Surg Endosc (2018) 32:217–224
https://doi.org/10.1007/s00464-017-5662-2

A structured, extended training program to facilitate adoption of new techniques for practicing surgeons

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Received: 17 March 2017 / Accepted: 6 June 2017 / Published online: 22 June 2017

Abstract

Introduction Laparoscopic inguinal hernia repair has been shown to have significant benefits when compared to open inguinal hernia repair, yet remains underutilized in the United States. The traditional model of short, hands-on, cognitive courses to enhance the adoption of new techniques fails to lead to significant levels of practice implementation for most surgeons. We hypothesized that a comprehensive program would facilitate the adoption of laparoscopic inguinal hernia repair (TEP) for practicing surgeons.

Methods A team of experts in simulation, coaching, and hernia care created a comprehensive training program to facilitate the adoption of TEP. Three surgeons who routinely performed open inguinal hernia repair with greater than 50 cases annually were recruited to participate in the program. Coaches were selected based on their procedural expertise and underwent formal training in surgical coaching. Participants were required to evaluate all aspects of the educational program and were surveyed out to one year following completion of the program to assess for sustained adoption of TEP.

Results All three participants successfully completed the first three steps of the seven-step program. Two participants completed the full course, while the third dropped out of the program due to time constraints and low case volume. Participant surgeons rated Orientation (4.7/5), GlovesOn training (5/5), and Preceptored Cases (5/5) as highly important training activities that contributed to advancing their knowledge and technical performance of the TEP procedure. At one year, both participants were performing TEPs for "most of their cases" and were confident in their ability to perform the procedure. The total cost of the program including all travel, personal coaching, and simulation was $8638.60 per participant.

Discussion Our comprehensive educational program led to full and sustained adoption of TEP for those who completed the course. Time constraints, travel costs, and case volume are major considerations for successful completion; however, the program is feasible, acceptable, and affordable.

Keywords Laparoscopic inguinal hernia repair · Continuous professional development · Surgical coaching · Clinical performance assessment · Clinical outcomes · Simulation

In the United States, nearly 800,000 inguinal hernia repairs are performed annually [1]. While early studies comparing the laparoscopic and open approach to repair of inguinal hernias showed a decreased rate of recurrence favoring the open technique [2], more recent literature has shown similar rates of recurrence between the two techniques [3, 4]. While recurrence rates are similar, there are many quality of life outcomes that are superior with the laparoscopic approach including earlier return to work and normal

This project has been accepted for podium presentation at the 2017 SAGES meeting in Houston, TX.

Presented at the SAGES 2017 Annual Meeting, March 22-25, 2017, Houston, Texas.

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activities and lower rates of acute and chronic postoperative pain [4, 5].

Despite the benefits associated with the laparoscopic approach, it remains significantly underutilized. A recent population-based cohort study of inguinal hernia repair in Quebec, Canada, showed that the laparoscopic approach was only employed in 8% of all hernia repairs performed between 2007 and 2011 [6]. Even in bilateral hernias where the benefits of laparoscopy are even greater, the laparoscopic approach was used in only 28% of cases. When surveyed about the barriers to performing laparoscopic inguinal hernia, 59% of respondents felt that they lacked the requisite training and 26% of respondents were interested in learning the technique [7]. Nearly 75% of those surveyed believed that the best method of education was a course followed by expert precepting.

While the educational experience of a short course followed by preceptorship has aided the adoption of the laparoscopic approach in the repair of ventral hernias [8], similar results have not been observed with laparoscopic inguinal hernia repair. Given the lack of perceived benefit, technical difficulty, and limited options for in-depth training outside of residency and fellowship, adoption of laparoscopic inguinal hernia repair remains quite poor. In response to this need, we created a novel educational program to foster the adoption of laparoscopic inguinal hernia repair utilizing a combination of simulation, hands-on experience, and surgical coaching. This paper summarizes the development and implementation of our educational training program.

Materials and methods

Curriculum design

Our quality improvement initiative was deemed exempt by the UW IRB on October 7, 2014. A team of experts in simulation, engineering, coaching, education, and clinical hernia care convened to design an educational training program for TEP inguinal hernia repair. Using an iterative process, a curriculum incorporating simulation, intraoperative training, and surgical coaching was developed. TEP was selected as our procedure of choice as our local resources included a previously created TEP simulator as well as two surgeons who were both TEP experts and had previously undergone training as surgical coaches.

Program development

The final version of the program included seven different training components, Fig. 1. Prior to orientation day, participants received introductory materials that included three journal articles [2, 9, 10] and a short, narrated video of TEP. They were also given personality assessments (the Myers–Briggs Type Indicator and the Learning Styles Inventory [11]) with the goals of helping them understand themselves as learners and to encourage them to consider how different personality traits impact their relationships with their coaches.

The orientation day incorporated didactic and procedural teaching focused on the TEP procedure. Teaching materials included a PowerPoint™-based expert-led review of literature supporting the use of TEP in clinical practice. This was followed by a video-based review of an unedited TEP procedure performed by an expert in TEP. Following the didactic learning session, participants underwent a written assessment of TEP focused on relevant anatomy and the reviewed literature. A TEP simulator was used for a baseline assessment of participants' operative skills, Figs. 2A, B. These activities were facilitated by the course director (JAG), while the remainder of the orientation day was facilitated by the surgical coach. After the baseline assessment, trainees were familiarized with the principles of surgical coaching via didactic lecture from an expert in surgical coaching (CCG) and were given the opportunity to go over their performance on the simulator with their assigned coach. The next stage involved hands-on intraoperative training at our institution utilizing a previously existing program for continuing education for surgeons in practice [12]. During this training, the participant scrubbed in with an expert in TEP to observe and perform TEP repairs in the expert's operating room. This was followed by the surgical coach precepting several cases in the participant's operating room. The final stage of training involved video-based review of the participant's first ten independent cases with their surgical coach. Upon completion of the program, participants returned for an exit interview and post-test simulation assessment with their surgical coach.

Surgeon recruitment

Eligible surgeons who performed primarily open inguinal hernias, with a case load of at least 50 inguinal hernia repairs a year, and who had an interest in adopting TEP into their practice were recruited through email and postal mailings. Coaches were identified by study team members based on procedural expertise, desirable interpersonal and communication skills, and willingness and availability to participate in the study. All coaches participated in a 4-h coach training session led by members of the Wisconsin Surgical Coaching Program. This program adapts methodology and theory from the disciplines of education, music, and athletics to identify key elements of successful coaches and coaching programs that may be transferable to

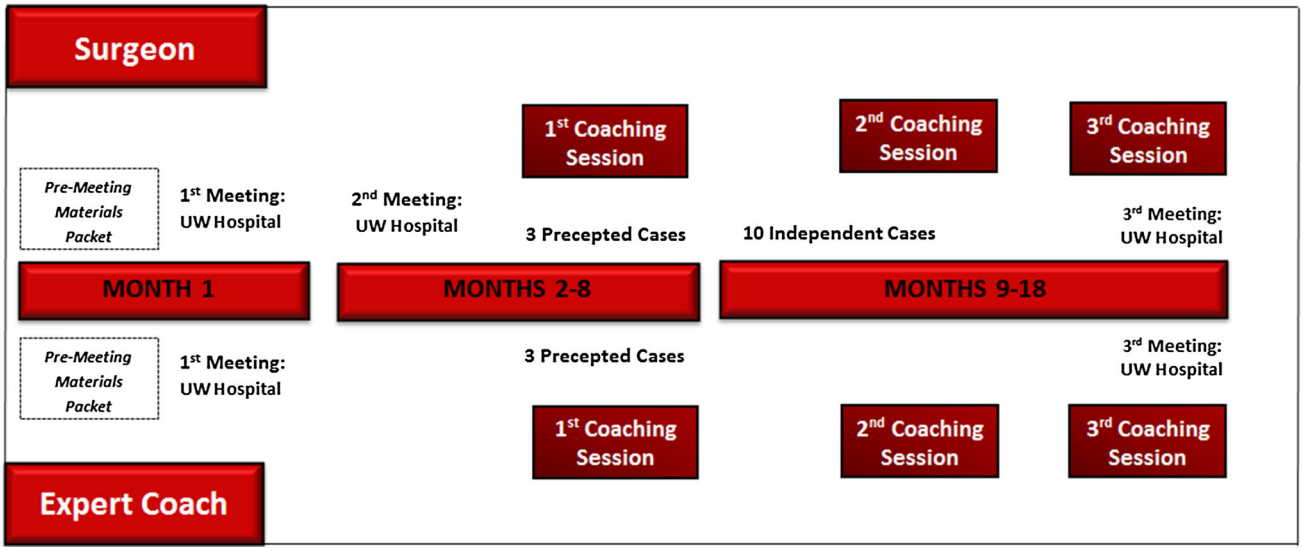

Fig. 1 Projected program timeline

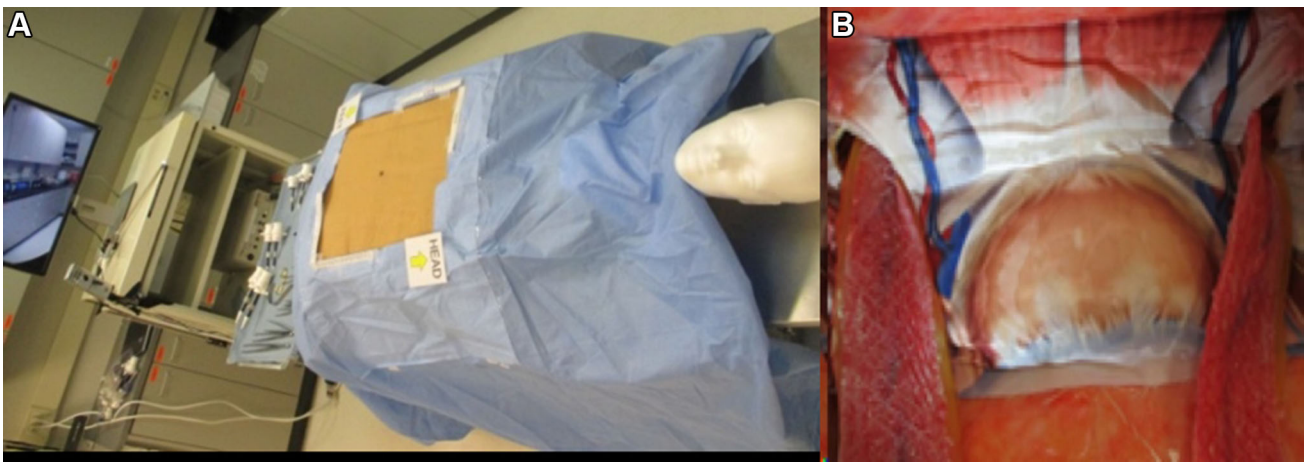

Fig. 2 **A** External view of the TEP simulator and **B** internal view of the TEP simulator

surgery. All participating surgeons underwent a coaching orientation to introduce them to the concept of surgical coaching and its potential benefits. Each participating surgeon set his or her own goals for the program and worked with their trained coach to design and implement a plan of action. Our target enrollment for this pilot project was three practicing surgeons who were willing to commit to a prolonged period of structured coaching. The 18-month projected training timeline for the program is outlined in Fig. 1.

Data collection

Audio and video recordings of the simulator sessions and video recordings of all cases were collected for assessment and review. Procedural videos, both live and simulated, were reviewed by the operating surgeon, their surgical coach, and three independent reviewers who were experts in TEP utilizing a modified version of two previously validated instruments [13, 14]. Intraoperative and 30-day outcomes were self-reported for the participating surgeons' first ten independent cases including operative time, estimated blood loss, readmission, and major and minor complications. Additionally, programmatic elements were evaluated by participant surgeons using a five-point Likert scale to determine the educational effectiveness of each program component.

Results

Three surgeons were recruited via mail, email, and personal contact. All three had previously attended at least one course to learn laparoscopic inguinal hernia repair but did

not ultimately adopt the procedure. The first participant completed all aspects of the program in 7 months, while the second participant completed the program in 5 months. The third participant was not able to complete the entire program due to scheduling difficulties.

Programmatic assessment

Orientation day activities, including the didactic sessions, coachee training, and TEP simulation, were rated by all three surgeon participants as "very helpful for learning" (4.5/5). The lowest score reported was in the appropriateness and accessibility of the presentation materials in the coaching handbook (3.7/5). Participants wished they had received the coaching handbook ahead of time so they could thoroughly explore it. When participants were asked what the best aspects of the orientation were, all three felt that it was the interaction, hands-on experience, and the ability to discuss details and technique of the TEP procedure with two different surgeons (course director and surgical coach) in a simulated setting. All participants rated the training activities high in terms of advancing their understanding of and comfort with the TEP procedure (Table 1). Qualitative analysis of the coaching transcripts and feedback from study participants revealed the benefits of surgical coaching via video-based review:

> First couple were a lot more difficult because as many times as I had seen him do the access I struggled with that and I think it sort of set up the case to be a lot more difficult. Those were a little bit more challenging, but the coaching session obviously helped that and I took whatever feedback I got from the coaching session and the second round of independent cases, it ended up being 6 cases, those went much more smoothly even though they were a little bit more difficult.

The clinical outcomes for the first 10 cases of participants 1 and 2 are shown in Tables 2 and 3, respectively. Mean operative times for participant 1's first 10 cases were 52 min (range 35–120 min). Mean estimated blood loss was 5.5 ml (range 5–10 ml). Mean operative time for participant 2's first 10 cases was 63 min (range 45–90 min). Mean estimated blood loss was 13 ml (Range = minimal−20 ml). There were no major complications, and no patients were readmitted. There were no early recurrences with 30-day follow-up for all 20 cases. Both participants had injuries to the epigastric vessels during one case. Participant 2 created a peritoneal tear during another case.

At 1-year follow-up after completion of the program, both participants who completed the program have fully adopted TEP into their clinical practice and both stated that they utilize TEP as the primary repair technique for unilateral and bilateral inguinal hernias.

Program costs

Costs for one surgeon to participate in the entire training program are shown in Table 4. The financial breakdown includes costs for three simulators, per participant as required over the course of the program; simulation center fees for a surgical simulation room in which to allow participants to interact with their coaches using the TEP simulator; and all costs for participants' and coaches' travel which included hotels, mileage, and meals. In addition, the fee paid to coaches was $6000. This fee was based upon standard industry compensation for surgeon consultations and was set at $300 per hour, billed at 20 h. These hours included participating in the orientation day, precepting, coaching sessions, and other miscellaneous activities. Other fees involved in the program included printing the coaching manual, paying for acquisition of online personality assessments, and fees incurred to FedEx to ship encrypted flash drives with case video from participants to coaches.

Discussion

Despite its clinical benefits, laparoscopic inguinal hernia repair remains underutilized in practice. One of the largest barriers to implementation remains the current model for procedural learning involving hands-on courses with limited follow-up for the practicing surgeon. Our results demonstrate that it is feasible to create a structured training

Table 1 Programmatic Evaluation Scores for training components

How important were these training activities in advancing your understanding of and comfort with the TEP procedure?	Average rating of importance
Orientation ($n = 3$)	4.7
Hands-on operative experience ($n = 3$)	5
Precepting ($n = 2$)	5

Table 2 Participant 1: self-reported operative outcomes and expert reviewer ratings

Self-reported operative outcomes										Reviewer rating	
Case No.	Case time	Unilateral or bilateral	EBL[a] (cc)	Vas deferens injury	Vessel injury	Peritoneal tear	Bladder injury	Bowel injury	Other	Overall Performance Score	Case difficulty
1	1:20	Unilateral	10	No	Yes	No	No	No	Yes	NR	NR
2	1:05	Unilateral	5	No	No	No	No	No	No	2.3	2
3	1:00	Unilateral	5	No	No	No	No	No	No	2.7	2
4	0:40	Unilateral	5	No	No	No	No	No	No	NR	NR
5	1:00	Unilateral	5	No	No	No	No	No	No	NR	NR
6	0:50	Unilateral	5	No	No	No	No	No	No	NR	NR
7	0:59	Unilateral	5	No	No	No	No	No	No	3.3	3
8	0:35	Unilateral	5	No	No	No	No	No	No	4.3	3
9	0:40	Unilateral	5	No	No	No	No	No	No	NR	2.3
10	0:35	Unilateral	5	No	No	No	No	No	No	2.6	3.3

[a] Estimated blood loss, *NR* not reviewed

Table 3 Participant 2: self-reported operative outcomes and expert reviewer ratings

Self-reported operative outcomes										Reviewer rating	
Case No.	Case time	Unilateral or bilateral	EBL[a] (cc)	Vas deferens Injury	Vessel injury	Peritoneal tear	Bladder injury	Bowel injury	Other	Overall Performance Score	Rating of case difficulty
1	1:15	Unilateral	Minimal	No	No	No	No	No	No	3.3	3
2	1:30	Bilateral	<10	No	No	No	No	No	No	3.7	3
3	1:00	Unilateral	<20	No	No	No	No	No	No	3	2.7
4	0:45	Unilateral	<10	No	No	No	No	No	No	3.7	3.3
5	1:00	Unilateral	20	No	No	No	No	No	No	3	2.3
6	NR	Unilateral	<10	No	No	No	No	No	No	3.7	2.7
7	0:58	Unilateral	<10	No	No	Yes	No	No	No	4	3.7
8	1:00	Unilateral	<20	No	No	No	No	No	No	3.3	3.3
9	0:45	Unilateral	<20	No	No	No	No	No	No	NR	NR
10	1:15	Unilateral	Minimal	No	Yes	No	No	No	No	2.7	3

[a] Estimated blood loss, *NR* not reported

Table 4 Program cost per person

Cost type	Cost
Three simulators and supplies (SEnSE Lab and outside vendor)	$900.00
Simulation room rental	$200.00
Participant travel and meals	$800.00
Coach travel and meals	$400.00
Coach fee	$6000.00
Coaching manual	$200.00
Online personality assessments	$108.60
FedEx (USB)	$30.00
Total	$8638.60

curriculum for laparoscopic inguinal hernia repair that results in successful adoption of this technique into practice. The two participants who completed the entire training program have both successfully and safely incorporated TEP into their clinical practice and continue to employ this technique for repair of inguinal hernias one year following completion of their training.

In 1985, Erich Mühe performed the first laparoscopic cholecystectomy [15]. The technique was then popularized in Europe by Phillipe Mouret and was initially presented in the United States by Jacques Perissat at the 1989 Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) meeting [16]. In the decade that followed, minimally invasive surgery exploded in the United States and worldwide. While surgeons in training were able to learn these new techniques during their residency, surgeons in practice were forced to learn on their own while maintaining their clinical practice. In 1994, the Society of American Gastrointestinal and Endoscopic Surgeons released their framework for post-residency surgical education and training [17]. These guidelines stated that the primary purpose of post-residency education is to ensure that patients receive safe care of high quality. They specifically recommended seeking such training for procedures that are new to the surgical community at large or to the practice of that individual surgeon. As a result of these recommendations and the widespread implementation of minimally invasive techniques in general surgery, a critical need developed for continuing medical education that focused on surgical techniques. This need was largely filled by the creation of short courses featuring both didactic and hands-on experiences led by surgeons already familiar with the new technique [18]. These courses continue to be offered today and remain the most common venue for practicing surgeons to gain exposure to new procedures, techniques, and devices.

Short courses, defined as courses that last for several days or less, result in improvement in both procedure-specific skill as well as general technical skills. Sarker and colleagues published their experience with a 3-day core skills course in laparoscopic surgery [19]. They found that 91% of course participants improved upon their pre-course laparoscopic skills. Additionally, laparoscopic skills increased more for those with less pre-course training. Hance and colleagues found that there were significant improvements in psychomotor skills including path length, number of movements, and time to task completion for participants in their 2-day course for laparoscopic cholecystectomy [20].

Unfortunately, courses alone have not led to significant adoption of many advanced laparoscopic procedures into practice. Zerey and colleagues surveyed 234 surgeons who had attended a laparoscopic ventral hernia repair course over a 5-year period to determine whether attendance at their 1-day course influenced surgeon adoption of this technique into practice [8]. Nearly three-fourths of course attendees had performed a laparoscopic ventral hernia repair following completion of the course. Adoption was dependent on the surgeon's prior experience with advanced laparoscopic procedures and the availability and presence of a procedural expert to serve as a preceptor in the surgeon's operating room while performing their initial independent cases. All of the surgeons that were precepted adopted laparoscopic ventral hernia repair, while only 58% of those that did not have a preceptor adopted the procedure.

Our training program incorporated a variety of learning modalities focused on the operating surgeon in order to enhance procedural adoption. Course participants were grounded in the procedure through didactic procedure-based learning and video-based review. They were subsequently able to practice the procedure on a laparoscopic inguinal hernia simulator with prior validity evidence [21]. They were able to further develop their procedure-specific skills during their hands-on experience [12] and were additionally provided a surgical preceptor for their first independent cases. Lastly, they had a longitudinal relationship with their surgical coach who worked with them during their simulation experience, served as their preceptor, and assisted them with video-based review and feedback during their first 10 independent cases. Video-based coaching for postgame analysis has been shown to be a valuable modality for continuous professional development [22]. Among the benefits of surgical coaching are the ability to focus on learning goals that are set by the practicing surgeon and can focus on technical skill, cognitive skills and decision making, or non-technical skills such as leadership and situational awareness [23]. In our program, the majority of the coaching interactions focused on technical skills and procedural performance but also addressed other aspects of surgical performance such as patient selection.

Barriers to adopting new techniques into practice extend well beyond course attendance and the availability of a preceptor. Variations in patient populations, hospital resources, and availability of skilled assistants can all affect procedural adoption. While our training curriculum focused on the surgeon and did not explicitly address any of these other factors, we were still able to positively influence procedural adoption for our participants.

There are several limitations to our study. We had a small sample size of participants and one of our three surgeon participants was not able to complete the entire training program. The surgeon who failed to complete all the programmatic elements practiced in a rural setting and had difficulty taking time away from practice to participate

in the program. While the attrition rate from a time-consuming training program such as this will certainly not be 0%, it is unlikely to be 33% with a larger sample size. Scheduling of training activities was the largest programmatic challenge. Finding mutually convenient times for two busy surgeons led to delays in progressing through the program for one participant and in the end contributed to the attrition of our other participant. While this could be streamlined, we feel that scheduling will be a difficult aspect of any comprehensive training program similar to ours. Low case volume also contributed to one participant's failure to complete the program. While our recruitment process was targeted at surgeons with at least 50 cases annually, significant gaps in time between cases impeded the progress of our participant who withdrew from the study. Finally, the hands-on intraoperative experience at our institution is a unique program that may not be generalizable to other institutions and may lead to difficulties in scalability of our training program. A cadaver lab could be used as an alternative to this experience but may not inspire similar confidence in course participants and could increase programmatic costs. As this was a pilot program, we feel that we have demonstrated feasibility of this training program. We hope to partner with industry and surgical societies to offer this training program on a larger scale.

Conclusion

A structured, extended training course including simulation, precepting, and surgical coaching can facilitate the adoption of new techniques for practicing surgeons. Expansion of this program outside of our institution is planned and will help gain further knowledge about its outcomes and its overall impact on procedural adoption.

Acknowledgements The authors would like to thank Shanu N. Kothari, MD and Michael J. Garren, MD who served as surgical coaches for this project. We would also like appreciate the surgeons who participated in this program.

Funding This project was funded by an investigator-initiated grant from Medtronic, Inc., the Susan Behrens, MD Professorship in Surgical Education Fund, and the Wisconsin Partnership Program for Education and Research.

Compliance with ethical standards

Disclosures Jacob A. Greenberg is a paid speaker for Medtronic, a paid consultant for Ariste Medical, and a paid speaker for W.L. Gore. Sally Jolles, Sudha Quamme, Sarah Sullivan, Carla Pugh, and Caprice Greenberg have no conflicts of interest. Efforts on this study and manuscript were made possible by a VA Career Development Award to Dr. Funk (CDA 15-060. The views represented in this article represent those of the authors and not those of the DVA or the US Government. This project was sponsored by support from Medtronic, but was product agnostic and did not require use of Medtronic products.

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