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The use of simulators in training programs for single-access laparoscopic surgery

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The evolution of surgery toward less invasive methods has led to the development of new techniques beyond traditional laparoscopic surgery such as single incision laparoscopic surgery (SILS). Simultaneously, there has been an explosion in the number of tools available to enhance medical education, and many training methods that simulate surgical procedures and laparoscopic operations in particular have been developed. However, there are not many reports regarding formal training in SILS and especially the use of specific SILS simulators, despite the fact that this new procedure appears to be more technically challenging and is associated with a significant learning curve. Training programs should develop more formal laparoscopic training rather than relying on teaching SILS in weekend courses in order to decrease the potential negative effects of its learning curve. Simulators could offer a solid basis for the development of proficiency-based training.

Key words: simulators, training, SILS, education.

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TIMES ARE CHANGING

Traditionally, training of young surgeons usually consisted of direct observation of operations or practicing directly on patients in the operating room based on the Halstedian apprenticeship model "See one, do one, teach one". Under these circumstances learning can occur only when the circumstances permit it, with questionable safety for the patients [1].

However, in recent years, the concept of "learning by doing" has become less acceptable, particularly in the field of surgery where invasive procedures are required. Surgical trainers have been prompted to look for new and alternative methods to teach medical knowledge and provide procedural experience [2]. Fortunately, during the last ten years there has been an explosion in the number of tools available to enhance medical education and many training methods that simulate surgical procedures and laparoscopic operations in particular have been developed, including cadaveric animal models or anaesthetized pigs, box trainers with synthetic models, and virtual reality (VR) simulators [3].

WHY DO WE NEED SIMULATORS?

Simulators present some basic advantages compared to the more traditional ways of acquiring surgical skills. First of all, use of a simulator-based laparoscopic training program offers the prospect of learning basic laparoscopic skills, including the use of laparoscopic camera tools outside the operating room, with safety, since errors do no harm, and without any time constraints [4]. The learning episode can also be planned according to the schedule of trainers and trainees and the level of difficulty can change and be adjusted to

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the level of the trainee. Another basic advantage that simulators offer is objective evaluation according to parameters like time, path or economy of movement that can be measured, recorded for each participant separately and reproduced whenever needed [5]. This possibility offers to the trainee structured and rapid feedback and accelerates the learning process. At last but not least, unusual circumstances such as anatomical variations or lack of specific instruments and even intra-operative errors can be programmed and learned, which may be very important for the novice surgeon in order to be prepared when similar circumstances occur during real surgical procedures [6].

SIMULATORS AND SINGLE INCISION LAPAROSCOPIC SURGERY (SILS)

When a new surgical technique is introduced its evaluation is usually based on the clinical advantage, feasibility, and safety of the method. These parameters, safety in particular, are highly dependent on how easily the new technique can be learned by the average surgeon, emphasizing the importance of thorough education and training for the operating surgeon, especially during the implementation phase of any new technique which is characterized by an increased rate of complications [7].

Since the first report of single incision laparoscopic surgery (SILS) by Navarra et al. [8] who performed a SILS cholecystectomy in 1997, many articles have been published regarding the use of SILS for appendectomy, sleeve gastrectomy, adjustable gastric band, splenectomy, nephrectomy, adrenalectomy, prostatectomy, and colectomy [9-15]. However, in the literature there are few reports regarding formal training in SILS and especially the use of specific SILS simulators, despite the fact that this new procedure appears to be more technically challenging and is associated with a significant learning curve.

In a recent study Santos et al. [16] compared the performance of standardized tasks from the Fundamentals of Laparoscopic Surgery (FLS) program such as peg transfer, pattern cutting, placement of a ligating loop, and intracorporeal suturing using either the standard laparoscopy technique (LAP) or the SILS technique. In this study twenty-seven participants who were medical students, surgical residents and attending physicians were divided into three groups: inexperienced, laparoscopy-experienced and SILS-experienced. Overall performance of standardized tasks using a SILS port was inferior to performance using a standard, multiport, laparoscopic technique and surgeons with SILS experience performed better at SILS than surgeons without SILS experience. The study demonstrated that using SILS techniques is more technically challenging than using LAP, even for surgeons with previous SILS experience. The lowest mean scores in all groups were those for peg transfer and pattern cutting, while ligating loop placement scores were more similar in LAP and SILS probably because of the lateral movements that are required for the performance of the first two tasks compared to the placement of a ligating loop. Regarding the intracorporeal suturing task, although SILS was independently associated with a decline in performance compared to LAP, the use of the conventional needle driver was associated with worse performance compared to the SILS Stitch (Covidien - Mansfield, MA, USA), suggesting that the use of innovative instrumentation may allow surgeons to more closely match their LAP performance using a SILS approach.

Brown-Clerk et al. [17] used a modified FLS simulator in order to compare in an objective way the technical performance of surgeons when using conventional laparoscopic and SILS surgical ports. In this study twenty-four novice participants performed the FLS peg transfer task using two conventional laparoscopic 12-mm working ports, the SILS port, the TriPort system (Advanced Surgical Concepts - Bray, Co. Wicklow, Ireland), and the GelPOINT system (Applied Medical - Rancho Santa Margherita, CA, USA). Participants' scores did not differ significantly between conventional laparoscopy and the single-port devices and no task score differences between trials for either the SILS port or the GelPOINT system were observed. However, there was a significant decline in performance when starting with the TriPort versus starting with either the SILS port or the GelPOINT. At the conclusion of testing, the participants also ranked each of the four ports overall. Conventional laparoscopy was rated the highest overall, although only the SILS port was rated significantly lower than either conventional laparoscopy or the GelPOINT system. This study provided evidence that the TriPort may be more challenging for novices to use in learning the single port laparoscopy procedure than either the SILS port or the GelPOINT system. Currently, no comprehensive comparison of the single-port devices and instruments used in SILS is available. Future randomized studies based on SILS

simulation programs could be very helpful in the evaluation of current and future instrumentation.

Our department is conducting an ongoing study that aims to compare a classic laparoscopy simulator with a SILS simulator in novice and advanced laparoscopic trainees. We have recruited 20 surgeons so far, who were classified into two groups: Group A consisted of 10 residents without any laparoscopic experience and group B consisted of 10 surgeons experienced in LAP (all of them have performed at least 60 laparoscopic cholecystectomies) but without any experience in SILS. Both groups followed a mini-trainee course that included four efforts on each simulator. Time, path and economy of movement were recorded and compared. Our first results demonstrate that in LAP simulation Group B had better scores in all parameters examined, while in SILS simulation only time scores were better for this group. Economy of movement did not differ significantly between the two groups while path values were better for beginners at the fourth effort. Moreover, the experienced group failed to improve path and economy of movement scores but beginners did. So, according to our first results, it seems that previous LAP experience is not a substitute for SILS experience and may actually be an obstacle during training in SILS. However, more randomized studies are needed in order to obtain more accurate results.

CONCLUSIONS

Currently, the Accreditation Council for Graduate Medical Education (ACGME) has no specific requirements for SILS training in general surgery residency programs and SILS is not a standard component of the Fundamentals of Laparoscopic Surgery curriculum. The majority of surgeons can perform SILS procedures without any training requirements and mostly receive their training from short, usually 2-day training courses and mini-fellowship programs. Recently those responsible for surgical training programs have begun to realize that they must develop more formal laparoscopic training instead of relying on short, weekend courses in SILS, in order to decrease the potential negative effects of the learning curve. Simulators, with standardized tasks at many different levels of difficulty and recordable results offer a solid basis from which to develop proficiency-based training and will soon enable residents and young surgeons to "see one, simulate many, do one".

RIASSUNTO

L'uso dei simulatori nei programmi di addestramento alla chirurgia laparoscopica con accesso singolo

L'evoluzione della chirurgia verso metodiche sempre meno invasive ha portato allo sviluppo di nuove tecniche che sono andate oltre la tradizionale chirurgia laparoscopica, come la chirurgia laparoscopica con incisione singola (*single incision laparoscopic surgery* - SILS). Contemporaneamente, si è assistito ad una proliferazione impressionante di strumenti per migliorare l'educazione medica ed allo sviluppo di numerose metodiche di addestramento che simulano gli interventi chirurgici, in particolare quelli laparoscopici. Tuttavia, sono ancora pochi i *report* che si occupano dell'addestramento formale alla SILS e, soprattutto, dell'uso di simulatori specifici, malgrado questa nuova procedura sia impegnativa tecnicamente ed abbia una curva di apprendimento significativa. Per diminuire i potenziali effetti negativi della curva di apprendimento della SILS dovrebbero essere sviluppati dei regolari programmi di addestramento piuttosto che limitarsi ad insegnare la SILS nei corsi di fine settimana. I simulatori possono fornire una base solida per lo sviluppo di programmi di addestramento basati sulla competenza.

Parole chiave: simulatori, *training*, SILS, educazione.

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