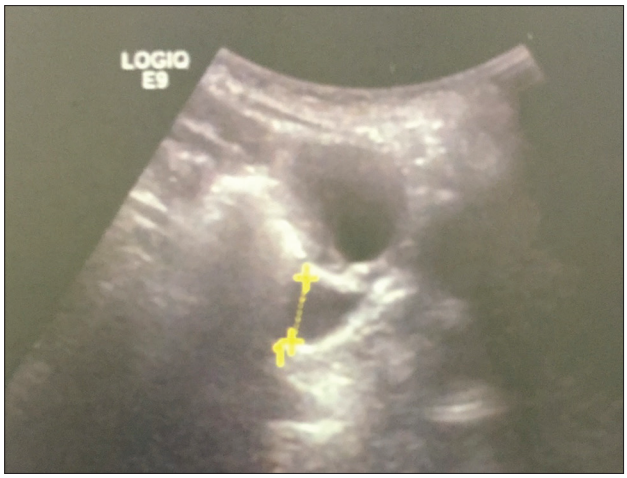

Figure 2: Bladder diverticulum on the right side

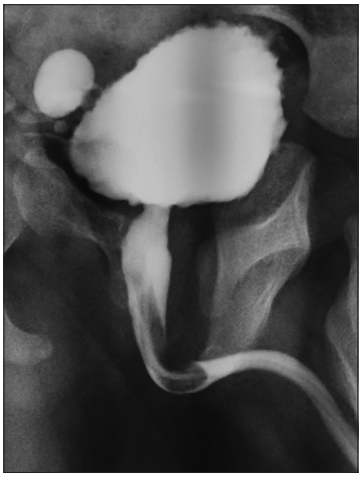

Figure 3: Filling defect on the posterior urethra (voiding cystourethrogram)

Figure 4: Excised urethral polyp

lamina propria and hypertrophy of the smooth muscle cells were detected.

One year postoperatively, a new voiding cystourethrogram was performed and a normal urethra was detected. The patient is under follow-up for 6 years without any symptoms of the lower urinary tract or urinary tract infections. There is no postvoiding residual detected on the ultrasound, while the thickness of the bladder wall was diminished. The diverticulum remains stable at 1.1cm without clinical presentation.

Discussion

The UPs constitute a rare pathological finding in the pediatric population. In most patients, they affect the posterior urethra of boys, while in the anterior urethra of boys and in girls are extremely rare. Their origin is controversial, and many theories were interpreted. Based on the literature, newborns or infants may suffer from UCs. This fact favors their congenital origins. Downs supported that UCs are the remnants of an unsuccessful regression of Muller's tubercle. On the contrary, Kuppusami and Moors investigated the association of the metaplastic epithelium, which may be present in the UC, with the estrogens that are released during pregnancy.[4,5] The mean age of presentation varies in the published cohort studies from 3 to 3.5 years.[2,3] In our case, the patient who suffered from UC was younger (20 months old), but the location of the UC was the expected one (posterior urethra).

The clinical manifestation of UCs is a triad including intermittent urinary retention, lower urinary tract symptoms, and hematuria.[2] Akbarzadeh *et al*. investigated a group of 18 patients with UCs, in which urinary retention was the main clinical sign in 38.9% of the cases.[2] The incidence of hematuria varies from 30 to 60%,[6] while Gentle *et al*. estimated that dysuria is present in 52% of the UC patients.[7] Moreover, another urinary tract anomaly may be present in 50% of patients suffering from UC with vesicoureteral reflux being the dominant one.[2] In our case, the boy was referred to the emergency department due to acute urinary retention, while the bladder diverticulum was detected as additional urinary tract malformation.

The milestones in the diagnosis of the UCs are the ultrasound and the voiding cystourethrogram. Voiding

cystourethrogram can detect the filling defect in the posterior urethra in 70% of the cases.[6] Afterward, the diagnosis is confirmed by the urethrocystoscopy which constitutes the gold standard. Despite its diagnostics role, urethrocystoscopy also plays a curative role as it provides surgeons the possibility to excise the UC at the same time. Various instruments were utilized for the excision of UCs, with resectoscope, laser, and biopsy or foreign body forceps to dominate.[8] In some cases, extremely enlarged UCs were excised by cystotomy.[9] In the majority of cases, UCs are not associated with recurrence if they are completely excised, while the median follow-up duration is 3 years. The follow-up plan includes ultrasound, voiding cystourethrogram (especially if vesicoureteral reflux is present), and uroflowmetry (in cases of symptoms).[2]

Conclusion

Congenital UPs constitute a rare benign lesion, which is mainly presented with urinary retention or severe lower urinary tract symptoms in the pediatric population. The first steps in the clinical investigation include ultrasound and voiding cystourethrogram, while the diagnosis is confirmed by urethrocystoscopy. In most cases, the treatment consists of endoscopic resection of the polyps with a high success rate.

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Conflicts of interest

There are no conflicts of interest.

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