

Academician Zeljko KASTELAN<sup>1,2</sup> MD PhD,  
Assistant Professor Tvrtko HUDOLIN<sup>1</sup> MD PhD  
and Tomislav KULIS<sup>1</sup> MD PhD.

## **ROBOTICS IN UROLOGY – UNIVERSITY HOSPITAL CENTER ZAGREB, OUR EXPERIENCE**

### **Abstract**

Robotic surgery as a minimally invasive procedure has now been considered, for some time, the best operative method in many surgical fields, including urology. We present here the advantages of robotic surgery with an emphasis on the Senhance® robotic platform, which we have been using for more than 2 years, mainly for radical prostatectomy, but also for other upper urinary tract surgeries at our institution. This system has an open cockpit and four robotic arms, eye-tracking technology and 3D vision, articulated instruments and feedback function, a comfortable and adjustable seat for optimal position and, most important, reusable instruments, significantly reducing costs, therefore bringing this new and exciting technology with all its benefits for patients and surgeons at a lower cost.

**Key words:** robotic surgery, radical prostatectomy, Senhance®, minimally invasive surgery

### **Introduction**

Since 2000, when the DaVinci® robotic surgical system was first introduced in urology, there has been a significant shift from open to robotic

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<sup>1</sup> Department of urology University Hospital Center Zagreb and School of Medicine Zagreb, Croatia

<sup>2</sup> Croatian Academy of Sciences and Arts, Zagreb, Croatia

surgery, especially in radical prostatectomy (RP). Although it was initially planned as a robot for cardiothoracic surgery, its application has expanded to many areas of surgery over these past two decades.<sup>1</sup> Open surgery will not go away, but it has been significantly replaced by a robotic approach, especially in the United States (US), where the vast majority of RPs are now performed using the DaVinci® platform which has been considered the gold standard for minimally invasive treatment of prostate cancer for some time now.<sup>2</sup>

Robotic surgery offers several important advantages over open surgery, to both the patient and the surgeon.<sup>3</sup> Patients operated on by the robot have less blood loss, spend fewer days in the hospital, have smaller incisions and scars, and thus less pain, and also mobilize shortly after surgery. They return to their usual daily activities earlier, but they also return to work earlier. There are benefits for the surgeon as well. For example, it is certainly more comfortable to sit and work, while tremor and movements are corrected or amplified by the robotic arms, compared to standing and applying the physical force needed to create space to access or to manipulate the target organ or tissue. Furthermore, robotic platforms allow for augmentation and thus better visualization of anatomical structures located deep in the pelvis, which is important for the oncological and functional outcomes of RP. But those benefits come with a price that, while significant, can be justified even for lower-income countries compared to Western countries, especially the US, when all benefits are taken into account.

The cost of DaVinci®'s robotic platform is approximately US\$2 million, with maintenance costs around US\$200,000 per year, plus the additional cost of disposable instruments for each operation. These disposable instruments can vary significantly, from several hundreds to several thousand of US dollars, therefore it is not a cheap procedure.<sup>4</sup>

There is a logical question as to what we receive for this price? In order to answer this question many variables must be taken into account, but still, we will not receive a universal answer. Why? Because many of these variables are different for different countries. For example, in the Western world, especially in the US, health care providers encourage hospitals to reduce the length of hospital stay (in days), which is considered one of the most important variables which reduces the cost of the procedure, thus increasing hospital earnings. That's why there is such a strong desire for hospitals to increase their use of robotic RP, after which, patients can be

discharged on the first day or even the same day. This is becoming an increasingly common practice in the US.<sup>5</sup> In many other countries, especially former Socialist ones, including Croatia, hospitals are still not under any strong pressure to discharge patients as quickly as possible. In a recent analysis of the 25 European Union member states, for which data are available for 2016, the two countries with the highest average length of hospital stays were the Czech Republic and Croatia.<sup>6</sup> There are several reasons for this. One of the most important is traditional (in the former Socialist countries, patients are used to stay longer in the hospital). It is also important to state that we still do not have large private hospitals or large private insurance companies that will support shorter hospitalization in order to reduce costs and increase profits. But that is changing because the benefits of one or two days in the hospital made possible by robotic surgery are becoming more and more obvious, and we will surely go towards this in the near future.

Another important advantage of robotic surgery is minimal blood loss, especially compared to open RP, where intra-operative blood loss can be more than 500 mL.<sup>7</sup> This is also something that must be considered when comparing the cost of open and robotic prostatectomy. The use of blood has its price, moreover, there is always, albeit a very small, nevertheless permanent risk of getting blood-borne diseases if a patient needs a transfusion. Less pain after robotic RP is also something that may not be crucial, but it is certainly important for the patient as well as early mobilization, which can all reduce costs but also reduce the likelihood of some complications associated with prolonged bed rest.

Furthermore, patients operated on with robotic platforms return earlier to their usual activities and work compared to open surgery and therefore significantly reduce sick leave costs.

There is also one very important question we need to ask ourselves when thinking about robotic surgery, its need, cost, and benefits. What kind of urologists we would like to be? Those whose time is slowly passing, or those whose time is coming or rather has come? This is especially important for young urologists: if they do not learn minimally invasive urology, they will not be competitive, and it will be much harder for them to find a job. But this should not be limited to them, and older urologists could and should learn new methods. Their experience from open surgery can be used as an advantage when switching to minimally invasive procedures. Of course, this

is something we are only partially responsible for because hospital management has to buy a robot and has to send the surgeon for training. But if one is not aware of all these benefits and if one does nothing to present them to hospital management, one will certainly not receive a robot.

It is also important to say that a good and motivated assistant is very important for robotic prostatectomy, but also that the support of the entire surgical team is needed: from nurses and technicians in the operating room to anesthesiologists, especially at the introduction of the robotic method. Our experience

At the end of 2018, our hospital purchased the Senhance® robotic platform. This platform was originally designed and manufactured by an Italian company, which was later bought by the American company Trans Enterix, Morrisville, NC, US, and was approved by the Food and Drug Administration in 2017. It is an open cockpit platform with four robotic arms (Fig 1a and b). This was our first real contact with a robotic platform. After initial education at our institution, members of the surgical team went to Italy to an animal farm for additional training on pigs and we visited one hospital in the Netherlands, where we watched RRP. Upon our return to Zagreb, we started surgery, mainly on the adrenal gland, kidneys, and radical prostatectomy. Our surgical technique and our experience have already been published in detail.<sup>8,9,10</sup> Here we will present few important aspects related to robotic RP.

We decided to use an extraperitoneal approach for two reasons. First, we had experience with it because we were using it for laparoscopic RP, and the same approach was used in the Netherlands. We think that the extraperitoneal approach is a good approach for RP. The only problem we had was when we accidentally opened the peritoneum and had to increase the opening in the peritoneum to reduce the pneumoperitoneum. Using an extraperitoneal approach, the surgeon avoids the abdominal cavity and potential associated morbidity.

We still do lymph node dissection, when indicated by a laparoscopic approach, for the same two reasons. We hope to improve our technique, step by step, and as a next step we plan to perform a robotic lymph node dissection. This will likely require more planning and consultations as well as learning by doing.

What we noticed in our series is a relatively higher rate of positive surgical margins for the disease stage. It has already been shown that the risk of positive margins decreases with surgeon experience.<sup>11</sup> We also hope to decrease that rate by increasing the number of procedures we complete. Another fact that is important to note is that since we used a laparoscopic instrument to hold and manipulate the prostate, there is also the possibility of iatrogenic prostatic disruption, as already shown. Minor surface abrasions or lacerations of the prostate are seen in a significant proportion of laparoscopic RP. The act of grasping and manipulating the prostate *in situ* commonly traumatizes the surface of the gland, resulting in iatrogenic positive margins.<sup>12</sup>

We also showed that with increased experience, we reduced the number of days in the hospital from 6 to 5, as well as a lower estimated blood loss, from 300 to 200 ml. Our average operative time was the same, but we started to see an increase in the number of patients who had lymphadenectomy, further increasing the time of the procedure. This explains the same operative time for the first 40 and 75 cases.<sup>8,9</sup> We expect to improve our results further as we gain more experience. What is also important to note is that, in the beginning, it took us a lot of time to prepare everything for the surgery. Furthermore, we spent extra time removing and setting up the robotic instruments, but with increasing experience we became faster, and now we can change the instruments almost as fast as in laparoscopy. Our docking time for a robot is less than 5 minutes.

We think the Senhance® system has several important advantages over laparoscopy and some other robotic platforms, such as eye-tracking (this is significantly improved with the newer, updated software) and 3D vision, for faster and better visualization by enlarging important anatomical structures. Articulated instruments add additional benefits, and the force feedback function works very well, enabling the surgeon to sense whether he has grabbed the needle or to feel stitch tension when pulling, for example. A comfortable and adjustable seat for optimal position, especially for longer surgical procedures, is also important. What is also very important is the lower cost of maintenance and operation compared to the DaVinci® machine. Although it is not easy to directly compare the two platforms, as prices can be different (especially for the instruments), depending on the supplier and the country, but this could probably only be done if both systems were in the same institution, i.e. the same country. We can thus say that Senhance®

instruments are very good and robust and can be used for many surgical procedures (as in laparoscopy). This allows for a significant reduction in costs, as compared to single use instruments (Fig. 2).

An additional advantage is that since the system is based on laparoscopy, the conversion to laparoscopy can be done very simply, one must only remove the robotic arms and replace the robotic instruments with laparoscopic ones. It may be something that is very rarely seen in robotic RP, but we must also consider possible conversions to laparoscopy for other urological, gynecological, or surgical procedures that are being done, or can be done, with this robotic platform. Since this is a new robotic system, there will probably be cases that will have to be converted into laparoscopy, at least until surgeons gain enough experience. We can therefore say that this is also a possible advantage of the platform.

Based on our experience, but also based on personal communication with other urologists using this platform, as well as based on studies published on PubMed, we can say that Senhance® is a safe robotic platform that can perform numerous urological surgical procedures while reducing costs. Studies of a large number of patients, as well as comparisons with other robotic platforms and other types of radical prostatectomy, are needed to actually assess its oncological and functional outcomes.

In addition to Senhance®, there are a number of new robotic platforms that are in the final stages of development, some are already under testing, and some are in the approval phase or have been approved for clinical use. The increased number of robotic platforms will certainly make this technology more accessible and hopefully cheaper than it is now. As previously mentioned, when we consider the system costs, maintenance, and instruments, there are platforms which have reusable instruments, and this can bring significant cost reductions, making them attractive to hospitals in lower-income countries. Hence, the costs are not really that high if we have carefully selected and if we consider the advantages and disadvantages of each platform, as well as the savings achieved by reducing the number of hospital days, less blood loss, and a faster return to work, just to name a few. In any case, robotic surgery is not the future, it is the present, and it is imperative that this must be recognized by every hospital that wants to follow world trends and provide its patients with the best possible care.



Figure 1a. and b. – Open cockpit platform and two (out of four) robotic arms (which can be easily moved around the operating room).

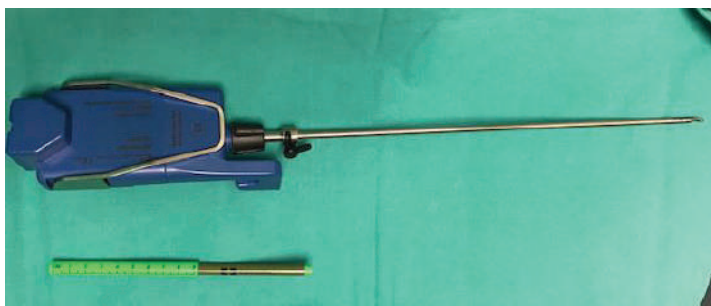


Figure 2 – Senhance® robotic instruments are sturdy and robust and can be reused for many procedures.



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