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Prone access of right kidney showing pelvolithiasis

Large expanding retroperitoneal hematoma

ISSUE HIGHLIGHTS

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LETTER TO THE EDITOR

Bridging Pediatric and Adult Urology in the Philippines: Why Transitional Care Must Be Built Now

Transitional urologic care—the purposeful, planned shift from pediatric-centered to adult-oriented services—is essential for adolescents with congenital or childhood-onset urologic disease (AAP, 2002). Its goal is uninterrupted, developmentally appropriate care that maximizes lifelong function and quality of life (AAP, 2002). Structured transition is not a hand-off of charts; it is a coordinated process with clear roles, shared decision-making, and preparation before, during, and after transfer, as emphasized by NICE Guideline (National Institute for Health and Care Excellence [NICE], 2016).

The need is most visible in conditions like neurogenic bladder (often spina bifida) and congenital anomalies. At their adolescent transition presentation, approximately 90% of spina bifida patients have active problems—urinary incontinence (52%), recurrent UTIs (34%)—and the majority require new investigations or interventions (97%); these figures reflect care gaps that accumulate when transition is ad hoc rather than systematic (Summers et al., 2014). Dedicated transitional clinics can change trajectories.

A multidisciplinary team (MDT) is the cornerstone—pediatric urologists, adult reconstructive/neuro-urology specialists, general urologists, family physicians, rehabilitation medicine, nursing, social work, and neurology/neurosurgery. Surveys of North American urology leaders underscore that neither pediatric nor adult services alone feel fully equipped; most believe specific training in congenitalism/transitional urology is warranted and that general urologists alone are seldom prepared (Roth et al., 2020). For spina bifida specifically, providers recommend standardized pathways, MDT clinics, and advanced training to ensure continuity of adult care (Agrawal et al., 2019). In addressing this, a Bladder Reconstruction, Independence Development, Diversion for Urinary Empowerment (BRIDGE) Program is currently underway at SickKids, Toronto. The aim of this program includes MDT management of neurogenic and myogenic bladder patients from antenatal to transition (SickKids, 2025).

Risk stratification should guide triage and resource allocation. The AUA/SUFU guidelines for adult neurogenic lower urinary tract dysfunction (NLUTD) and CUA guidelines for Pediatric NLUTD recommend classifying patients as low, moderate, or high risk and aligning follow-up intensity and interventions accordingly (Ginsberg et al., 2021a, 2021b, Chua et al, 2023). Translating this to transition pathways:

- **Low-risk** survivors of uncomplicated childhood conditions may be followed primarily in the community by family physicians with periodic general urology review.
- **Moderate-risk** patients (e.g., stable posterior urethral valves, prior obstruction) should transition to general urology with protocolized surveillance and ready access to subspecialty advice.
- **High-risk** patients (e.g., neurogenic bladder, exstrophy, continent catheterizable channels, augmentations) require direct transfer to adult reconstructive/transitional urology within an MDT.

A recent scoping review highlights wide practice variation, persistent barriers (awareness, training, access), and the need for leadership and policy support to build MDT systems for urologic transition (Chua et al., 2023). In fact, this topic

was presented by the author during a plenary session at the 2019 Annual Convention of the Philippine Urological Association. That effort raised awareness, but measurable system-level impact still needs improvement. Encouragingly, the Philippine Children's Medical Center has begun pursuing collaboration with counterpart government adult tertiary institutions to support adolescents with complex urologic conditions—an important first step toward structured, scalable transition pathways. Aligning with national societies and the Department of Health can catalyze progress by issuing standards for timing, documentation, shared clinics, and referral networks; supporting pilot neurogenic bladder transition clinics at tertiary centers; and developing short-course training that pairs pediatric and adult reconstructive competencies (NICE, 2016).

Ultimately, transitional urologic care is a shared responsibility. Pediatric and adult reconstructive urologists must buy in, primary care and patient advocates must be integrated, and systems must adopt risk-stratified pathways. Doing so protects kidneys, continence, fertility, and dignity—well beyond the 18th birthday (Summers et al., 2014; Chan et al., 2014; Ginsberg et al., 2021a, 2021b, Chua ME et al, 2023).

• Michael E. Chua, MD, FPUA •

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ORIGINAL RESEARCH

Breaking Barriers in Robotic Surgery: Efficiency and Safety of a Low-Cost, Single-Port Extraperitoneal Robotic-Assisted Radical Prostatectomy

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Introduction and Objective: The increasing demand for cost-effective surgical techniques has driven innovations in robotic-assisted radical prostatectomy (RARP). While single-port robotic surgery reduces invasiveness and improves cosmesis, its widespread use is limited by high costs and technical constraints. This study evaluates the safety, feasibility and cost-effectiveness of extraperitoneal single-port robotic-assisted radical prostatectomy (espRARP) using a modified Da Vinci Si HD system, employing a wound protector and surgical glove as a low-cost multi-channel laparoscopic port.
Methods: Ten patients with localized prostate cancer underwent espRARP using a three-arm Da Vinci Si system and side docking to enhance instrument access. A homemade multi-channel port was constructed using an Alexis® wound protector and surgical gloves. Perioperative outcomes—including operative time, blood loss, complications and oncologic results were analyzed descriptively.
Results: All cases were completed without conversion to open surgery. The mean operative time was 215.8 minutes with an estimated blood loss of 200 mL. No positive surgical margins were recorded, and 20% of patients exhibited pathological upgrading. The average hospital stay was 3.4 days. One patient developed a Clavien–Dindo II complication; no major complications occurred.
Limitations: This pilot study is limited by its small sample size (n = 10), single-surgeon, single-institution design, short follow-up period, and absence of functional outcome assessment. Only descriptive analysis was performed without statistical comparison.
Conclusion: The modified espRARP technique using a low-cost glove-port and three-arm Da Vinci Si system is safe, feasible and cost-efficient. Comparable perioperative and oncologic outcomes to conventional multi-port and proprietary single-port systems were achieved at a fraction of the cost. This approach provides a practical and accessible alternative for robotic prostatectomy in resource-limited healthcare settings.

Key words: robotic surgery, single-port; radical prostatectomy, cost-effective innovation, extraperitoneal approach

Introduction

Radical prostatectomy (RP) has undergone substantial advancements in recent years, transitioning from conventional open surgeries to minimally invasive techniques. Robotic-assisted radical prostatectomy (RARP) has emerged as the "gold standard" for the treatment of localized

prostate cancer (PCa) as a result of its enhanced precision, improved visualization, and reduced recovery time.[1,2]

The development of single-port (SP) robotic systems has further advanced minimally invasive surgery by reducing incisions and enhancing cosmetic outcomes.[3,4] Since the first report of single-port RARP (spRARP) in 2008[4], the technique has not only generated excitement but also challenges, mainly limited working space, instrument collisions and a steep learning curve.[4,5,6]

In 2011, Lee et al[7] from Yonsei University demonstrated the feasibility of robot-assisted laparoendoscopic single-site surgery (R-LESS) using an improvised single-port device that was made from an Alexis® wound retractor and surgical glove. Their 68-case experience proved that such improvised systems could offer adequate range of motion and flexibility, establishing the foundation for subsequent adaptations in various urologic procedures. The launch of the da Vinci SP® system in 2018 reignited global interest by allowing surgeons to control three articulating instruments and a 3-D camera through a single 2.5 cm access port.[8] Chang et al[9] later documented their initial experience with single-port transperitoneal robotic-assisted radical prostatectomy utilizing the Da Vinci Si system, demonstrating encouraging results despite the technical constraints associated with early SP setups.

Alongside these innovations, the extraperitoneal approach to RARP has demonstrated comparable efficacy to the transperitoneal approach, while offering added benefits such as shorter hospitalization, less bowel disturbance and quicker recovery[10,11] More recently, Wang et al. (2025) demonstrated that an extraperitoneal single-site robotic prostatectomy using a commercial multi-channel port and the da Vinci Xi system can achieve excellent perioperative results without entering the peritoneal cavity.[12] Their findings suggest that success in single-port robotic surgery depends more on surgical technique and innovation than on access to specialized equipment.

However, the challenge of making single-port robotic surgery is not only technically feasible but also economically attainable, especially in developing healthcare systems where access to advanced SP platforms remains limited. This study aimed to address that gap by evaluating the safety, feasibility and cost-effectiveness of performing extraperitoneal single-port robotic-assisted radical prostatectomy (espRARP) using the Da Vinci Si HD system. This technique involves the innovative use of a wound protector and surgical gloves to create a functional multi-channel laparoscopic port. This provides a more economical alternative to conventional robotic systems, reducing procedural costs while maintaining the efficacy and precision of single-port robotic surgery. Through this study, the authors seek to demonstrate that such modifications can deliver comparable outcomes without compromising patient care.

Methods

This retrospective study included ten male patients, aged 54 to 77 years, with biopsy-confirmed prostate cancer (PCa) who underwent extraperitoneal single-port robotic-assisted radical prostatectomy (espRARP) between October 2023 and June 2024. Institutional Review Board (IRB) approval was obtained, and all patients provided written informed consent prior to surgery.

Preoperative evaluation included multiparametric magnetic resonance imaging (mpMRI) and prostate-specific membrane antigen positron emission tomography (PSMA PET) scans. Imaging revealed localized disease in nine patients and locally-advanced PCa in one. Pelvic lymph node dissection was performed in a single case based on PSMA PET findings demonstrating nodal involvement.

Surgical Technique

A 4–5 cm transverse incision was made approximately 5 cm above the pubic symphysis. The anterior rectus fascia was incised, and the rectus abdominis muscle was separated from the peritoneum by blunt finger dissection. An extraperitoneal working space was created using a surgical glove inflated with approximately 400 mL of saline as a homemade balloon dilator (Figure 1a). An assistant 12-mm trocar was inserted approximately 8 cm lateral to the primary incision. A wound protector was placed beneath the rectus muscle, over which a size 8 surgical glove was

tightly secured to create a multi-channel glove port (Figure 1b). Camera and robotic trocars were introduced through the finger portions of the glove and secured with 2-0 silk sutures (Figures 2a & 2b). After insertion of a 20 Fr Foley catheter, the extraperitoneal space was insufflated with CO_2.

The patient was positioned in a Trendelenburg position, and the da Vinci Si robotic system was side-docked. A 12-mm, 30° laparoscope was inserted and maintained in a 30° upward orientation to minimize instrument collision. Monopolar curved scissors and Maryland bipolar forceps were used for dissection.

After removal of the anterior prostatic fat, the lateral endopelvic fascia was incised. The dorsal venous complex was ligated with 0-Vicryl on a CT-1 needle. The bladder neck was identified and transected, and the vasa deferentia were ligated, followed by dissection of the seminal

Figure 1 (a) Creation of the extraperitoneal space using a 20 Fr Foley catheter as a homemade balloon dilator. **(b)** A multi-channel glove port constructed from a size 8 sterile surgical glove and an Alexis® wound protector.

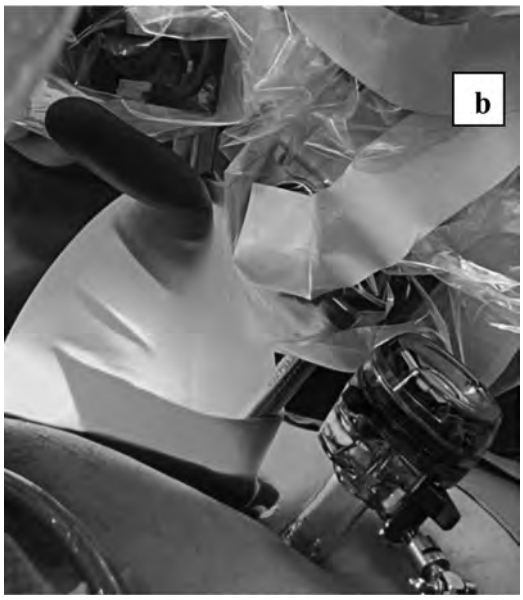

Figure 2 (a) Multichannel laparoscopic glove port with an assistant 12-mm trocar placed in the retropubic space. **(b)** Robotic arms docked to the glove port and camera port in a three-arm configuration.

vesicles. Intra-fascial dissection of the prostate was performed, with Hem-o-lok clips used to control the neurovascular bundle. Apical dissection was then carried out, and the distal urethra was transected. The prostate specimen was placed in an endoscopic retrieval bag for extraction. A rectal integrity test was performed using a rectal tube, and hemostasis was ensured.

The urethrovesical anastomosis was completed using 3-0 V-Loc™ barbed sutures in two running layers: one from 5 o'clock to 11 o'clock and another from 4 o'clock to 12 o'clock. A bladder leak test confirmed anastomotic integrity. The 20 Fr Foley catheter was then replaced with an 18 Fr catheter.

A Jackson-Pratt drain was inserted through the assistant port, the specimen was retrieved, and the incision was closed in layers.

Data Collection

Preoperative and postoperative parameters, including patient demographics, perioperative outcomes and complications, were recorded and analyzed. Prostatectomy specimens were assessed for surgical margin status and final pathological staging, which was determined according to the 2017 TNM classification system.[13] Postoperative complications were classified using the Clavien–Dindo grading system.[14]

Results

A total of 10 patients were included in this study. The mean age of the patients was 66 years, with a mean body mass index (BMI) of 25.6. The mean preoperative prostate-specific antigen (PSA) level was 11.37 ng/mL. Clinical staging indicated that 7 patients (70%) presented with cT1c disease, while 3 patients (30%) were diagnosed with cT2a-c disease. Pathological outcomes showed that 8 patients (80%) had a Gleason score of 7 (Grade Group 2-3), and 2 patients (20%) had a Gleason score of 8-10 (Grade Group 4) [Table 1].

All surgeries were completed without conversion to open procedures. The median operative time was 215.8 minutes, and the median console time was 141.1 minutes. The estimated blood loss (EBL) had a mean of 200 mL across the cohort. The median length of hospital stay was 3.4 days. Catheter duration averaged 8.9 days. The surgical technique successfully controlled bleeding and reduced operating time as experience with the modified approach progressed. No major intraoperative complications occurred, confirming the feasibility of the procedure [Table 2].

Table 1. Baseline characteristics

Parameter	N= 10 (mean)
Age at RP	66
BMI	25.6
Prior Abdominal Surgery	0
PSA	11.37
cT stage at RP	
cT1c	7
cT2a/b/c	3
cT3	0
p Gleason score at RP	
6 (grade group 1)	0
7 (grade group 2-3)	8
8-10 (grade group 4-10)	2

Table 2. Outcomes

Parameter	N= 10 (mean)
OR time	215.8 minutes
Console Time	141.1
EBL	200 cc
Positive margin	0
Length of hospital stay	3.4 days
Catheter duration	8.9 days
Complications	
Clavien I	0
Clavien II	1
Clavien III	0

Importantly, no patients in this cohort experienced positive surgical margins (PSM), indicating complete cancer resection. Pathological analysis revealed that 2 patients (20%) had an upgrade in pathological staging compared to their preoperative clinical stages, reflecting more aggressive disease than initially expected [Table 3]. These findings suggest that the modified approach is oncologically safe, yielding results comparable to standard multi-port RARP.

The overall complication rate in this study was 10%. One patient experienced a Clavien-Dindo II

complication, which involved back pain that was successfully treated with analgesics. No Clavien-Dindo III or higher complications were observed. There were no cases of rectal injury, and no major postoperative complications were recorded.

Table 3. Pathological data

PSM, n	0
PSM risk	
Low risk	0
Favorable intermediate risk	5
Unfavorable intermediate risk	3
High risk	2
Biopsy Grade Group	
Grade Group 1	0
Grade Group 2	5
Grade Group 3	3
Grade Group 4	2
Grade Group 5	0
Pathological Stage	
T2a	2
T2b	4
T2c	2
T3a	1
T3b	1
Upgrade	2

Discussion

This study demonstrates the safety and feasibility of performing extraperitoneal single-port robotic-assisted radical prostatectomy (espRARP) using a cost-effective, improvised multi-channel port. The da Vinci Si system was adapted to function as a single-port platform, employing only three robotic arms instead of the conventional four-arm configuration commonly used in multi-port procedures. Despite this simplified setup, the technique achieved perioperative and oncologic outcomes comparable to those reported in contemporary single-port and multi-port robotic series, supporting the practicality and potential applicability in resource-limited settings.

The mean operative time was 215.8 minutes, slightly longer than the 161 minutes reported by Agarwal et al. (da Vinci SP)[15] and similar to the 210 minutes reported by Wang et al. (2025, da Vinci Xi). The longer operative time is probably due to the absence of a fourth robotic arm, additional setup time for the homemade glove port, and the expected learning curve associated with the modified technique. A slight decrease in operative time after the fifth case was observed, demonstrating improved efficiency and familiarity with the single-port configuration as experience accumulated.

The mean estimated blood loss was 200 mL, which is consistent within the range reported for single-port RARP. Chang, et al reported 100 mL using a transperitoneal da Vinci Si approach, while Wang et al. documented 50 mL in extraperitoneal single-site prostatectomy with extended lymph-node dissection. Although slightly higher, current finding confirms that single-port surgery, whether using a commercial or improvised system, allows meticulous dissection and reliable hemostasis under enhanced magnified visualization. Importantly, the simplified three-arm Si configuration did not increase bleeding risk compared with multi-port setups, emphasizing that surgical skill and surgeons' experience, rather than proprietary technology, are the primary determinants of intraoperative safety and hemostatic efficiency.

The mean hospital stay was 3.4 days, slightly longer than the one-day stay reported by Agarwal and Wilson but comparable to the 2.8 days described by Chang et al.[16] This difference likely reflects variations in discharge protocols, drain management, and the early learning phase of the technique. With growing familiarity and optimized perioperative coordination, hospital stays are expected to shorten, consistent with recovery trends reported in other single-port series.

All patients in this study achieved negative surgical margins, comparable to or better than the 8–10% positive-margin rates reported in prior single-port studies.[15,16] Although encouraging, this finding should be interpreted with caution, given the small sample size and limited follow-up. Nonetheless, it demonstrates that a well-executed, low-cost modification can maintain oncologic precision and completeness of resection without reliance on dedicated SP instrumentation.

Only one patient (10%) experienced a Clavien–Dindo II complication (back pain), and no major (≥ grade III) events occurred. This aligns with reported complication rates in single-port series (8% in Agarwal, et al, 0% in Wilson, et al[17]), affirming that the combination of a homemade

glove-port and a three-arm da Vinci Si system does not introduce additional procedural risk and can be safely applied in appropriate candidates.

Using a customized glove-port with a three-arm da Vinci Si configuration markedly reduces procedural cost without compromising safety or surgical quality. The glove-port made with an Alexis® wound protector (≈ USD 50) and a standard surgical glove costs under USD 60 in total, which is much cheaper than the USD 500–1,000 needed for commercial multi-channel ports or the USD 1,500–2,000 for proprietary da Vinci SP® kit access systems.[18] This configuration makes robotic prostatectomy more accessible, especially in facilities with limited resources, by reducing the number of instruments needed and doing away with the need for specialized SP equipment. Biebel et al.[18] reported that the average operating-room cost of da Vinci SP RALP was USD 3,100, which is a 36% increase per case compared to USD 2,271 for Xi RALP. The use of only three robotic arms in the current setup further reduced overall costs by eliminating the need for an additional robotic instrument and drape typically required in four-arm configurations.

Overall, this study illustrates that innovation does not need to be expensive. Through simple, thoughtful modification, using existing hardware and readily available materials, comparable surgical outcomes can be achieved at a fraction of the cost. This approach provides a practical and scalable solution for expanding access to robotic prostatectomy in developing healthcare environments, without compromising safety, precision, or oncologic efficacy.

Limitations

This study is limited by its small sample size (n = 10), single-surgeon and single-institution design, and short follow-up period, which preclude definitive conclusions about long-term functional and oncologic outcomes. Functional outcomes such as continence and sexual function were not included due to the short postoperative observation window and the study's focus on perioperative feasibility. Furthermore, the results were analyzed using descriptive statistics only, without inferential testing. While early outcomes are promising, larger multicenter prospective studies with longer follow-up are warranted to validate these findings, assess the learning curve, and evaluate functional recovery and quality-of-life outcomes.

Conclusion

The modified extraperitoneal single-port robotic-assisted radical prostatectomy (espRARP) using a three-arm da Vinci Si system and a homemade glove-port is a safe, feasible, and cost-effective alternative to conventional multi-port and proprietary single-port robotic systems. Despite its simplified design, the technique achieved comparable operative times, blood loss, hospital stay, complication rates, and oncologic outcomes to contemporary single-port series.

By using readily available materials, an Alexis® wound protector and standard surgical glove, this technique dramatically reduces costs while maintaining surgical precision. The findings highlight that technical innovation, surgical skill and efficiency can overcome technological limitations, making advanced robotic surgery more accessible to resource-limited healthcare systems. Further long-term studies with larger patient cohorts are recommended to confirm its oncologic durability and functional outcomes.

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ORIGINAL RESEARCH

Diagnosis and Treatment of Urologic Malignancies in the Philippines: A Multi-center Prospective Cohort Study (PUMA Study)

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Objective: To create a pilot urologic malignancy registry using demographic and clinical data of a cohort of patients newly diagnosed to have urologic malignancies in the year 2021.
Methods: This was a prospective cohort study conducted in four study sites: National Kidney and Transplant Institute, East Avenue Medical Center, UP-Philippine General Hospital and Batangas Medical Center.
Results: A total of 243 patients with newly diagnosed urologic cancers were enrolled. The median age was 61 years, with a wide range of 1 to 87 years. Most of the patients (81.47%) were male, while there were 45 females (18.52%) who had either urinary bladder, kidney or upper urothelial cancer. The most common type of malignancy was prostate cancer (34.57%), followed by kidney cancer (30.04%) and urinary bladder cancer (24.69%), consistent with the currently observed worldwide incidence. There were also 3 patients (1.23%) noted with multiple primaries. More than half of the patients (63.37%) received surgery as active treatment. After the two-year follow-up period, thirteen patients (5.35%) developed progressive disease, and 14 patients (5.76%) died.
Conclusion: This urologic cancer registry represents the first multi-center, investigator-initiated epidemiologic study of its kind in the Philippines. As a proof-of-concept (POC) project, it demonstrates the feasibility of establishing a national database capturing baseline data on the country's most common urologic malignancies.

Key words: Epidemiology, urologic cancers, hospital-based cancer registry

Introduction

A global shift from communicable to non-communicable disorders has been observed over the past few years, influenced by various factors, from improvements in technology and health care to different environmental exposures.[1,2] This is supported by the most recent data from the World Health Organization (WHO) showing that cardiovascular disease, followed by cancer, are the leading causes of death in 127 countries, including the Philippines.[1] Such observations have also been seen in the field of Urology, as malignancies involving the prostate, kidney and bladder have now ranked 5th, 16th and 18th, respectively, as causes of cancer morbidity and mortality worldwide.[2,3]

Urologic cancers, which arise within the urinary tract of men and women and reproductive

organs of men, include cancers of the bladder, kidney, penis, prostate, testes and ureter.[4] These are relatively common, with prostate cancer being the most commonly diagnosed urologic cancer, the 4th most commonly diagnosed cancer in the world, and the 5th most commonly diagnosed cancer in the Philippines (5.2% of all incident cancers).[5]

Urinary bladder and kidney cancer incidences are on the rise globally, being the 9th and 14th most commonly diagnosed cancer, respectively, in 2022, from 12th and 16th in 2020.[5,6]

In the local setting, Raymundo et al. reported that prostate cancer is the most common urologic malignancy in a tertiary hospital in the Philippines. This was followed by malignancies of the bladder and kidneys.[2] The Cancer CARE Registry and Research Philippines Hospital-Based Cancer Registry System (CARE PH HBCR), likewise reported in its 2023 Annual Report, 1,108 prostate and other male urogenital cancers which make up 5.0% of their total 21,816 new registrants for the year 2023.[7]

Although penile cancer, testicular cancer and upper tract urothelial cancer (UTUC) are relatively uncommon compared to other urologic cancers, their numbers are also rising. The 2018 penile cancer worldwide incidence of 0.80 per 100,000 person-years is predicted to increase by more than 56% by 2040, according to the Global Cancer Registries (GLOBOCAN) Cancer Tomorrow prediction tool.[8] The incidence of testicular cancer has been increasing over the last three to four decades, especially in the White population. Though in Southeast Asia, testicular cancer occurs in 0.9/100,000 of the population, similar to 0.5/100,000 cases seen in the Philippines.[9] The incidence of UTUC remains low at 1–3 cases/100,000 people/year, but it is also rising in many nations around the world.[10]

Analyzing the incidence of urological cancer may assist in its early detection and prevention as well as promote a better understanding of the urological cancer patterns in any country.[11] Current practitioners in Urologic Surgery, Nephrology, and Medical Oncology in the Philippines are guided by the National Cancer Comprehensive Network (NCCN) Guidelines[12] and the European Society of Medical Oncology (ESMO) Practice Guidelines.[13] There have been great advances in the diagnosis and treatment of urologic malignancies in the era of molecular medicine, targeted therapy, and immunotherapy, but there is heterogeneity in practice because of disparities in economic capability and healthcare provisions in a developing country like the Philippines. To date, local Clinical Practice Pathways or Clinical Practice Guidelines and Health Technology Assessments have not yet been created.

There is a need to gather baseline epidemiologic data on the diagnosis and treatment of urologic malignancies in the country. Incidence rate, stage upon diagnosis, treatment given, time to treatment, surgical morbidities, remission rates, relapse rates and overall survival data will reveal gaps in current diagnosis and management practices that will help prioritize programs and policies. This will ultimately result in the improvement of the quality of life and survival rates of patients with these common dreaded diseases. The benefits of this study will reach not just the individual patients diagnosed with urologic malignancies but will also help in the creation of clinical practice guidelines and lead to evidence-based public health policy and better healthcare for Filipino cancer patients.

This study aimed to determine the feasibility of creating a registry containing demographic and clinical data of a cohort of patients newly diagnosed to have urologic malignancies in the year 2021, as a proof-of-concept. Starting the registry in a subset of hospitals will allow for the observance and determination of best practices and optimal data flow, before eventually rolling out the registry on a nationwide scale.

Methods

Study Population

Patients newly diagnosed to have a urologic malignancy (based on a surgical pathology report or a letter of referral from an oncologist or urologist) or treated for a newly diagnosed urologic malignancy at the study site from 01 January 2021 to 31 December 2021 were included in the study. The study sites included were: National Kidney and Transplant Institute, Philippine General Hospital, East Avenue Medical Center, and Batangas Medical Center, which have training programs in Urology

recognized by the Philippine Society of Urologic Oncology (PSUO).

Research Design

This was a prospective cohort study. Clinical data was collected from the patients at baseline, then in 6-month intervals or whenever there was a status change, until the study ended in 2023, or the death of the patient, whichever came first. No other procedures were done on the participants aside from procedures decided by their attending physicians on their standard-of-care visits.

Data Collection and Monitoring

Case Identification

All cases with urologic malignancies registered with new patient identification numbers (PIN) in the 2021 Hospital Cancer Registry of the participating hospitals, and 2021 census of the Department of Surgery or Division of Urology were included in the study masterlist. Logbooks of patients seen in the radiation, chemotherapy units, and surgery suites of the hospitals, as well as surgical pathology logbooks, were also reviewed. Each patient was assigned a non-identifiable study identification (ID) number.

Data Collection and Data Collection Instruments

A new record for each patient using only the study ID number containing de-identified patient data (demographic information, details of diagnosis and treatment) was created through an electronic data collection form (eDCF) RedCap, a web application for building and managing online surveys and databases developed by Vanderbilt University. The database is hosted on secure servers, and accessible only to trained and Good Clinical Practice (GCP) certified site clinical personnel.

The clinical status and outcomes of patients were monitored for 2 years, until the end of 2023. Follow-up data were recorded through chart review by noting patient status at six-month intervals from date of diagnosis. Any status change/s in between set intervals were also recorded.

Ethical Considerations

This study involved the gathering of data from human participants which were first de-identified before analysis. It was approved by all concerned hospital Ethics Boards, and conducted in compliance with the National Ethical Guidelines for Health and Health-Related Research (NEGHHRR) on the ethical conduct of clinical research.

Results

A total of 243 patients with newly diagnosed urologic cancers were enrolled from four study sites. The median age was 61 years, with a wide range of 1 to 87 years. Most of the patients (81.47%) were male, while there were 45 females (18.52%) who had either bladder, kidney or upper urothelial cancer. Table 1 shows the proportion of patients identified according to type of malignancy stratified according to sex and age.

The most common type of malignancy was prostate cancer (34.57%), followed by kidney cancer (30.04%) and bladder cancer (24.69%), consistent with the currently observed worldwide incidence.[5] There were 3 patients (1.23%) noted with multiple primaries.

More than half of the patients (63.37%) received surgery as active treatment.

After the two-year follow-up period, thirteen patients (5.35%) developed progressive disease, and 14 patients (5.76%) died. The rest of the treatment outcomes of the patients are shown in tables 2 and 3.

Table 2 shows the disease characteristics of patients with urologic cancers specific to males, which includes prostate, testicular and penile cancers. Patients with cancer with multiple primaries are also included as they all had prostate and bladder cancers. The table shows the percentage of those diagnosed with the specific cancers, the most common histologic subtypes, laterality, staging details, treatments received and patient response, as well as disease outcomes.

Prostate cancer, the most common type of cancer among patients enrolled, is noted to have a middle-aged to elderly patient population, with a median age of 66 years (range 46-83 years). More than a quarter of patients presented with high risk

Table 1. Age and sex of patients according to type of malignancy. (N 243)

Malignancy Type	n	% of total	Age in years (Median, Min-Max)	Males	%Males	Females	%Females
Prostate	84	34.57%	66 (46-83)	84	100.00%	N/A	N/A
Kidney	73	30.04%	56 (1-78)	51	69.86%	22	30.14%
Urinary bladder	60	24.69%	62.5 (30-87)	40	66.67%	20	33.33%
Testicular	13	5.35%	33 (18-48)	13	100.00%	N/A	N/A
Penile	6	2.47%	51 (29-68)	6	100.00%	N/A	N/A
Upper urothelial	4	1.65%	64 (59-74)	1	25.00%	3	75.00%
Multiple primaries	3	1.23%	69 (63-74)	3	100.00%	0	0.00%
TOTAL	243	100.00%	61 (1-87)	198	81.47%	45	18.52%

Table 2. Disease characteristics of patients with male-specific urologic cancers.

Characteristic	Prostate	Testicular	Penile	Multiple Primaries
Count	84 (34.57%)	13 (5.35%)	6 (2.47%)	3 (1.23%)
Histologic Subtype	Adenocarcinoma – 49 (58.33%) Acinar adenocarcinoma - 31 (36.90%) Atypical small cell acinar - 1 (1.19%)	Seminoma – 7 (53.85%) Yolk Sac Tumor – 3 (23.08%) Mixed Germ Cell Tumor – 2 (15.35%)	Squamous cell carcinoma – 5 (83.33%) Verrucous carcinoma – 1 (16.67%)	Papillary urothelial carcinoma and Acinar adenocarcinoma – 3 (100.00%)
Laterality				
Left	-	5 (38.46%)	-	-
Right	-	6 (46.15%)	-	-
Bilateral	-	1 (7.69%)	-	-
No data	-	1 (7.69%)	-	-
TNM Staging Clinical				
Stage I	5 (5.95%)	3 (23.08%)	2 (33.33%)	0 (0.00%)
Stage II	16 (19.05%)	2 (15.38%)	2 (33.33%)	1 (33.33%)
Stage III	6 (7.14%)	5 (38.46%)	0 (0.00%)	1 (33.33%)
Stage IV	23 (27.38%)	0 (0.00%)	2 (33.33%)	0 (0.00%)
No data	34 (40.48%)	3 (23.08%)	0 (0.00%)	1 (33.33%)
TNM Staging Pathologic				
Stage I	5 (5.95%)	-	2 (33.33%)	-
Stage II	1 (1.19%)	-	2 (33.33%)	-
Stage III	5 (5.95%)	-	0 (0.00%)	-
Stage IV	11 (13.10%)	-	2 (33.33%)	-
No data	62 (73.81%)	-	0 (0.00%)	-

Treatment Received				
Surgery	46 (54.76%)	11 (84.62%)	5 (83.33%)	2 (66.67%)
Chemotherapy	9 (10.71%)	3 (23.08%)	1 (16.67%)	1 (33.33%)
Radiotherapy	8 (9.52%)	0 (0.00%)	1 (16.67%)	0 (0.00%)
Treatment Response				
Progressive Disease/Tumor Recurrence	2 (2.38%)	-	1 (16.67%)	2 (66.67%)
No data	-	-	-	-
Outcome				
Alive	16 (19.05%)	1 (7.69%)	1 (16.67%)	0 (0.00%)
Dead	5 (5.95%)	2 (15.38%)	0 (0.00%)	0 (0.00%)
Lost to Follow-Up	63 (75.00%)	10 (76.92%)	5 (16.67%)	3 (100.00%)

and advanced disease at diagnosis, as twenty-three patients (27.38%) were placed in the higher risk groups following the National Comprehensive Cancer Network (NCCN) risk stratification, and 23 patients (27.38%) had stage IVB cancer following the TNM clinical staging. Forty-six (54.76%) patients underwent surgery, of which radical prostatectomy was the most common (29.76%); and fifteen patients (17.86%) underwent androgen-deprivation therapy.

Meanwhile, testicular cancer was noted to be more common in the younger age group with the median age at diagnosis at 33 years (range 18-48 years). Most of the patients were also diagnosed at a later stage (38.46%). A total of 11 (84.62%) patients underwent surgery, of which radical orchiectomy was the most common (69.23%).

Penile cancer proved to be one of the rarer types, comprising only 2.47% of the study population. The median age at diagnosis is 51 years with a wide range of 29-68 years. The most common location of the tumor is the glans penis (66.67%), with most of the patients diagnosed at an earlier stage (66.67%). Five (83.33%) patients underwent partial penectomy.

Rarer still are cancers with multiple primaries, which only comprised 1.23% of the study population. The median age at diagnosis was older at 69 years (range 63-74 years). Interestingly, all patients had both bladder and prostate cancer, with papillary urothelial carcinoma and acinar adenocarcinoma as histologic subtypes, respectively. Staging was varied with all three patients diagnosed with both primaries at different stages.

All patients underwent surgery, either radical cystectomy or transurethral resection of the bladder tumor. This type of cancer showed a high proportion of disease progression, with 2 out of 3 patients (66.67%) noted to have tumor recurrence.

Table 3 shows the disease characteristics of patients with urologic cancers which can affect both males and females, including kidney, bladder and upper tract urothelial cancers. It shows the percentage of those diagnosed with the specific cancers, the most common histologic subtypes, laterality, staging details, treatments received and patient response, as well as disease outcomes.

Kidney cancer is the second most commonly diagnosed type of cancer among the study population, comprising mostly males (69.86%), with the median age at diagnosis at 56 years (range 1-78 years). The most common histologic subtype is clear cell renal cell carcinoma (68.49%), and all the patients had unilateral disease, with more than half of them developing cancer in the left kidney (57.53%). Most of the patients were diagnosed at an early stage (36.99%). A total of 68 (93.15%) patients underwent surgery, of which radical nephrectomy was the most common.

Bladder cancer is mostly noted among males (66.67%), with the median age at diagnosis at 62.5 years (range 30-87 years). The most common histologic subtype is urothelial cancer (68.33%), and most of the patients were diagnosed at an early stage (60.00%). A total of 17 (28.33%) patients underwent muscle-invasive therapy.

Upper urothelial cancer patients were mostly female (75.00%), with the median age at diagnosis

Table 3. Disease characteristics of patients with urologic cancers affecting both sexes.

Characteristic	Kidney	Bladder	Upper Tract Urothelial
Count	73 (30.04%)	60 (24.69%)	4 (1.65%)
Sex			
Male	51 (69.86%)	40 (66.67%)	1 (25.00%)
Female	22 (30.14%)	20 (33.33%)	3 (75.00%)
Histologic Subtype	Clear cell renal cell carcinoma – 50 (68.49%) Papillary renal cell carcinoma – 4 (5.48%) Chromophobe renal cell carcinoma – 3 (4.11%)	Urothelial cancer – 41 (68.33%) Adenocarcinoma – 8 (13.33%) Squamous cell carcinoma – 2 (3.33%)	Urothelial cancer – 4 (100.00%)
Laterality			
Left	42 (57.53%)	-	3 (75.00%)
Right	31 (42.47%)	-	1 (25.00%)
Bilateral	0 (0.00%)	-	0 (0.00%)
No data	0 (0.00%)	-	0 (0.00%)
TNM Staging Clinical			
Stage 0	-	4 (6.67%)	-
Stage I	27 (36.99%)	14 (23.33%)	1 (25.00%)
Stage II	16 (21.92%)	18 (30.00%)	1 (25.00%)
Stage III	17 (23.29%)	5 (8.33%)	2 (50.00%)
Stage IV	8 (10.96%)	8 (13.33%)	0 (0.00%)
No data	5 (6.85%)	11 (18.33%)	0 (0.00%)
TNM Staging Pathologic			
Stage 0	-	4 (6.67%)	-
Stage I	30 (41.09%)	11 (18.33%)	0 (0.00%)
Stage II	9 (12.33%)	14 (23.33%)	1 (25.00%)
Stage III	24 (32.88%)	5 (8.33%)	3 (75.00%)
Stage IV	5 (6.85%)	11 (18.33%)	0 (0.00%)
No data	5 (6.85%)	15 (25.00%)	0 (0.00%)
Treatment Received			
Surgery	71 (97.26%)	17 (28.33%)*	4 (100.00%)
Chemotherapy	5 (6.85%)	13 (21.67%)	0 (0.00%)
Radiotherapy	0 (0.00%)	2 (3.33%)	0 (0.00%)
Treatment Response			
Progressive Disease/Tumor Recurrence	2 (2.74%)	6 (10.00%)	-
No data	-	-	-
Outcome			
Alive	3 (4.11%)	8 (13.33%)	0 (0.00%)
Dead	4 (5.48%)	3 (5.00%)	0 (0.00%)
Lost to Follow-Up	66 (90.41%)	49 (81.67%)	4 (100.00%)

**Muscle-invasive therapy*

at 64 years (range 59-74 years). Most of the patients had advanced disease (75.00%), and all four patients underwent surgery, either radical nephrectomy or radical nephroureterectomy. Unfortunately, all four patients were lost to follow-up so the study was unable to elucidate their outcomes.

Discussion

Key findings show that urologic cancer incidence in the Philippines follows worldwide trends with prostate, kidney and bladder cancers as the top 3 most common types. Although other types are relatively rarer, proper attention should still be given to these types, especially testicular cancer that has the youngest median age of 33 years. On the other hand, multiple primaries (comprising of bladder and prostate cancer) have the oldest median age of 69 years. It should be noted that most patients with bladder, prostate, and kidney cancer are older adults, while testicular cancer affects much younger males.

Additionally, among urologic cancers that affect both men and women, bladder and kidney cancers are significantly more common in men, accounting for about 65–70% of cases. In contrast, upper urothelial cancer predominantly affects women, making up approximately 75% of cases.

Certain malignancies tended to be diagnosed at advanced stages. For example, around 27% of prostate cancer cases were clinically identified at stage IVB, while more than half of the upper urothelial cancer cases presented at stage III. These findings highlight the need for improved screening and surveillance strategies for these types of cancer.

A significant limitation of the study is the high rate of patients lost to follow-up across all groups, exceeding 75% of the population. This greatly hinders the ability to assess outcomes and plan for long-term care. Among the cases with available data, bladder and penile cancers had the highest proportion of surviving patients, while testicular cancer showed the highest recorded mortality rate. This could reflect late presentation, aggressive disease or data limitations. Prostate and kidney cancers had relatively low death rates (less than 10% each) and moderate survival, though interpretation remains limited by incomplete follow-up. Notably, all patients with upper urothelial cancer were lost to follow-up, preventing any assessment of outcomes for this group. These findings emphasize the need for improved patient tracking to enable more accurate survival analysis.

Despite this, the available data suggest low rates of disease progression or recurrence overall. Bladder cancer showed the highest recurrence rate at 10%, while prostate, kidney and penile cancers had relatively low recurrence rates of approximately 2–3%.

Benefits of Patient Registries

Registries are essential tools in epidemiologic research. In fact, the number of registry-based publications has grown significantly in the last five years. This rise is likely due to both the growing number of registries and an improved understanding of their value, as evidenced by their increasing presence in major publications.[14] Registry data provide important insights into real-world health issues by offering information on incidence, prevalence, outcomes, prognostic factors, confounding variables and other clinically relevant factors. As such, registry data can help streamline focus of clinical guidelines and health policies.

One of the greatest advantages of registries is their ability to include and track large numbers of patients, making them especially effective for observational research. This stands in contrast to randomized controlled trials (RCTs), which often struggle with small sample sizes and require years of multi-center recruitment to gather enough participants. Another key benefit of registries is their cost-effectiveness. Registry-based data collection is significantly less expensive than conducting clinical trials, particularly in the case of rare cancers, where multiple sites are needed to recruit only a few patients at each location to achieve an adequate sample size.

Registries are valuable tools for quality improvement, offering feedback and benchmarking to clinicians, hospitals and healthcare organizations. This urologic cancer registry can play a key role in identifying gaps in patient care, guiding public health priorities, and serving as a rich resource for further research. Ultimately, it offers long-term value by contributing to improved care and

outcomes for patients with urologic cancers. Patient registries have been particularly successful in managing urologic cancers like prostate cancer and are capable of monitoring outcomes across large patient populations.[15]

Limitations

By the end of the study period, a total of 243 patients were enrolled, which is notably lower than the 1,108 cases of prostate and other urogenital cancers reported by the 27 contributing hospitals of the Cancer CARE Registry and Research Philippines Hospital-Based Cancer Registry (CARE PH HBCR) in its 2023 Annual Report.[17] It's important to consider that the COVID-19 pandemic was still ongoing during this time, which may have affected patients' health-seeking behaviors and contributed to the lower enrollment numbers. There was also a high rate of patients lost to follow-up which limited the understanding of outcomes.

The quality of a registry depends heavily on the accuracy and consistency of the data entered. Ideally, data should be collected by specially-trained professionals, as variation in the experience or background of data collectors can introduce bias into the dataset. Incomplete data is a widespread challenge regardless of the collection method, and poor follow-up or documentation can result in missing key events or outcomes—such as adverse events—which are then excluded from analysis. Additionally, data in registries are often collected opportunistically during healthcare interactions, not on a pre-determined schedule like in a randomized controlled trial (RCT). Crucial data on important outcomes may be missed or not recorded.

Future Directions

To maximize the impact of this disease registry, several key enhancements are necessary. Foremost is the improvement of follow-up tracking systems as the high rates of patients lost to follow-up poses a major barrier to accurate survival analysis and effective long-term care planning. Standardization of documentation is also critical as this ensures consistent recording of staging and treatment details, especially in prostate cancer, where nearly 50% of cases lacked risk stratification data. Developing integrated care pathways is essential to support coordinated management strategies, including surgical and chemotherapeutic interventions particularly for prostate and bladder cancers. Additionally, implementing robust protocols for tracking recurrence is vital.

Taken together, these improvements will enhance the registry's effectiveness and contribute to more informed care strategies and improved outcomes for patients with urologic cancers.

Conclusion

This urologic cancer registry represents the first multi-center, investigator-initiated epidemiologic study of its kind in the Philippines. As a proof-of-concept (POC) project, it demonstrates the feasibility of establishing a national database capturing baseline data on the country's most common urologic malignancies.

Building and maintaining a disease-specific registry remains a significant challenge for healthcare professionals and researchers. This current study's team faced similar obstacles in launching this pioneering effort. The study revealed critical gaps in patient care, particularly in the documentation of staging, treatment and follow-up—a reflection of the real-world limitations in current clinical practice.

Moving forward, the next phase involves leveraging advances in information technology to integrate cancer registries with hospital electronic medical records (EMRs). This sets the stage for applying data science and artificial intelligence (AI) to enhance early and accurate diagnosis, improve survival rates, and elevate the quality of life for patients with these cancers.

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ORIGINAL RESEARCH

The Use of Artificial Intelligence Machine Learning Models to Predict Stone-Free Status After Percutaneous Nephrolithotomy: A Meta-Analysis

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Objective: This meta-analysis aimed to evaluate the diagnostic capability of machine learning (ML) models in predicting stone-free status following percutaneous nephrolithotomy (PCNL).
Methods: A comprehensive literature search was conducted across MEDLINE, Embase, Scopus, Cochrane, Google Scholar and supplementary databases was undertaken until June 2023. Inclusion criteria were English publications assessing the sensitivity and specificity of ML in predicting post-PCNL stone-free status. Studies on non-human subjects or with incomplete data sets were excluded. Quality assessment utilized the Cochrane Risk of Bias Tool. Pooled sensitivity, specificity, and other diagnostic metrics were calculated using Meta-Disc 1.4 software.
Results: Of the 65 initial articles, 5 met the inclusion criteria, representing a total of 1,773 participants. The accuracy of ML models ranged from 44% to 94.8%. The pooled sensitivity and specificity were 0.60 (95% CI [0.57, 0.63]) and 0.87 (95% CI [0.84, 0.89]), respectively. The pooled positive likelihood ratio was 4.69 (95% CI [3.82, 5.77]) and the negative likelihood ratio was 0.45 (95% CI [0.41, 0.48]). The diagnostic odds ratio was 10.93 (95% CI [8.35, 14.33]). The area under the curve (AUC) stood at 0.9372, signifying an excellent diagnostic performance.
Conclusion: Machine learning models demonstrate significant potential in accurately predicting stone-free status post-PCNL. However, the small number of included studies, retrospective designs, and heterogeneity in ML approaches limit generalizability. Standardized definitions, larger multicenter datasets, and prospective validation are required before routine clinical adoption.

Key words: Machine learning, percutaneous nephrolithotomy, stone-free status, diagnostic capability, meta-analysis.

Introduction

Urolithiasis remains one of the most prevalent urologic disorders worldwide, with an estimated lifetime incidence ranging from 1.7% to 14.8%.[1,2] It is more common among males and continues to rise globally, imposing a significant socioeconomic and quality-of-life burden.[3,4] Technological innovations have transformed the management of renal calculi, shifting from open surgery toward minimally invasive procedures such as extracorporeal shock wave lithotripsy (ESWL), retrograde intrarenal surgery (RIRS) and percutaneous nephrolithotomy (PCNL).[1,3,5] PCNL remains the standard of care for renal stones ≥20 mm, offering high clearance rates while preserving renal function.[4]

Predicting postoperative stone-free status (SFS) after PCNL is crucial for clinical decision-

making, patient counseling, and optimizing surgical outcomes. Several conventional scoring systems, such as Guy's Stone Score, the Clinical Research Office of the Endourological Society (CROES) nomogram, and the S.T.O.N.E. nephrolithometry score, have been developed to estimate stone-free outcomes.[5-7] However, these tools are limited by their reliance on a fixed set of variables, subjective grading, and an assumption of linear relationships among predictors. They may fail to capture the complex, nonlinear interactions between patient demographics, stone characteristics and intraoperative parameters that influence surgical success.[5-7]

Artificial Intelligence (AI) refers to any computer technology that examines intricate patterns and solves complex problems by imitating human cognitive functions, such as thinking, learning and problem solving. Machine learning (ML) is a subtype of AI that analyzes and understands complex patterns using data-driven dynamic algorithms and semi-automatically improves its analysis.[4-6] Training data sets are used to create algorithms for rapid identification of complex patterns and relationships of future data.[4,6] Deep learning (DL), a variant of ML artificial neural network (ANN), is patterned on the function and structure of the human brain, wherein artificial neurons are arranged and are interconnected in complex architectural layers.[2,5] It uses computer vision in conjunction with DL algorithms to examine medical images. It provides precise and reliable anatomical models for operational support, and predicts outcomes and success rates of treatment when used alongside computed tomography (CT) images. It aids medical practitioners in decision making, thereby decreasing iatrogenic errors.[2] In recent years, AI has been in the forefront of medical diagnostics and analytics research; and image-based diagnostic systems have been developed for many medical specialties.[1]

In the field of urology, there has been increasing use of ML in predicting the outcome of renal calculi following ESWL and PCNL. However, there are only a few studies looking into the sensitivity and specificity in the application of urologic condition. Thus, this study aimed to determine the diagnostic characteristic of ML in predicting stone-free status after PCNL.

Methods

A comprehensive literature search was conducted across MEDLINE, Embase, Scopus, Cochrane, Google Scholar and supplementary databases was undertaken until June 2023. To enhance comprehensiveness, additional databases and gray literature sources were explored. The MeSH terms used for the search included: [[artificial intelligence] OR [machine learning] OR AI OR [deep learning] OR [neural network]] AND [[urinary calculi] OR [kidney calculi] OR [renal calculi] OR urolithiasis OR renal OR ureteric OR stones] AND [percutaneous nephrolithotomy] OR nephrolithotomy. Supplementary studies were identified through manual scanning of reference lists from relevant articles.

Inclusion Criteria:
- Published in English.
- Assessed the sensitivity and specificity of ML in predicting stone-free status after PCNL.

Exclusion criteria encompassed:
- Studies on non-human subjects.
- Studies with incomplete data sets.

All the identified articles were screened for eligibility by three independent researchers (RHK, EIL, KMT). The PRISMA flowchart was adopted to map out the study selection process, ensuring transparency and replicability. In cases of disagreement between reviewers, consensus was reached through a majority vote.

A standardized form was used for data extraction. This form included key variables such as study design, sample size, ML model used, sensitivity, specificity, positive and negative likelihood ratios, diagnostic odds ratio, and any other relevant metrics. When data were not explicitly mentioned, they were derived and computed based on available information.

The quality and risk of bias for each study were assessed using the Cochrane Risk of Bias Tool. Elements of assessment included selection bias, performance bias, detection bias, attrition bias and reporting bias. Studies were classified as having low, unclear, or high risk of bias.

Heterogeneity among the studies was evaluated using the I^2 statistics. Studies with an I^2 value

over 60% were considered to have substantial heterogeneity, and in such cases, the DerSimonian Laird's random effects model was applied. A sensitivity analysis was also undertaken, and the rationale for excluding specific studies, such as that by Geraghty et al., was explicitly documented.

Several ML models were detailed and analyzed:

1. **Artificial Neural Network (ANN)**: This emulates interconnected neural synapses and networks, akin to the human brain. Its mechanism and parameters, including the number of neurons in the input layer and output calculation method, were outlined.
2. **Support Vector Machine (SVM)**: A widely applied supervised learning model for regression and classification, its cross-validation process and training phase were highlighted.
3. **Other Models**: Additional models used in the studies, like logistic regression, sequential forward selection (SFS), Fisher discriminant analysis (FDA), quadratic discriminant analysis (QDA), K-nearest NEIGHBORS (KNN), multilayer perceptron neural network (MLPNN), and random forest (RF) were described with specific references to their core mechanics, algorithms and applications in the context of the research.

Meta-Disc 1.4 software was employed for statistical analysis. Pooled sensitivity, specificity, positive and negative likelihood ratio, and diagnostic odds ratio were calculated, and a random effects model was employed in the presence of high heterogeneity.

Results

Initial literature search found 63 articles screened for this study. Ten additional articles were identified through cross-referencing and review of bibliography of the included articles. Eight duplicate articles were identified and removed, leaving 65 articles. A review of the abstracts of each articles was done, and 59 articles failed to meet the inclusion criteria. Of the 6 articles that underwent full text review, 1 article was excluded due to incomplete data for analysis. Overall, there were a total of five articles that were included for analysis.[7-11] The PRISMA flow diagram of literature search is shown in Figure 1. To ensure the quality of each included article, a risk of bias analysis of all the included articles was done. All included articles had low risk of bias (Figure 2).

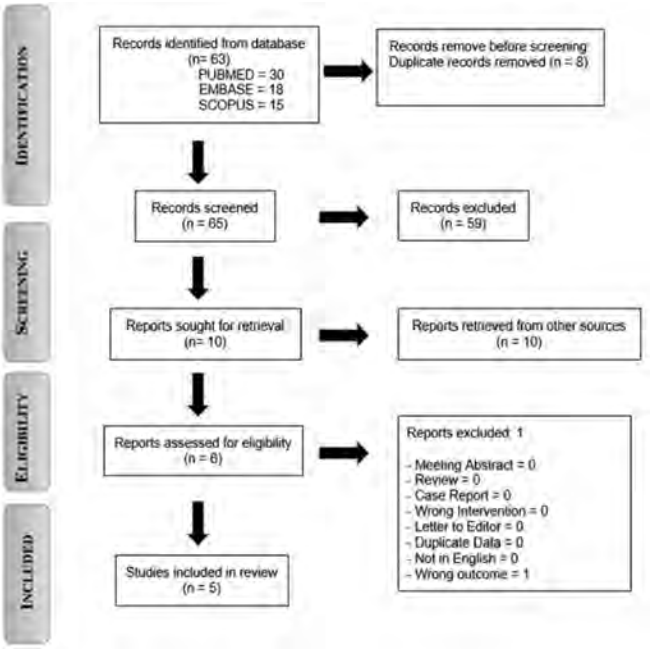

Figure 1. PRISMA flow diagram of literature search.

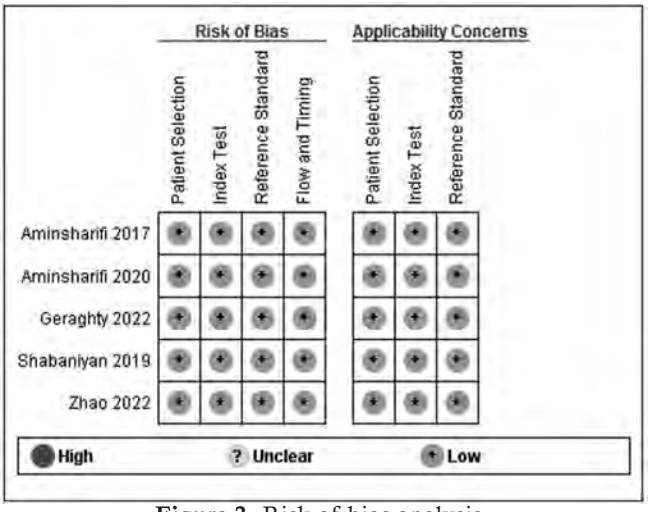

Figure 2. Risk of bias analysis.

The details of each included study are summarized in Table 1. There were a pooled total of 1,773 participants in this metaanalysis, with mean age between 40 and 50 years old. Various

ML algorithms were used, including artificial neural networks (ANN), support vector machines (SVM), random forest (RF), extreme gradient boosting (XGBoost), and logistic regression models. Validation approaches varied, with most studies performing internal cross-validation. Only the study by Aminsharifi et al. (2020) conducted external validation using an independent dataset to compare its ML model against Guy's Stone Score and the CROES nomogram. Definitions of stone-free status (SFS) varied considerably across studies. Some defined SFS using non-contrast CT scans, whereas others relied on plain KUB radiography or ultrasound, with follow-up intervals ranging from immediate postoperative imaging to six weeks after surgery. This inconsistency in imaging modality and timing likely contributed to the observed heterogeneity in pooled diagnostic estimates. Table 2 shows the summary of diagnostic testing of the included studies. The accuracy of the ML model ranges from 44% to 94.8%. The sensitivity varies from 0% to 100%, while specificity varies from 21% to 100%. The positive predictive value (PPV) and negative predictive value (NPV) ranges from 0% to 97.3% and 31.2% to 100%, respectively. The false positive rate (FPR) varies from 0% to 78.6%. Lastly, the area under the curve (AUC) ranges from 0.50 to 0.915.

Table 1. Summary of included studies.

Study	ML models	N	Mean age (years)	Mean stone size (mm)	No. stone free status
Artificial neural network system to predict the postoperative outcome of percutaneous nephrolithotomy A. Aminsharifi et al. (2017)	ANN	254	46.64 ± 12.16	21.587 ± 9.09	194
Predicting the postoperative outcome of percutaneous nephrolithotomy with machine learning system: Software validation and comparative analysis with Guy's stone score and the CROES nomogram A. Aminsharifi et al. (2020)	SVM	146	49.3 ± 12.6	451.2 ± 427.8	106
Use of internally validated and deep learning models to predict outcomes of percutaneous nephrolithotomy using data from the BAUS PCNL audit R. Geraghty et al. (2022)	1. LR 2 .RF 3. XGBoost 4. BGLM 5. Partitioning 6. Neural networks	778	56.5 ± 19.4	Not stated	535
An artificial intelligence-based clinical decision support system for large kidney stone treatment T. Shabaniyan et al. (2019)	1. SFS 2. FDA a. QDA b. KNN c. MLP d. SVM	254	46.6 ± 12.2	21.587 ± 9.09	194
Predicting the stone-free status of percutaneous nephrolithotomy with the machine learning system: comparative analysis with Guy's stone score and the S.T.O.N.E score system H. Zhao et al. (2022)	1. Lasso logistic 2. RF 3. SVM 4. Naïve Bayes	222	54.81 ± 13.31	Not stated	111
Legend: machine learning (ML), artificial neural network (ANN), support vector model (SVM), logistic regression (LR), random forest (RF), extreme gradient boosting (XGBoost), Bayesian generalized linear model (BGLM), partitioning, sequential forward selection (SFS), Fisher discriminant approach (FDA), Quadratic discriminant analysis (QDA), K-nearest NEIGHBORS (KNN), Multilayer perception neural network (MLP)					

Table 2. Summary of diagnostic testing of included studies.

Study/ ML model	Accuracy	Sensitivity	Specificity	PPV	NPV	FPR	AUC
Aminsharifi 2017							
ANN	82.8%	83%	81%	83%	81%	19%	0.861
Aminsharifi 2020							
SVM	91.8%	92%	88.9%	95%	83.3%	11%	0.915
Geraghty 2022							
RF	70%	0%	100%	0%	31.2%	0%	0.69
Partitioning	70%	0%	100%	0%	31.2%	0%	0.55
XGBoost	65%	20%	87%	77.2%	33.1%	13.2%	0.70
LR	62%	30%	78%	75%	33.6%	21.8%	0.61
Neural network	70%	0%	100%	0%	31.2%	0%	0.50
BGLM	69%	30%	88%	84.6%	36.4%	11.9%	0.67
Deep neural network (single otcome)	59%	43%	78%	81,1%	38.3%	21.8%	0.62
Deep neural network (multiple outcome)	44%	92%	21%	71.9%	54.4%	78.6%	0.60
Shabaniyan 2019							
QDA_SFS	70.3%	71.1%	69.5%	88.3%	42.7%	30%	
QDA_SFSFDA	78%	72.3%	84.7%	93.9%	48.6%	15%	
KNN_SFS	73.5%	80.7%	65.3%	88.3%	51.1%	35%	
KNN_SFSFDA	79.4%	85.6%	72.3%	90.9%	60.8%	28.3%	Not stated
MLP_SFS	63.9%	71.1%	55.6%	83.8%	37.3%	45%	
MLP_SFSFDA	75.5%	81.9%	68.1%	89.3%	53.8%	31.7%	
SVM_SFS	92.3%	92.7%	91.6%	97.3%	79.5%	8.3%	
SVM_SFSFDA	94.8%	100%	88.9%	96.7%	100%	11.7%	
Zhao 2022							
Lasso logistic	81.81%	75.76%	87.77%	86.1%	78.36%	12.61%	0.879
RF	80.3%	75.76%	84.85%	83.34%	77.78%	15.32%	0.803
SVM	81.82%	75.76%	87.88%	86.21%	78.38%	11.71%	0.818
Naïve Bayes	80.3%	83.33%	77.78%	78.95%	82.35%	22.52%	0.803
Rami AlAzab 2023							0.761
Predicting the Stone-Free	0.74						0.769
Status of Percutaneous	0.72	Not stated	Not stated	Not	Not	Not	0.751
Nephrolithotomy with the	0.74			stated	stated	stated	0.666
Machine Learning System							0.71
Zeeshan Hameed 2021							
With MRMR treatment extracting top 3 features		96%		60 %			
With MRMR treatment extracting top 5 features	81%	84%	Not Stated	60 %	Not Stated	Not Stated	LDA 0.81 MRMR 0.64
With MRMR treatment extracting top 10 features		68%		60 %			

Legend: machine learning (ML), positive predictive value (PPV), negative predictive value (NPV), false positive rate (FPR), area under the curve (AUC), artificial neural network (ANN), support vector model (SVM), logistic regression (LR), random forest (RF), extreme gradient boosting (XGBoost), Bayesian generalized linear model (BGLM), partitioning, sequential forward selection (SFS), Fisher discriminant approach (FDA), Quadratic discriminant analysis (QDA), K-nearest NEIGHBORS (KNN), Multilayer perception neural network (MLP)

Overall, ML is an excellent diagnostic tool capable of predicting stone-free status after PCNL, with a pooled sensitivity of 0.60, 95% CI [0.57, 0.63], pooled specificity of 0.87, 95% CI [0.84, 0.89], pooled positive likelihood ratio of 4.69, 95% CI [3.82, 5.77], pooled negative likelihood ratio of 0.45, 95% CI [0.41, 0.48], and pooled diagnostic odds ratio of 10.93, 95% CI [8.35, 14.33] (Figures 3-7). The SROC curve for the diagnostic performance of ML in predicting stone-free status after PCNL is shown in Figure 8. The size of the circle represents the sample size of the study and its location represent the different sensitivity and specificity of ML in the included studies. The area under the curve (AUC) is 0.9372.

Moderate heterogeneity was observed across studies ($I^2 > 60\%$), likely due to differences in datasets, model architectures, and SFS definitions.

Sensitivity analysis excluding the outlier study by Geraghty et al., which included multiple models with very low sensitivities, increased the pooled sensitivity to 0.86 (95% CI: 0.83–0.89) without significantly altering specificity. (Figure 9)

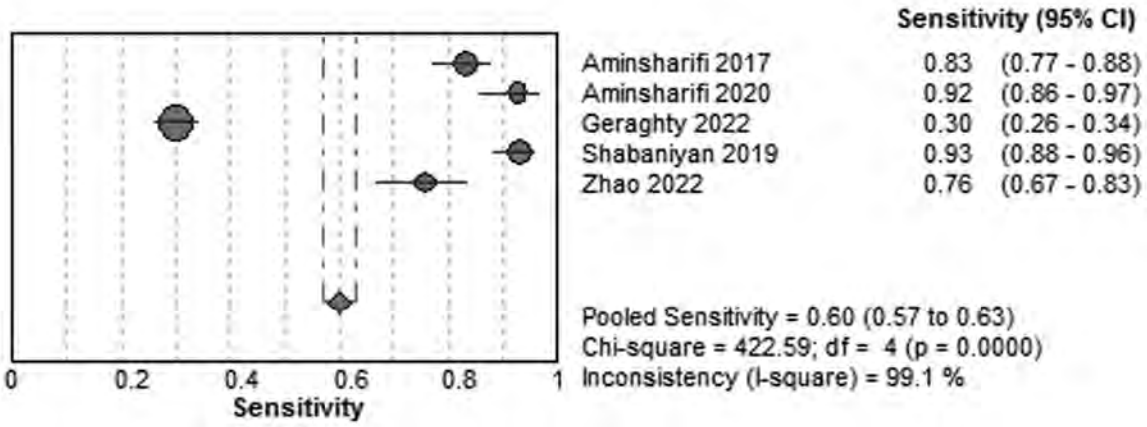

Figure 3. Pooled sensitivity of ML in predicting stone-free status after PCNL.

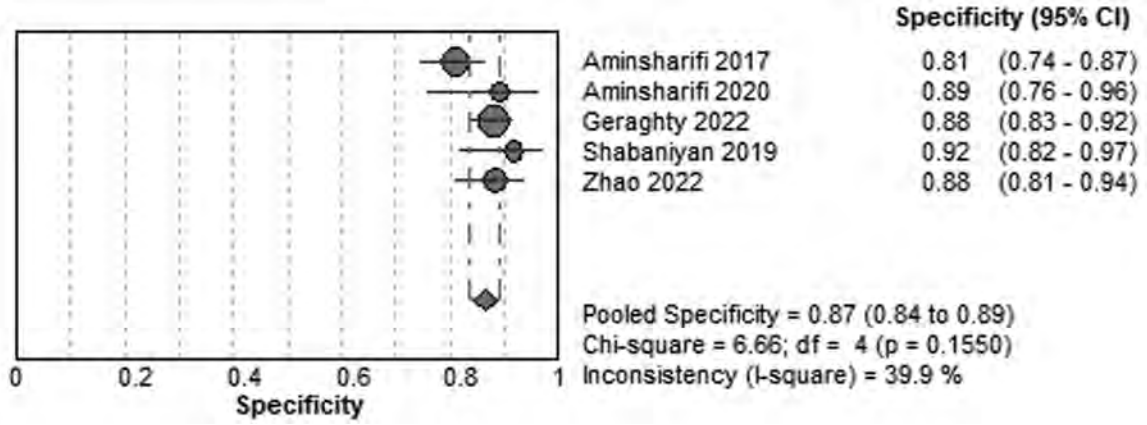

Figure 4. Pooled specificity of ML in predicting stone-free status after PCNL.

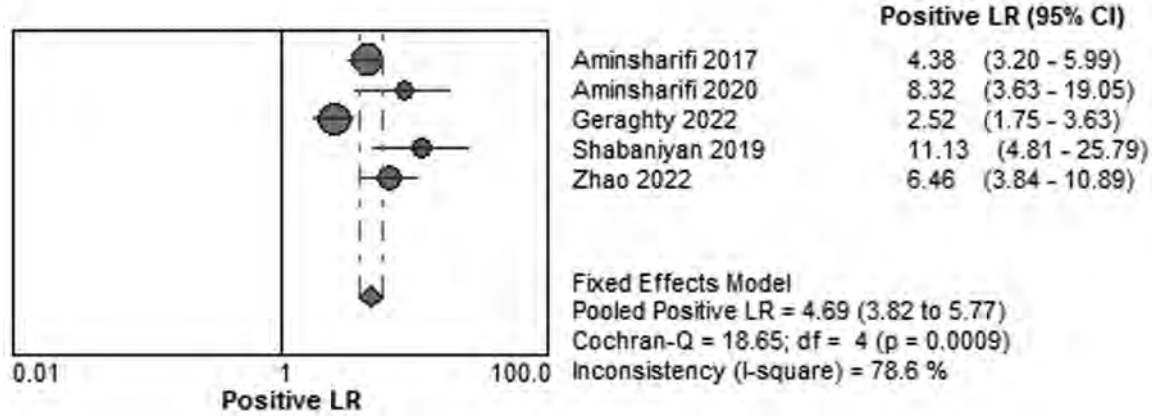

Figure 5. Pooled positive likelihood ratio of ML in predicting stone-free status after PCNL.

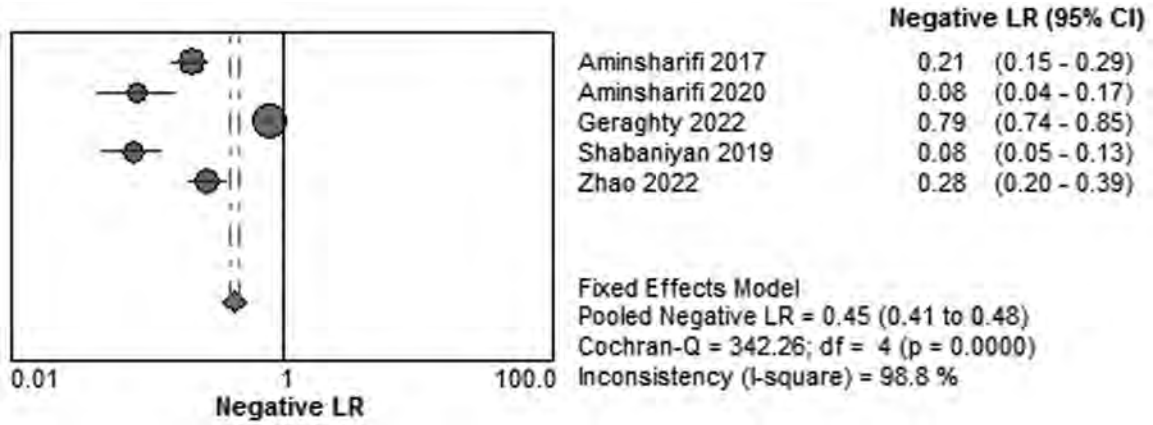

Figure 6. Pooled negative likelihood ratio of ML in predicting stone-free status after PCNL.

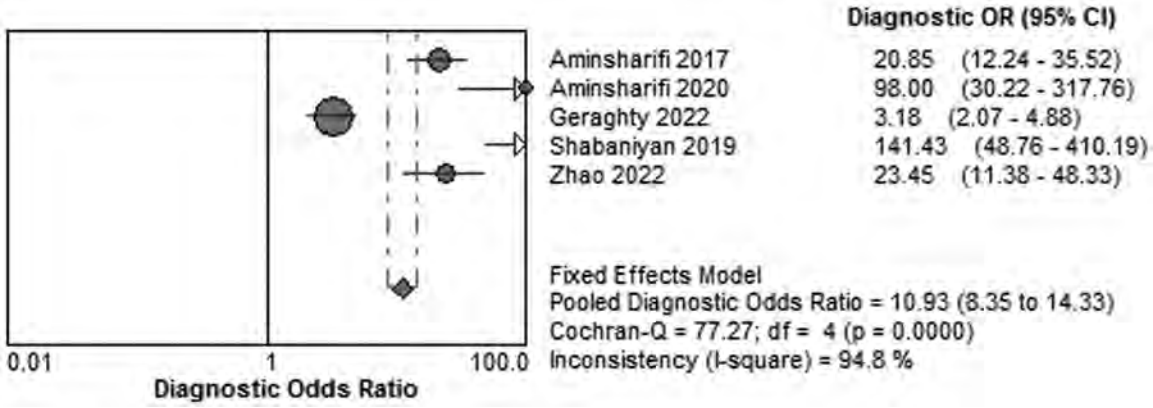

Figure 7. Pooled diagnostic ratio of ML in predicting stone-free status after PCNL.

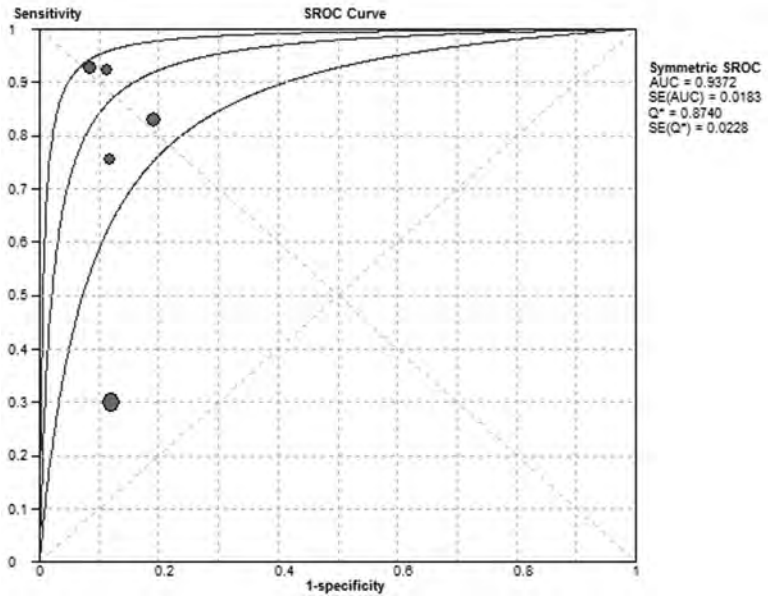

Figure 8. SROC of ML in predicting stone-free status after PCNL.

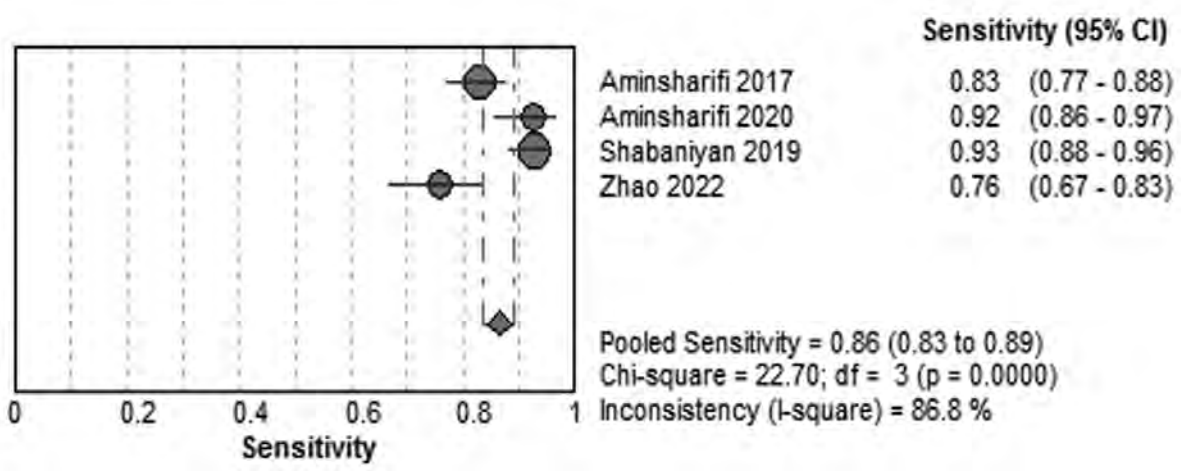

Figure 9. Sensitivity analysis of the sensitivity of ML models.

Discussion

This meta-analysis demonstrates that machine learning (ML) models show considerable potential in predicting stone-free status (SFS) following percutaneous nephrolithotomy (PCNL). The pooled analysis revealed a sensitivity of 0.60 and a specificity of 0.87, with an area under the SROC curve (AUC) of 0.94, indicating excellent overall discriminative ability. The diagnostic capabilities of ML models in this regard were further validated by a positive likelihood ratio of 4.69 and a negative likelihood ratio of 0.45. These results suggest that ML algorithms are highly effective at identifying patients who will achieve stone-free status after PCNL. Furthermore, the diagnostic odds ratio stood at 10.93, hinting that patients deemed stone-free by ML models are nearly 11 times more likely to achieve that status than those predicted otherwise.

These results have important clinical implications. Accurate preoperative prediction of SFS can aid in patient counseling, individualized treatment planning, and efficient use of operative resources. Machine learning (ML)-based models can provide a more flexible and nonlinear analysis than traditional methods by taking into account a wide range of factors, such as patient demographics, stone features, operating parameters and imaging data. On the other hand, traditional scoring tools like the Guy's Stone Score, CROES nomogram, and S.T.O.N.E. nephrolithometry score are limited since they depend on static, linearly weighted data and subjective interpretation. Several studies, such as Aminsharifi et al. (2020), have shown that ML models can outperform these conventional scores in predictive accuracy when externally validated. The wide variability observed in model accuracy (44–94.8%) and sensitivity (0–100%) across included studies reflects differences in algorithm architecture, dataset size, variable selection and validation strategy. The heterogeneity is further compounded by inconsistencies in defining "stone-free status," with some studies relying on KUB radiography or ultrasound, while others used non-contrast CT scans at varying follow-up intervals from immediate postoperative to six weeks. Moreover, most studies utilized internal cross-validation, with only one study (Aminsharifi et al., 2020) performing external validation. This limits the generalizability of the models and may lead to overly optimistic estimates of diagnostic performance.

Although ML models demonstrate significant potential, numerous practical obstacles must be overcome before they can be widely adopted in the clinical setting. First, most published models are trained on single-center, retrospective datasets with limited external applicability. Second, the "black box" problem, which makes it hard to understand how models make decisions, is still a problem since doctors may not want to use models that are hard to

understand. Third, for ML technologies to function with clinical workflows, they need to work with imaging systems, have consistent data inputs, and follow data privacy laws like HIPAA and GDPR. Variation in imaging modality, scanner parameters and feature extraction protocols can further affect model performance and reproducibility.

Despite these limitations, ML represents a transformative step toward personalized, data-driven urolithiasis management. The ability to process complex multidimensional data offers the potential for improved prediction of surgical success and tailored postoperative care. Future research should focus on prospective, multicenter studies using standardized definitions of SFS, transparent model architectures, and external validation across diverse populations. Collaborative registries that integrate clinical, radiologic, and intraoperative data may enhance generalizability and accelerate clinical translation.

Conclusion

Machine learning (ML) models demonstrate promising diagnostic capability in predicting stone-free status (SFS) following percutaneous nephrolithotomy (PCNL), with high specificity and excellent overall discriminative performance. Compared with conventional scoring systems, ML offers greater flexibility in analyzing complex clinical and imaging variables. Nevertheless, the current evidence remains limited by the small number of studies, heterogeneity in definitions of SFS, and reliance on retrospective, single-center data with predominantly internal validation. To guarantee clinical reliability and reproducibility, future research should prioritize transparent model reporting, standardized imaging-based definitions, and external multicenter validation using large, prospective datasets.

Although ML is not yet capable of replacing clinical expertise or established scoring tools, it is a promising complementary tool for individualized management, patient counseling, and preoperative planning. To transform these algorithms into practical, real-world decision-support systems in endourology, it will be important to maintain collaboration among urologists, data scientists and engineers.

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CASE REPORT

Concomitant Bilateral Nephrolithiases, High-Grade Muscle Invasive Urothelial Cancer, and Renal Mass: What Would You Do?

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This paper discusses the diagnostic and therapeutic approach to a patient with concomittant serious clinical conditions such as bilateral nephrolithiasis, and possible dual primary malignancies of the kidney and the urinary bladder.

A 62-year-old male presented with gross hematuria. Radiographic imaging revealed a large urinary bladder mass, bilateral hydronephrosis due to obstructive nephrolithiases, and a left solid renal mass. After appropriate cardiopulmonary optimization, the authors opted to do a preliminary transurethral resection of the bladder tumor. This was followed by staged therapies with right ultrasound-guided PCNL; a left partial nephrectomy with nephrolithotomy, and radical cystectomy with ileal conduit. Unfortunately, the patient did not survive the multiple surgeries and expired. The chronology of the various therapeutic procedures in cases of synchronous serious clinical conditions of the urinary tract such as nephrolithiasis, renal and bladder neoplasms need to be individualized and will dictate the outcome of the entire therapy.

Key words: nephrolithiasis, Xanthogranulomatous pyelonephritis, muscle-invasive urothelial carcinoma

Introduction

Serious clinical conditions such as genitourinary malignancy and nephrolithiasis, significantly impact on the prognosis of a patient. When diagnosed together in a single patient, this requires a well-planned chronology of therapeutic steps in order to provide a good clinical outcome. Presented here is a case of an elderly male with gross hematuria and subsequent diagnoses of muscle invasive bladder cancer, chronic kidney disease resulting from obstructing bilateral nephrolithiases, and a renal mass.

A comprehensive review of the related literature was conducted in an attempt to provide a broader understanding of these conditions and their management. However, there was no data available involving all three entities in a single patient. The main challenge is anchored on which condition to prioritize as most impactful on survival, while at the same time applying, a combination of minimally invasive and nephron-sparing approaches to both upper and lower tract pathologies in order to preserve as much renal function as possible while achieving adequate oncological control. The treatment of choice for bladder tumor is straightforward, consisting of a preliminary biopsy for histopathological diagnosis followed by radical extirpative surgery and urinary diversion. For the nephrolithiasis, PCNL is the standard of care. However, the presence of a renal mass with nephrolithiasis complicates the situation. They

deemed that an open partial nephrectomy with nephrolithotomy is most effective and safest for this condition. The final question is determining the sequence of events which may be variable depending on the clinical judgment. The authors present here their own approach.

The Case

A 62-year-old hypertensive male, complained of gross painless hematuria with amorphous clots. He has an unremarkable past medical, family and social history. History was significant for a previous transurethral resection of a large 9.6cm x 9.3cm bladder mass last March 2023. Histopathology revealed low grade urothelial carcinoma, with no muscle layer seen. No intravesical or adjuvant chemotherapy was conducted thereafter.

The patient then transferred to this institution for higher level of care. In April 2023, the patient sought consult in the emergency room due to persistence of gross hematuria. He had a creatinine of 6.7mg/dL. Unenhanced CT scan showed the following findings: 3.7-cm. (1689HU) pelvolithiasis and 2.2-cm (756HU) superior calyceal calculus on the right kidney; a 3.4-cm (1551HU) ureteropelvic junction (UPJ) calculus, inferior calyceal calculi measuring up to 0.9cm (987HU) (Figure 1) and a 3.4-cm middle pole mass on the left kidney (Figure 2) and a 3-cm urinary bladder mass located at the right lateral wall (Figure 3). There was no indication for dialysis and the patient was optimized through adequate hydration and electrolyte monitoring. The following procedures were done in sequence, after appropriate optimization by cardiology, nephrology and infectious diseases services:

The patient initially underwent bimanual examination under anesthesia, and transurethral resection of the bladder tumor on May 2, 2023. (Figure 4). Intraoperative findings showed

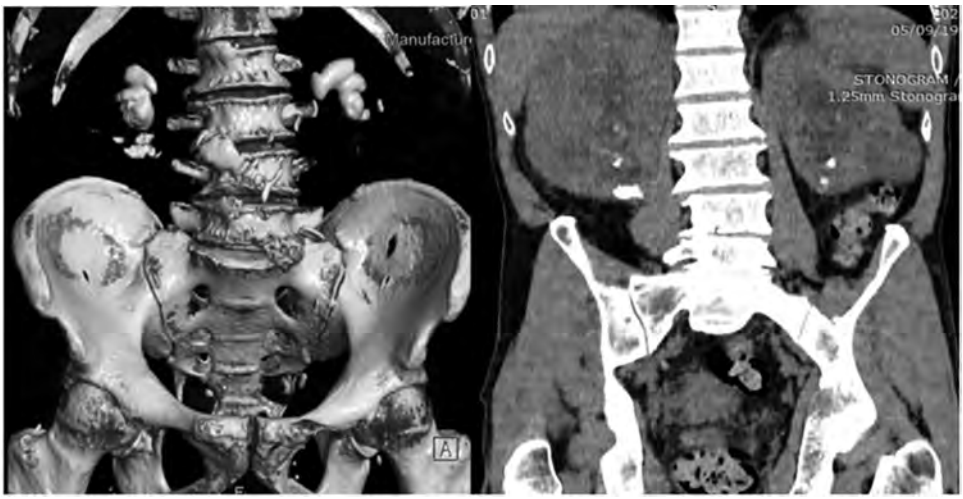

Figure 1. Left: Coronal view of CT scan showing the left renal mass (encircled).
Figure 2. Right: 3D reconstruction showing bilateral nephrolithiasis.

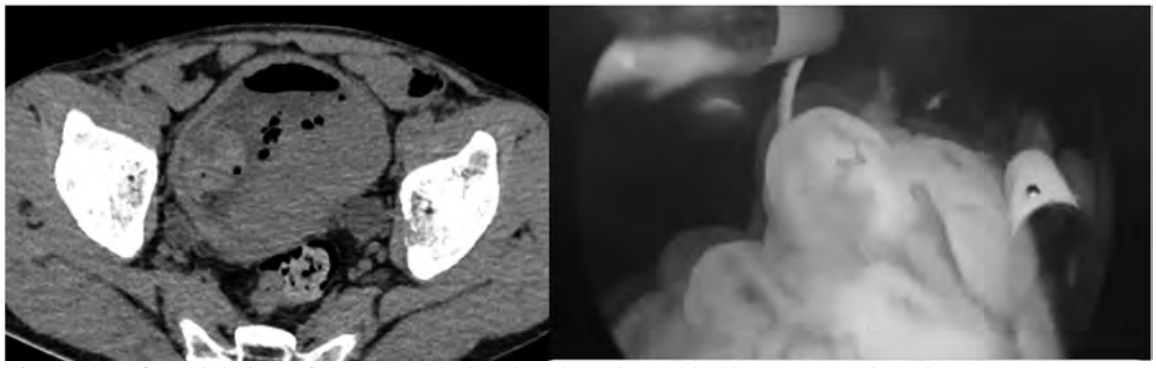

Figure 3. Left: Axial view of the CT scan showing the urinary bladder mass (encircled).
Figure 4. Right: Urinary bladder mass as seen in cystoscopy.

multifocal fungating intravesical masses arising from the left lateral wall. Histopathology revealed high grade papillary urothelial carcinoma with squamous differentiation.

After recovery, he underwent an ultrasound-guided right PCNL, with nephrostomy tube insertion. He also received triple lumen internal jugular catheter on May 20, 2023 (Figures 5 & 6) in anticipation of possible hemodialysis.

He underwent a left open partial nephrectomy with nephrolithotomy and nephrostomy tube insertion on May 26, 2023 (Figure 7). Intraoperative findings revealed a 3.5cm ureteropelvic junction calculus and pyohydronephrosis. Purulent urine came out after extraction of the renal calculus. There was a 3.5cm cystic mass on middle to inferior pole with no enlarged lymph nodes. The estimated blood loss was 500cc, and the warm ischemia time was 15 minutes. Histopathology showed xanthogranulomatous pyelonephritis, with no evidence of malignancy.

Finally, the patient underwent an open radical cystectomy, bilateral pelvic lymph node dissection, and ileal conduit on June 20, 2023. Intraoperative findings included a urinary bladder with irregular and asymmetric thickened walls, with multiple

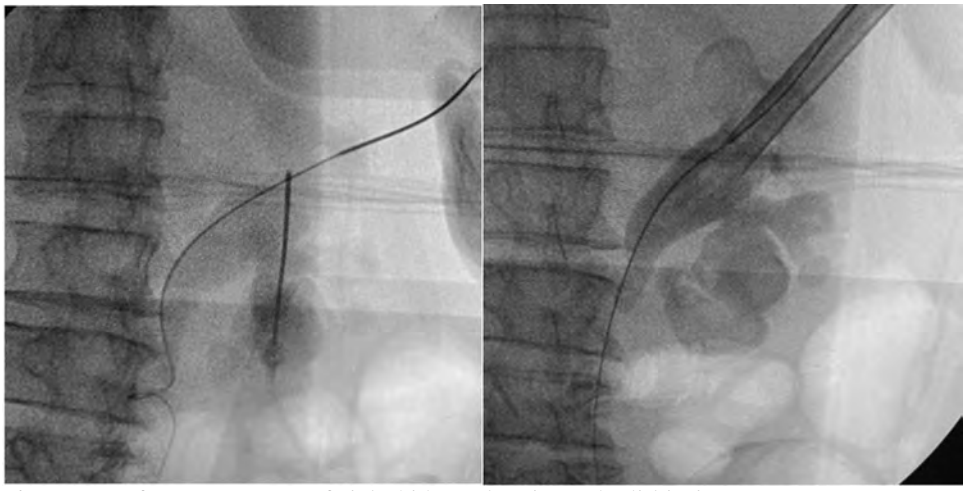

Figure 5. Left: Prone access of right kidney showing pelvolithiasis.
Figure 6. Right: Nephrostogram post percutaneous nephrolithotomy, showing maximal stone clearance.

Figure 7. On the Left: 3.4cm left renal mass. On the Right: 3.4cm Ureteropelvic junction calculus

intraluminal fungating fleshy masses; no enlarged pelvic lymph nodes. The estimated blood loss was 900cc, and the operative time was 270mins. The final histopathology was high grade muscle invasive urothelial carcinoma pT4N0M0.

All procedures were completed successfully, with blood loss remaining within acceptable limits. Following the last surgery, the patient was stable and cleared by anesthesia to return to regular ward. Overnight, he remained comfortable with stable vital signs. He reported no fever, chest, abdominal or flank pain or dyspnea. However, in the morning, he was found pulseless and with no blood pressure. He expired on 21st of July (post operative day 1) secondary to fatal arrythmia.

Discussion

The coexistence of multiple urological pathologies such as obstructive nephrolithiasis, renal mass, and a urinary bladder tumor in a single patient highlights the complexity of diagnosis and dilemma in management.

A case report by Gaines, et al (2024) discussed a patient with horseshoe kidney, bilateral nephrolithiasis and high grade UTUC treated in a percutaneous approach – the first of its kind. While Another report by Guglin, et al (2023) had a young patient with upper tract urothelial carcinoma in the setting of xanthogranulomatous pyelonephritis, which are rare entities on its own but even more challenging altogether. In a retrospective study by A Fallatah et al, 10 patients with XGP were treated with nephrectomy in their department between 1988-2000: nine cases were associated with renal stones leading to non functioning kidney, 1 case associated with renal cell carcinoma and 1 case associated with transition cell carcinoma of the renal pelvis, illustrating the possible link between inflammatory processes and malignancy.

The foremost goals of therapy include achieving an oncologically free status, rendering patient stone-free and maintaining as much renal function as possible. While this case resulted in a tragedy and the authors saddened by the outcome, they based their decision on the following rationalization. The initial transurethral resection of bladder tumor was performed in order to re-establish the nature of the previously diagnosed urothelial cancer. They felt that this takes precedence over all the other clinical conditions because any delay in the management equates to a poorer prognosis.

The right ultrasound-guided PCNL was done as a minimally invasive approach to achieve a high-stone free rate while relieving the obstruction and minimizing renal trauma. This allowed maximal renal preservation for this side. The presence of both nephrolithiasis and a possible malignant renal mass in the left kidney presents a complex clinical situation. Therefore the authors opted to do an open partial nephrectomy provided adequate removal of the tumor, with renal conservation and an opportunity to remove the stone via the nephrolithotomy. While the final histopathological analysis showed a xanthogranulomatous pyelonephritis, their intent was to treat it as a renal cell carcinoma, and this justified the partial nephrectomy, which was intended to preserve renal function while achieving oncological control.

Finally, a radical cystectomy with bilateral pelvic lymph node dissection and ileal conduit was necessary in order to treat the muscle invasive bladder cancer as is consistent with the recommendations of the recent NCCN guidelines. Unfortunately, the patient did not survive this last procedure which was apparently uneventful intraoperatively. The likely cause of death may have been an arrhythmia or acute pulmonary embolism.

The synchronous presentation of conditions like those seen in the patient is rare due to the lack of prior reports and studies indicating its uncommon occurrence. The association between urothelial tumor of the renal pelvis and staghorn calculus has been described in a study by Katz, et all, where 3 of the 500 PCNLs were diagnosed with urothelial cancer during or following stone removal, but not preoperatively, affirming its diagnostic dilemma. They concluded that a high index of suspicion be raised in those with infected staghorn calculi. Urinary calculi are also frequently seen in post radical cystectomy patients with urinary diversion, however again, not simultaneously.

Conclusion

There is no perfect algorithm that will determine the most ideal treatment for this patient. The literature supports the effectiveness of each

of the procedures the authors had performed, in the treatment of bladder tumors, kidney stones, renal tumors, and muscle-invasive bladder cancer. The choice of therapy depends on factors such as the stage and extent of the disease, patient characteristics, and surgical expertise. Further studies are needed to explore advancements in surgical techniques, perioperative care, and long-term outcomes in patients undergoing these complex procedures. The challenge for similar patients with multiple diseases is rooted may be resolved through an individualized approach that takes into account the severity of each condition and its impact on the patient's prognosis.

Acknowledgment

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CASE REPORT

Prostate Synovial Sarcoma in a 29-Year-Old Male: A Case Report

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Synovial sarcoma is an extremely rare soft tissue cancer that predominantly affects young adults, typically occurring at the para-articular region of the extremities. Primary synovial sarcoma of the prostate is exceptionally uncommon in clinical practice.

Presented here is a case of a 29-year-old male with prostatic synovial sarcoma. He experienced lower urinary tract symptoms and eventually had urine retention. The imaging findings, treatment plan, and differential diagnosis, were also discussed.

The patient experienced urinary frequency, dysuria, and acute urinary retention, which led to the insertion of a Foley catheter. Subsequent ultrasound scans revealed a large lobulated solid prostate gland. A prostate biopsy confirmed the presence of a malignant spindle cell neoplasm, indicating a prostatic stromal sarcoma. Immunohistomorphologic findings (TLE-1+, STAT6-, S100-, CD34-, ER-, PR-) were consistent with a diagnosis of Monophasic Synovial Sarcoma. The patient underwent six cycles of neoadjuvant chemotherapy before a Radical Prostatectomy was performed. The postoperative course was uneventful, and the patient was discharged in a significantly improved condition.

Given the rarity of this condition, the authors report a case of prostatic synovial sarcoma and how they managed it. They performed a radical prostatectomy with neoadjuvant chemotherapy, which had a positive effect. Subsequent postoperative monitoring and imaging showed no further symptoms.

Key words: Prostate synovial sarcoma, prostate cancer, prostatectomy

Introduction

Synovial sarcoma is an extremely rare soft tissue cancer that predominantly affects young adults, typically occurring at the para-articular region of the extremities.[1] Most synovial sarcomas in the genitourinary system have been reported in the kidney.[2] Synovial sarcoma of the prostate overwhelmingly affects young to middle-aged men, presenting as increased urinary frequency, hematuria, dysuria, nocturia, and eventual urinary retention due to bladder outlet obstruction.[3,4] Primary synovial sarcoma of the prostate is exceptionally uncommon in clinical practice and given its non-specific symptoms, synovial sarcoma of the prostate is commonly detected in its later stages.[5,6]

The purpose of this case study was to document and analyze the clinical presentation, diagnostic process, treatment approach, and outcomes of an extremely rare case of prostatic synovial sarcoma in a 29-year-old male. This study aimed to contribute to the limited body of knowledge regarding this rare malignancy, provide insights into effective diagnostic and therapeutic strategies, and discuss the implications for prognosis and patient management. This case aimed to provide a comprehensive presentation of a 29-year-old male

who experienced lower urinary tract symptoms and eventually had urine retention. Presented here was a compelling case of synovial sarcoma of the prostate with treatment plan and surgical intervention.

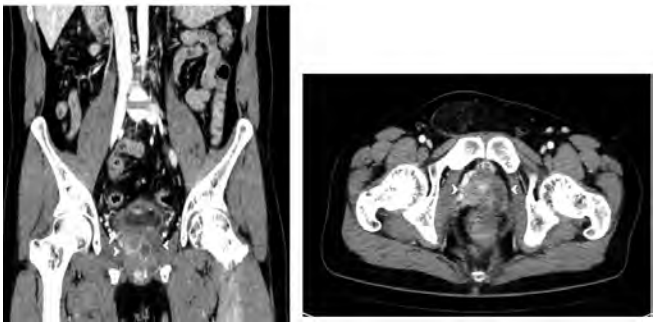
This case study is significant because prostatic synovial sarcoma is an exceedingly rare condition with only 10 previously reported cases. Due to its rarity, there is limited information available on its clinical behavior, optimal treatment strategies, and long-term outcomes. By documenting this case, the study aimed to enhance understanding of the disease, support the development of evidence-based treatment protocols, and potentially improve prognostic predictions. Additionally, this case can provide valuable data on the viability of surgical resection and contribute to ongoing discussions regarding the role of chemotherapy in managing this rare cancer.

The Case

A 29-year-old man complained of urinary obstructive symptoms that began seven months prior to consult. This symptom progressed with increased urinary frequency and straining, eventually leading to acute urinary retention. The patient sought consultation at a private hospital and was referred to a urologist, who inserted an indwelling catheter. Upon physical examination, an irregularly enlarged prostate was observed during the digital rectal examination. Ultrasound showed a large lobulated solid mass measuring 64mm x 67mm x 82mm. Computed Tomography scan of the whole abdomen revealed a large heterogenous mass (87mm x 73mm x 63mm) in the prostate gland, centered in the left and posterior aspect of the prostate gland (PG: 184 grams) and the urethra was noted to be displaced to the right. The prostate capsule appeared intact. The mass the rectum posteriorly but with intact fat plane. The absence of a specific family history of cancer or occupational hazards was noted.

The patient underwent cystoscopy and Transurethral Resection of the Prostate. Pathologic examination revealed a malignant spindle cell neoplasm, indicating a potential prostatic stromal sarcoma. The immunohistomorphologic findings suggested a diagnosis of Monophasic Synovial Sarcoma, as it tested positive for TLE-1. However, STAT6, S100, CD34, ER, and PR tested negative on immunohistochemical examination.

The patient was discharged uneventful and was advised to consult with a medical oncologist. The patient received six cycles of (AIM: Adriamycin, Ifosfamide, Mesna) chemotherapy. A follow-up CT scan showed a decrease in the size of the previously enlarged prostate gland, which measured 4.3cm x 4.6cm x 3.3cm with a computed volume of 33 ml (Figures 1 & 2).



Figures 1 and 2. The coronal cut and axial cut of the CT scan showing the prostatic mass.

The patient was referred to Urology service. A digital rectal examination revealed an approximately 30-40 gram prostate gland with a palpable firm nodule noted at the left prostatic lobe. Subsequently, the patient underwent Radical Prostatectomy (Figure 3). Postoperatively, the patient's recovery was uneventful. The patient was discharged in improved condition, with the surgical incision dry, intact, and healing well.

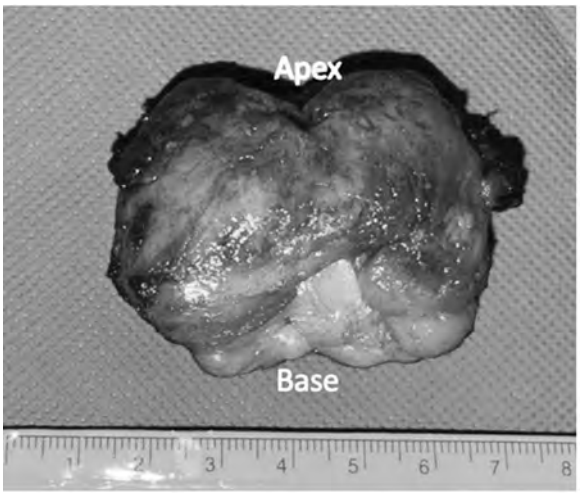


Figure 3. Prostatic mass

Discussion

Synovial sarcomas represent 8% of all soft tissue sarcomas and predominantly affect young adults between the ages of 15 and 40, although they can occur in individuals across a wide age range.[7] It is a type of malignant and aggressive tumor that originates from the soft tissues, such as the muscles, tendons, or the lining of joints. It typically carries a poor prognosis and may not respond well to treatment.[4,8] This type of tumor can spread through the bloodstream to other parts of the body (systemic spread) or by directly infiltrating surrounding tissues and structures (local invasion).[8,9] Early detection and prompt treatment are crucial for managing synovial sarcoma.[10] Primary prostatic sarcomas are exceptionally rare, comprising less than 0.1% of cases.[11]

A case report by Hou, et al described 10 cases of prostatic synovial sarcoma, including their own report. Patients' ages ranged from 22 to 63 years and had an average age of 42 years.[1] The primary clinical symptoms in 9 out of 10 patients were related to the urinary tract, such as dysuria, acute urinary retention, and hematuria.[1] In the current case, the patient also exhibited symptoms of dysuria, urinary frequency, and eventually urinary retention.

In imaging studies, synovial sarcoma of the prostate is typically a large and heterogeneous lesion, easily distinguishable from the surrounding tissues,[12,13] as is the case with the patient before chemotherapy with Doxorubicin, Ifosfamide, and Mesna (AIM).[14,15] Since prostate sarcomas are rare, treatment protocols have not been clearly defined.[7,13] Sarcomas usually do not respond well to radiotherapy, and they too have a poor response to chemotherapy.[14,15] Aggressive surgical resection should be considered, taking into account the patient's age and the absence of distant metastases and lymphadenopathy.[16,17] In the current case, after six cycles of chemotherapy, the authors observed a positive response in the patient's sarcomatous mass, and they were able to successfully perform a prostate resection.[18]

In most reported cases, the preferred treatment method entails radical surgical resection, combined with radiotherapy and chemotherapy tailored to the tumor's specific characteristics.[1,3,5,6] In the current case, the patient successfully underwent surgical resection of the prostate with notable tolerance. Subsequent follow-up examinations revealed an absence of any patient-reported complaints, indicating a favorable postoperative course.

Conclusion

Diagnosing and treating synovial sarcoma of the prostate is challenging due to nonspecific clinical and radiological data, low incidence, and rarity. Treatment decisions are based on tumor extent, staging, and risk-benefit analysis. Prognosis is generally unfavorable with a relatively short survival time. Surgical resection is a viable option, while the benefits of chemotherapy are still undetermined. More cases are needed to establish a better diagnosis and treatment plan.

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CASE REPORT

High Risk Cardiovascular Candidate for Renal Transplantation: A Journey to Success

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The most common cause of mortality after a kidney transplant is a cardiovascular event. This is why most patients with poor cardiovascular status are denied a transplant. A 70-year-old male, ESRD from hypertensive nephropathy, was declined renal transplantation in the United States for advanced age, severe coronary disease and abdominal aortic aneurysm. The patient sought a second chance at a possible transplantation here in the Philippines. After a comprehensive cardiovascular evaluation, he underwent coronary artery bypass graft for a three-vessel disease followed by endovascular aneurysm repair (EVAR) which he tolerated well. After four weeks, he underwent a living-related kidney transplantation with immediate allograft function. On postoperative day 5, after catheter removal, the patient was unable to void spontaneously. He was diagnosed with benign prostatic obstruction and underwent transurethral resection of the prostate. He tolerated this and voided freely since catheter removal. One year later, the patient has a functioning allograft and stable cardiac status. High risk patients with cardiovascular disease may be given a chance at kidney transplantation after a meticulous evaluation and optimization.

Key words: Renal transplantation, endovascular aneursym repan (EVAR)

Introduction

The incidence of end-stage renal disease (ESRD) is rising and kidney transplantation has been the preferred treatment for these patients. This allows for a better quality of life with an overall survival benefit of at least 10 years and good allograft survival of up to 20 years compared to those who remain on dialysis.[1]

Most patients with ESRD have multiple co-morbidities hence the importance of proper screening and selection of patients prior to transplant surgery. Absolute contraindications for kidney transplantation include severe cardiac or pulmonary disease, active infection, active drug abuse, and uncontrolled psychiatric disease. An acute cardiovascular event is usually the cause of death with a functioning allograft. For this reason, most transplant centers will not proceed with a transplant among high-risk cardiac patients. The authors experience shows that a patient with severe cardiovascular disease need not necessarily be disqualified from receiving a kidney transplant provided that his conditions are addressed accordingly prior to the planned kidney transplant procedure.

There is a strong association between abdominal aortic aneurysms (AAA) and renal failure brought about by atherosclerosis and chronic kidney disease. With the advancements in technology, endovascular aneurysm repair (EVAR) has brought favorable results in terms of morbidity and operative

time. An increasing number of ESRD patients with AAA have undergone EVAR successfully but only a few have been reported.[2]

George et al published in 2001 the first successful renal transplantation in a patient after EVAR for AAA. Outcomes showed that the transplanted kidney maintained a normal serum creatinine level of 1.3 mg/dL without any progression of peripheral vascular disease.[3] In 2007, Shrestha et al reported another successful renal transplantation on a 54-year old male who underwent endovascular bifurcated stent graft (EVBSG) for AAA. Post-operatively, patient had an uneventful course in the hospital. MAG-3 renogram showed a well-perfused kidney 5 days after the surgery. Serum creatinine levels dropped from 1100 umol/L to 140 umol/L on day 10. At 6 months post-surgery, the serum creatinine levels remained stable at 115 umol/L.[2]

There is a rapid rise in cases of AAA in ESRD patients on chronic hemodialysis. Despite severe cardiovascular disease being an absolute contraindication to kidney transplantation, current developments in coronary interventional surgery and aortic aneurysms such as minimally invasive CABG and EVAR, respectively have provided good outcomes for these types of patients allowing for successful and uneventful renal transplantation. Only two reports have been published as of today. This report will further demonstrate that with the proper diagnostics and management, patients with severe cardiovascular disease can be optimized well enough for kidney transplantation.

The Case

The patient is a 70-year-old male diagnosed with end-stage renal failure secondary to hypertensive nephrosclerosis and has been on hemodialysis thrice a week since 2021 through a brachiocephalic arteriovenous graft on the left. He has a history of ischemic heart disease and underwent percutaneous coronary intervention with placement of 3 cardiac stents last 2018 in Hawaii. He is maintained on aspirin, atorvastatin, carvedilol, losartan, calcium carbonate, sevelamer, cinacalcet, and vitamin D. He is a previous 50-pack-year smoker and alcoholic beverage drinker.

The patient was initially assessed for a possible kidney transplantation in the United States but failed evaluation due to severe cardiovascular disease resulting from multiple-vessel coronary disease and abdominal aortic aneurysm. The patient opted for a second opinion at this medical center.

As part of the pre-transplant evaluation, he underwent dobutamine stress echocardiogram which revealed an ST segment elevation in leads II, III, aVF, V4-V6 with ST depression in leads I, aVL, and V2, consistent with severe ischemic disease of the inferolateral wall. Echocardiogram showed an akinetic basal inferior septum and inferior wall. His laboratory results showed an elevated Troponin I level of 29.5. Although the patient was asymptomatic, these were considered critical findings.

A coronary angiogram was performed (Figure 1) showing chronic total occlusion of the middle portion of right coronary artery with intercoronary collaterals from the septal branches of left anterior descending artery, severe coronary artery disease of ostial, proximal and middle left anterior descending artery, proximal left circumflex artery and first obtuse marginal artery; moderate coronary artery disease of middle left circumflex artery. Immediate consult was sought with the cardiovascular surgical team. The patient underwent minimally invasive coronary surgery - coronary artery bypass grafting (off-pump) (MICS-CABG OPCAB) using left internal mammary artery (LIMA) on October 27, 2023.

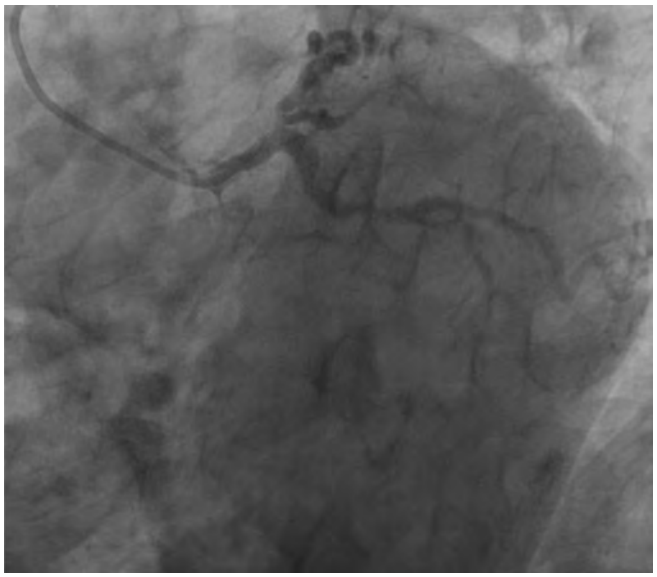

Figure 1. Coronary angiogram

A CT aortogram (Figure 2) was done and confirmed the presence of an infrarenal saccular aneurysm measuring 5.1cm x 3.2 cm x 3.7 cm (previously 5 cm x 3.1 cm x 3.5 cm) with mural thrombus along its anterior-right paramedian aspect. The non-enhancing thrombus had a maximum thickness of 2.1 cm without dissection or contrast extravasation seen. Eight days later, on November 4, 2023, the patient then underwent endovascular aneurysm repair (EVAR) of infrarenal saccular aneurysm.

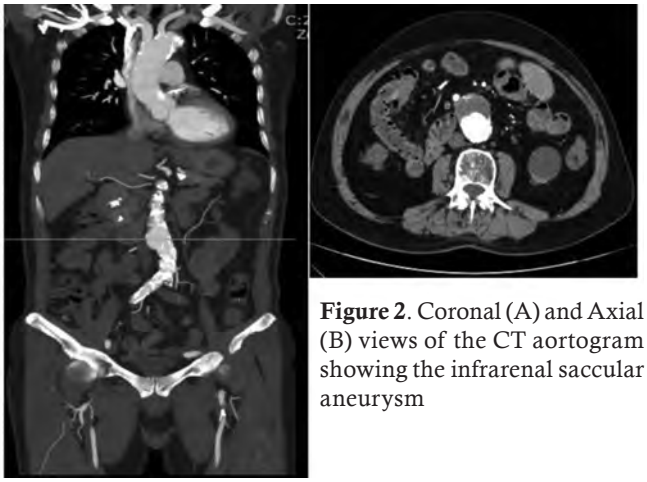

Figure 2. Coronal (A) and Axial (B) views of the CT aortogram showing the infrarenal saccular aneurysm

In the interim, the patient complained of moderate lower urinary tract symptoms. Laboratory tests yielded an elevated prostate-specific antigen at 7.3 ng/mL with 20 grams of prostate on imaging. Patient underwent transperineal biopsy of the prostate on November 29, 2023 which showed benign prostate hyperplasia and was started on tamsulosin 400 mcg/tablet once daily at bedtime and solifenacin 5mg/tablet once daily.

The patient made an uneventful recovery and underwent a living kidney donor-transplantation four weeks later on December 8, 2023. Donor CT angiogram showed bilateral single main renal artery and vein. Intraoperatively, the renal vein was anastomosed to the right external iliac end-to-side using Prolene 5-0 sutures, continuous technique, followed by the end-to-side anastomosis of the right renal artery to the right external iliac artery using Prolene 6-0 sutures, continuous technique. Immediate reperfusion of the allograft with good turgor and color was noted. The total vascular anastomosis time was 42 minutes. The allograft ureter was spatulated and anastomosed to the anterolateral surface of the urinary bladder dome using PDS 6-0 sutures, continuous technique. Bladder serosa was apposed using continuous PDS 6-0 sutures with an antireflux repair over an indwelling ureteral stent. Intraoperatively, patient was maintained on dobutamine, norepinephrine, and dopamine due to hypotension with blood transfusion of 2 units of packed red blood cells. There were no post-operative complications.

Induction was done using rabbit anti-thymocyte globulin (rATG) 72.3mg induction with pre-treatment with methylprednisolone 125-250mg intravenously. On post-operative day 1, the renal allograft doppler (Figure 3) showed good cortical vascular flow or perfusion. The peak systolic velocity of the aorta is 100 cm/sec. The renal vein is patent. Serum creatinine improved from 4.6 to as low as 0.6 mg per dL. Patient was discharged on postoperative day 7.

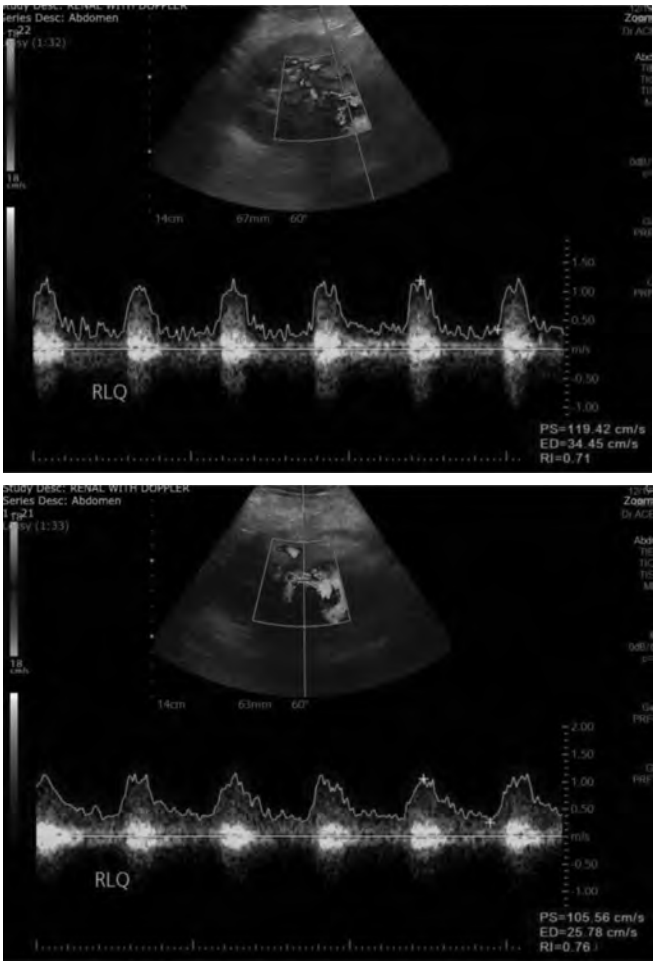

Figure 3. Renal power doppler ultrasound of allograft kidney

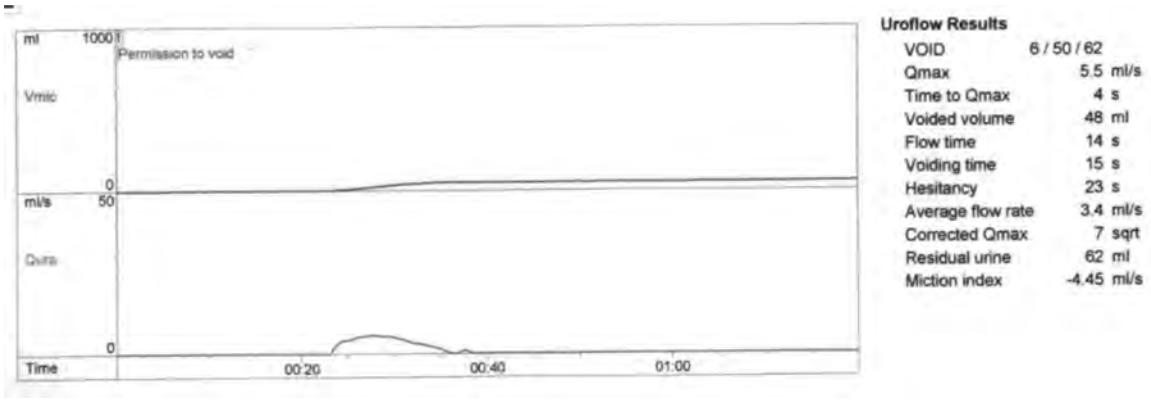

Figure 4. Uroflowmetry tracing

Two days since discharge, the patient complained of terminal dysuria with occasional gross hematuria prompting consultation at the Emergency Department. Serum creatinine was at 0.82 mg/dL. Ultrasound showed prostate gland size of 17 grams with only 6 mL urine residual. Repeat power doppler gave a peak systolic velocity of the aorta is 110 cm/sec. Tacrolimus Trough level was at normal levels. Patient was the advised admission. Further workups revealed a low Qmax at 5.5 ml/seconds (average Qmax 3.4 mL/seconds) and a 62 mL urine residual on Uroflowmetry with bladder scan (Figure 4). After clearances were secured, the patient was then scheduled for Cystoscopy, ureteral stent removal with transurethral incision and resection of the prostate on December 22, 2023. Post-operatively, the patient remained stable. Foley catheter was hooked to cystoclysis and was maintained for 2 days. Patient was able to void freely after catheter removal. All throughout this period, the patient had adequate urine output and stable allograft function. At one-year follow-up, he maintained stable renal function and good cardiovascular status.

Discussion

The meticulous pre-transplant evaluation of any ESRD patient hinges on the principle that the donated allograft is a very scarce commodity. Therefore, for every transplant surgery to be considered worthwhile, the transplanted recipient should have an anticipated long-term survival of at least 10 years with a functioning allograft. Severe cardiovascular disease has been considered an absolute contraindication to renal transplantation. This is because the most common cause of death among recipients with a functioning allograft is a serious cardiovascular event.

This strong association between abdominal aortic aneurysms (AAA) and renal failure resulting from atherosclerosis and chronic kidney disease remains to be a rate-limiting step in the clearance of potential candidates for renal transplantation. Patients are denied of the definitive procedure solely due to high-risk cardiovascular disease.

As developments in coronary interventional surgery and aortic aneurysms such as minimally invasive CABG and EVAR emerge, these patients are provided the opportunity to undergo renal transplantation with very favorable outcomes. Two studies mentioned earlier have been published and have produced efficacious outcomes.

A collaborative effort with different specialties consisting of transplant surgery, nephrology, cardiology, cardiovascular and urology service is key to the success in managing these patients.

Conclusion

The authors' experience with this case demonstrates that ESRD patients with severe cardiovascular disease may still undergo renal transplantation after a comprehensive pre-operative planning and collaboration with an excellent cardiovascular team. As technological advancements arise, the authors continue to modify the recipient acceptance criteria and increase the pool of patients for kidney transplantation.

Acknowledgements

The authors declare no conflict of interest in the study. The study abided by the Principles of the Declaration of Helsinki (2013) and was conducted along the Guidelines of the International Conference on Harmonization-Good Clinical Practice (ICH-GCP). The Clinical Protocol and all relevant documents were reviewed and approved by the SLMC Institutional Ethics Review Committee.

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CASE REPORT

Wunderlich Syndrome in a Gravid 31-Year-Old with Tuberous Sclerosis Complex and Bilateral Angiomyolipoma: A Case Report

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Wunderlich Syndrome is a rare potentially life-threatening phenomenon that involves spontaneous non-traumatic retroperitoneal hemorrhage. At present, identifying the course of conservative management in these patients, especially in pregnancy, has not been clinically established.

Presented here is a known case of Tuberous Sclerosis Complex with a Bilateral, 10cm Angiomyolipoma in a 31-year-old female, initially managed with active surveillance. At 27 weeks of pregnancy, she presented with a sudden onset of left flank pain with a hematocrit of 22%. Anemia was corrected with blood transfusions. A contrast-enhanced MRI of the abdomen showed a large subcapsular perirenal hematoma of the left kidney. Renal angioembolization of the bleeding segmental renal artery was done. The patient was conservatized until 37 weeks of pregnancy and underwent cesarean section delivery.

Four months after angioembolization, she had a recurrence of the left flank pain associated with gross hematuria and hypovolemic shock. The patient underwent emergency renal exploration of the left kidney via a transabdominal approach. Three liters of hemoperitoneum and a large expanding left retroperitoneal hematoma were noted intraoperatively. Early vascular control before nephrectomy of the left kidney was done. The postoperative course was unremarkable and the patient was discharged with improved condition.

This case displays a unique course in the management of a bleeding angiomyolipoma especially during pregnancy. Renal angioembolization can aid in achieving the age of viability in pregnancy. However, close monitoring for rebleeding should be kept in mind. A lower threshold for conservative management should be utilized when patients have a previous history of bleeding.

Key words: Wunderlich syndrome, angiomyolipoma, tuberous sclerosis complex

Introduction

Angiomyolipoma (AML) is a benign renal tumor composed of dysmorphic blood vessels, smooth muscles and adipose tissue. It is estimated that the prevalence of AML is at 0.13% in the general population and has a strong female preponderance.[1-2] These tumors arise sporadically but are also part of genetic mutation syndromes such as Tuberous Sclerosis Complex (TSC) and Lymphangioleiomyomatosis (LAM).[2]

Wunderlich Syndrome is a rare potentially life-threatening phenomenon that involves spontaneous non-traumatic retroperitoneal hemorrhage. At present, identifying the course of conservative management in these patients, especially in pregnancy, has not been clinically established.[3-4] Several management options depend on patient

stability and other risk factors.[5] There have been a few reported cases discussing the management of these patients, however, these were all solitary in nature.[6-7]

This paper discusses the course of management of a gravid 31-year-old female diagnosed with Tuberous Sclerosis Complex with Bilateral Angiomyolipoma in Wunderlich Syndrome who underwent an emergency nephrectomy of the left kidney.

The Case

The authors a case of a 31-year-old female diagnosed with Tuberous Sclerosis Complex. The patient has no known comorbidities. She is a non-smoker and a non-alcoholic beverage drinker. Heredofamilial diseases were unremarkable.

On physical examination, there were noted facial angiofibromas on the cheeks (Figure 1). A Contrast-Enhanced MRI of the Brain showed multiple cortical tubers consistent with Tuberous Sclerosis (Figure 2).

Figure 1. Facial angiofibromas

On further workup, an incidental finding of a stable bilateral 10cm Angiomyolipoma was seen on a contrast-enhanced abdominal CT scan. Her attending urologist initially managed her with annual abdominal imaging as a means of active surveillance.

After four years of active surveillance, the patient was 27 weeks pregnant with her first baby and presented at the emergency room for sudden onset of severe left flank pain. She was a G2P0(0010) wherein she previously underwent dilatation and curettage for an incomplete abortion. The current pregnancy had regular prenatal checkups. The congenital anomaly scan was also unremarkable.

On current physical examination, she presented with pallor but with no episodes of hypotension or hematuria. The abdominal examination noted a gravid uterus with left flank tenderness. All other findings were unremarkable. The patient was admitted under OB-GYN service and was referred to Urology. Further workup showed anemia (Hematocrit = 22%) which was corrected with multiple blood transfusions. A contrast-enhanced MRI of the abdomen showed bilaterally enlarged kidneys with multiple varisized angiomyolipomas. The largest was in the medial aspect of the left kidney measuring 11.8cm x 5.6cm x 10.6cm (Figure 3). A large subcapsular perirenal hematoma of the left kidney was also seen (Figure 4). The right angiomyolipoma remained stable. The patient was maintained on complete bed rest and serial hematocrit determinations to maximize conservative management and prevent rebleeding of the angiomyolipoma. The status of the fetus was unremarkable and remained stable.

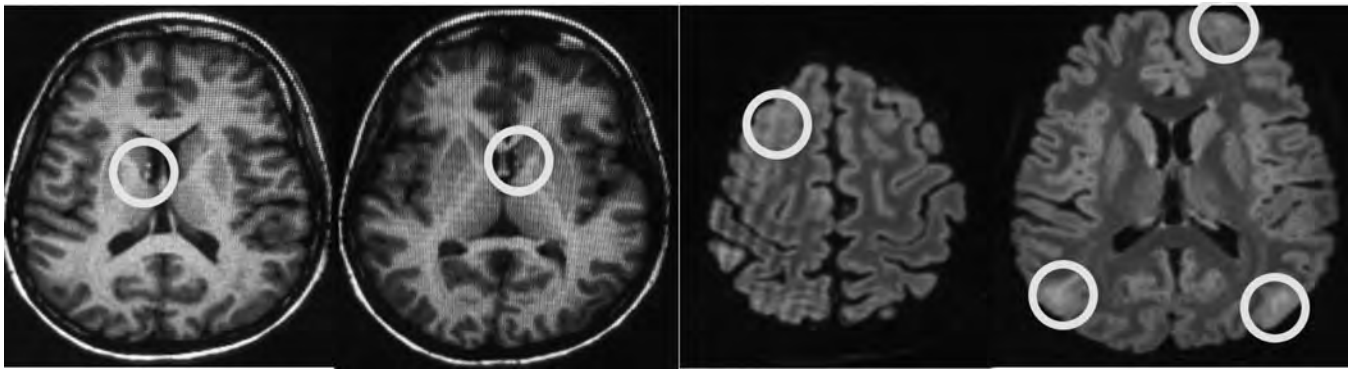

Figure 2. Contrast-enhanced magnetic resonance imaging of the brain showing multiple cortical tubers consistent with tuberous sclerosis.

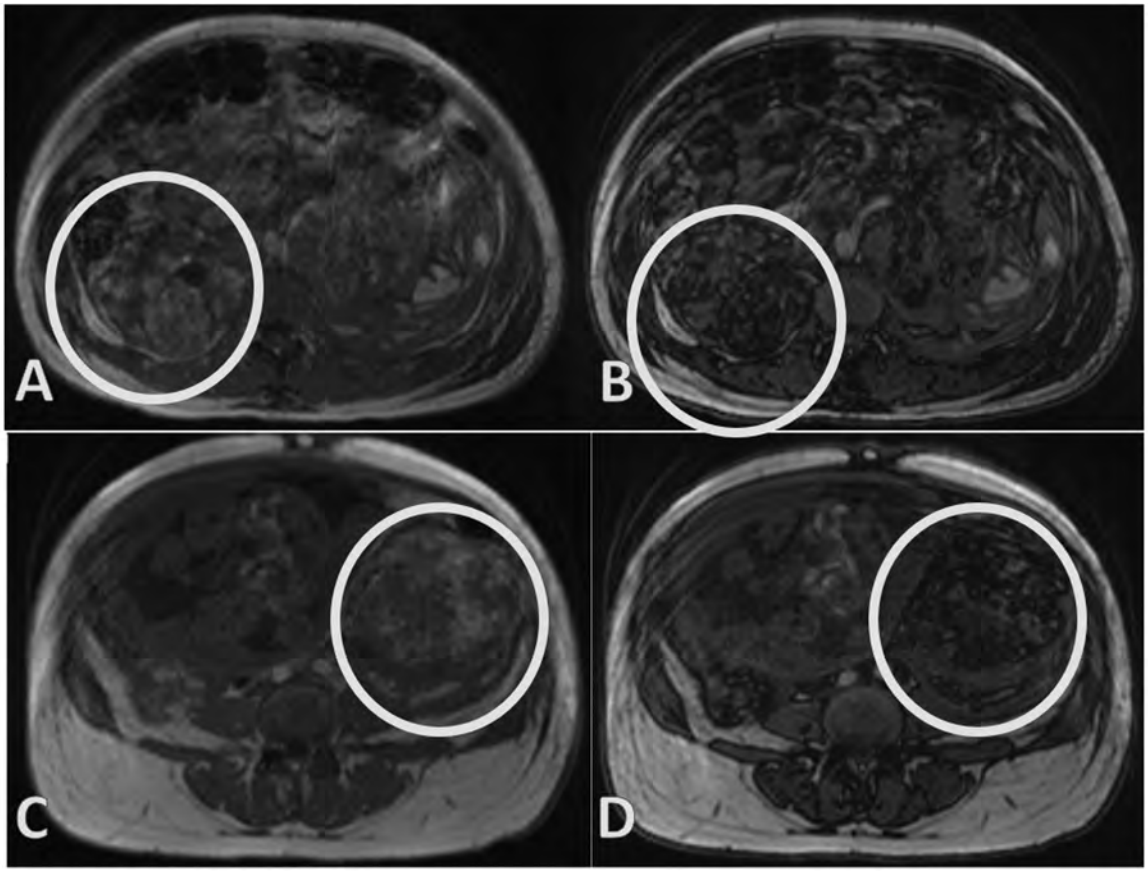

Figure 3. Contrast-enhanced magnetic resonance imaging of the abdomen (Dual Gradient Echo Sequence).
A. Right Angiomyolipoma (In Phase); B. Right Angiomyolipoma; C. Left Angiomyolipoma (In Phase);
D. Left Angiomyolipoma (Out Phase).
Note the Fat Signal Drop on the Out Phase.

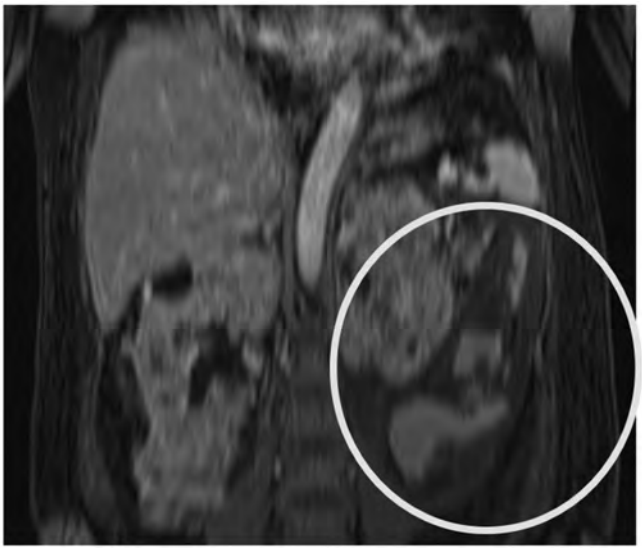

Figure 4. Contrast-enhanced magnetic resonance imaging of the abdomen (Coronal View).
Subcapsular perirenal hematoma.

The patient was scheduled for a renal artery angioembolization to stop retroperitoneal hemorrhage and try to preserve both kidneys. Upon renal angiography, there was contrast extravasation of the superior pole of the left kidney, and the affected superior segmental artery was subsequently embolized (Figure 5). She was then discharged with improved condition and with plans to conservatize the pregnancy until the age of viability.

The patient underwent a scheduled cesarean delivery at 37 weeks of pregnancy after reaching fetal viability. Delivery was unremarkable. She had an unremarkable post-partum course with no hematuria or recurrence of left flank pain.

Four months after angioembolization, the patient presented back to the emergency room due to recurrence of the left flank pain associated with gross hematuria. A contrast-enhanced

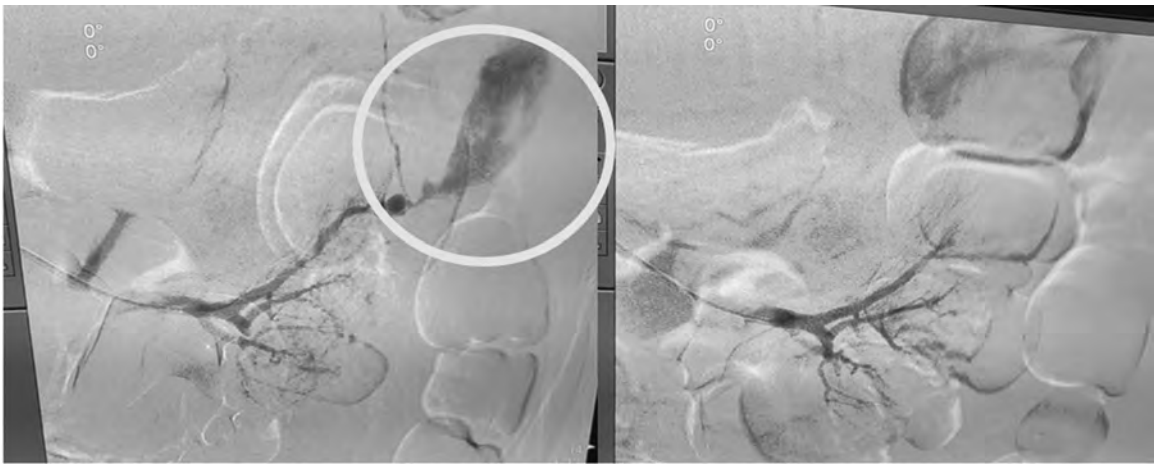

Figure 5. Fluoroscopic images of renal angiography.
A. Pre renal angioembolization showing contrast extravasation of the superior pole of the left kidney;
B. Post renal angioembolization showing normal vascularization of the kidney

CT scan of the abdomen was done showing massive hemoperitoneum, and a large, left suprarenal hematoma extending down to the left retroperitoneal space (Figure 6). She now had episodes of hypotension and was scheduled for emergency renal exploration of the left kidney via a transabdominal approach.

Figure 6. Contrast-enhanced CT scan of the abdomen. Large left retroperitoneal hematoma.

Intraoperatively, three liters of hemoperitoneum was evacuated and a large expanding left retroperitoneal hematoma was noted (Figure 7). Midline early vascular control (Figure 8) was done and urologists proceeded with nephrectomy after ligating the renal hilum. The postoperative course was unremarkable and she was then discharged with improved condition after 1 week.

Figure 7. Large expanding retroperitoneal hematoma.

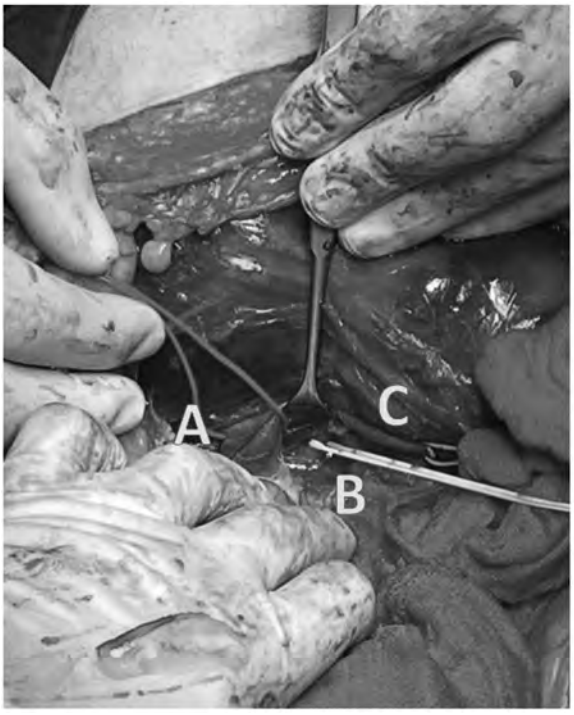

Figure 8. Isolation of the renal hilum via midline early vascular control
A. Renal Vein; B. Renal Artery; C. Ureter

Currently, the right angiomyolipoma, on active surveillance, has remained stable with no intralesional aneurysm or hemorrhage. The patient has been started with everolimus and has been on regular follow-ups every month. A contrast-enhanced CT scan of the abdomen will be done annually for active surveillance of the right kidney.

Discussion

The presented case highlights the different definitive therapeutic interventions of patients with angiomyolipoma. It does not, however, discuss further on the medical and genetic aspect of patients with tuberous sclerosis complex. This case presents a therapeutic dilemma in the management of a bilateral angiomyolipoma in wunderlich syndrome in a pregnant patient.

Angiomyolipomas (AML) are benign renal entities composed of dysmorphic perivascular tissues. Sporadically, they arise as solitary entities. However, when a part of genetic syndromes, such as your Tuberous Sclerosis Complex (TSC), they can affect both kidneys. AML is diagnosed mainly through CT scans or MRIs of the abdomen, in which the mass is predominantly high in fat content.[8]

Wunderlich syndrome is a rare clinical condition of nontraumatic renal hemorrhage which can arise in 15% of patients with Angiomyolipoma.[9] These patients may present with acute hypovolemic shock, sudden onset flank or abdominal pain, and a palpable abdominal mass characterized as your "Lenk's Triad."[10] Pregnancy has been an identified risk factor for spontaneous hemorrhage due to hormonal changes in these tumors.[11]

Current trends in the management of angiomyolipoma have include active surveillance, renal ablation, nephron-sparing surgery and mTOR inhibitors. Angiomyolipomas of less than 4cm have been managed conservatively with annual imaging. Larger tumors have a greater propensity for bleeding leading to nephron-sparing surgery or nephrectomy.[2] Indications to end the active surveillance and proceed to surgical intervention would include persistent pain, hemorrhage, and consideration of probable malignancy. These treatments should be tailored to each individual based on hemodynamic stability and symptom-based therapy.[12]

Steiner et al. suggested that patients with angiomyolipomas must have planned pregnancy and can be managed with pre-pregnancy angioembolization and/or nephron-sparing surgery.[11] However, in the present case, the risk of retroperitoneal hemorrhage and recurrent hemorrhage is high due to pregnancy despite being managed conservatively.

Tanaka et al. reported a case of a ruptured renal angiomyolipoma in pregnancy wherein renal angioembolization was done after successful vaginal delivery.[13] Another case was reported by Shah et al. which discussed angioembolization prior to delivery as a means to conservatize the pregnancy and achieve fetal viability.[14] However, all of these documented cases were solitary in pathology.

This case highlights the management thresholds from active surveillance to active intervention when the patient becomes symptomatic. Although nephron-sparing surgery is the gold standard for angiomyolipomas,[15] this case highlights the difficulty in preserving the kidney when presented

with a large bleeding angiomyolipoma which can lead to emergency nephrectomy. Another dilemma would be to balance out fetal viability as well as achieve adequate conservative management in the ruptured angiomyolipoma.

Conclusion

This case displays a unique management course in a patient with tuberous sclerosis complex and bilateral angiomyolipoma presenting with frank retroperitoneal hemorrhage during pregnancy. Renal angioembolization can aid in achieving the age of viability in pregnancy. However, close monitoring for rebleeding should be kept in mind. A lower threshold for conservative management should be utilized when patients have a previous history of retroperitoneal hemorrhage.

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