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DIFFERENT TRAINING METHODS USED TO IMPROVE LAPAROSCOPIC SKILLS IN VETERINARY SURGERY

METODE DIFERITE DE ANTRENAMENT UTILIZATE PENTRU ÎMBUNĂTĂȚIREA ABILITĂȚILOR LAPAROSCOPICE ÎN CHIRURGIA VETERINARĂ

C. MICȘA[1),*)], Maria Roxana TURCU[1)], Alexandra PETEOACĂ[1)], F.P. POSASTIUC[1)], N.T. CONSTANTIN[1)]

ABSTRACT | REZUMAT

Laparoscopic surgery is gaining popularity among the veterinary surgical community. Training in minimally-invasive surgery is nowadays recognized as a valid instrument for teaching surgeons about different laparoscopic procedures. Laparoscopic surgery requires a unique subset of surgical skills that, for the inexperienced, can significantly prolong the duration of surgery. However, its role as an evaluation test and self-assessment tool to verify basic laparoscopic surgical skills is still under discussion. A multimodality-intensive laparoscopic training course should become a standard requirement for veterinary surgeons, allowing them to acquire basic and advanced laparoscopic skills on a routine basis. In this study, we demonstrate the role of simulation and training as powerful tools to improve surgical technical skills. By gradually increasing the difficulty of the exercises, the trainees can improve their instrument handling and adapt to the conditions imposed by minimally-invasive surgery.

Keywords: education, laparoscopy, surgical simulation, skill assessment, training

Chirurgia laparoscopică câștigă popularitate în rândul comunității chirurgilor veterinari.Formarea în chirurgia minim-invazivă este astăzi recunoscută ca un instrument valid pentru învățarea chirurgilor în diferite proceduri laparoscopice. Chirurgia laparoscopică necesită un subset unic de abilități chirurgicale care, pentru cei neexperimentați, poate prelungi semnificativ durata intervenției chirurgicale. Cu toate acestea, rolul său de test de evaluare și instrument de autoevaluare pentru verificarea abilităților chirurgicale laparoscopice de bază este încă în discuție. Un curs de pregătire laparoscopică multimodală intensivă ar trebui să devină o cerință standard pentru chirurgii veterinari, permițându-le să dobândească abilități laparoscopice de bază și avansate în mod obișnuit. În acest studiu, demonstrăm rolul simulării și antrenamentului ca instrument de bază pentru îmbunătățirea abilităților tehnice chirurgicale. Prin creșterea treptată a dificultății exercițiilor, cursanții își pot îmbunătăți capacitatea de manipulare a instrumentelor și se pot adapta la condițiile impuse de operația minim-invazivă.

Cuvinte cheie: educație, laparoscopie, simulare chirurgicală, evaluare a aptitudinilor, instruire

Basic surgical skills and procedures are required of newly graduated veterinarians. The Medical College and Ministry of Education expect veterinary medical schools to efficiently give training in the most up-to-date surgical skills and elective procedures. Surgical procedures are constantly improving in order to reduce morbidity and increase efficiency. A better vision of internal organs, fewer blood losses, smaller incisions, less pain, and shorter hospitalisation or recovery times are all claimed benefits of laparoscopy. With an increasing number and variety of procedures, small animal and equine minimally invasive surgery (MIS) is becoming more common. As a result, there seems to be a huge opportunity to teach and train veterinary students in MIS procedures (4, 26). Some studies found that teaching students fundamental surgical skills during their pre-clinical years increased their interest in surgery and made them more likely to pursue it as a career (8, 31, 35). Other studies have shown that practicing basic laparoscopic skills and laparoscopic surgery methods on models and simulators improves surgeon proficiency (1, 9, 19, 37). These skills are different from standard surgical skills and require a considerable amount of time with training simulators as well as clinical practice.

There are several laparoscopic training programmes available; however, their effectiveness is debatable. It's uncertain whether trainees have sufficient access to these programmes and whether they're adequate for developing the necessary skills (2, 7).

1) University of Agronomic Science and Veterinary Medicine, Faculty of Veterinary Medicine, Bucharest, Romania
*) *Corresponding author: mcscatalin@yahoo.com*

Furthermore, it has been recognised that the modern operating room is not the optimal learning environment due to increased time restrictions, cost, stress, and ethical problems. It's also unknown how that training should be designed to obtain the best results for veterinary surgeons. Tested methods of outcome assessment will become increasingly important as our standards and expectations for skills training increase (22, 33).

In veterinary surgery, no progress has been made in assessing quantifiable skills outcomes of surgery training. Our capacity to progress in this area is restricted by the absence of validated outcome evaluation tools. Providing construct validity of a test like this would show that it can distinguish between skilled and inexperienced surgeons (13, 16).

Initially, veterinarians performed laparoscopy for diagnostic (e.g., cryptorchidism) or surgical procedures in the management of diseases (e.g., orchiectomy, nephrectomy). Laparoscopy was used in the treatment of malignancies as their experiences grew and technical adjustments were made, and it went from simple to technically complex reconstructive methods. The range of grounds for laparoscopic therapy is growing, and patients are increasingly demanding a variety of treatment options. As the use of minimally invasive laparoscopy becomes more common,more emphasis is being placed on training and teaching (27).

Laparoscopy is the "gold standard" therapeutic option for ovariohysterectomy and cholecystectomy in general surgery (38). For a variety of additional operations, the advantages of minimally invasive methods over traditional open surgery have been established. Among surgeons, there is agreement that laparoscopic procedures of low and medium difficulty represent part of the general surgical training (3). Laparoscopic OVH and cholecystectomy are among the most regularly performed surgical procedures, opening the path for laparoscopic techniques to be widely used in general surgery (10, 28).

Despite these challenges, laparoscopic procedures have become normal practice, especially at veterinary centres that specialise in laparoscopy. This innovation, however, poses an additional difficulty to the veterinarian community: surgeons in training will be required to master laparoscopic methods without having previously performed the technique in a traditional manner (5, 17, 24).

Despite a growing understanding that laparoscopic procedures are here to stay, the veterinarian community must address many concerns. Structured training programmes (dry lab, animal lab) are needed to address the absence of training procedures, and the acquired experience must be integrated into daily clinical practice (6, 12, 15, 29). Furthermore, we must determine if complex endoscopic/laparoscopic procedures can be performed by novices without prior open/conventional surgical training, or whether prior open surgery experience is required to learn laparoscopic techniques (23, 36). Progress through the testing of theoretical knowledge and surgical skills is required to get professional status as a surgeon. The surgical craft is defined by the combination of distinct procedural skills. These abilities were previously acquired by spending long hours in operating rooms (18). The cultural, social, and educational environment, on the other hand, is rapidly evolving. The traditional apprenticeship programme, which was frequently long and drawn out, is being called into question (11, 34). It was required for the surgical curriculum to shift away from the traditional apprenticeship model and toward the methodical and rational teaching of skills through action rather than watching (32).

Laparoscopic surgery requires abilities that are distinct from open surgery, being more related to endoscopy than traditional laparotomy. The surgeon must create a smaller incision to penetrate the peritoneal cavity, using long instruments with only their tips visible, and become acquainted with the haptic feedback and motion inversion. Procedures are carried out with limited tactile feedback while viewing a two-dimensional video image on a screen (25).

As a result, so-called objective structured evaluations of technical skills have been used to assess these skills. This testing has used live-animal models, and/or bench station testing, which has proven to be equally as effective and accurate (30).

The purpose of this study was to compare the effectiveness of different laparoscopic training models for veterinary students, to evaluate student confidence in skill development between groups, and to see if there was a link between acquiring laparoscopic basic skills and prior surgical experience (20), (21).

MATERIAL AND METHODS

A vast variety of simulators and models for laparoscopic training in general surgery with different levels of validity and reliability are available. They vary widely in their platforms (physical or virtual reality), performance measures used (out-come based or movement based), and demonstrated validation level.

Physical simulators include a box trainer and real instruments (as used in the laparoscopic room). The materials used in these simulators can provide texture and behaviour similar to real tissues.

Training boxes (pelvic trainers) and practising laparoscopy on various animal models are two prominent laparoscopic training facilities. Only basic laparoscopic activities can be performed on unanimated models, such as inorganic or vegetable things, or meat portions, such as chicken legs, muscle pieces, or more particular organs, in the trainers' video-based environment.

The trainees will be able to solve problems caused by laparoscopies, such as a lack of hand-eye coordination, a two-dimensional reduction of their vision on a video screen, a change in visual scale, and movement inversion due to the presence of the trocar as an additional fixed point on their instruments

Laparoscopic simulator

The LapSim® laparoscopic simulator (Mentice, Gothenburg, Sweden) comprises two standard laparoscopic instruments held together on a frame with position-sensing (Fig. 1 and 2). These are linked to a personal computer and movements of the instruments are relayed in real-time to a computer monitor. Targets appear on the screen and are 'grasped' or 'manipulated' with performance measured by time, error rate, and economy of movement for each hand.

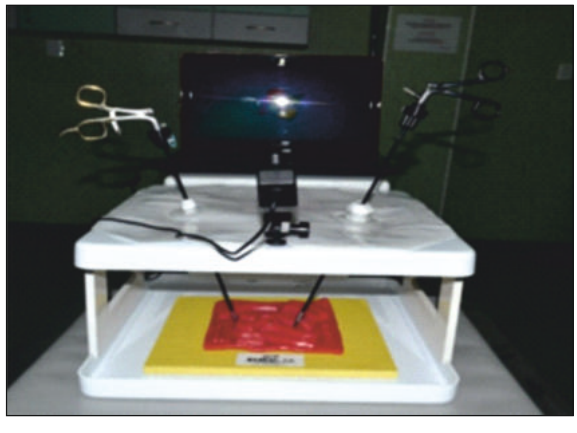

Fig. 1. LapTrainer SimuVision

Box-trainer

Locally manufactured box-trainer contains a board placed in a black training box fitted with rubber gaskets to accommodate cannulae for the scope and tools (Fig. 3). A fibre-optic light source and camera equipment are used and the image is displayed on a video monitor. The following instruments are used 1. Atraumatic grasping forceps, both jaws opening 2. Grasping /dissecting forceps curved left, both jaws opening (Maryland Dissector) 3. Scissors curved left, both blades opening (Metzenbaum) 4. Modular needle holder, straight with carbide insert with top lock.

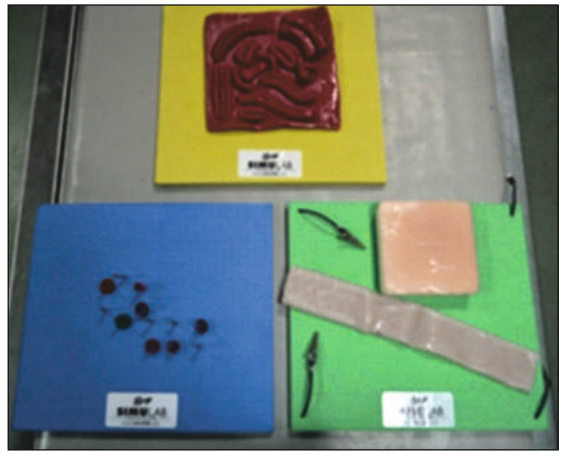

Fig. 2. Skillset with standardized exercises

Fig. 3. Training box developed to simulate laparoscopy procedures

Large animal models

Fig. 4. Swine laparoscopic training

Large animal models are used widely and have been validated for almost all surgical protocols. Based

on the anatomic similarities between the human abdominal cavity and several mammal models, canine, ovine, and porcine models are used on a wide base as a last step before true human applications. They offer a better working space compared with the smaller models. Furthermore, tissue characteristics and haemostasis control are very similar to humans (5, 21) (Fig. 4). Porcine laparoscopy enables the performance of real-time laparoscopy and complete procedures on tissues. Clinical applications in veterinary medicine provide access to a wide variety of procedures, in addition to educational or experimental purposes. Live animal swine models allow training in realistic conditions; animals are anaesthetized and ventilated, surgeons are dressed, and stress conditions are destitute to keep the model alive until at least the end of the procedure (20, 36). These models have the disadvantages that are much more expensive, especially because of their housing and handling requirements. They also are not universally available because of ethical or national legal restrictions.

Training programmes

Students in their final year of veterinary school were invited to participate in the study. Students had previous long and many hours learning traditional basic surgical skills (instrument introduction and handling, suture introduction and patterns) and a similar number of hours observing or assisting during neuter and spay surgery in the small-animal clinic or the veterinary ambulatory surgical theatre. Before this study, there was no exposure to or training in laparoscopic surgery in the curriculum. Students filled out a questionnaire on their past laparoscopic surgical exposure and experience, and they were only included in the study if they had no prior laparoscopic training or experience. Each student was then randomly assigned to either Group A, which received training on a laparoscopic LapSim (Fig. 1), or Group B, which received training on a laparoscopy box trainer (Fig. 3), or to be assigned to Group C to perform basic and advanced manoeuvres on a live swine animal model (Fig. 4).

Participants had to read written instructions and see video recordings of each of the five tasks before taking the test (peg transfer, pattern cutting, ligature loop placement, extra-corporeal suturing, and intracorporeal suturing) - Group A-B, or were asked to perform the same techniques, but on a live animal model (group C) - the participant was instructed to perform a complete abdominal cavity exploration and to retrieve three foam objects, to place an intra-corporeal suture and to dissect a cyst from a structure without rupturing it. If a participant had any additional questions subsequently, the person evaluating performance would reply to them immediately before the assessment. Before the evaluation, the subject was allowed a few minutes of instrument handling outside the trainer box to familiarise themselves with the instruments.

Basic laparoscopic skills were assessed in all students before and after training on the assigned training model, Group A on the LapSim and Group B on the box trainer (Fig. 1 and 3), and Group C on the live animal model (Fig. 4). These exercises were specifically selected as outcome measures because they are most relevant to the skills required of novice surgeon. They have been validated and used in prior studies of pre-clinical medical students in both human and veterinary medicine. A pre-training assessment was completed, followed by a post-training assessment. The subjects had a specific time to complete the activity, and scoring was based on the total time to completion. All tasks were evaluated by the same investigator based on time to completion.

RESULTS AND DISCUSSIONS

We planned to include the following comparisons.

- Box model training supplementing standard laparoscopic training versus standard laparoscopic training.
- Box model training supplementing standard laparoscopic training versus animal model training supplementing standard laparoscopic training.
- Video-box trainer versus mirrored-box trainer supplementing standard laparoscopic training.
- One type of video-box trainer versus another type of video-box trainer supplementing standard laparoscopic training.
- One type of mirrored-box trainer versus another type of mirrored-box trainer supplementing standard laparoscopic training.

Co-interventions were allowed if they were delivered equally to all intervention groups.

None of the students had any prior experience with laparoscopic surgery or training. In every element, both groups reported identical levels of confidence. After training, student confidence in doing basic laparoscopic activities improved significantly in all groups. Similarly, student confidence in identifying and handling laparoscopic devices was equivalent across all groups and improved dramatically following training, with no statistically significant differences between

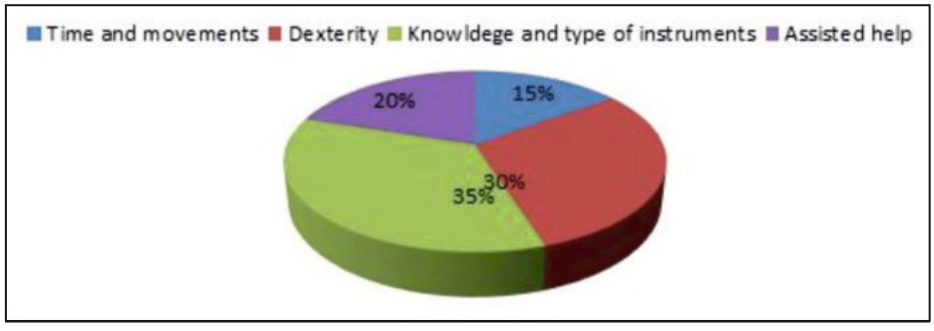

Fig. 5. Pre-training evaluation

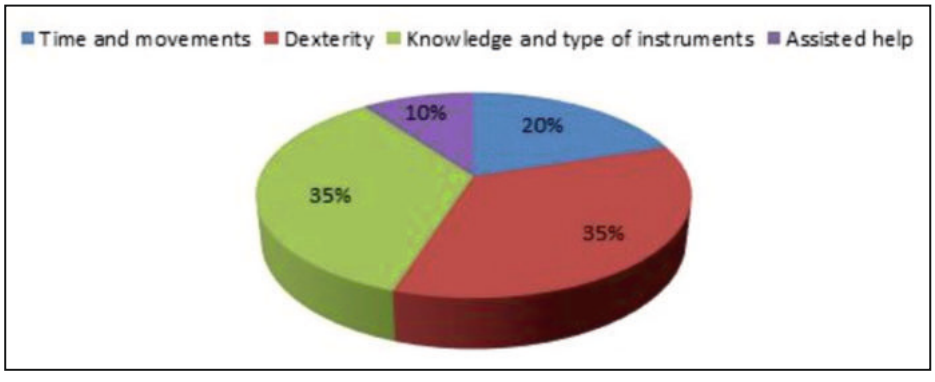

Fig. 6. Post-training evaluation

them. There was no significant difference in confidence level improvement across the groups when executing basic laparoscopic tasks.

Following my research on laparoscopy, I was able to conclude that the rapid development of laparoscopic surgery has naturally led to concerns about training activities and an accreditation system in the new field of video endoscopic techniques, whose Perception by the surgeon is different from classical surgery.

As noted in the previous tables, laparoscopic surgery requires sustained training that changes the skills and manual skills of the surgeon who is readjusting to the new type of surgery. Learning new skills for minimally invasive surgery is difficult to do and should be started from the "in the box" simulation and continuing with the other stages from close to close.

The present study shows that the data from the specialized literature highlight the fact that both the simulative training and the assessment of skills are very important ways of working that emerge from the data of the above tables, data that we obtained in the pre-training preparation.

The methodology and evaluation of the pre-training must be standardized according to the utilities of the training on several students in such a way as to establish the initial level, individual skills, and individual progress so that finally we appreciate on a scale the number of pre-training and to form groups of students according to the skills and competence of accumulating the instrument handling and the rules that are established.

Individuals participating in the training who are residents and do not have considerable accumulated experience will need more pre-training sessions than students who have behind them a rich experience in classical surgery. During the pre-training, it turned out that the ways to master the theoretical problems are also more easily received by experienced surgeons compared to resident surgeons.

Establishing a fixed number of procedures and the number of hours allocated to pre-training cannot be considered the optimal approach or standard framework specific to laparoscopic surgery for all students alike.

In initiating laparoscopic surgery, we believe that there is a need for objective and skills-based pre-training and the accumulation of theoretical problems for each student.

This study showed a significant efficiency in acquiring these skills after evaluation with the help of tests and scales and comparison tests in conclusion, the results showed an evolution of 75-100% between pre-training and post-training (Fig. 5 and 6).

These evaluation methods used and mentioned a-

bove bring an improvement in instrument handling, with a percentage of 15-20% from pre-training to the next sessions.

Based on the anatomical and topographic similarities with the human abdominal cavity, swine models are suitable for the transition from training to laparoscopic surgery on humans. Body size in human patients provides a greater field of work, and the surgeon has more freedom of movement. Also, the bipedal position of the man, which entails ligaments that fix in a significant proportion to the topography of the viscera, gives a faster approach and completion of the procedures in a shorter time.

The swine model offers surgeons a real approach due to inhaling anaesthesia of animals similar to human anaesthesia, providing adequate ventilation until the end of the procedures, without endangering the patient's life.

In terms of cost, live animal training is more expensive compared to other training methods. In training models for laparoscopic surgery on live animals, close collaboration is needed between human surgeon lecturers, veterinary surgeons, and human and veterinary anaesthesiologists.

The study highlights that after several training sessions at short intervals between them, the results were similar, regardless of the scores initially obtained by students. Objective assessment of students' "laparoscopic skills" draws attention to the application of the initial training methodology to the need to improve teaching methods, standardization, and adaptation of the course format and evaluation of participants' performance. We also emphasise the importance of accurately assessing and distributing students with similar performance based on the group evaluation.

There have been reports of surgeons finding it difficult to transition from a traditional surgery to a surgery with indirect and remote viewing, unable to adjust the posture between instrument handling and staring at the image.

From the data obtained, short-term and intensive courses add value to the acquisition and improvement of laparoscopic surgery techniques.

This study proves that these short-term, focused, and intensive courses improve students' laparoscopic surgery skills. Advanced training in the operating room for novice surgeons has limited access to complex laparoscopic procedures. This stage is performed on the swine model and mainly includes cholecystectomies, ovariohysterectomies, gastropexies, and / or biopsies samples.

The studies found showed an encouraging trend in terms of improving the student's post-training skills, and these improvements focused on using training as a tool in itself. Some such tools have proven to be useful and constructive.

CONCLUSIONS

The main finding of this study was that laparoscopic training was effective in improving veterinary students' confidence levels and performance scores in basic laparoscopic skills. Training facilities outside the industry have become more common both as independent institutions and in hospitals.

The use of animals, box trainers, and hybrid trainers invariably requires some organizational logistics due to legal and ethical factors as well as technical reasons. Even a box trainer requires the acquirement of organs and setting up of the system by an experienced technician. Simulators for laparoscopic surgery training play a very important role in initiating students and in learning theoretical and practical skills. The initial training, Lap-Sim, and the "box" training are mandatory steps for all those who will specialize in laparoscopic surgery. The advantage of the box and hybrid trainers is that the tactile response is the same as in real laparoscopic surgery and the real organs allow training not only in dexterity but also in decision-making and orientation in the anatomy. The advantage of hybrid trainers compared to box trainers is that they can provide the trainee with feedback on both scores and guidance on how to perform the task. In this sense, it would be rational to assume that a high-fidelity simulation model, such as anaesthetized animal tissue, would be superior in terms of training outcome to a synthetic plastic model. At the moment there is no standardized way to validate simulators before using them in the education of surgeons. Comparison of the different simulators by using the literature is therefore difficult. There is little evidence about the learning mechanisms involved in acquiring laparoscopic skills and the best method suitable for training, thus, the goal of this article. In conclusion, the adequate training pathway begins with a basic skills course followed by independent practice in simulator training models and assisting during laparoscopic procedures. The trainee then should attend an advanced skills course and an animal laboratory program. Finally, they should perform mentorship-guided laparoscopic procedures until the surgeon is competent enough to perform laparoscopy independently.

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