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Impact of robotic general surgery course on participants' surgical practice

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Abstract
Background Courses, including lectures, live surgery, and hands-on session, are part of the recommended curriculum for robotic surgery. However, for general surgery, this approach is poorly reported. The study purpose was to evaluate the impact of robotic general surgery course on the practice of participants.
Methods Between 2007 and 2011, 101 participants attended the Geneva International Robotic Surgery Course, held at the University Hospital of Geneva, Switzerland. This 2-day course included theory lectures, dry lab, live surgery, and hands-on session on cadavers. After a mean of 30.1 months (range, 2–48), a retrospective review of the participants' surgical practice was performed using online research and surveys.
Results Among the 101 participants, there was a majority of general (58.4 %) and colorectal surgeons (10.9 %). Other specialties included urologists (7.9 %), gynecologists (6.9 %), pediatric surgeons (2 %), surgical oncologists (1 %), engineers (6.9 %), and others (5.9 %). Data were fully recorded in 99 % of cases; 46 % of participants started to perform robotic procedures after the course, whereas only 6.9 % were already familiar with the system before the course. In addition, 53 % of the attendees worked at an institution where a robotic system was already available. All (100 %) of participants who started a robotic program after the course had an available robotic system at their institution.
Conclusions A course that includes lectures, live surgery, and hands-on session with cadavers is an effective educational method for spreading robotic skills. However, this is especially true for participants whose institution already has a robotic system available.

Keywords Robot · Course · Training · General surgery · Practice

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After laparoscopy, robotics has revolutionized the minimally invasive approach in surgery. Many advanced and complex procedures have been reported to be feasible and safe by a robotic approach [1–5], whereas their laparoscopic counterparts were done before only by exceptionally skillful surgeons [6].

As the evidence for clinical safety and advantages of robotic surgery continues to be collected [7–9], the demand for training will continue to increase. This new challenge was clearly described by several authors [10, 11]. The recommended curriculum for robotic surgery is still debated, and the different societies for minimally invasive surgery collaborate to draw a consistent training module [12, 13]. Moreover, the initial training on the robot might be difficult, because the teaching surgeon has reduced direct control [14]. Yet, it seems relatively clear that the training courses should include lectures, live surgery, and hands-on session. For urology, several groups [14–19] have reported their experience and the impact of structured courses on the participants' practice. However, for general surgery, this approach has been poorly evaluated so far.

At our institution, we started our robotic activity in 2006, and since 2007 our division has proposed robotic courses, mainly focused on robotic general surgery. Thus, the study was designed to report our experience and to evaluate the impact of this kind of robotic general surgery courses on the participants' practice.

Materials and methods

Between 2007 and 2011, 101 participants attended the Geneva International Robotic Surgery Course, held at the University Hospital of Geneva, Switzerland. During the study period, 13 courses were held, with a special focus for general, bariatric, and colorectal surgeons. This 2-day course fulfilled the criteria of the SAGES (Society of American Gastrointestinal and Endoscopic Surgeons) and MIRA (Minimally Invasive Robotic Association) guidelines [12] and included:

– Theory lectures: history and basic principles of robotic surgery, troubleshooting and mangement, port positioning, main indications and results, tips and tricks, future developments.
– Dry lab: basic skills on inanimate models, using the da Vinci S and then Si Surgical System (Intuitive Surgical Inc., Sunnyvale, CA).
– Live surgery/case observation: procedure according to the interest of the audience (colorectal resection, bariatric procedure, rectopexy, single-site procedures), docking.
– Hands-on session on cadavers, using the standard da Vinci System. The procedures performed were chosen according to the interest of the audience.

All of the robotic courses are supervised by experienced laparoscopic and robotic surgeons. At the end of the course, a robotic certificate is attributed to every attendee.

After a mean of 30.1 months (range, 2–48), a retrospective review of the participants' surgical practice was then performed. We used Intuitive database, online research, and individual surveys to compete our database. The main outcome was to assess whether the participant started a robotic practice (clinical or experimental). An experimental practice concerned the research groups that started a nonclinical robotic program (animal or cadaver models) after the course. Secondary endpoints were the previous robotic experience of the attendees and the availability of a robotic system at their institution.

Data were fully recorded in 99 % of cases. One participant was lost from the follow-up and was not reached afterward.

Statistical analysis

The results of parametric and nonparametric data were expressed as mean ± standard deviation (SD) and median (range), respectively. GraphPad Software (GraphPad, La Jolla CA) was used for all statistical analyses. Confidence intervals were set at 95 %. A two-sided P value ≤ 0.05 was considered to be statistically significant. Comparisons between both groups were determined using Fisher's exact test for discrete variables and Student's t test for continuous variables

Results

During the study period, 101 participants attended our robotic course (Table 1). The majority of the attendees came from Europe (81 participants: 80.2 %): Switzerland (47.5 %), United Kingdom (9.9 %), Greece (8.9 %), Italy (4 %), Czech republic (4 %), Germany (3 %), Romania (2 %), and Poland (1 %). Fifteen came from Asia (14.9 %): Turkey (8.9 %), Lebanon (3 %), Pakistan (1 %), Korea (1 %), and Japan (1 %). Finally, five were from America (5 %): Brazil (3 %) and United States of America (2 %).

Not surprisingly, there was a large majority of general (58.4 %) and colorectal surgeons (10.9 %). Other specialties included urologists (7.9 %), gynecologists (6.9 %), pediatric surgeons (2 %), surgical oncologists (1 %), engineers (6.9 %), and other specialties (5.9 %).

Concerning the impact of the robotic course on the attendees' surgical practice, 46 participants (46 %) started to perform robotic procedures after the course. Of note, only 6.9 % of them were already familiar with the system before the course. If we exclude from the analysis the participants who are not surgeons ($n = 9$; 9 %), 49.5 % of

Table 1 Participants' demographics ($n = 101$)

Origins	
Europe	81 (80.2 %)
Asia	15 (14.9 %)
America	5 (5 %)
Specialties	
General surgery	59 (58.4 %)
Colorectal surgery	11 (10.9 %)
Urology	8 (7.9 %)
Gynecology	7 (6.9 %)
Engineering	7 (6.9 %)
Orthopedic surgery	2 (2 %)
Pediatric surgery	2 (2 %)
Cardiovascular surgery	2 (2 %)
Internal medicine	2 (2 %)
Surgical oncology	1 (1 %)
Previous experience in robotic surgery	7 (6.9 %)
Availability of a robotic system at their institution	53 (53 %)

participants started to perform robotic procedure after the course.

In addition, 53 % of the attendees worked at an institution where a robotic system was already available. When only those participants are taken into consideration, 86.8 % started robotic cases after the course. Moreover, 100 % of participants who started a robotic program after the course had an available robot at their institution. In other words, no participant, who did not have a robot available at his/her institution, started a robotic program after the course.

When we compare the participants who have started a robotic practice after the course to those who did not, there were no differences in terms of specialties or origins, with the exception for colorectal surgeons ($P = 0.002$). The latter were more prone to establish a robotic program when they were back at their institution.

There were no differences between participants who had a previous robotic experience and those who had no previous experience. In fact, 71.4 % (5/7) of participants with previous robotic experience started a program. On the other hand, only 44.1 % (41/93) of participants without previous experience started a robotic program. Yet, the difference was not statistically significant ($P = 0.24$).

In addition, participants who came in groups (robotic team) started a robotic practice with the same rate compared with attendees who came alone. Finally, there was a strong difference between attendees who have a robot at their institution and those who had no robot ($P = 0.0001$; Table 2). The former were more prone to start a robotic program.

Discussion

The introduction of robotic surgery has brought new and interesting challenges. As the evolution of robotics is gaining an increasing importance, the necessity to train minimally invasive surgeons becomes obvious. Hands-on educational activity is generally seen to be the most effective method. Several courses are available in different centers [11, 14–20] and are recommended during the robotic curriculum [12]. Yet, the impact of such robotic course on participants' surgical practice remains relatively poorly investigated. In the present study, we showed that almost half of the participants began a robotic practice after the course. Similar findings were reported by other groups for urology. For example, Altunrende et al. [15] reported an increase of 56 % in the robotic cases in the surgical practice of the attendees at 3 months. This rate can be high as 100 % if the population is well selected and proctoring proposed after the course [18].

When comparing the groups of attendees who started a robotic practice to those who did not, the availability of a robotic system at their institution was the main contributing factor. Even if it seems obvious, this parameter should be emphasized. It has been shown here clearly that 100 % of the participants who started robotic surgery had an available system at home. It reflects finally the rule of the offer and the demand. In centers where only experienced robotic surgeons are considered, the results are relatively similar to ours [15].

In addition, our data showed other interesting findings. First, the type of specialty was not seen as an independent factor when comparing the surgeons who start a robotic practice to those who did not. Yet, it was not true for colorectal surgeons who were clearly more inclined to begin robotic cases after the course. Obviously, colorectal resections are seen as a good model for robotic surgery [21, 22], especially rectal resection [23]. Pelvic surgery is probably one of the best indications of robotics. Indeed, urologists, gynecologists, and colorectal surgeons have adopted robotic

Table 2 Differences between the groups of participants who started a robotic program to those who did not

	Start a robotic program at their institution ($n = 46$)	Did not start a robotic program ($n = 54$)	P value
Origins			
Europe	37 (80.4 %)	43 (79.6 %)	1
Asia	5 (10.9 %)	10 (18.5 %)	0.4
America	4 (8.7 %)	1 (1.9 %)	0.18
Specialties			
General	29 (63 %)	29 (53.7 %)	0.42
Colorectal	10 (21.7 %)	1 (1.9 %)	*0.002*
Urology	2 (4.3 %)	6 (11.1 %)	0.28
Gynecology	3 (6.5 %)	4 (7.4 %)	1
Previous experience in robotic surgery	5 (10.9 %)	2 (3.7 %)	0.24
Participants present in groups	30 (65.2 %)	30 (55.6 %)	0.41
Availability of a robotic system at their institution	46 (100 %)	7 (13 %)	*0.0001*

Italics indicate the value that are statistically significant ($p < 0.05$)

surgery well. However, in the present series, we were unable to demonstrate a significant difference for urologists and gynecologists, because they were really few. Our course targeted first general surgeons and, naturally, few other specialties were represented.

Then, the notion of robotic team is important [11, 24], and it was shown to be important for laparoscopy as well. Corica et al. [25] provided evidence that having two surgeons collaborating together to learn a new surgical technique in a supportive environment was critical. Interestingly, they have shown that a laparoscopic trainee attending with a colleague had a 100 % take-rate, whereas those who did not had a 77 % take-rate at 8-month follow-up. Similarly, more participants started a robotic practice after the course if they came in groups (65.2 vs. 55.6 %). Yet, these results were not statistically significant ($P = 0.41$), although the role of a robotic team needs to be emphasized. Indeed, we usually prefer to give the courses to small groups of people coming from the same center. The probability for them to start a robotic program, if a system is already available at their institution, seems higher, even if not significant. A team of two surgeons with one or two scrub nurses is usually the best way to start a successful and long-standing robotic practice.

Finally, the role of previous experience interestingly was not seen as an independent factor to start robotic surgery after our course. Besides, the number of those attendees who had already had experience was pretty low. Of note, we propose several different types of courses, from the basic to more advanced courses with a special focus on specific procedure. Usually, our main target population is naïve surgeons for robotic surgery, which may explain this small number of experienced attendees in robotics.

The data reported herein showed the value of performing robotic course for general and colorectal surgeons. Our method is the same as other centers and has already been proven effective [14, 15, 17]. These 2-day courses, including lectures, dry lab, cases observation, and hands-on sessions on cadavers, seem to be a good compromise between theory and development of basic skills. Already in 2001, Chitwood et al. [24] proposed a similar curriculum, wildly used by others centers with success. Mini-fellowships of 1 week or more were reported as well [16, 17]. After a mini-residency program of 5 days, McDougall et al. [17] reported 95 % of participants practicing robotic prostatectomy, and even to maintain this procedure in clinical practice in the long-term [16].

Moreover, this kind of course allows the development of focused training, with specific procedure. In addition, the cadaveric model is a good training model, even if expensive. The anatomy is fully respected; the docking position and other technical tips and tricks can be applied with success. On the other hand, the animal model offers a more accurate model concerning the bleeding. In our institution, we decided to use the cadaveric model since 2007. In other centers, simulators are used as well with interesting results [12, 13, 15]. At the end of 2012, we plan to acquire a robotic simulator to integrate into our curriculum. The simulator is supposed to give the residents the possibility to acquire basic robotic skills without the use of an expensive cadaver or without the cost of a prolonged operative time.

Our study has some limitations that deserve comments. First, it is a retrospective series, but our data bring new and interesting results. The majority of the audience was a local population, and maybe the data could not be generalized elsewhere. There is an important bias, because the course was targeted for general and colorectal surgeons. The selection bias remains that only highly motivated participants attended the course. Finally, the follow-up is short, but it is anticipated that the participant should start his/her robotic activity quickly, with the risk otherwise not to start at all.

The parameters reported herein are important to take into consideration before starting a robotic program and attending a robotic course. Indeed, if a robot is not available at the participant's institution, the probability to develop a robotic program is really low. In addition, the role of proctoring needs to be emphasized [18, 20]. However, the main objectives of our courses are not to give formal proctoring but should be implemented in the near future.

Conclusions

A course that includes lectures, live surgery, and hands-on session on cadavers is an effective educational method for spreading robotic skills. However, this is especially true for participants whose institution already has a robotic system available.

Disclosure Drs Buchs, Pugin, Volonté, and Morel have no conflicts of interest or financial ties to disclose. Dr Hagen has a financial relationship with Intuitive Surgical.

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