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Upper urinary tract surgery and radical prostatectomy with Senhance® robotic system: Single center experience—First 100 cases

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Abstract

Background: The Senhance® robotic surgery system is a novel robotic platform used in several European and World centres. We present our experience in urologic surgery using this platform.

Patients and Methods: From May 2019 to December 2020, we performed 30 operations of upper urinary tract (UUT) and 70 extraperitoneal radical robotic prostatectomies (RRP). Relevant data were prospectively collected for key outcomes.

Results: The median age for UUT was 51, and for RRP 65 years. The average estimated blood loss for UUT was 30, and for RRP 200 ml. The average operating time for UUT was 160, and for RRP 200 min. In-hospital stay for UUT was on average 4, and for RRP 5 days. In UUT group, one patient had Clavien–Dindo complication grade II and one had IIIb. In RRP, three patients had grade I complications and three patients had grade II complications. Catheter was removed on average 8 days after RRP.

Conclusion: The Senhance® robotic system is a safe and feasible approach to urological surge.

KEYWORDS
adrenalectomy, minimally invasive surgery, nephrectomy, prostate cancer, pyeloplasty, radical prostatectomy, robotics, Senhance®

1 | INTRODUCTION

The Senhance® robotic system was approved by the Food and Drug Administration in 2017 and it is a new robotic platform that can be used for a wide range of surgical procedures. The number of institutions using this system is increasing, especially in Europe where the availability of other robotic systems may be limited compared to the United States.[1]

Searching the PubMed database (until November 2020), we found 36 publications related to the Senhance® surgical system, mainly on abdominal and gynaecological surgery, while only three publications describe urological procedures (two from our institution describing robotic radical prostatectomy [RRP] and one from Lithuania).[2–4] We have been using the Senhance® surgical system for adrenalectomy and nephrectomy since May 2019, and in November 2019, we have started extraperitoneal RRP. Here we present our experience with Senhance® robotic surgical system in several urological procedures.

2 | PATIENTS AND METHODS

From May 2019 to December 2020, we operated 100 patients using the Senhance® robotic system (TransEnterix, Inc.). Before the surgery, all patients were presented to our multidisciplinary team to select the best treatment option. Those eligible for laparoscopy were

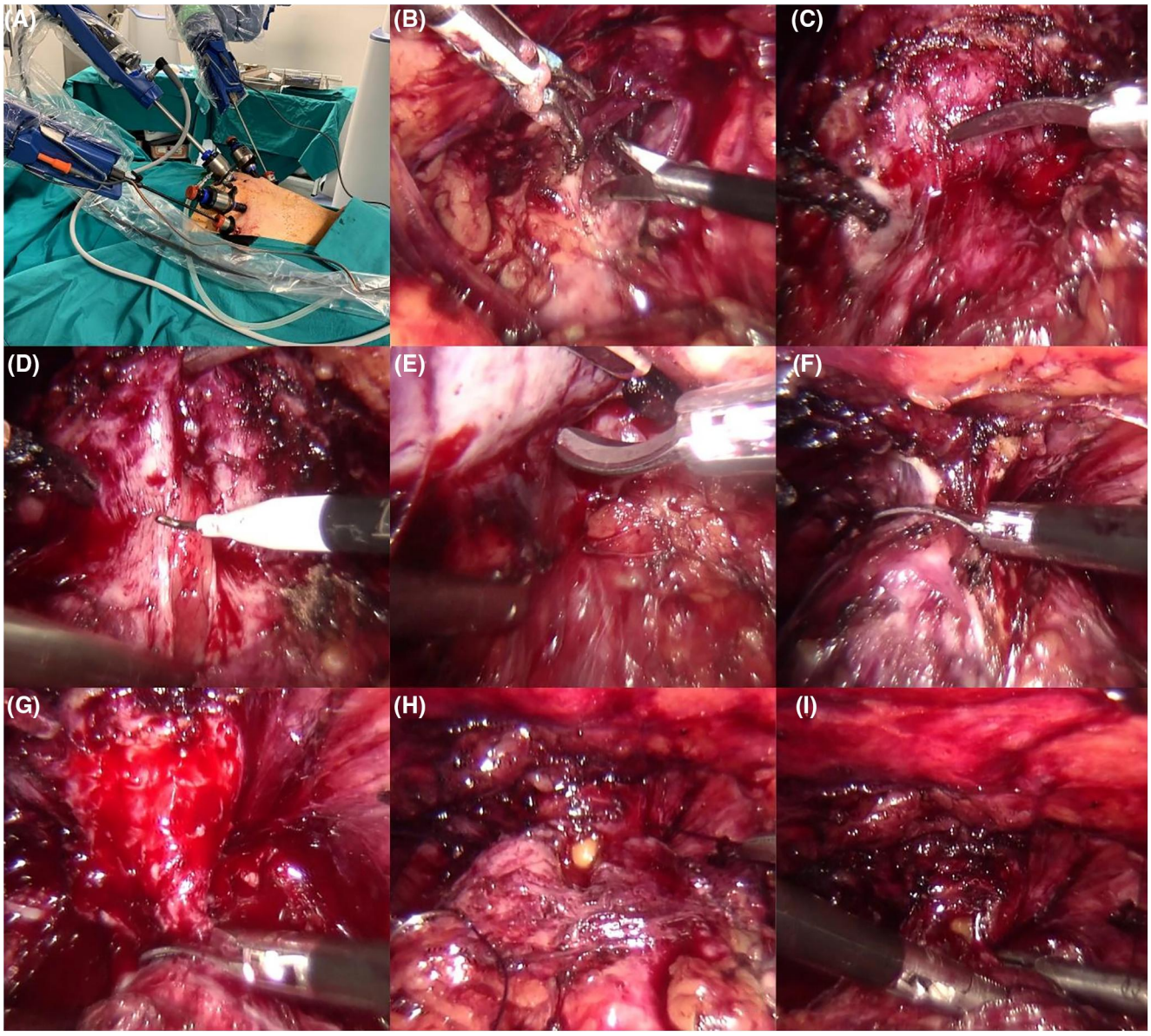

FIGURE 1 Photographs of the selected parts of the extraperitoneal robotic radical prostatectomy with Senhance. (A) Position of the trocars with robotic instruments in place. (B) Incision of the endopelvic fascia. (C) Moment before incision of the urethra at the bladder neck. (D) Incision of the posterior bladder neck. (E) Developing of the plane between the prostate and the rectum. (F) Incision of the dorsal venous complex. (G) Incision of the urethra at the prostatic apex. (H) Placing the urinary catheter after suturing the posterior part of the anastomosis. (I) Suturing anterior part of the anastomosis

offered robotic surgery. All data were collected prospectively. The average age of the patients was 60 (24–79) years. All upper urinary tract (UUT) patients had benign diseases, and all prostate cancer (PCa) patients had clinically localised disease without metastases based on prostate-specific antigen (PSA) level, digital rectal exam, number and percent of positive biopsy cylinders, Gleason score (GS) and additional imaging modalities (computerised tomography or magnetic resonance imaging) if needed. We have calculated the risk for lymph node metastases based on the novel Briganti nomogram and performed a laparoscopic lymphadenectomy if indicated.[5] Average PSA was 7.1 (4–15) ng/ml. Clinical stage was from T1c to T2c. Average prostate volume calculated using ultrasound was 40 (20–100) ccm. Patients were generally in good health without absolute contraindications for laparoscopic surgery. Their American Society of Anesthesiologist score was ≤3 and BMI <30, (only one patient had BMI 34). Complications were assessed using the Clavien–Dindo classification.[6] Pathology data, including grade, extraprostatic extension, seminal vesicle invasion and surgical margins (for PCa) are reported. Pathology data, intraoperative blood loss, urinary continence and operative time have been compared between the first 40 and second 30 cases. Statistical analyses between groups have been conducted with the Fisher's exact test or χ^2 test. The study was approved by the Institutional Ethical Review Board (approval number 02/21 AG) and all participants signed informed consent.

2.1 | Surgical technique

Extraperitoneal robotic radical prostatectomy surgical technique was described in our previous publication (Figure 1).[2] We are a high-volume laparoscopic adrenalectomy centre with over 800 laparoscopic adrenalectomies performed during the last 20 years, our adrenalectomy procedure and results were published in 2011.[7] When we started robotic assisted laparoscopic adrenalectomies, we decided to combine our previous laparoscopic experience with technical requirements of the new robotic system. The operative approach was lateral transperitoneal, but the patient positioning and trocar placement were slightly modified to accommodate the 0° camera since our laparoscopic procedures are performed using a 30° camera. The camera port is thus positioned a few centimetres laterally and the left and right arm working ports are preferably positioned a palm's width apart from the camera port in the epigastric and lower abdomen quadrant area (Figure 2). This is the necessary working position because in this way the working space of each instrument inside the body is optimal, and the robotic arms outside have enough space to move around avoiding collision (Figure 3). Pneumoperitoneum achievement, trocar placement and the initial steps are identical to laparoscopic adrenalectomy, as previously published.[7] Once the pneumoperitoneum is achieved and the operative field inspected, the robotic instruments are docked. Gland preparation and dissection are performed using a monopolar hook and a bipolar grasping instrument. First, we mobilise the adrenal gland on the medial, superior and inferior side. This allows for the lifting the gland off the muscle and clear exposure of the adrenal vein. The vascular clipping of the adrenal vein is performed by the assistant using Hem-o-lock clips. After cutting the adrenal vein, the gland is further dissected from surrounding tissues, removed and placed in an *endobag*. After completion of haemostasis the bag is removed by extending one trocar incision, usually the one in the lower lateral abdominal quadrant. After the suturing of the peritoneum and reinflation of the pneumoperitoneum, second look haemostasis, if necessary, is performed laparoscopically as well as drain placement. The incisions are sutured in a standard fashion.

For kidney surgery ports are placed in similar fashion. However, considering the anatomical position of the kidney in each patient, we modify the position of trocars in the craniocaudal line. Robotic surgery is performed similarly to laparoscopic approach while we mostly use robotic monopolar hook and a bipolar grasping instrument.

3 | RESULTS

We have operated 19 women and 81 men. Median age for UUT was 51 (24–75), and for RRP 65 (45–79) years. The average estimated blood loss for UUT was 30 (0–200), and for RRP 200 ml (100–700). The average operative time for UUT was 160 (60–280), and for RRP 200 (120–305) min. Average hospitalisation for UUT was 4 (2–9), and for RRP 5 (4–7) days. In the UUT group, one patient had Clavien–Dindo complications grade II and one patient had IIIb, and for RRP three patients had grade I and three grade II complications. Drain was removed after a few days (when secretion was <50 ml), and the catheter for RRP on average 8 (6–15) days after surgery.

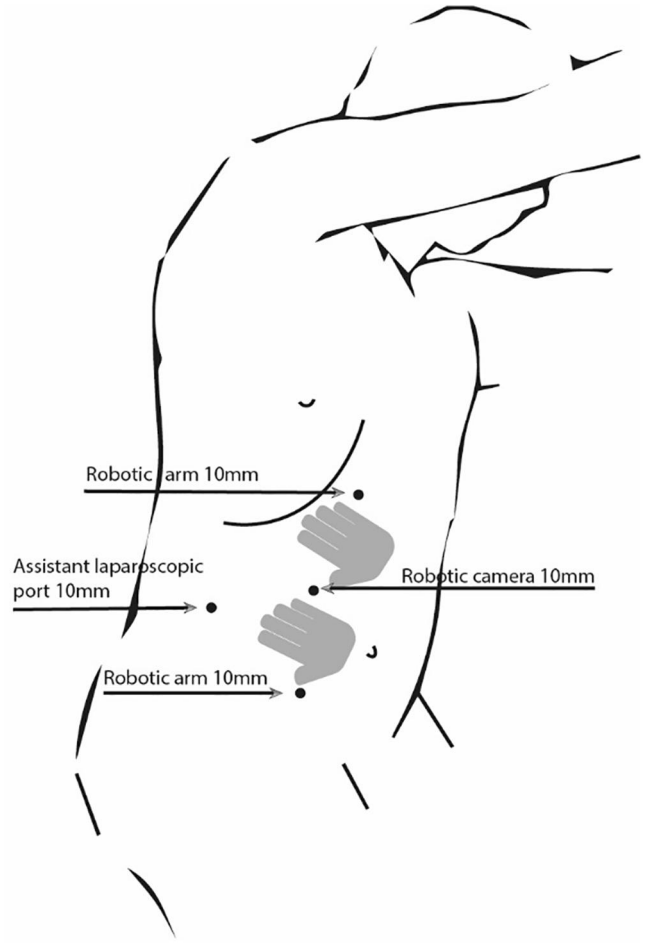

FIGURE 2 Position of trocars for robotic adrenalectomy. Robotic trocars have to be separated at least palm's width. For kidney surgery, the position of trocars was the same, however they are slightly repositioned craniocaudal reflecting the expected position of the kidney

Data of UUT are shown in Table 1. For RRP the most common GS was 3 + 4, followed by GS 3 + 3, 4 + 3, but we also had three patients with GS 4 + 5. Tumour stage was T2 in most patients, although we had 12 patients with T3a/b stage of disease, and 18 (25.7%) patients had a positive surgical margin. Visual Analog Scale for pain score for the first postoperative day was on average 3.0 (1–8), the second day 1.5 (0–5), and on the day of the discharge from hospital 0.5 (0–5). Overall urinary continence was 88.6%, with follow-up time of 2–15 months. Comparison of parameters between the first 40 and second 30 cases is reported in Table 2.

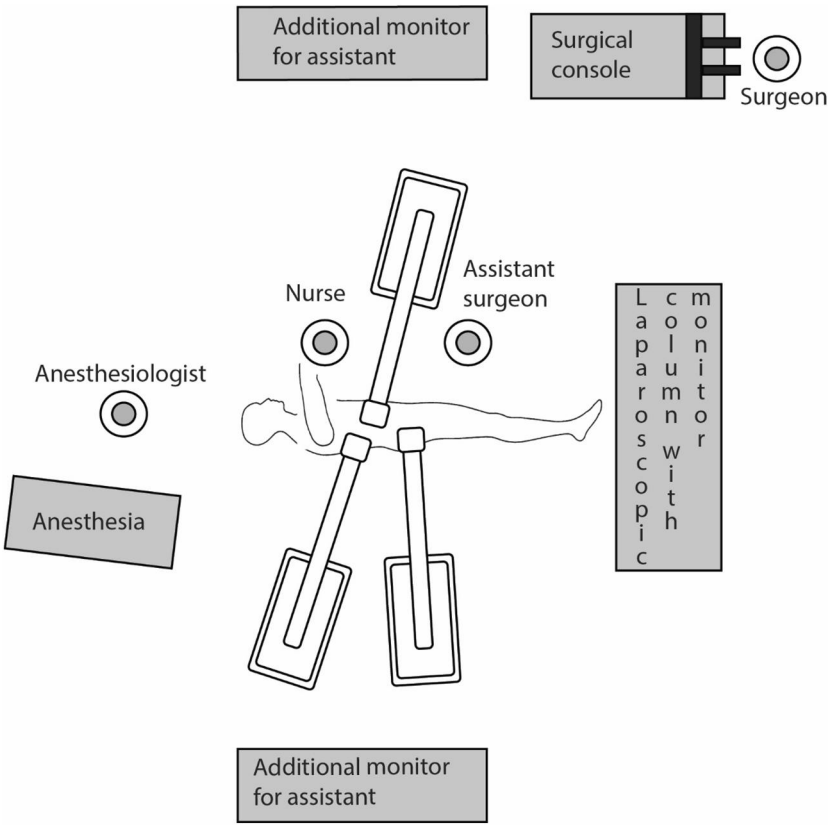

FIGURE 3 Position of robotic arms and surgical team for operations in upper urinary tract

Procedure	Number	Clavien–Dindo grade
Adrenalectomies (adenoma) size: 1.7 cm (1–3)	9	One patient: IIIb—bleeding
Nephrectomy (nonfunctioning kidneys)	6	One patient: II—fever
Kidney cyst fenestration size: 12 cm (9–18)	11	
PU reconstruction	4	

TABLE 1 Data for 30 upper urinary tract procedures, pathology and complications

4 | DISCUSSION

Today, the vast majority of robotic operations are performed using the DaVinci surgical platform, but new systems are coming in the field of robotic surgery, and the Senhance® surgical system is one of the first. However, these new systems have to confirm their safety and effectiveness. Currently, there are only two centres (our and Lithuanian group) that have published their experience in urology using Senhance® surgical system from actually a small number of procedures. The group from Lithuania presented their first 100 cases using Senhance® for various abdominal, gynaecological and urological procedures. They performed 27 RRP, 1 varicocelectomy, 1 pyeloplasty, 1 pyelolithotomy and 1 nephrectomy, a total of 31 urological procedures. They did not present their isolated data for RRP patients (they are planning to show them in the near future in a separate paper) but they showed that out of six (6%) patients who had complications, four (more than half) had RRP, with intraoperative bleeding greater than 500 ml. In their study the RRP was the procedure associated with the most complications compared to other abdominal and gynaecological procedures. Our team had no experience with abdominal and gynaecological procedures, and in our first 70 RRP the average estimated blood loss was 200 ml, and although we had patients who lost more blood intraoperatively (mainly during dissection of dorsal vein complex) only one of the patients had blood transfusion after the surgery. Given their technique and possible differences between ours and their approach, we have no additional technical data from them to compare, but we can comment on the use of articulatory instruments for the anastomosis they used. We find that the Radia (Senhance® articulated needle holder) is relatively robust and not easy to manipulate deeply in the male pelvis, so we used one needle holder and one grasper on robotic arms without any problem. The company is developing a new 5-mm Radia and in future we expect that this instrument will facilitate anastomosis suturing. We have used a 10-mm Radia instrument for pyeloplasty and can report that it can facilitate suturing, however, it has its own learning curve.

Data on Senhance® Surgical System in adrenal and renal surgery are even more limited than for the prostate, and are mainly

TABLE 2 Patients data and results of 70 extraperitoneal robotic radical prostatectomies

Patient data	Median (range)	Interquartile range (IQR)
Age	65.0 (45–79)	61–72
PSA	7.1 (4–15)	5–10
Prostate vol. (ml)	40 (20–100)	33–55
Operating time (min)	200 (120–305)	180–230
Estimated blood loss (ml)		
Overall	200 (100–700)	150–400
First 40 cases	300 (100–700)	200–500
Last 30 cases	150 (100–400)	100–300
Hospital stay (days)	5 (4–7)	5–5
VAS pain score		
First postoperative day	3.0 (1–8)	2–5
Third postoperative day	1.5 (0–5)	0–2
At discharge	0.5 (0–5)	0–1
Catheter removal (days)	8 (6–15)	7–11
	No. of patients (%)	
Biopsy Gleason score		
3 + 3	35 (50)	
3 + 4	26 (37.1)	
4 + 3	9 (12.9)	
Clinical stage		
cT1c	39 (55.7)	
cT2a	11 (15.7)	
cT2b	18 (25.7)	
cT2c	2 (2.9)	
Clavien–Dindo classification		
Grade I (fever, hypertension, haematuria with vesical tamponade)	3 (4.2)	
Grade II (pneumonia, paroxysmal atrial fibrillation, anaemia requiring blood transfusion)	3 (4.2)	
Pathological stage		
pT2	56 (80)	
pT3a	9 (12.9)	
pT3b	5 (7.1)	
N1	1 (1.4)	
Positive surgical margins		*p* Value
Overall	18 (25.7)	
First 40 cases	11 (27.5)	
Last 30 cases	7 (23.3)	0.414
Positive surgical margin in correlation with pT stage		
T2	14/56 (25)	

(Continues)

TABLE 2 (Continued)

	No. of patients (%)	
T3a	3/9 (33.3)	
T3b	1/5 (20)	0.310
ISUP grade group 1 (Gleason 3 + 3)	11 (15.7)	
ISUP grade group 2 (Gleason 3 + 4)	46 (65.7)	
ISUP grade group ≥ 3	13 (18.6)	
Urinary continence[a]		
Overall	62 (88.6)	
First 40 patients	33 (82.5)	
Last 30 patients	29 (96.7)	0.126

[a]1 or no pad per day.

presented as experimental technique on porcine model.[8] We performed 30 operative procedures of adrenal gland and kidney without any significant complications and with good functional outcome (for pyeloplasty based on creatinine levels, ultrasound and scintigraphy). The average time of robotic adrenalectomy was 170 min which is longer compared to laparoscopy in which we have extensive experience, and we expect to reduce that time with experience. Furthermore, we expect that robotic ultrasonic instrument that we plan to acquire will significantly influence time of procedure.

When we started with Senhance® Surgical System, the whole team needed a significant amount of time to prepare everything for surgery, also during the procedure we spent more time removing and placing robotic instrument compared to laparoscopy but with the experience, this time significantly reduced and now it can be done much faster. Currently, our docking of the robot takes less than 5 min.

At least 30 cases are required to achieve considerable proficiency and the learning curve is reduced in a surgeon with previous laparoscopic experience.[1,9] Our preliminary data are showing that with experience, the estimated blood loss, positive surgical margins and operative time are reduced (in most of the last 30 RRPs we have performed a lymphadenectomy so that this difference is not observed in the reported operative time). However, currently there is no statistical significant difference between the groups.

Based on our experience we can only confirm the conclusions from other studies that Senhance® robotic system is feasible and safe for various surgical procedures, including urological ones. Furthermore, this system offers several important advantages over laparoscopy and some other robotic platforms, such as better visualisation-magnification, 3D vision, eye tracking technology (significantly improved by new upgraded software), articulated instruments, haptic feedback and comfortable seated position. What is also important is that the instruments are reusable and that the costs of maintaining and using the Sentence® platform are significantly lower compared to the DaVinci system, although an actual comparison could only be made if both systems were available.

During our 100 operations we had to replace and acquire new robotic reusable instruments just several times, to be more precise we have replaced five scissors and one bipolar. Finally, the conversion to laparoscopy can be done easily, quickly and safely, just by removing the robotic and placing the laparoscopic instruments.

To conclude, the number of robotic operations is increasing and this is likely to be the dominant type of surgery in the future. Our case series results show that Senhance® robotic surgical system is safe and versatile. It is adaptable and can be positioned to perform all usual urological laparoscopic operations and provide the benefits of robotic surgery with lower costs. Long-term follow-up of a large number of patients is required to assess actual functional and oncological outcomes.

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None.

CONFLICTS OF INTEREST

All authors have nothing to disclose.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available upon reasonable request, from the corresponding author.

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