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REVIEW ARTICLE

Senhance 3-mm robot-assisted surgery: experience on first 14 patients in France

J. Montlouis-Calixte[1] · B. Ripamonti[1] · G. Barabino[2] · T. Corsini[1] · Céline Chauleur[1,3,4,5]

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Abstract

The objective of this article is to present our experience with the 3-mm instruments using the Senhance surgical robotic system in gynecological and abdominal surgery from July to December 2017 by a retrospective observational study. All patients who underwent a robot-assisted 3-mm laparoscopic procedure with the Senhance surgical robotic system were enrolled. Two separate populations were involved: nine female gynecological patients and five digestive surgery patients. Five cholecystectomies, three annexectomies, four ovarian cystectomies, one myomectomy and one endometriotic nodule resection were performed. For the gynecological cases, the median time spent at the console was 37 min (12–77), while the total duration of the intervention was 81.33 min. All the interventions were performed on an outpatient basis. There were no postoperative complications. The average visual analog scale for pain (VAS) was 2.11 (± 1.91) on D0. For the abdominal surgery cases, the median time was 39 min (21–64). The average total duration of the intervention was 87.4 min (± 36.82). One of the five interventions was performed on an outpatient basis. There was one laparoscopy conversion. No postoperative complications in the 2 weeks following the operation. There are few 3-mm instruments available with the Senhance surgical robotic system, which limits the number of interventions. However, it is possible to perform gynecological interventions with 3-mm instruments on an outpatient basis in complete safety. It is possible to perform cholecystectomies by pairing the use of 3-mm and 5-mm instruments. The recent arrival of new 3-mm instruments will enable a wider range of surgical indications.

Keywords Senhance surgical robotic system · 3 mm · Robot-assisted laparoscopy · Gynecology · Cholecystectomy

Introduction

Minimally invasive surgery has demonstrated its benefits over open surgery. Indeed, the use of minimally invasive surgery provides comfort to the patient, both in terms of postoperative pain and from an esthetic perspective, as well as ensuring a decrease in the duration of hospitalization and a decrease in morbidity and mortality while providing excellent quality of care [1].

Robot-assisted surgery was introduced in the 1990s with the "master–slave system" program in order to enhance the aptitude of the surgeon during long surgical procedures. Robot-assisted surgery enables accurate visualization of the procedure performed and increases the precision of said procedure [2].

The da Vinci® ROBOT is currently a pioneer in robot-assisted surgery. However, the high purchase price and the high maintenance costs render it an inaccessible instrument for many structures [3].

In 2013, the Senhance surgical robotic system (formerly named the TELELAP ALF-X) appeared on the gynecological surgery scene and is the only currently available alternative to the da Vinci® ROBOT. This surgical robotic system boasts certain innovations, including high-definition 3D visualization and the eye-tracking system. It is the only surgical robotic system with a haptic feedback that is very close to reality.

✉ Céline Chauleur
celine.chauleur@chu-st-etienne.fr

1 Department of Gynecology and Obstetrics, University Hospital, 42055 Saint-Étienne, France

2 Department of General Surgery, University Hospital, 42023 Saint-Étienne, France

3 INSERM U1059, Saint-Étienne 42023, France

4 University of Lyon, 42023 Saint-Étienne, France

5 Department of Gynecology and Obstetrics, Saint-Etienne University Hospital Centre, North Hospital, Avenue Albert Raimond, 42270 Saint Priest en Jarez, France

Another distinctive feature is the independent arms that enable repositioning and installation of instruments that can all be resterilized and used with 5-mm trocars, with an identical installation to that of conventional laparoscopy [3].

Since February 2017, the Saint-Etienne University Hospital is the only French site with experience of using the Senhance surgical robotic system in surgery. Recently, 3-mm instruments have been added, but as of yet, there are no available instruments with bipolar energy.

The objective of this article is to present our experience with the 3-mm instruments using the Senhance surgical robotic system in gynecological and abdominal surgery.

Materials and methods

This is a retrospective observational study conducted at the Saint-Etienne University Hospital from July to December 2017. All patients who underwent a robot-assisted 3-mm laparoscopy with the Senhance surgical robotic system were enrolled. The data were obtained by consulting the electronic patient records and from a database. Three surgeons performed the interventions. They were all experienced in laparoscopic surgery and they received a specific training for the use of the Senhance system.

The data collected were as follows: age, sex, duration of the intervention, type of intervention, body mass index, diameter of the trocars used, visual analog scale of early postoperative pain, duration of intervention at the console, surgical indication and postoperative complications.

There were two separate populations: digestive surgery with cholecystectomies only and gynecological surgery. All the interventions were performed under general anesthesia with an operating room nurse, a surgical assistant and a circulating operating room nurse who received Senhance training.

Surgical procedure

Gynecological interventions

Patients in the gynecological position, arms alongside the body, one 10-mm umbilical trocar for the 30° optical camera, one 3-mm suprapubic trocar and one 3-mm trocar in the left iliac fossa (Figs. 1, 2, 3). When it was deemed necessary for the intervention, a 3-mm trocar was added in the right iliac fossa for the surgical assistant and/or a uterine manipulator. The instruments used were monopolar scissors and Maryland grasping forceps. All the patients received an infiltration of 20 cc of Naropin 7.5 mg into the umbilical scar at the end of the intervention. All the interventions were performed on an outpatient basis.

Digestive surgery

Patients in supine position tilted forward, legs semi-bent and separated. A 5-mm optical camera was used for two

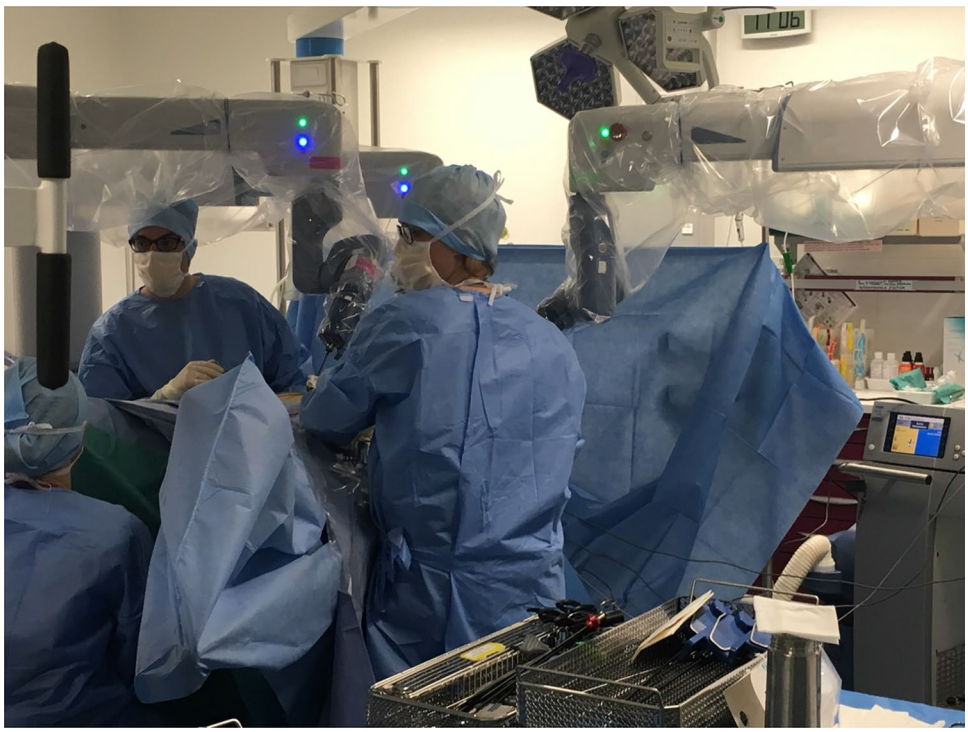

Fig. 1 Classic configuration for hysterectomy by using the Senhance robotic system: 1 scrub nurse, 1 main assistant and another for the uterine manipulator

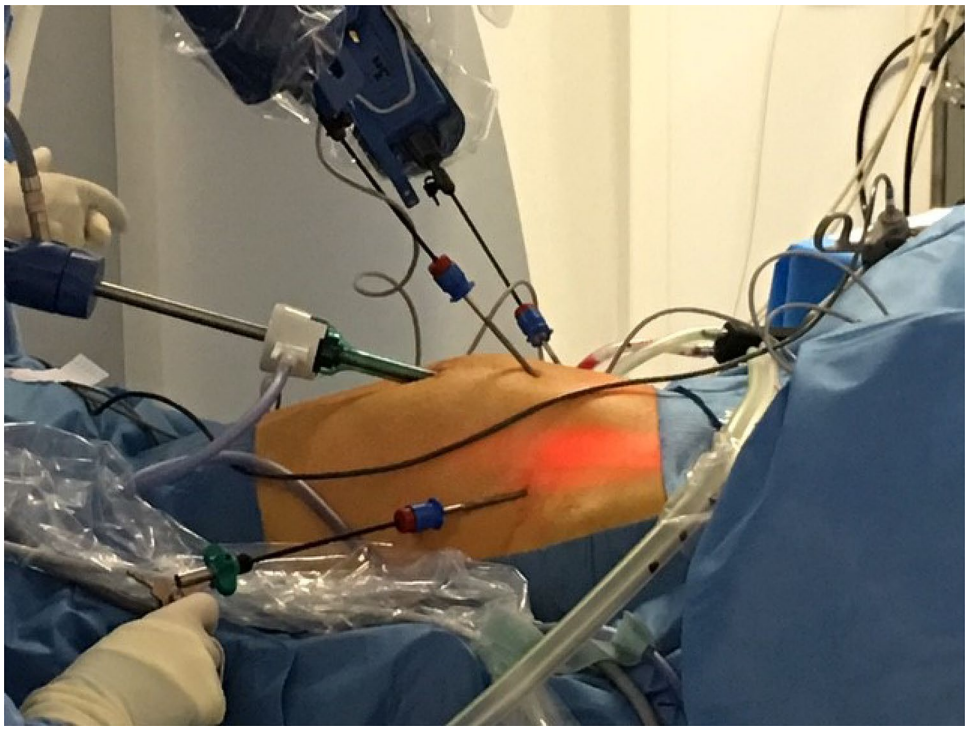

Fig. 2 3-mm instruments of the Senhance robot: we use only two of the robot's arms

Fig. 3 Configuration for a hysterectomy

interventions, which meant that there was no 3D visualization, and a 10-mm optical camera with 3D visualization was used for the other interventions. Three or four trocars were used—a 10-mm umbilical trocar, a 5-mm trocar in the left paraumbilical region and two 3-mm trocars in the right paraumbilical region and the epigastric region. The instruments were as follows: 3-mm grasping forceps without teeth (Maryland) and scissors, classic 5-mm grasping forceps without teeth, 5-mm hook, 5-mm Hemo-Lok clip applier, and 5-mm bipolar forceps. Some interventions were performed on an outpatient basis and others with complete hospitalization according to the digestive surgery department protocol.

Statistical analysis

The data were collected in an Excel table and the statistical analyses were carried out using this analysis tool.

Results

From July to December 2017, 14 patients were enrolled—9 patients for gynecological surgery and 5 patients for digestive surgery. The patients' demographic data are set out in Table 1. Five cholecystectomies, four annexectomies, three ovarian cystectomies, one myomectomy and one endometriotic nodule resection were performed. The median time spent at the console was 37 min (12–77) for the gynecological interventions. The average total duration of the intervention (incision–closure) was 81.33 min (± 19.87). All the patients were treated on an outpatient basis. The average postoperative pain measured according to the visual analog scale for pain (VAS) was 2.11 (± 1.91) on D0. There were no immediate postoperative complications and no repeat hospitalizations. Only one of the eight patients complained of dysuria and persistent pelvic pain at 1 month within the context of pelvic endometriosis.

Four interventions were performed with four trocars positioned, respectively, in the right iliac fossa, left iliac fossa, on the midline and in the navel, and five interventions were performed without the surgical assistant's trocar in the right iliac fossa. The uterine manipulator was used for one intervention only.

There were three men and two women for the digestive surgery interventions. The median time spent at the console was 39 min (21–64). The average total duration of the intervention was 87.4 min (± 36.82). One of the five patients was treated on an outpatient basis. One intervention was converted to a laparoscopy. The average postoperative pain was 1.2 (± 0.98) on D0. There were no complications in the 2 weeks following the intervention.

Table 1 Demographic data of the population studied

	Gynecological interventions	Digestive intervention
Number of patients	*N* = 9	*N* = 5
Sex	9 women	2 women
		3 men
BMI (kg/m^2)	45 (17–54)[a]	45 (19–63)[a]
Surgical indications		
Myomas	1	
Endometriosis	2	
Adnexal pathologies	6	
Acute calculous pancreatitis		2
Calculus migration		1
Biliary colic		1
Acute calculous cholangitis		1
History of abdominal surgery		
Laparoscopy	4	1
Laparotomy	0	1
None	5	3

[a]Median (extreme values)

Discussion

Since it has been established in the robot-assisted surgery market, the Senhance surgical robotic system has displayed a capacity for innovation with regard to the diameter of the instruments used. We have been able to perform around ten simple interventions in gynecological and digestive surgery with 3-mm instruments, but without bipolar energy, in complete safety. Numerous studies have demonstrated its use in gynecological [1, 4–10] and abdominal surgery [11] with 5-mm robotic instruments. Our experience follows on from the previous study by B. Ripamonti et al. (submitted), which demonstrated the feasibility and safety of this new device in a standard laparoscopic configuration at our site.

The low population within our study can be explained, in part, by the low number of 3-mm instruments available within the Senhance surgical robotic system; this limits the types of treatable pathology. In fact, only two instruments were available: the Maryland grasping forceps and the monopolar scissors. This also explains why 5-mm and 3-mm trocars have to be combined in digestive surgery. In the event of the need to perform bipolar electrocoagulation, it was possible to temporarily lift one of the arms from a trocar and the surgical assistant performed hemostasis. The intervention was then continued as a robot-assisted intervention. In addition, given the number of trays, only one operating room intervention per day was possible. One procedure was converted into a laparoscopy due to a lack of experience on the part of the surgical assistant, meaning that adequate safety levels could not be guaranteed for the entire intervention to be performed in the form of robot-assisted laparoscopic surgery. All the patients in the gynecological population benefited from an infiltration of local anesthetics into the scars, which may partially explain the low rate of early postoperative pain. The discrepancy between the median time spent at the console and the total duration of the intervention can be attributed to the difficult extraction of the surgical specimens, in particular extracting large ovarian cysts via the umbilical orifice following cystectomy, and the robot installation time, which was not included in the time

spent at the console. The development of 5-mm articulated instruments is still unavailable at our site to date.

In our study, we did not compare the cost of the Senhance robot compared to the other methods available on the market. A surgical operation with the Senhance robotic system costs as much as a laparoscopy thanks to the use of resterilizable instruments. The only additional cost would be the price of sterile slipcovers uses for the various arms of robot.

Salvatore Gueli Alletti et al. [12] showed that it is possible to perform gynecological interventions with 3-mm instruments.

Conclusion

Our study shows that we can execute gynecological intervention with 3-mm instruments exclusively on an outpatient basis. It is also possible to perform cholecystectomies via the robot-assisted laparoscopic route by combining 3-mm and 5-mm instruments. At present, new 3-mm instruments are available and should enable a wider range of surgical indications. More prospective and randomized studies are required.

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Compliance with ethical standards

Conflict of interest J. Montlouis Calixte, B. Ripamonti, G. Barabino, T. Corsini, C. Chauleur declare that they have no conflict of interest and nothing to disclose.

Ethical approval All procedures followed were in accordance with the 1964 Helsinki Declaration and approved by the ethical committee institutional. Informed consent was obtained from all patients included in the study.

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