Original Article

How to reduce intraoperative preparation and docking time to minimal in a team with a robotic naïve surgical experience?

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Abstract

Purpose: To evaluate the effect of preoperative training in an experimental setting on the preparation and docking of the avatera robotic system.

Materials and Methods: Two different surgical groups (consisting of two nurses, one assistant, and one operating surgeon) attended an initial training on robot draping and docking procedures. Group 1 was involved in 10 robotic-assisted operations while Group 2 was trained in the dry lab using an artificial insufflated abdominal model (10 sessions). The decrease in time needed for docking and draping was evaluated. After the completion of the initial training, each group performed docking and draping procedures in five surgeries (including robotic-assisted radical prostatectomy and pyeloplasty) and the recorded times were compared.

Results: In Group 1, the docking and draping time were diminished during the initial training program from 17 to 7 min and from 12 to 5 min, respectively. In Group 2, the docking time was decreased from 9 to 6 min and the draping time from 8 to 5 min. Both types of training (during real-life OR program vs. dry laboratory setting inclusive an insufflated abdominal model) resulted in nearly the same positive training effect for Group 1 and Group 2, respectively.

Conclusions: Conducing a training of patient preparation and docking in the dry laboratory using an insufflated abdominal model facilitates experience acquisition in a safe and calm environment. The training method of Group 2 might help to avoid the potentially longer anesthesia times for patients during the early learning curve of Group 1.

Keywords: Avatera robotic system, docking, experimental study, learning curve, robot-assisted surgery

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INTRODUCTION

The expanding interest in robot-assisted surgeries (RASs) among different surgical disciplines has led to the standardization and adoption of many surgical techniques. Since 2019, with the expiration of most of the patents held by the da Vinci company, several robotic systems have entered the market. Nevertheless, the current literature is overwhelmed with the already existing da Vinci system.[1]

Generally speaking, robotic procedures compared to open counterparts convey the benefits of minimally-invasive surgeries, such as reduced perioperative blood loss, improved complication rates, and better cosmetic and for some procedures functional outcomes.[2] Compared to laparoscopic procedures, RASs offer better control of the working instruments and more flexible and finer movements. In addition, robotic surgeries are reported to be associated with shorter learning curves.[3] Much of the effort is put into evaluating and reducing the procedure-related learning curves. Whereas, the procedure-independent variables including the draping and docking time are less discussed. The latter variables are often excluded from the analyses when the primary outcome of console time is evaluated.[4] When counting the whole procedure, draping and docking can significantly affect the whole procedure time,[5] especially at the beginning of the transition from open or laparoscopy to RAS. In describing different surgical techniques most of the evaluation is performed for the entire operation time. One of the concerns of robotic surgeries may be the prolonged preparation and docking time. So far, most of the studies evaluating the overall preprocedural patient preparation are based on the data from the da Vinci robotic system. Currently, there is almost no data regarding the safety and effectiveness of these new systems. Authors have demonstrated that the draping and docking times can be minimal.

The study aimed to evaluate the effect of preoperative training in an experimental setting on the preparation and docking of the avatera robotic system (ARS).

MATERIALS AND METHODS

Study design

The study utilized a prospective observational design. The study was approved by the local institutional review board. All patients gave their written consent to perform RASs and use the perioperative data for the analysis.

Two different surgical groups consisting of two nurses, one assistant, and one operating surgeon were included. All the members of both groups had an experience with >100 laparoscopic cases. For both of the groups, initial training in robot draping and docking was conducted by the ambassadors of the ARS. In addition, an internal standardized step-by-step cognitive manual was prepared by the operating surgeons before the start of any procedure. These standardized draping and docking steps were meant to be repeated during real surgeries. After completing the initial training, the first surgical group (Group 1) was involved in performing robot-assisted 4-arm pyeloplasties and prostatectomies. The preparation and docking times were recorded for each procedure. In total, 6 prostatectomies and 4 pyeloplasties were performed over 20 days for gaining experience. After the initial 10 cases, additional five procedures (three prostatectomies and two pyeloplasties) were performed. The latter data were used for the comparative evaluation.

The second surgical group (Group 2) continued the training for draping and docking in the dry laboratory using the artificial insufflated abdominal model. The members of the second group were not involved in the preparation and docking during the initial 10 RASs. The robot draping and docking were performed every second day following the initial recommendations. In total, six anterior dockings (mimicking prostatectomy) and four side docking (mimicking pyeloplasty) were performed. The time required to drape and dock the robot during each session was documented. After these 10 sessions, 3 robot-assisted prostatectomies and 2 pyeloplasties were performed by the second surgical group.

Patient preparation and predefined steps

All patients underwent robot-assisted pyeloplasty or extraperitoneal endoscopic radical prostatectomy. The draping of the surgical unit was performed by two nurses at the time of anesthesia. After initiating general anesthesia, the patients were placed in the respective positions, lateral decubitus for pyeloplasties, and supine position with adducted legs for prostatectomies. Access to the peritoneal cavity and extraperitoneal space was gained using an open Hasson technique. The robotic trocars were placed respecting the 4-finger-breadth distance between the robotic instruments. Thereafter, the surgical unit was brought to the operating table and the robotic arms were mounted to the trocars.

Evaluated parameters

The main variables of interest were the draping and docking times. The comparison between the two groups was performed after the surgical groups had completed either the initial 10 RASs or 10 training sessions. The mean draping and docking times of robotic procedures performed after the initial cases were used to compare the variables. In addition, the time improvement from the 1st to 10th surgery or 1st to 10th sessions was evaluated. The draping time was calculated as the time between switching the surgical unit of the robot and moving the surgical unit toward the patient/training model. The docking time was defined as the time between the start of moving the surgical unit and the end of the docking of all arms, where no movements of the robotic arms were performed. Pitfalls and difficulties, including intraoperative clashing and the need for trocar repositioning, if any, were accounted. The earlier and late postoperative surgical and functional patient outcomes were not interest of to the current study and were not analyzed and compared.

Statistical analysis was performed using SPSS v. 24.0 (IBM Corp., Armonk, NY, USA). A $P < 0.05$ in the Mann–Whitney *U*-test was considered statistically significant.

RESULTS

In total, 15 and 5 surgeries were performed by the first and second surgical groups, respectively. The first group performed six pyeloplasties and nine prostatectomies, whereas the second group performed two pyeloplasties and three prostatectomies. In the first surgical group, the draping and the docking time for the first prostatectomy case were 12 and 17 min respectively. A continuous significant improvement of the above-mentioned parameters was observed during the subsequent six cases reaching 5 min for draping and 7 min for docking.

In the second surgical group, the reported times during the first training session were 8 min for draping and 9 min for docking. The plateau for docking was reached after fifth training session. The mean docking time for the first five cases was significantly shorter compared to the mean time of the 6th–10th cases (7.6 vs. 5.4, $P = 0.05$) [Table 1].

A further comparison between the 1st and 2nd surgical groups was performed using the mean docking and draping separately for prostatectomy and pyeloplasty [Table 2]. The 2nd surgical group did not possess any significant difference in docking and draping times compared to the 1st surgical group [Table 3].

DISCUSSION

In our current study, we evaluated two training patterns to decrease the time needed for the draping and docking procedures before the start of the robotic-assisted urological cases. Based on our results, the surgery and the artificial insufflated abdominal training program can achieve similar docking and draping time for robotic-assisted operations.

The DaVinci Robotic surgical system was a revolution in the field of minimally invasive surgery with great resonance in urology. A second revolution was reported after the expiration of the patents of the da Vinci system. The market was opened to new systems and technologies aiming to improve robotic surgery.[1] Some important innovations were reported by the ALF-X system (Senhance; Trans – Enterix®, Morrisville, USA) system. The position

Table 1: Docking and draping time of the surgeries (Group 1) and dry laboratory sessions (Group 2) during the initial phase

Surgery	Docking time (min)	Draping time (min)	Issues requiring re-mounting
1st surgical group initial phase			
Prostatectomy	17	12	Undocking
Prostatectomy	13	10	Undocking
Prostatectomy	11	7	
Pyeloplasty	14	6	Undocking
Pyeloplasty	11	7	
Pyeloplasty	8	5	
Pyeloplasty	7	5	
Prostatectomy	8	6	
Prostatectomy	7	5	
Prostatectomy	7	5	
2nd surgical group training phase			
1st session (anterior docking)	9	8	
2nd session (anterior docking)	8	7	
3rd session (anterior docking)	8	7	
4th session (side docking)	6	6	
5th session (side docking)	7	5	
6th session (side docking)	6	6	
7th session (side docking)	5	5	
8th session (anterior docking)	5	5	
9th session (anterior docking)	5	5	
10th session (anterior docking)	6	5	

Table 2: Average docking and draping time of the surgeries (after completion of the initial phase)

Surgery	Average docking time (min)	Average draping time (min)	Issues requiring re-mounting
1st surgical group			
Prostatectomy	8	5.3	NA
Pyeloplasty	8.5	5	NA
2nd surgical group			
Prostatectomy	9.3	5	One undocking case
Pyeloplasty	9	5	One undocking case

NA: Not available

Table 3: Comparison of the average docking and draping times between the 2 groups

Surgery	1st surgical group	2nd surgical group	*P*
Prostatectomy			
Docking time	8	9.3	0.205
Draping time	5.3	5	0.374
Pyeloplasty			
Docking time	8.5	9	0.423
Draping time	5	5	1.0

of the surgeon is improved without the need for a closed console and the camera movement was developed using the eye tracking technique.[6] The amelioration of the haptic feedback and the independent placement of each of the four arms are very important elements that separate this robotic system from the DaVinci models.[7] Except for ALF-X, MiroSurge (Medtronic, Minneapolis, USA) constitutes an innovative robotic system. This new system is characterized by a specially opened console with an auto-focus monitor. The three lightweight arms provide tactile feedback thanks to the potentiometers. Clinical trials followed by the insertion in the market are the next steps for MiroSurge.[8] In our study, we evaluated the preoperative preparation times in the Avatera Robotic surgical system (Avateramedical, Jena, Germany). The slender eye-piece design, which provides the opportunity for communication with the operation room, and the exclusive use of bipolar energy are the cornerstones of this new technology. The surgeon is capable to complete the learning curve easier thanks to its modern training program and more cost-efficient surgeries.[9] The decrease in draping and docking times can reinforce the innovation of the avatera system.

During the last decades, as the use of robotic surgical systems is expanding a great number of new surgeons are interested in this new technology. As the number of trainees increases the pathway of education becomes more complicated and the necessity of simulation programs is obvious. During this pathway, the trainees can complete the learning curves characterized by more efficacy and experience. In this direction, dry and wet laboratories and robotic surgical and Virtal Reality (VR) simulators were developed.[10] The advantages of these systems are multiple. First of all, special tasks adapted to a specific operation can be realized for the trained surgeons to be familiar with the steps of the operations. An inanimate model was reported by Goh *et al*. simulating tasks for robotic-assisted radical prostatectomy.[11] Second, artificial tumors, stones or lymph nodes can be created with cotton balls, gelatin solution, or rubber tubing.[12] Based on this innovation, very interesting models were reported. For example, a partial nephrectomy model was presented by Hung *et al*. with the use of a Styrofoam ball as a pseudo-tumor.[13] In addition, these programs are available and beneficial even for residents with small or no experience in minimally invasive surgeries. Especially, in combination with prerecorded educational videos, inexperienced residents can improve their skills.[14] In our study, we realized an inanimate model capable to train the nurses and assistants to improve the time-consuming preoperative draping and docking. To the best of our knowledge, our study is the first to present a simulator model for draping and docking procedures.

As technology advances, novel innovations require adequately trained and experienced users.[15] On behalf of the innovations of robotic surgical systems, the creation of standardized training programs and curriculums seems to be necessary. In the last years, the establishment of this kind of program was expanding. There is a variety of programs (web-designed, on-site, or a combination of both).[15] The Fundamentals of Robotic Surgery and the DaVinci technology training pathways constitute two web-designed-only robotic curriculums.[16,17] Following these programs, new hybrid curriculums (web and on-site training) were reported. The SAGES robotic master series is the firstly presented program that includes online and on-site education. There are three different levels of complexity based on the status of each trainee.[18] The Robotic Training Network (RTN) and the Fundamental Skills of Robotic-Assisted Surgery (FSRS) are two training patterns based on on-site training. RTN is separated into two phases, each of which has a different purpose. Phase I is dedicated to bedside training and phase II is to console training.[19] FSRS is structured in three different levels of certification (basic, intermediate, and advanced) offering to the trainees the possibility to choose the extent of their education.[20]

The mentioned development of the robotic systems and training programs aims to a reduction of operating time. Many published studies evaluate the operating time as console time neglecting the draping and docking steps. Only a little information is available about these parts of robotic-assisted surgeries.[21] Iranmanesh *et al*. presented the average time of 96 robotic-assisted surgeries using the DaVinci system. The mean time of draping and docking was 22 min and 10 min, respectively. It should be noted that there was not a specific team (surgeon, bedside assistant, and scrub nurses) during this evaluation and this fact may be the cause of the prolonged interval of set-up procedure.[22] The creation of an organized team seems to improve the time needed for draping and docking procedures. van der Schans *et al*. noticed that a well-trained team can complete in a mean interval of 5.6 ± 1.4 min the draping step and 7.8 ± 2.7 min docking step. Statistically significant amelioration of these results was realized after a specific number of operations (21 operations for robot draping and 18 operations for robot docking).[21] The next level of improvement of set-up time could be a structured training program for both surgeons and nurses before the operation room. To our knowledge, our study is the first to present a specific preoperative training program and to compare this with the gained experience in the operating room.

The fact that our study was restricted to robotic-assisted radical prostatectomy and pyeloplasty could be considered a limitation. Our purpose was to evaluate the results of the artificial insufflated abdominal model. Further studies with separate training protocols for every operation need to be performed.

CONCLUSIONS

Conducting training of patient preparation and docking in the dry laboratory using an insufflated abdominal model facilitates experience acquisition in a safe and calm environment. On average five RASs and six training sessions are required to build an adequate experience among surgeons and nurses to perform draping and docking.

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Conflicts of interest
There are no conflicts of interest.

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