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Implementation of simulation in surgical practice: Minimally invasive surgery has taken the lead: The Dutch experience

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Abstract

Minimal invasive techniques are rapidly becoming standard surgical techniques for many surgical procedures. To develop the skills necessary to apply these techniques, box trainers and/or inanimate models may be used, but these trainers lack the possibility of inherent objective classification of results. In the past decade, virtual reality (VR) trainers were introduced for training minimal invasive techniques. Minimally invasive surgery (MIS) is, by nature, very suitable for this type of training. The specific psychomotor skills and eye–hand coordination needed for MIS can be mastered largely using VR simulation techniques. It is also possible to transfer skills learned on a simulator to real operations, resulting in error reduction and shortening of procedural operating time. The authors aim to enlighten the process of gaining acceptance in the Netherlands for novel training techniques. The Dutch Societies of Surgery, Obstetrics and Gynecology, and Urology each developed individual training curricula for MIS using simulation techniques, to be implemented in daily practice. The ultimate goal is to improve patient safety. The authors outline the opinions of actors involved, such as different simulators, surgical trainees, surgeons, surgical societies, hospital boards, government, and the public. The actual implementation of nationwide training curricula for MIS is, however, a challenging step.

Introduction

In healthcare, as in society at large, computer-aided implementations of innovations have become daily practice. Computer-aided scanning by MRI, (PET)CT, and other technical modalities in radiology; device-driven steering mechanisms in endoscopy, self-employable stenting devices in cardiology and vascular surgery, and full robotic surgical systems in laparoscopic surgery are examples of such advances. Laparoscopic surgery may be the area in which computer-aided implementations are most prominently visible, as this young specialty has always been driven by technological innovation and has been an early adopter of novel techniques, from its start.

In the twenty-first century, minimally invasive surgical (MIS) techniques have become the standard of surgical care for many patients. Unlike open surgery, MIS is, by its nature, a technique that is very suitable for simulation-based training. The specific psychomotor skills and eye–hand coordination needed for this type of surgery can be trained easily through simulation (Derossis et al. 1998; Grantcharov et al. 2003). For skills training, box trainers or computer-enhanced trainers may be used, but in the past decade, new virtual reality (VR) trainers have been introduced for training minimally invasive techniques. Nowadays, simulation training, often enhanced using VR techniques is used for a wide range of training purposes: laparoscopy (Gurusamy et al. 2008), robot-assisted surgery (Kenney et al. 2009), endoscopy (Bittner et al. 2010), cystoscopy (Schout et al. 2010), hysteroscopy (Bajka et al. 2010), and intervention radiology (Ahmed et al. 2010). It is possible to transfer skills learned on a simulator to real operations, leading to less errors and shorter operating time (Larsen et al. 2009; Thijssen & Schijven 2010). Recently, e-learning programs and "serious games" for MIS, embedding a training curriculum, step-by-step approaches, encouraging the making and solving of mistakes, and a diversity of storylines have been introduced (Verdaasdonk et al. 2009).

Practice points

- Simulator training cannot stand on its own, but needs to be a part of a training curriculum.
- A simulator on itself is not "valid". The way it is used in a particular teaching curriculum determines its validity for the cause.
- Proficiency-based skills training leads to less errors in the operating room and reduces operating time.
- Well-developed training programs must be demanded by the government, developed and defined by the medical societies, and facilitated by the hospitals.
- Allocating time for training and consequences when not fulfilling the training requirements stimulates skills training.

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The traditional "apprentice–mentor" education model is commonly used to learn surgical skills. In this model, surgery is largely mastered through observation, followed by imitation of the actions of the mentor. For MIS, this model is challenged due to several factors. Reduced working hours and increased number of residents on the work floor result in less exposure to surgery. Constant innovation in treatment modalities to be learnt by the mentors reduces the number of surgical procedures available for teaching and learning of apprentices. Furthermore, the continuous pressure on reducing operation time in order to be more cost effective and the ethical aspects to limit patient morbidity, to reduce complications, and to maximize patient safety drive the public awareness and demand professional responsibility. In 2008, after publishing their report entitled "Risks minimally invasive surgery underestimated" (IGZ 2007), the Dutch government demanded strict rules for MIS. As a result, requirements for skills training were defined by the surgical societies, and hospitals were obliged to implement these requirements in their training programs. Nowadays, every resident in surgical training and every surgeon needs to demonstrate that he or she possesses minimum standards of skill before operating on patients. Performing MIS without demonstrated competence is considered unethical and unprofessional. In this view, it has become mandatory to establish objective-validated measurable levels of practical skills prior to start MIS on patients. Since these skills can be mastered using simulation techniques, it is not surprising that MIS has taken the lead in using simulation applications for training (Larsen et al. 2009). The Dutch Societies of Surgery, Obstetrics and Gynecology, and Urology each developed a training curriculum for MIS, to be implemented in daily practice (Stassen et al. 2010). The implementation of a nationwide trainings curriculum for MIS will be the next step. The Dutch Society for Simulation in Healthcare (DSSH 2010) provides a platform to share experiences, which will accelerate a nationwide implementation of proficiency-based training curricula. This article describes the current developments regarding MIS training and illustrates the Dutch experiences with development and implementation of training curricula for MIS.

Simulation in MIS

Specific psychomotor skills are needed to perform MIS. Hand-eye coordination, adaptation from three-dimensional to a two-dimensional screen, dealing with the fulcrum effect – the need for the surgeons to move their hand in the opposite direction in which the tip of the instrument intends to go – acquiring fine motor skills to handle the long instruments without proper tactile feedback – the sense of touch when applying force – are all skills which the future laparoscopist needs to master (Derossis et al. 1998). Simulation has proven to be a proper tool to learn and train these skills (Korndorffer et al. 2005; Larsen et al. 2009). Several simulation modalities can be used for learning and training MIS. There are different animal models, box/video trainers, and VR simulators to choose from. In addition, "serious gaming" has entered the field of MIS training as well.

Box training

Box and video trainers provide a relatively easy and cheap simulation model for MIS. These platforms usually consist of a normal laparoscopic tower with a training box, but are also available as stand alone units with an inbuilt camera (Figure 1). For the acquisition of basic laparoscopic skills box, trainers are equally effective as VR trainers (Munz et al. 2004). Box trainers provide realistic haptic feedback, yet objective assessment is difficult and an expert observer must be available to assess performance. In the past decade, different box/video trainer models and exercises have been developed. When using box trainers, it is important to use validated exercises with a proper training goal. An overview of validated exercises is given in Table 1. The fundamentals of laparoscopic surgery (FLS) program (FLS 2010) implemented existing box trainer exercises in its program (Ritter & Scott 2007). For the FLS program, a special portable box trainer with an inbuilt camera was developed. Performance on this box trainer correlated well with objective assessment of intraoperative performance (Fried et al. 2004). For training MIS at home, portable and inexpensive box trainers can be used (Al-Abed & Cooper 2009).

VR training

VR simulators (Figure 2) provide a safe and standardized environment to practice specific skills for MIS and have the surplus value of being able to measure performance outcome of the trainee simultaneously and objectively (Aggarwal et al. 2004). Compared to box/video trainers, VR simulators are at least as effective and can supplement standard laparoscopic box/video training (Gurusamy et al. 2008). Unlike box trainers, most VR simulators lack realistic tactile feedback. To overcome this problem, augmented reality laparoscopic simulators have been developed. These training devices provide both objective assessment after performance and realistic tactile feedback (Botden & Jakimowicz 2009). In the past decade, several VR simulators have been developed and validated (Table 2). In contrast to box trainers, VR trainers have the capacity to train both basic skills and simulate full procedural surgical tasks (e.g. the laparoscopic salpingectomy or laparoscopic cholecystectomy). These innovations could be used in addition to box trainers to train skills needed in more advanced surgical procedures. VR training improves overall laparoscopic surgical skills and the acquired skills on a VR simulator are, in itself, not procedure-specific (Lucas et al. 2008). There is a significant correlation between operative performance and psychomotor performance on VR reality simulators (Kundhal & Grantcharov 2009). Above all, the newly learned skills on the VR simulator are transferable to actual laparoscopic operations in human patients (Aggarwal et al. 2007; Larsen et al. 2009).

E-learning and serious gaming

In the past decade, the use of e-learning has rapidly grown. Many students browse the Internet routinely, for search, play, and information purposes. In fact, these elements are needed for successful learning. In most modern medical curricula, e-learning is introduced to satisfy this need for modern

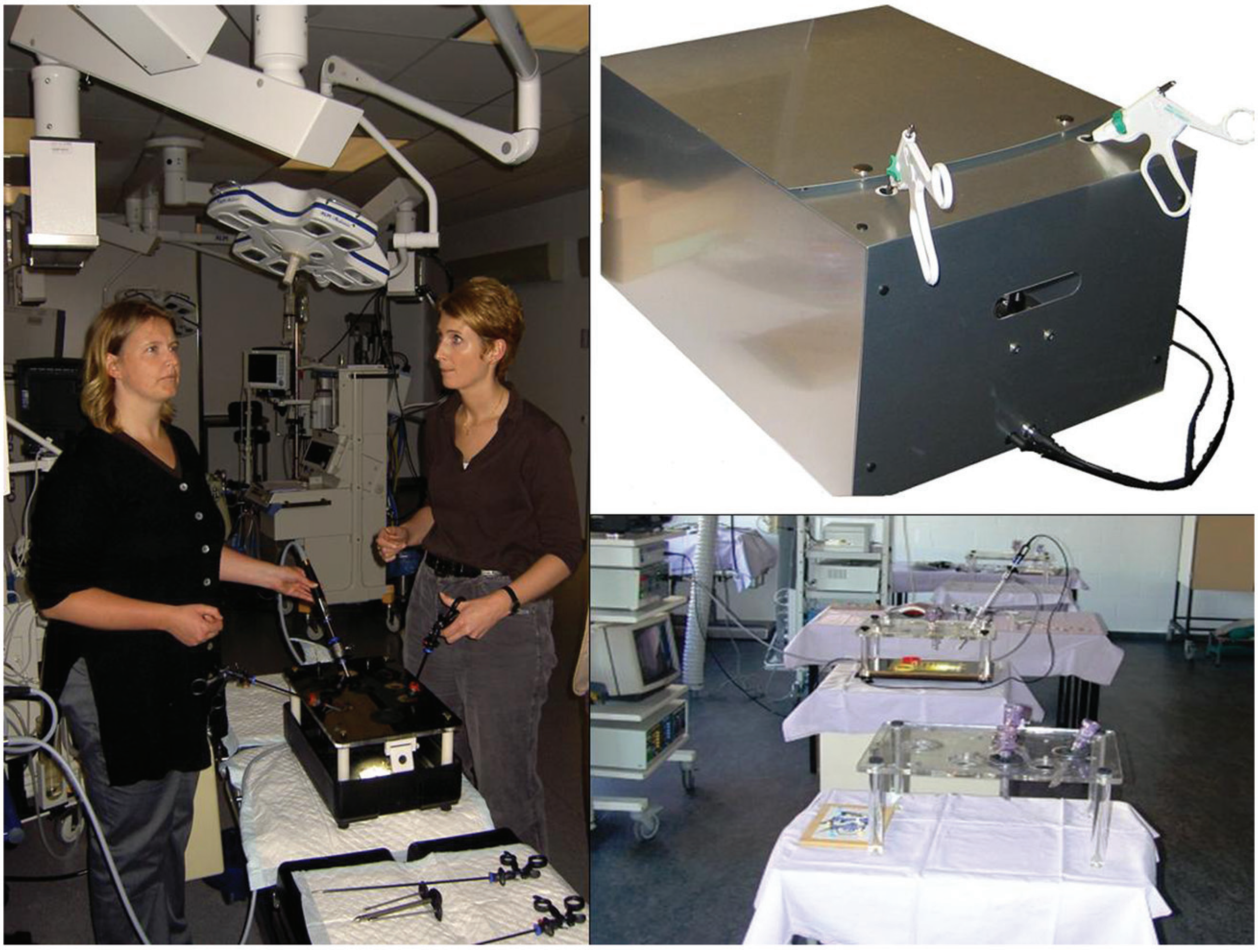

Figure 1. Box trainers for training MIS.

information gathering. Traditional classroom problem-based learning can also be transferred to a virtual environment, like in Second Life, thus enabling a modern yet familiar environment for problem-based learning (Conradi et al. 2009). Applications for MIS have, likewise, been initiated. Web-based applications like the *World Electronic Book of Surgery* (WebSurg) are widely used in the surgical community. This online learning portal contains a large collection of streaming and downloadable HD quality videos of surgical procedures, combined with how-to step-by-step surgical teaching guidelines to aid the implementation of MIS procedures for various surgical disciplines.

Recently, the first interactive e-learning program for MIS was introduced. The "Simpraxis™ Laparoscopic Cholecystectomy Trainer" is a customizable interactive simulation software training platform for cognitive learning of surgical procedures. It integrates multimedia (such as video, 3D models, radiology, illustrations, text, and still images, all captured from live procedures) and combines them with expert cognitive training pedagogy to create a powerful simulation of the procedure (Figure 3). All these elements combined simulate the feeling of performing the actual physical procedure while only using a computer. There is a detailed assessment of performance and one should complete the whole module within a set score to pass. The e-learning module is certified by the Accreditation Council for Continuing Medical Education of the USA and in this way it is possible to earn CME credits.

Besides e-learning, there is also a place for "serious gaming" in learning MIS. Since there is a positive correlation between video game skills and laparoscopic surgical skills, video games may be a practical training tool to help surgeons (Shane et al. 2008). Badurdeen et al. (2010) demonstrated a skill overlap between certain games for the Nintendo Wii™ gaming console and basic laparoscopic skill tasks. This gaming console is relatively inexpensive, allows natural hand movements similar to those performed in laparoscopy, and can be effectively used as a "take-home" simulator (Bokhari et al. 2010). Another application of serious gaming is creating an online competition for VR simulation training, which may enhance voluntary skills training (Verdaasdonk et al. 2009).

Animal models

Animal models, mainly pig models, have the advantage of simulating tissue handling and clinical scenarios better than any other simulation model and are still frequently used for procedure and device training in-company supported programs. Due to financial, legal, and ethical reasons, animal model training is slowly being replaced by other simulation

Table 1. Validated box/video trainers for minimally invasive laparoscopic surgery.

Name	Trainer type	Face validity	Construct validity	Predictive validity
McGill inanimate system for training and evaluations of laparoscopic skills (MISTELS) (Fried et al. 2004)	Box trainer	Yes	Yes	Yes
Fundamentals of laparoscopic surgery (FLS) (Ritter & Scott 2007)	Box trainer	Yes	Yes	Yes
Yale laparoscopic skills and suturing programme (YLSSP) (Rosser et al. 1997)	Laparoscopic surgical trainer	No	Yes	No
Southwestern video trainer stations (Korndorffer et al. 2005)	Video trainer	Yes	Yes	Yes
SIMULAB 1 (Mettler et al. 2006)	LapTrainer with SimuVision LTS-10	No	Yes	No
SIMULAB 2 (Kirby et al. 2008)	LapTrainer with SimuVision LTS-10	No	Yes	No
SIMULAB 3 (Dayan et al. 2008)	LapTrainer with SimuVision LTS-10	Yes	Yes	No
Laparoscopic skills testing and training (LASTT) (Campo et al. 2010)	Szabo trainer box	Yes	Yes	No
Legacy inanimate system for laparoscopic team training (LISETT) (Zheng et al. 2008)	Ethicon Laptrainer	No	Yes	No
Pelv-Sim (Arden et al. 2008)	Pelv-Sim box trainer	No	Yes	No
Lentz (six tasks developed by author) (Lentz et al. 2001)	Mirrored trainer and box trainer	No	Yes	No
Black (five tasks, developed by author) (Black & Gould 2006)	Video trainer	No	Yes	No
Kolkman (five tasks developed by author) (Kolkman et al. 2008)	Box trainer	No	Yes	No
Clevin (five tasks developed by author) (Clevin & Grantcharov 2008)	Box trainer	No	Yes	No
Risucci 2001 (Risucci et al. 2001)	Box trainer	No	Yes	No

models. With the new generation of VR simulators this shift is possible without compromising on the quality of the skills training.

Other simulators in MIS

Recently, new VR simulators for other fields of MIS were developed. A new area of MIS is robot-assisted laparoscopic surgery (Schreuder & Verheijen 2009). This type of surgery is becoming more and more accepted and there is a growing need for training residents and fellow's in this type of surgery. Two new VR simulators for robotic surgery are recently validated, and face and construct validity were established (Kenney et al. 2009; Seixas-Mikelus et al. 2010). In the field of gynecology, hysteroscopy is an important minimally invasive tool to treat abnormalities inside the uterine cavity. Training hysteroscopy is traditionally done using a porcine bladder to simulate the cavity and perform resections, which has been shown to improve resident performance (Burchard et al. 2007). In 2009, a VR simulator especially for hysteroscopy was introduced and validated (Bajka et al. 2010). The use of simulation is nowadays well-established in training MIS in most areas. For open surgery simulators are still difficult to develop.

Team training

Training how to act in the operation theater or emergency room generally happens on individual basis. In practice, however, a hospital patient is treated by a multidisciplinary team. It has been shown that giving multidisciplinary team training to clinical teams leads to improvements in dealing with fatigue, teambuilding, communication, recognizing dangerous situations, decision-making, and providing feedback (Grogan et al. 2004). For the purpose of such team training, specific full body simulators are developed. These high-fidelity patient simulators can be fully programmed to simulate an acute disorder. Scenarios can be tailored to specific target groups. Participants can be tested on their individual clinical skills and competence to work together under pressure as a team. Training in a medical simulation center with high-fidelity simulators offers the opportunity to train rare emergency scenarios under standardized conditions and give targeted feedback on functioning as individual and team. Training of healthcare teams in emergency situations promotes cooperation and reduces the number of communication errors (Leape & Berwick 2005). Therefore residents should not only be trained in medical knowledge and skills, but also in collaboration and communication, two other competencies of the CanMED model (Frank & Langer 2003). Eighty per cent of the time spent in a recently established multidisciplinary Gyn and OB simulation training focuses on communication and collaboration. The concept can be easily transferred to other specialties and multidisciplinary team training for surgical residents will be introduced in 2010.

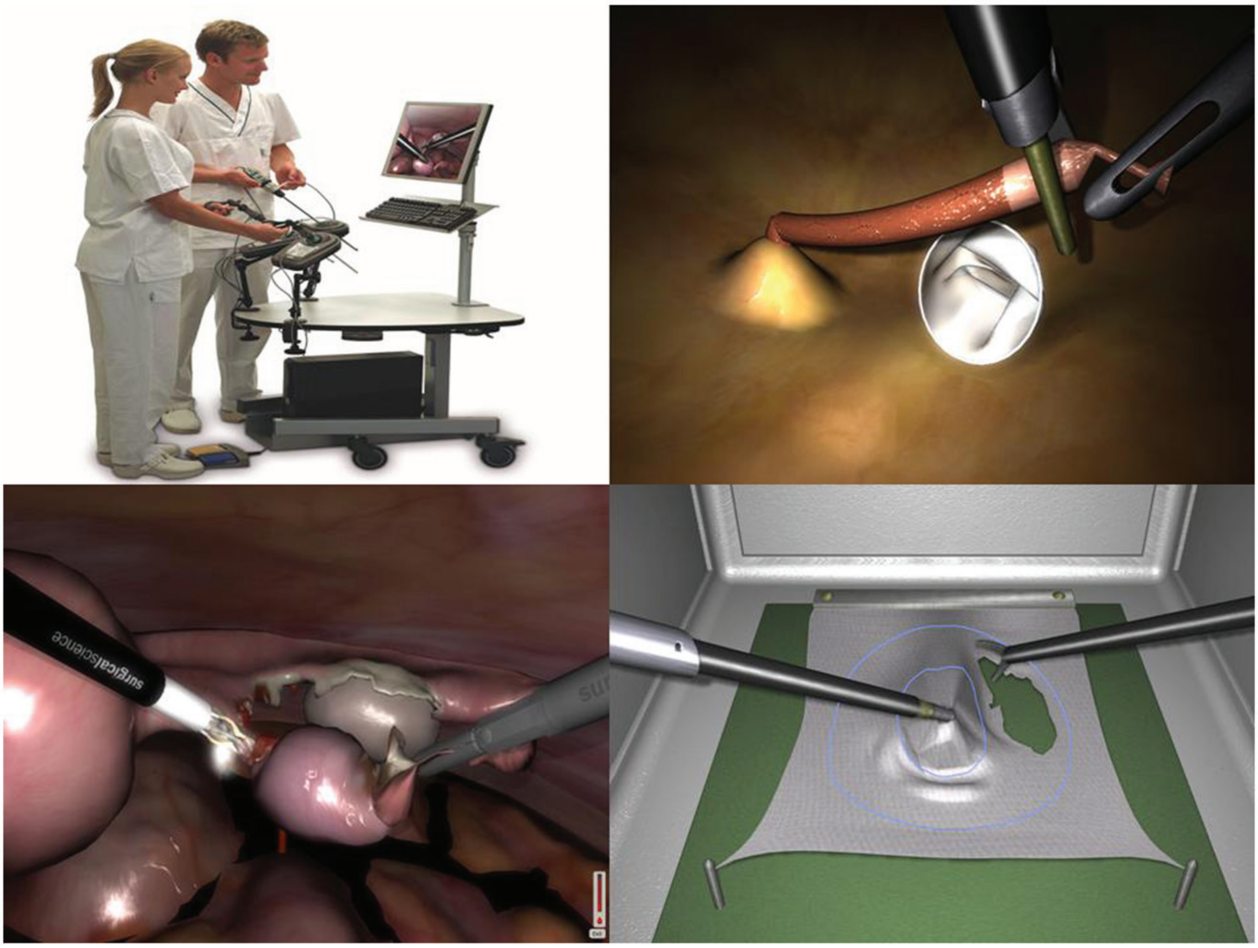

Figure 2. VR simulation (images provide by Surgical Science^{TM}).

Table 2. Validated VR simulators for minimally invasive laparoscopic surgery.

VR Simulator		Construct validity	Predictive validity	Haptic feedback	Basic skills	Procedural task	Curriculum	Team training
Simendo (Verdaasdonk et al. 2007)	Laparoscopy	Yes	No	No	Yes	No	Yes	Yes
ProMiss (Pellen et al. 2009)	Laparoscopy	Yes	No	Yes	Yes	Yes	Yes	Yes
MIST-VR (Grantcharov et al. 2003)	Laparoscopy	Yes	Yes	No	Yes	No	Yes	No
Procedicus KSA (Ström et al. 2004)	Laparoscopy	Yes	No	Yes	Yes	No	Yes	No
Lap mentor (Zhang et al. 2008)	Laparoscopy	Yes	Yes	Yes	Yes	Yes	No	No
Lap Sim (Larsen et al. 2006)	Laparoscopy	Yes	Yes	No	Yes	Yes	Yes	Yes
EndoTower (Stefanidis et al. 2007)	Laparoscopy	Yes	No	No	Yes	No	No	No
Xitact LS 500 (Schijven et al. 2004)	Laparoscopy	Yes	Yes	Yes	Yes	Yes	No	No
SepSurgery (Bunzink et al. 2010)	Laparoscopy	Yes	No	No	Yes	Yes	No	No
Lap-VR (Iwata et al. 2010)	Laparoscopy	Yes	No	Yes	Yes	Yes	Yes	Yes
dV-Trainer (Kenney et al. 2009)	Robotic surgery	Yes	No	No	Yes	No	No	No
RoSS (Seixas-Mikelus et al. 2010)	Robotic surgery	Yes	No	No	Yes	No	No	No

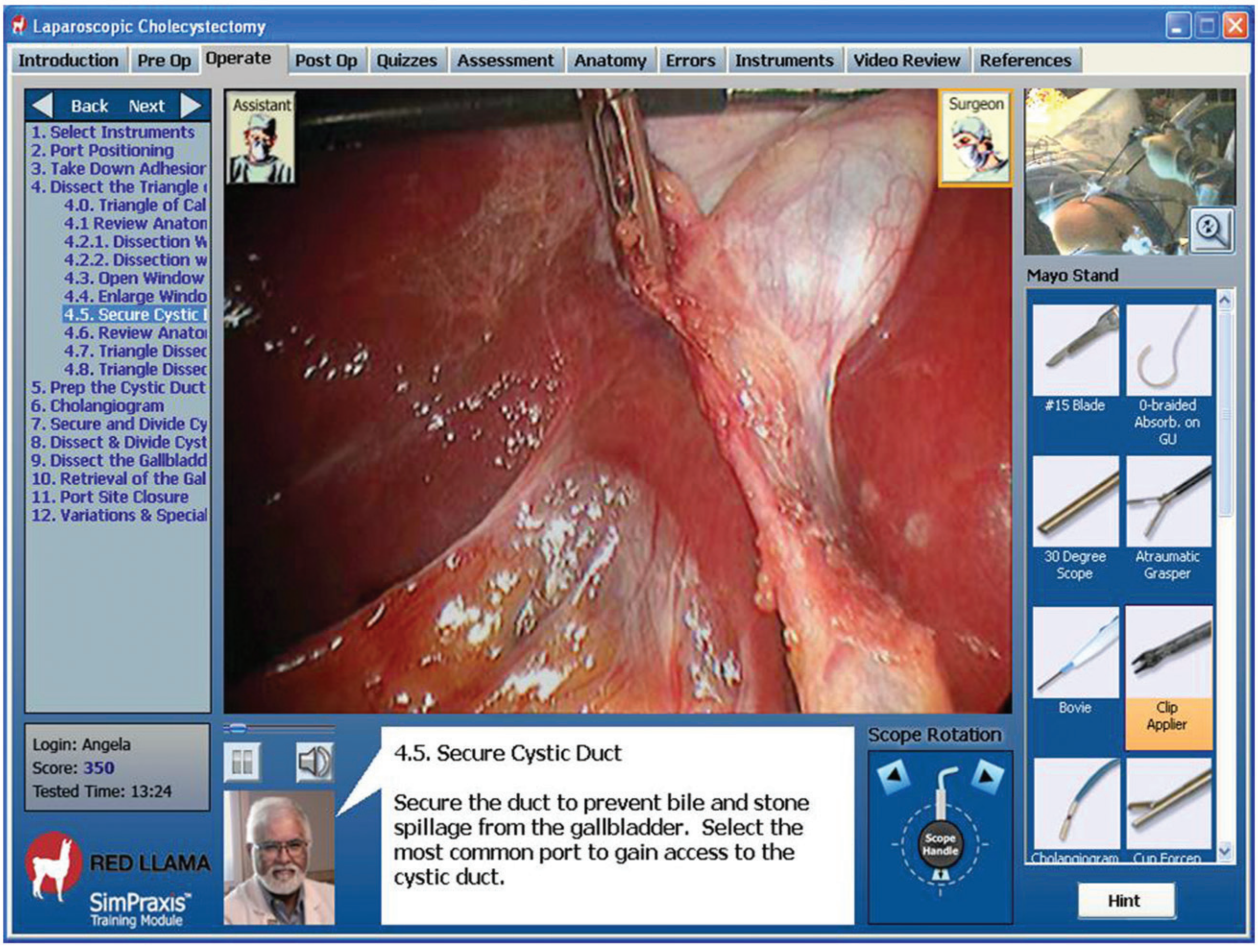

Figure 3. Laparoscopic cholecystectomy e-training program (image provided by Redlamatech®).

Current state of implementation of skills training for MIS in the Netherlands

In the Netherlands, MIS is professionally organized. The Dutch Society of Surgery, Dutch Society of Obstetrics and Gynecology, and the Dutch Society of Urology each have their own working group on MIS, together combined and represented by the Dutch Society of Endoscopic Surgery. In November 2007, the Dutch Inspectorate for Healthcare published a firm report entitled "Risks minimally invasive surgery underestimated" (IGZ 2007), expressing its concern regarding endoscopic surgery and patient safety in the Netherlands. Training in MIS was found to be inadequately structured and implemented. A need for national standardized training programs for MIS, with strict criteria, was stressed and firm recommendations were stated. Furthermore, a number of nationally endorsed hospital interventions were demanded, many of which surpassed specialist-specific boundaries. In reaction, various working groups of the respective clinical medical specialties started developing structured, competency-based MIS curricula including appropriate outcome evaluation.

General surgery

A standardized surgical training protocol for MIS was developed by the Dutch Society of Endoscopic Surgery and the Working Group for Endoscopic Surgery, residing under the Dutch Society for Surgery. A preset level of knowledge is required and further development of laparoscopic know-how and skills embedded in a three-step curriculum (Table 3). This level-of-skill must be tested and periodically re-evaluated. As a consequence, if a resident is no longer able to pass a certain level of knowledge or skill, he or she is no longer allowed in the clinical surgical laparoscopic setting as a first operator on patients. More precisely, every resident in training for surgery must follow this curriculum and pass the test before embarking on patient surgery and must have the opportunity to train repeatedly on a permanently available and functional laparoscopic training setting. Ideally, a supervising, certified surgeon is present to correct posture and problems of the training environment. The nationwide implementation of this three-step curriculum is not an easy process, as many regions have their own programs. Nevertheless, it is to be expected that these programs will adhere to the standardized training protocol in the near future as it is the framework against which these programs will be tested by the government.

Gynecology

The Dutch Society of Gynecological Endoscopy developed recommendations for training and learning MIS early 2008, which were accepted by the national society. In this report, a

Table 3. Separate programs for MIS training in the Netherlands.

General Surgery
Three-step curriculum to be completed in the first 2 years of training

- Step 1
  - Staff endorsed knowledge module
- Step 2
  - Validated laparoscopic psychomotor skills curriculum. This can be box/video trainer, VR trainer or porcine ex-vivo gallbladder or a combination
  - Only after completion of steps 1 and 2 progress to step 3
- Step 3
  - Living anesthetized pig model for teaching laparoscopic surgical steps and procedures

Gynecology
  - General format to be filled in regional
- Year 1
  - Combined 2-day course with exam (theory, practical skills)
  - Regular competence-based practical skills training in own hospital, validated local exam to be past before starting with laparoscopy

Starting with level I (easy) procedures

- Year 2–4
  - Regular assessment of skills in operating room and skills lab using OSATS
  - With gaining experience starting with level II (moderate) procedures
  - Retention of skills measured by repeating simulator exam with increasing difficulty every 6–12 months
- Year 5–6
  - Combined 2-day advanced course with exam (theory and practical skills) in year 5
  - Regular assessment of skills in operating room and skills lab using OSATS
  - Retention of skills measured by repeating simulator exam with increasing difficulty every 6–12 months

Urology
Competence-based program ‘‘Basic Laparoscopic Urological Skills’’: including

- Knowledge exam
- Practical exam laparoscopic skills exam
  - Abstracted from the FLS training model with two new exercises developed more specific for urology
  - Yearly nationwide examination

Note: OSATS – Objective structured assessment of technical skills (Martin et al. 1997).

format for a structured competence-based curriculum for learning MIS is described (Table 3). The hospitals were obliged to have a box trainer or a VR trainer. In gynecology, the complexity of laparoscopic procedures is defined by the European Society of Endoscopic Surgery. In the 6 years of training, skills up to level II need to be acquired. The courses are organized regionally, on a small scale, to secure enough practical exposure and personal feedback for the participants. Practical training on simulators is mainly done in the separate teaching hospitals. Unfortunately, the availability of skills labs and simulation facilities still varies among the different hospitals. This hampers the implementation process and can make passing a simulation exam before starting surgery difficult. In some regions, a portfolio for laparoscopic surgery is used. This enables a good insight in the progression of the resident.

Urology

The Dutch Foundation of Endourology forms the platform for urological endoscopic skills training. A large national project ‘‘Training in Urology’’ with a focus on the development of extended educational programs, using validated training models was started in 2007. A special module ‘‘Basic Laparoscopic Urological Skills’’ for training MIS in urology was developed (Table 3). Residents receive the program when they start training and can start the basic skills training in their own hospitals.

Skills curricula and skills laboratory: Common denominators and differences

Providing sophisticated simulators to hospitals is not enough to assure that trainees will start training. Simulator training should be incorporated in an obligatory training program. If this does not happen, most trainees will simply not be sufficiently motivated to train (van Dongen et al. 2008). To be optimally effective, the simulator training should be incorporated not only in an obligatory, but also in a competency-based training program. These programs are based on the progression of the trainee rather than on parameters measuring merely efficiency (such as ‘‘path length’’ or time spent on training). This is important as we know now that the rate of progression, as reflected in the individual learning curve, may vary considerably among trainees (Schijven & Jakimowicz 2004).

Surgical skill acquisition can be subdivided in a three-stage progression model: a cognitive stage (knowledge), an associative stage (technical skill), and an autonomous stage (adequate judgment). All the three stages need to be addressed in a good surgical skills curriculum (Reznick et al. 2006). The practical surgical skill curricula developed in the past decade mainly focus on the associative stage. Some authors describe a more general development of a surgical skills curriculum in which an integrated approach of all the three stages is well-documented. Gallagher et al. (2005) describe an eight-step approach to set up a surgical skills curriculum regardless of specialty program, including: (1) didactic teaching, (2) instruction, (3) common errors, (4) test of didactic information, (5) technical skills training, (6) immediate feedback, (7) summative feedback, and (8) repeated trials, learning curve, and a proficiency performance goal. McClusky and Smith (2008) give a good description of a sequential, progressive, modular surgical skills curriculum. The modular system distinguishes five different modules: Module 1 – knowledge acquisition, Module 2 – psychomotor assessment and initial acquisition, Module 3 – integration of knowledge and psychomotor skills, Module 4 – supervised ‘‘real-world’’ application, and Module 5 – mastery. With such a stepwise or modular system in mind, it is possible to develop proficiency or competence-based surgical skills curricula for all type of procedures. Depending on the goal of the curriculum, different simulators or specific tasks, as long they themselves are validated, may be incorporated in the curriculum.

When bringing a well-designed surgical skills curriculum into practice, an appropriate environment such as a skills center is essential (Figure 4). Before setting up a skills center, it is important to define the mission of the center. Definition of the purpose(s) and identification of the stakeholders (e.g. one specialty or more specialties) and resources are important

Figure 4. VR skills center for training MIS.

early on in its development. The personnel, space resources, and equipment purchased should be tailored by the curricular needs and not the other way around (MacRae et al. 2008). If not, one could end up with an expensive empty shell, being a beautifully equipped, empty space with a disappointed staff to run it.

Discussion

Developing and implementing a nationwide training program for MIS is a very complex and demanding process. The guidelines, derived from the report of the Dutch Inspectorate of Healthcare in 2007 (IGZ 2007), enforced the development of structured competency-based training programs in surgery, obstetrics and gynecology, and urology. These three front running subspecialties using MIS now have their own program on paper, but they all experience problems with nationwide implementation of the programs. Facilities are not always properly equipped, teaching staff is not always willing or able to teach such a curriculum, and residents are often too occupied with daily practice core activities to train (Schijven et al. 2010). Eventually, most often human barriers are the hardest to overcome. The NVMO special interest group in skills and simulation and the DSSH are building bridges between the different subspecialties for optimal use of resources and to enhance standardization of training programs.

In all programs, simulation-based training to a certain level of competence is stated to be mandatory before the trainee can start MIS on patients as a first operator. To implement and enforce this, a change in the culture of residents and staff is required. Without additional support from the department chair and institution board of the hospital, this is almost an impossible mission. A key factor is the motivation of staff and trainees, who all should commit themselves to the agreed training program. Trainee motivation may be influenced to a certain extent. Internal motivation of trainees varies from person to person and is difficult to change, but external motivation of trainees can be influenced by staff and program directors, by organizing time to train during working hours, setting-up a competition, giving feedback, providing a small and easy accessible skills lab in the resident's room, and so on. Department chairs and program directors should communicate the skills program to all involved and should create the allocated training time during working hours, instead of trusting trainees to train by themselves in their off-duty hours (Schijven et al. 2010). It should be clear what is expected from trainees and staff. Furthermore, staff must agree on the issue not to allow residents to operate on patients unless they have reached the set level of competence. The dedication and quality of staff regarding MIS training could be of decisive importance for the success of a nationwide training program. The institutional board must facilitate the initiative in terms of offering space and resource for the initiative. The government, at last, through defining rules and checking the current status of implementation, is key in enforcing timely action on the proper implementation of proposed nationwide curricula and those institutes lacking to do so.

We know that many factors can affect the effectiveness of a surgical skills curriculum for MIS. When creating a skills curriculum, one should take these factors into account, in order to optimize skills acquisition and improve trainee readiness for the operating room. Important factors are: deliberate practice, trainee motivation, performance feedback, task demonstration, practice distribution, task difficulty, practice variability, proficiency-based training, and performance assessment (Stefanidis 2010). To enhance self-directed learning and to evaluate results, a portfolio for the trainee is a useful tool (Lewis et al. 2010). In the Netherlands, a separate section for MIS training was introduced in the subspecialty portfolios of general surgery and gynecology.

When building a skills laboratory, it is important to adjust or equip the skills laboratory based on the needs of the people working near to it, the demands of the institute in which it is hosted, and the skills curricula set by the different professional embodiments. In this way, skills training for MIS can be cost-effective (Stefanidis et al. 2010).

Conclusions

Simulation-based training is effective for training MIS and the learned skills have shown to be transferrable into the operating room, leading to improvement of patient safety. Simulators should not be used on their own, but should be incorporated in a competency- or proficiency-based laparoscopic training curriculum, using criteria set by the professional community, to be enforced by the hospital board. To implement such a curriculum, good cooperation among institutional board, program director, department chair, medical staff, and trainees is thus essential. In the Netherlands, the subspecialties of surgery, obstetrics and gynecology, and urology each developed a training curriculum for MIS. These subspecialties are now challenged with the implementation of the training curricula and notice that funding, motivation, and commitment are crucial factors. Perhaps most crucial is, however, the human factor. Different viewpoints on proposed national curricula are of course important, but on the other side, they cause serious delay in implementation. A better approach would be to start the implementation once agreed upon by the respective societies, and sharpen the curricula using careful and timely evaluation. The DSSH, a fast growing national simulation platform, provides an excellent platform for communication and sharing knowledge between the different subspecialties, medical educators, and hospital managers as far as it concerns simulation-based training.

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All authors are board members of the Dutch Society for Simulation in Healthcare, which is at the same time the NVMO Special Interest Group on Skills and Simulation.

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