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Initial experience of the Versius robotic system in robot-assisted radical prostatectomy: a study of 58 cases

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Introduction The study presents the initial outcomes of robot-assisted radical prostatectomies (RARPs) using the Versius robotic system in a urological centre with no prior robotic surgery experience.
Material and methods A retrospective analysis of 58 RARPs was conducted, including patients' parameters as well as Versius system performance.
Results The study involved 58 patients (average age 66.9 years). Median preoperative prostate specific antigen (PSA) was 9.8 ng/ml, with 48% having ISUP grade group ≥ 3 on biopsy and 25.8% showing extraprostatic extension on MRI. Median blood loss was 437 ml, with complications (10.3% Clavien-Dindo grade II and 4 grade III cases). One conversion to open surgery occurred (0.58%). Final pathology revealed 46.5% extraprostatic disease, and 25.8% had positive margins. Post-surgery, 96.5% had undetectable PSA at 6 weeks. Continence rates were 89.7% at 6 weeks, increasing to 91.3% at 12 months. Median catheter duration was 7.9 days, and the hospital stay was 4.5 days. Console time averaged 150.9 minutes, with a median operative time of 213 minutes. The Versius system reported medium priority alarms in 24.1% of operations, including 1266 alarms related to robotic arm clashes and 43 instrument swaps. One bedside unit exchange occurred with no console or robotic system failures.
Conclusions The Versius robotic system can be successfully introduced in a urological centre without prior robotic surgery experience. Our setup and operating room positioning are effective, safe, and reproducible. We encountered and resolved surgical and technical challenges. Further follow-up studies are needed to assess the system's performance.

Key Words: prostatectomy ‹› robotic system ‹› robot-assisted radical prostatectomy ‹› Versius

INTRODUCTION

Since the beginning of the twentieth century, robotic technology has brought changes to various surgical specialties, including urology. Even though a definition of a word 'robot', first used by Czech novelist Karel Čapek in 1921, refers to an autonomous machine resembling a human being and replicating its movements and tasks, it does not precisely apply to current surgical robots. Nevertheless, it has sparked an exciting vision for the future of surgery, which is expected to evolve further [1].

Admittedly, not all available data have demonstrated the clear clinical benefits of these new systems. However, both patients and surgeons are increasingly seeing robotic surgery as the next step in the evolution of surgical techniques. Up to now, the key improvement has been a manipulation capability with wrist-like instrument movements, but there are more to come, with haptic sensation, remote operations, and telemetric measurements among others [2, 3].

Recently, the robotic market has undergone significant changes with various companies entering the market, leading to costs reductions and increased accessibility to this technology [4, 5]. Some companies, like Intuitive, have continued to develop established principles and create machines like Da Vinci, while others have explored alternative solutions. One such

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system is the Versius robot, developed by CMR Surgical in Cambridge, UK, and introduced to the market in 2020.

The Versius system comprises an open surgeon's console with a pistol-like controller handgrip and a visualization bedside unit (BSU) equipped with a 3D vision camera and 2–3 independent operative BSUs for wristed instruments. The instruments offer 7 degrees of freedom at the tip and provide 720 degrees of rotation. The handgrip controller manages the camera, and a clutch integrated into the handgrip operates without the need for foot controls. The system also offers constant telemetric and visual recording of the procedure.

CMR has successfully miniaturized the robotic system, making it suitable for use in most surgical rooms without the need for special preparation. The instruments are 5 mm in diameter, and the Versius system is both portable and transportable. Its modular design allows individual arms to be moved within the operating room or to different operating rooms in the hospital without requiring any alterations.

The usage of the Versius system for RARP has been explored in preclinical studies on cadavers [6, 7] and live patients [8]. This study aims to present the short-term clinical results of the first 58 RARPs performed with the assistance of the Versius robot for prostate cancer patients in a medical centre with no prior experience in robotic surgery.

MATERIAL AND METHODS

A retrospective analysis was conducted on 58 consecutive patients who underwent RARP between July 2022 and December 2022. The first 5 surgeries were performed under the supervision of a proctor (S.G.), who had prior experience using the Versius robotic system with the same surgical prostatectomy technique and operating theatre setup.

All members of the surgical team participated in official technical training, which included theoretical and practical sessions, including cadaver operations, provided by the company in laboratory settings.

Prior to surgery, all patients were informed about the setup and details of the Versius robotic platform, as well as the use of collected data for analysis. Informed consent was obtained from all patients.

During the procedures, all patients were positioned in a 20-degree Trendelenburg position, with their legs slightly lowered to increase the angle between the upper body and pelvis, facilitating better access to the prostate under the pubic bone and reducing the risk of collision between the robotic arms and the pubic bone. A 12 mm endoscope port was placed 2–3 cm above the umbilicus along the midline. Two dedicated 7 mm 'Yellowports' for the robotic arms, specific to this robotic platform, were placed under direct visualization on a transversal line on both sides, approximately 5–6 cm below the optic port. The placement of the robotic ports varied between 9 and 12 cm apart, depending on the patient's anatomy and BMI. Measurements were taken after inflation of the abdomen with CO_2. Additionally, one 5 mm trocar for a suction-irrigation device and one 12 mm trocar for the laparoscopic clipper were placed on the right side of the abdomen to assist the surgeon, as shown in Figure 1.

The Versius robotic system consists of independent robotic units with cart-mounted arms, which require a dedicated setup before the operation. Part of this set up is the port training, which secures 'system self-orientation' of trocars performed by the surgical team in a step-by-step procedure to calibrate the instrument pivot points and align them with the targeted zone. This calibration is crucial for ensuring precision during the surgery.

The adaptation of the port configuration is carried out based on the patient's features, the position of the robotic units, and the instrument length. The unit cart's footprint is 38 × 38 cm, allowing for comfortable placement around the operating table to provide good access to the patient throughout the entire operation. The angles of the robotic arms and the height of the units were assessed by the surgical team, optimizing the working space for the table assistant on the right side of the patient and the scrub nurse assisting during the operation. The energy tower and monitor were positioned at the patient's feet (Figure 2). Endoscopic vision and electrosurgery were provided by the standard endoscopic set available in the operating theatre.

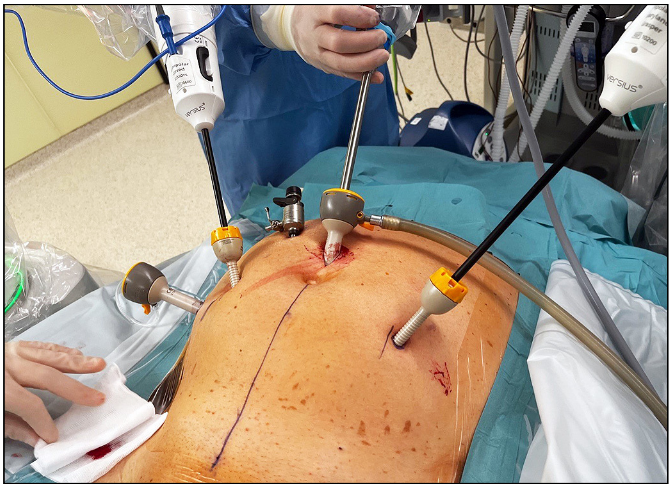

Figure 1. *Ports set up.*

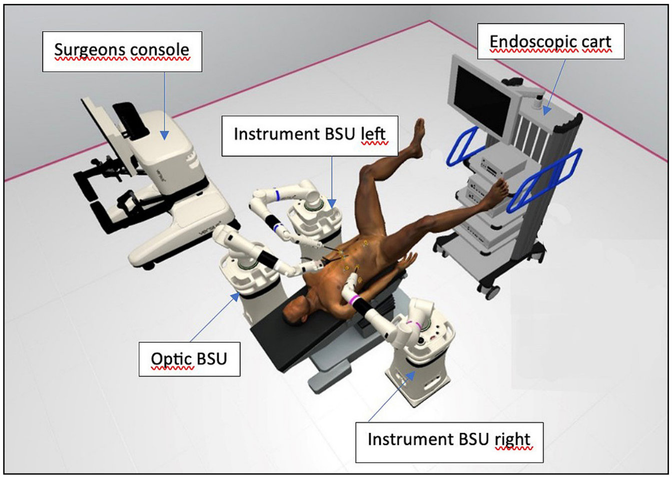

Figure 2. *System set up.*

BSU – bedside unit

Initially, the visual unit, positioned cranially on the left side of the patient, is docked. Camera mounting and port training are then performed. Subsequently, the 2 adjacent units are docked on both sides of the patient, caudally to the camera unit, as depicted in Figure 2.

During the operation, instruments are mounted, including a bipolar Maryland grasper on the left and monopolar curved scissors on the right. These instruments have a length of 30 cm and a diameter of 5 mm. Swipe and reach manoeuvres are performed to assess the range of operating tools for prostate excision and bilateral lymphadenectomy.

The scrub nurse worked on the right side of the patient, alongside the table assistant, to facilitate communication and access to the urethra. This configuration also allowed for easy access to all the robotic arms for instrument changes and camera cleaning.

RARP was performed in all cases using a transperitoneal anterior approach following standardized procedural steps [9]. The procedure began with bladder detachment, followed by incision of the endopelvic fascia and bladder neck dissection. Subsequently, dissection of the vas deferens and seminal vesicles was performed, followed by dissection of the posterior space between the prostate and rectum, dissection of the lateral parts of the prostate, suture of the dorsal venous complex, dissection of the prostate apex, posterior reconstruction, and vesicourethral anastomosis using 2 semi-continuous sutures. Each time, a leak test was conducted by filling the urinary bladder through the Foley catheter up to 100 ml. In cases where some leakage occurred, additional sutures were placed to secure it.

In all cases, a configuration of 3 robotic units was used, with a monopolar curved monopolar shear, a bipolar Maryland grasper, and a large needle driver. In cases where a fourth unit was used, it was placed caudally on the right side of the patient to accommodate a large fenestrated grasper, providing better exposure of the operating site.

The patients' data are presented in Table 1.

Complications, as per the Clavien-Dindo classification, were categorized as follows: Grade II complications occurred in 2 cases, and Grade III complications occurred in 4 cases. Additionally, one case required conversion to an open procedure, representing a 0.58% conversion rate. In this case, the decision to convert to an open procedure was necessitated by the presence of an inflammatory condition in the bladder resulting from prior BCG therapy, which rendered a safe resection of the prostate unfeasible.

Two cases of rectal damage were reported during the study. In the first case, the damage was identified and repaired during the surgery, obviating the need for a conversion to laparoscopic or open procedures. However, in the second case, rectal damage became evident 7 days after the operation. This damage was attributed to a Hem-o-Lock clip that had been placed on the rectal wall, leading to the development

Table 1. *Patients' preoperative and postoperative characteristics*

1	Number of patients	58
2	Median age (years)	66.9 (range 52–75)
3	median PSA (ng/ml)	9.8 (range 1.9–29.4)
4	ISUP ≥ 3 tumour on prostate biopsy	25/58 (48%)
5	MRI with a suspicion of extraprostatic disease	15/58 (25.8%)
6	Low risk prostate cancer	7/58 (12.06%)
7	Intermediate risk prostate cancer	40/58 (68.96%)
8	High risk prostate cancer	11/58 (18.9%)
9	Median console time (minutes)	150.9 (range 62–279)
10	Median operative time (minutes)	213 (range 128–348)
11	Extra prostatic disease on final pathology	27/58 (46.5%)
12	Positive surgical margins	15/58 (25.8 %)
13	Undetectable PSA (<0.1 ng/ml) 6 weeks after surgery	96.5 % (56/58)
14	Urinary continence after 6 weeks	52/58 (89.7%)
15	Median blood loss (ml)	437 (range 210–2050)
16	Complication rate	6/58 (10.3%)
17	Median hospital stay (days)	4.5 (range 4–12)
18	Median catheter duration (days)	7.9 (range 7–21)
19	Median prostate volume on preoperative MRI (cm^3)	48.5 (range 21–120)
20	Median BMI (kg/m^2)	27.3 (range 19–36)

ISUP – International Society of Urologic Pathology; MRI – magnetic resonance imaging; PSA – prostate-specific antigen; BMI – body mass index of a urethro-rectal fistula. Fortunately, the fistula was successfully repaired endoscopically using the ‘Endo Stitch’ technique, which was performed with the aid of a colonoscope by gastroenterologists.

During the postoperative course, anastomotic leaks were observed in 3 cases, accounting for a 5.1% incidence. These leaks were confirmed by cystograms. The management approach involved conservative treatment, along with the prolonged maintenance of the Foley catheter and Redon drain in the abdominal cavity. Fortunately, all cases of anastomotic leaks resolved successfully.

The Versius robotic platform incorporates an advanced security control system with various event notifications and alarms designed to alert users to different types of improper events. We have categorized these events into 3 groups, each with a distinct impact on the operation. All events are recorded in real time and stored by the telemetric system. At the beginning of each operation, 3 BSUs (2 instrumental BSUs and 1 visualization BSU) are prepared and draped before the procedure, readily available close to the operating table if required.

1. Small events (clashes) are signalled by audible and visual notifications that do not significantly affect the progress of the procedure. These events are triggered by the following:
   - Collisions of the robotic arms
   - Collisions of the instruments with each other or with tissues
   - Excessive rotation of the instrument's wrist
   - Trocar angles that are too steep (phantom clash)
2. In addition to those small events, the Versius system also reports more critical improper events, categorized as MPAs (medium priority alarms). Those alarms are activated by excessive force on the robotic arm due to the following:
   - Dynamic collisions between robotic arms
   - Decreased abdominal insufflation
   - Inadvertent patient movement on the operating table (sliding caused by the Trendelenburg position)
   - Increased abdominal pressure due to insufficient muscle relaxation (anaesthesia-related)

MPAs necessitate a restart of the affected unit with a self-test (power-on self-test (POST)).

3. The most severe events – HPAs (High Priority Alarms) – lead to the exclusion of the affected BSU from the surgery. A BSU must be swapped under standard settings during the operation. In most cases, this involves one element of the platform (console, BSUs) not the entire system. This approach allows the operation to continue without interruption. BSUs not affected by an alarm can remain operational until the malfunction is fixed.

These major alarms demand immediate attention because they can significantly impact the proper functioning of the system and the surgical procedure. Given that the Versius robotic system is relatively new and continuously evolving, the team encountered several incidents, including both medium and major alarms, which were successfully resolved during its operation.

Table 2 presents all the above-mentioned data related to the performance of the Versius robotic platform. Figure 3 presents the number of minor incidents in relation to the number of procedures over time in our case series.

DISCUSSION

Prostate cancer stands as one of the most commonly diagnosed cancers in men globally, presenting a significant health challenge that necessitates a comprehensive approach, incorporating various treatment modalities including robotic prostatectomy. The objective of our study is to present and assess the outcomes of a group of 58 patients who underwent RARP due to prostate cancer, and to evaluate the performance of the Versius robotic system.

Table 2. *Versius system performance*

1. Small events (clashes)	1266 (range 3–107)
2. MPAs	14
3. HPAs	0
4. Instrument swaps (malfunction)	43 (range 1–6)
5. Console alarm	0
6. System failure	0

BSU – bedside unit; MPAs – medium priority alarms; HPAs – high priority alarms

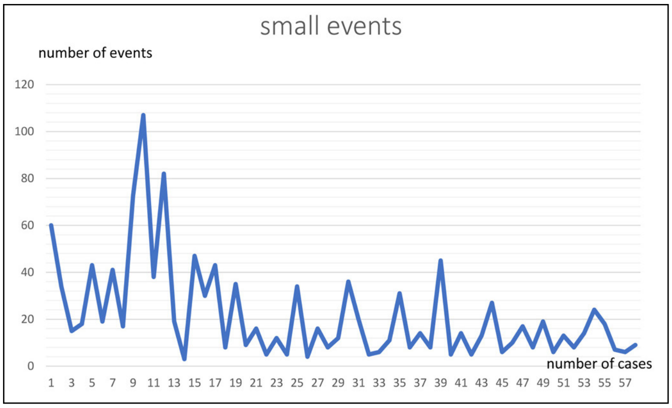

Figure 3. *The number of minor incidents in relation to the number of procedures over time.*

We retrospectively collected medical data for this patient group over a span of 6 months. The results and conclusions presented herein aim to offer insights into the performance and effectiveness of a urological team without prior experience in robotic surgery and into the performance of the new Versius robotic platform.

Our patient group comprised individuals across the same diverse risk factor categories as reported by other authors [10, 11]. This group includes 7 (12.06%) classified as low risk, who opted for RARP rather than active surveillance and underwent the RARP procedure. Furthermore, the data presented regarding early urinary continence after the procedure are consistent with findings in other publications [12].

The Versius system is one among several new robotic platforms available in the market alongside systems such as Hugo RAS, Hinotori, Avatera, and more, with the Da Vinci system being the most well-known and widely used [13]. Each platform offers its set of advantages and disadvantages. Ultimately, the choice of which platform to utilize depends on the specific surgical procedures, the preference of the surgeon, and the healthcare system in place.

All these robotic systems support various surgical procedures including prostate operations for benign prostate hyperplasia [14] and other urological procedures [15] not limited to RARP. They offer benefits such as enhanced precision with wrist-like instruments, precise control and stability of the surgical arms, and excellent 3D vision, making surgical procedures more comfortable to perform [16]. However, these may differ from one another in certain aspects, such as open or closed console design, hand or foot-controlled manipulators, instrument size, and combined or separated arms [17]. The features are important, but they do not greatly influence the general concept of the robot-assisted surgery. Unfortunately, all of them are very expensive, but we believe that the competition will reduce the prices and accelerate the technical progress. When comparing different robotic platforms, a major difference is the cost and affordability. The Da Vinci system is the most expensive [18], while Versius is designed to be more accessible and affordable [13]. This affordability makes the Versius system potentially more widely available, particularly for hospitals and healthcare systems in developing countries. The Hugo system falls between these 2 robotic systems, being somewhat expensive but designed with adaptability and flexibility in mind [19].

The CMR system we have introduced possesses several favourable characteristics worth mentioning. It is generally small and relatively lightweight, making it easy installable in nearly any operating room without requiring structural modifications. The independent arms enhance ease of docking, even in non-standard setup. The number of arms can be adjusted as per the case, and all components can be readily transported and stored within an operating room or hospital. Furthermore, it can be seamlessly integrated with available surgical devices in the operating theatre. Endoscopic vision and electrosurgery can be provided using the standard endoscopic tower-set, reducing costs. Our team used a standard Covidien laparoscopic set in a standard operating room without any structural adaptations.

The Versius instruments are also the smallest from those available on the market, with a diameter of 5 mm and shorter length of 30 cm [20]. The smaller incisions associated with these instruments can lead to reductions in pain, scarring, infections, and port site herniation. Additionally, the smaller instrument size facilitates conversion to laparoscopic surgery if necessary. However, the reduced instrument size may impact the strength of their jaws and their overall effectiveness, primarily for scissors and Maryland grasper. The company is actively working on improving these issues. [21]. One innovative feature of the Versius robotic platform is its modularity and small size, allowing for easy transport within the surgical theatre and the ability to use additional BSUs as needed. This flexibility empowers the surgeon to adapt to different patients and surgical scenarios, particularly in obese cases. The modularity and small size eliminate the need for special adaptations of the operating room, which is required for the larger Da Vinci system [22, 23].

Another feature under development is a robust security control system. This system proactively notifies personnel of situations where undesirable interactions between instruments and the patient's body may occur. It displays multiple types of alarms and can even halt the system when necessary. Some of the potential issues it detects include clashes between instruments, excessive force applied to tissues, lack of wrist rotation during manoeuvres, and other anomalies. These issues are usually solvable without interrupting the procedure, although there are also medium level alarms that can temporarily halt the operation until the problem is resolved. In rare cases, the highest level of alarms may be triggered by inadvertent changes in patient position, console malfunctions, or BSU malfunctions. When these alarms activate, the surgical team must promptly address and resolve the issues before the system can resume its work. While this robust security control mechanism significantly enhances patient safety, there have been occasional concerns about minor alarms causing brief delays in surgery. Consequently, the company is diligently analysing and refining the system to optimize its performance.

Another characteristic of the Versius robot is its constant online telemonitoring capability. This feature primarily aims to facilitate technical service supervision, ensuring the system operates smoothly. It also presents opportunities for data recording.

The recorded data can have numerous implications, such as enhancing surgical training, evaluation, and certification processes.

It is essential to emphasize that all the mentioned features of complex surgical tools like the Versius robot, as well as other surgical robots, must undergo thorough exploration before implementation. This exploration is achieved through comprehensive training programs provided by the companies, which typically include virtual simulations, cadaveric exercises, and supervised stages to ensure that surgical teams are well-prepared and competent in operating the robotic systems effectively and safely.

CONCLUSIONS

Our team successfully initiated a robotic surgery program using the Versius robotic system. We believe that our shared experience can offer valuable insights into what a new, inexperienced robotic team can expect when beginning to use the Versius system and what surgical results can be achieved, particularly as there are not many reports on the RARP procedure with the Versius. The key message is that the implementation can be quick and effective, provided that all necessary teaching steps are fulfilled.

The system has its specific characteristics, but the overall concept of robotic surgery resembles the better known DaVinci platform, with its own advantages and drawbacks. We anticipate that competition will drive the development of all these systems.

Further studies and comparative analyses are required to evaluate the clinical outcomes and cost-effectiveness of this technology.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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