ISSN: 1220-3173; E-ISSN: 2457-7618

BASIC LAPAROSCOPIC TRAINING PROGRAM FOR VETERINARY MEDICINE STUDENTS: FIRST ROMANIAN PILOT STUDY

PROGRAM DE FORMARE DE BAZĂ ÎN LAPAROSCOPIE PENTRU STUDENȚII DE LA MEDICINĂ VETERINARĂ: PRIMUL STUDIU PILOT ROMÂNESC

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ABSTRACT | REZUMAT

The minimally invasive surgery has already replaced the classic, open surgery in several procedures, now being considerably applied in veterinary medicine. When compared to open surgery, the postoperative outcomes are much better in laparoscopic or robotic-assisted procedures. However, it requires completely different skills such as depth perception, hand-eye coordination in order to work with a two-dimensional view, in a three-dimensional environment. Laparoscopic surgery training programs should be developed to overcome this barrier in veterinary medicine. To analyse the results of the veterinary students when performing minimally invasive surgery exercises on a box model for the first time. The aim of the project was to prove that they can benefit as much as medical students from a basic laparoscopic training program. Eighty students were randomly recruited, forty from general medicine and forty from veterinary medicine. An initial theoretical session regarding the introduction in laparoscopic surgery was given. The baseline skills were evaluated using five dedicated exercises (Shoelaces,Circles, Track, Little Bears and Matches) on training boxes. All of them were explained and practically presented by an experienced surgeon. The parameter measured was the total time taken until completion. The program spanned over a period of 8 days, with a group of 10 students performing the tasks every day, each student being accordingly supervised by a trainer. Both groups showed equal efficiency when performing the tasks. A student T-test and a Mann-Whitney U-test at 95% confidence interval showed no statistically significant difference between the two groups. The sole exception was in the Little Bears, task where the veterinary students managed a better time ($p<0.001$).

Keywords: veterinary students, training, laparoscopic surgery

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Chirurgia minim invazivă a înlocuit deja chirurgia clasică, deschisă pentru diferite proceduri fiind aplicată tot mai mult în medicina veterinară. În comparație cu chirurgia deschisă, rezultatele postoperatorii sunt mult mai bune în procedurile laparoscopice sau asistate robotic. Totuși, aceasta necesită abilități complet diferite, precum percepția adâncimii sau coordonarea mână-ochi pentru a lucra cu imagini bidimensionale, într-un mediu tridimensional. Programele de pregătire în chirurgia laparoscopică ar trebui dezvoltate tocmai pentru a depăși această barieră în medicina veterinară. Obiectivul proiectului a fost analizarea rezultatelor studenților veterinari după efectuarea, pentru prima dată, a unor exerciții pregătitoare pentru operații minim invazive utilizând un pelvitrainer. Vrem să arătăm că studenții de la medicină veterinară pot beneficia la fel de mult precum cei de la medicină generală de pe urma programului de pregătire minimă in chirurgia laparoscopică. 80 de studenți au fost recrutați în mod aleator, 40 de la medicină generală și 40 de la medicină veterinară. Inițial a fost organizată o sesiune teoretică de introducerea în chirurgia laparoscopică. Aptitudinile de bază au fost evaluate cu ajutorul a 5 exerciții special concepute pentru a fi efectuate pe pelvitrainere (Șireturi, Cercuri, Traseu, Ursuleți și Chibrituri). Toate au fost explicate și demonstrate practic de către un medic chirurg experimentat. Parametrul evaluat a fost timpul total până la completare (sec). Studiul s-a întins pe o perioadă de 8 zile, zilnic un grup de 10 studenți realizând cerințele propuse sub supravegherea unui mentor. Ambele grupuri au demonstrat eficiență egală în realizarea exercițiilor. Testul T-student și U-Mann-Whitney cu un interval de încredere de 95% nu au arătat nicio diferență semnificativă între cele două grupuri. Singura excepție a fost evidențiată la exercițiul Ursuleți unde studenții de la medicină veterinară au obținut un timp mai bun ($p<0.001$).Aceştia pot obține aceleași beneficii de pe urma unui program de formare în chirurgia laparoscopică precum colegii lor de la medicină generală. Un program de pregătire bazat pe abilități practice este o modalitate de a stimula practicarea laparoscopiei în medicina veterinară.

Cuvinte cheie: studenți de la medicină veterinară, formare, chirurgie laparoscopică

Ever since Georg Kelling has performed the first minimally invasive surgery on a dog in 1901 (9) in Germany, laparoscopy has become the most preferred technique in modern surgery due to its numerous and obvious advantages, such as decreased morbidity and mortality, a shortened hospital stay and less pain for the patient. The minimally invasive surgery is now extensively used even in veterinary medicine for the treatment of animals, having the same principles that apply in general medicine (19). At present, laparoscopy has numerous applications in veterinary medicine: from a simple exploratory laparoscopy to gastric foreign objects retrieval and gastropexy, obtaining biopsy samples in cats and dogs, tumour or organ resections, cholecystectomy and even ovariectomy in dogs in late gestation (5, 14, 19). However, one serious dilemma must be discussed: what is the most efficient method of learning the necessary skills to perform a laparoscopic surgery?

Conventional open surgery is based on a simple principle described by William Stewart Halsted as "See One, Do One and Teach One", according to which the medical trainee first watches an intervention being performed by his mentor, then tries to replicate it and finally the trainee is expected to have the ability to teach the procedure to another trainee (13). By contrast, laparoscopy is rather more difficult to perform since it requires a very developed hand-eye coordination, and since it implies working with two-dimensional images, it requires a proper perception of depth. Moreover, it has a few setbacks of its own: the physiological tremor of the surgeon, a limited degree of freedom in movements and there is also the fulcrum effect that has to be considered (6). This relatively new technique demands completely new ways of acquiring experience and different skills, beyond the classic teacher-student model. It is clear that for the benefit of the patient and in order to greatly improve the medical education for both doctors and veterinarians, a significant shift in training and teaching is necessary (1).

Live animals and cadavers are high fidelity models in training for medical residents (6, 17), but the ethical issues along with their low availability and high price make them very difficult to be used extensively for this purpose. That is why, in the last twenty years, the interest has gradually shifted towards virtual reality simulators and laparoscopic training boxes in order to overcome the learning obstacles of the minimally invasive surgery (1). This kind of simulation has the benefit of replicating a clinical situation (with different types of fidelity), but with the absence of the psychological stress of operating on living patients. It has been proven that these kinds of simulations are useful for reducing the learning curve and also, the skills can be applied into the clinical setting.Therefore, surgeons are prepared for real clinical situations, thus improving their efficiency and the safety of the patient (7).

Such training programs have demonstrated an improved manoeuvrability of the medical residents who were part of them.The result was a significant improvement of time and greater efficiency when performing the most difficult techniques associated with laparoscopy: intracorporeal knot-tying and suturing (7, 20).

Unfortunately, Romania has no standard training programs for either veterinary or medical students to allow them to acquire the basic skills for minimally invasive surgery. Moreover, there is an important deficit of specialist veterinary doctors who would use laparoscopy as a first intention technique also due to the lack of training in this area.

We sought to give the opportunity of practicing basic laparoscopic skills to students from both the veterinary and general medicine universities and to demonstrate that veterinary students could benefit from such a simulation as much as the general medicine students. For this purpose, a multidisciplinary team formed of veterinarians and general doctors conceived an educational training program for students. No published studies in Romania have examined the effectiveness of a simulation program in laparoscopy for veterinary students.

MATERIALS AND METHODS

Participants

We randomly selected 40 students from general medicine and 40 students from veterinary medicine from important regional centres, regardless of the year of study. Neither of their curricula involved laparoscopic surgery training at the time of the study, yet we selected the participants so none of them had previous laparoscopic surgery hands-on experience with laparoscopic instruments, such as during extra-curriculum surgery workshops for students. We divided the students into the two series considering their origin Faculty – General and Veterinary Medicine. Subsequently, we formed groups of two, each group being continuously supervised by an experienced trainer in laparoscopic surgery. Every resident signed a written consent form permitting us to use the data obtained during his training. Every student signed a written consent form permitting us to use the data obtained during his training.

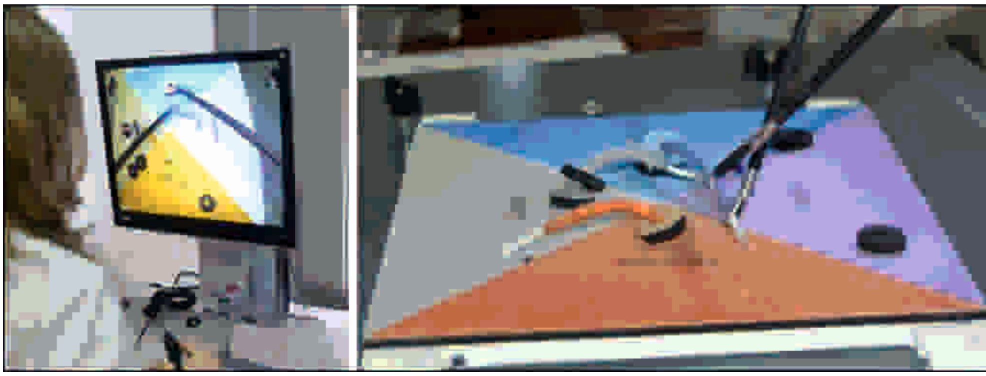

Fig. 1. First exercise: Shoelaces

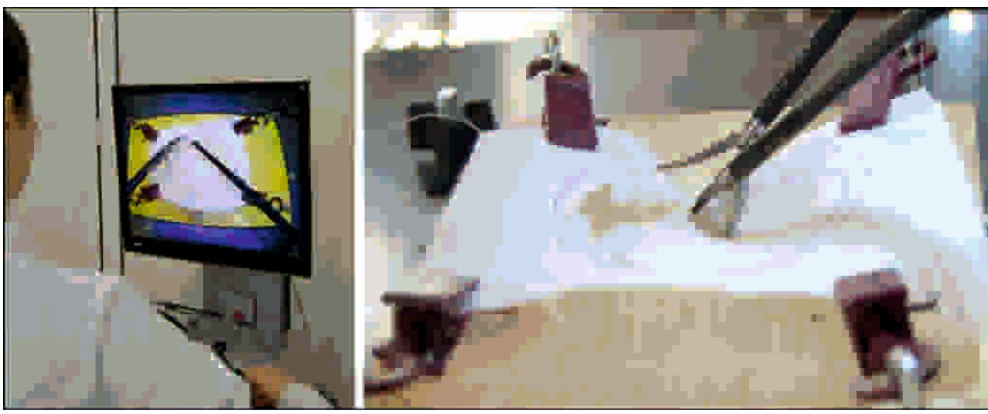

Fig. 2. Second exercise: Circles

The training program

The training program began with a theoretical part regarding the introduction to laparoscopic surgery. It was the same theoretical part for each group of students so that the participants would become aware of its concepts. We chose five exercises to be performed - Shoelaces, Circles, Track, Little Bears and Matches - all of them being explained and practically presented by an experienced surgeon. The programme spanned over a period of 8 days: every day a group of 10 students would perform the tasks. The theoretical and practical demonstration lasted 2 hours, while the practical time of work was 6 hours for each group.

We used five Helago laparoscopic training boxes, common laparoscopic instruments and for each task, different materials detailed as it follows:

1. For the first exercise – Shoelaces – eight one-sided-coloured rings (two of each colour: Orange, Gray, Blue and Violet) with a hole in the middle were scattered randomly with the coloured part facing down, on the 'Shoelaces' training aid. The training aid consisted of a cardboard divided into 4 coloured equivalent triangles (according to the colour of the rings) each of them having a thread attached to it – was placed on the laparoscopic training box floor. Two laparoscopic instruments were used for grasping. The students had to use one laparoscopic instrument to grasp each shoelace successively, and the other to pass each coloured ring through its matching colour thread (i.e., the two blue rings had to be placed on the blue thread) (Fig. 1).

2. For the second task – Circles – the materials used were a piece of soft textile material on which two concentric circles (with diameters of 7 and 6 cm, respectively) were drawn and fixed in tension on a wooden board with the help of four alligator clips; one laparoscopic grasper and scissors were used. The task was to grasp the piece of material with the laparoscopic grasper placed in their non-dominant hand and with the scissors position in their dominant hand, cut an area between the two concentrical circles without touching or going beyond their edge. The student could reposition the scissors in the non-dominant hand (Fig. 2).

3. The third task – Track – required a wooden board with eleven eye bolts fixed to it, a laparoscopic needle holder, a laparoscopic grasper and a 15 cm multifilament suture thread with needle (USP 2.0). The bolts were numbered from 1-11 with a red marker on the board. The students had to grasp the needle with the

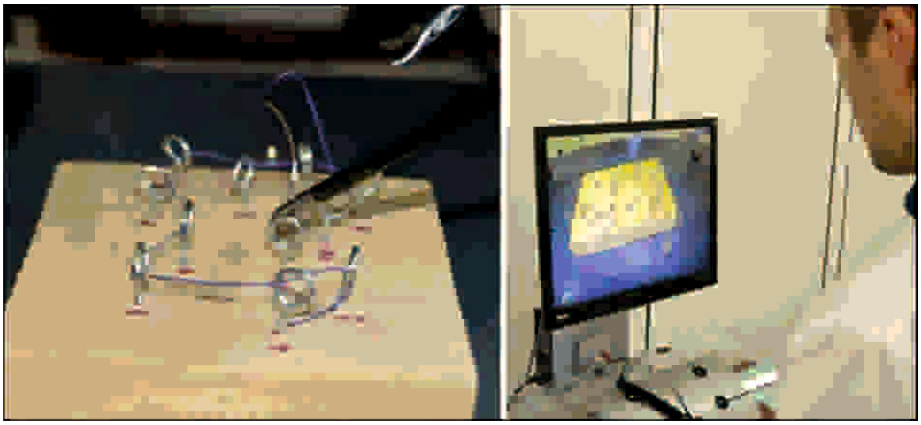

Fig. 3. Third exercise: Track

Fig. 4. Fourth exercise: Little Bears

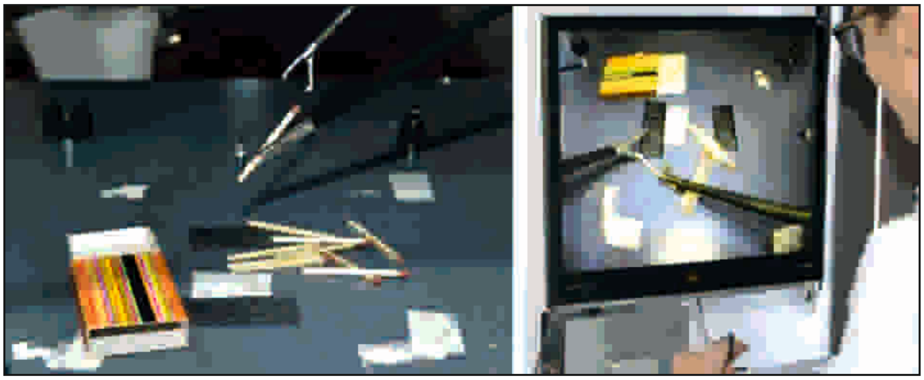

Fig. 5. Fifth exercise: Matches

needle holder placed in their dominant hand, pass its tip through one bolt, grasp the tip with the laparoscopic grasper placed in the non-dominant hand. Further, release the needle holder, pass all the remaining needle through the bolt, grasp it again with the needle holder and release the grasper. The task ended when the needle passed all the Track and the instruments were removed from the laparoscopic box trainer (Fig. 3).

4. Little Bears - required ten 2-centimeter-long bear-shaped multi-coloured gummy bears, scattered in the centre of the laparoscopic box's floor, a plastic cup placed in one corner and two graspers. The students had to hold the two prehension forceps in each hand. With the help of one instrument, the participants had to grasp and pick up each of the 10 gummy bears, hand it to the other instrument with which then placed the bear in the plastic container (Fig. 4).

5. The last task – Matches - required 10 matches spread in the centre of the laparoscopic box trainer and a half-open matchbox placed where the student wished among the matches; two laparoscopic graspers were used. The final exercise began after the students placed the matchbox wherever they pleased. Afterward, they had to grasp each of the matches in suc-

cession with the help of the instruments, place each match in the matchbox making sure they are in the same direction and then close the matchbox (Fig. 5).

In each group, one student was completing a task at the laparoscopic box,while their time was being monitored by their partner (positioned next to them) using the timer on their phones. Each duration was then marked down in the table provided to the students, in minutes and seconds. The stopwatch started the moment the video cam and the two instruments, specific for each exercise were inserted in the laparoscopic box and arranged the way the student wished. The timer was stopped when the task was completed and both instruments were removed from the laparoscopic box trainer. At the moment the task was completed and its duration written down, students switched places and roles. Immediately after all the participants finished, they all moved to the next task. Each team of students was supervised by a senior surgeon with experience in laparoscopic surgery during all time of hands-on exercises.

Statistical analysis

The statistical analysis was carried out with 2019 IBM SPSS Statistics (version 26.0). We compared data distribution with Shapiro-Wilk test, then compared the means or medians for each exercise. The first 3 exercises (Laces, Circles, Track) had normally distributed data, therefore we reported the variable as mean ± standard deviation (SD) and to compare the 2 groups we used the t Test – for unequal (Laces and Circles) and equal (Track) variances respectively as the F-Test Two-Sample for Variances dictated. The data from the two groups for the first two exercises had unequal variances, therefore we applied the t-Test: Two-Sample Assuming Unequal Variances and for the third exercise the data from the two groups had equal variances, therefore, we applied a t-Test: Two-Sample Assuming Equal Variances. The last 2 exercises (Little Bears, Matches) did not have normally distributed data so we expressed the variable as median and interquartile range [IQR] and we used Mann-Whitney U test to compare the two samples ranks. We considered a value of $p< 0.05$ as statistically significant.

RESULTS AND DISCUSSIONS

Table 1 shows the results collected from the five exercises. For four exercises - Shoelaces, Circles, Track and Matches - all the students obtained almost the same results without any significant difference regarding the time for completing the tasks. The only significant difference between the two groups was obtained in Little Bears exercise, the veterinary students were faster tents alike to be involved with laparoscopic techniques. The lack of statically significant difference between the times of the two groups suggests that, contrary to some popular opinions, the veterinary students' ability to learn how to perform laparoscopy for the first time is similar to that of medical students. It also indicates that a simulation training program in minimally invasive surgery could be implemented for veterinary students and residents in Romania, in order to increase their baseline level of surgical skills.

We found that of the five tasks applied and measured, the time results obtained at the Laces, Circles, Track and Matches exercises were not different between the veterinary group and the medical group, as we did not obtain significant statistical p values in the 4 exercises. As such, we could not reject the null hypothesis (There is no statistically significant difference between the two groups in performing laparoscopic

Table 1

The performance time for the two groups

Tasks	General Medicine Group (n= 40) Mean ± SD -seconds-	Veterinary Medicine Group (n= 40) Mean ± SD -seconds-	p value
Shoelaces	739.125±176.86	728.70 ±276.69	0.8
Circles	356.62±106.33	377.60±180.80	0.5
Track	664.25±184.8	639.95±215.59	0.5
	Median (P25%, P75%)	**Median (P25%, P75%)**	
Little Bears	191 (166,223)	140.5 (112.25, 176.75)	**<0.001**
Matches	526.5 (461.25, 635.5)	473.5(360.5, 646.25)	0.08

SD=standard deviation
P25%,P75% =25% and 75% percentiles

procedures). The only exception was the Little Bears task, where a time difference was statistically detected in the performance of the veterinary students compared to their medical counterparts. Further studies are necessary in order to approach and confirm these results, providing some consistent explanations for the results. These may be attributable to a number of factors, such as multiple approaches of different species by veterinary students, or video game experience in certain individuals' cases.

Regarding the video games, it is well known that nowadays, students allocate a lot of money, time and energy to playing video games and there is an abundance of evidence in medical literature that video games may represent an addition to laparoscopic skills training and that they decrease the necessary time to acquire those skills (11, 18). A systematic review concluded that amateurs and laparoscopic surgeons who have continuous video game experience have fewer errors, superior performance on the laparoscopic simulator with respect to the time necessary to complete the tasks and better efficiency in comparison to non-gaming surgeons (16).

Among the advantages of box training there are its low cost, the fact that all the consumable resources are quite cheap and within a very limited budget, hap-tic feedback, its versatility and the availability of validated training goals, making the study applicable to a much larger scale and in a constant, replicable mode (1, 7, 17).

The tasks were conceived so that the students could test and practice the most basic laparoscopic skills. The Laces is the task that necessitates finger dexterity, stability of the hand and the ability to per-form different actions with each hand at the same time, based on the principle of threading a needle. The second one, Circles, assessed the students' precision, by respecting the limits of the circles, cut in a conti-nuous line, respect the curves, and also manipulate the two instruments simultaneously – hold the paper still with the grasper and cut with the scissors. They were also allowed to change the hand holding the scissors in order to have a better position, therefore training their both hands to work with the same instru-ment. The Track was designed to measure their ability to simultaneously make different actions, while Little Bears and Matches were meant to assess the level of digital control in securing and releasing small items. All the tasks required a good hand-eye coordination (3, 7, 8, 15, 20).

As such, the students were evaluated from different points of view with regard to the application of laparoscopic techniques.

This study found that not only veterinary students are able to greatly benefit from proficiency-based training in laparoscopy, but their complete potential may be equal to that of the medical students in particular areas, thus explaining the necessity for a mandatory, standard training program based on virtual simulation in veterinary medicine curricula. Furthermore, this basic training program was created only to allow students to reach a baseline, but intermediate and advanced programs do not exist at the moment, so there are still a lot of gaps to be filled in this area. There is data which reports that learning is enhanced in trainees who practice tasks with progressively more difficult situations (10).

Similar training programs have existed for years in the international community and they have continuously evolved over time, from box trainers to virtual reality, becoming more and more popular with students who have taken an interest in laparoscopy, following simple, step-by-step guides to building cheap laparoscopic training boxes (2).

The Department of Urology at the Indiana University School of Medicine created the first laparoscopic elective course for their third-year and fourth-year medical students so that they could get accustomed to minimally invasive surgeries. It has been proven that the educational role of the virtual trainer is comparable to box trainer, with satisfying results in both cases (12, 15).

On the other hand, there are certain shortcomings to the study. Firstly, our population of students is relatively small and the short period of time did not allow us to re-evaluate the students or to observe their performance by repeating the same exercises, under the same conditions. As we did not have a unified scoring system for performance, it is difficult to quantify the potential or the improvement for each of the participants. Since this is a pilot study in Romania, there is no similar evidence in our medical literature, therefore our results cannot be corroborated by others to strengthen our conclusion.

It becomes clear that, in order to effectively educate the future surgeons, one must ensure that, beside extensive knowledge in the domain, the graduates and undergraduates have the necessary skills for the currents state of training and practice. Therefore, it is expected that veterinary medicine students will be included in the future training programs in order to incorporate new practices and procedures and periodically refresh their existing skills (4).

CONCLUSIONS

Veterinary students can attend basic laparoscopic training programs and enjoy all their benefits, just as much as their general medicine fellows.

This study opens new possibilities of research in training veterinary medicine students and residents, who can considerably increase their general practical activities and especially their laparoscopic skills. Future dedicated hands-on training programs are to be considered on this field.

Acknowledgments

This paper was realized within the Programme PN-III, which runs with the financial support of the Project „High-precision innovative approach of the robotic assisted treatment of liver tumors based on integrated imaging-molecular diagnosis" PN-III-P1-1.2-PCCDI-2017-0221 / 59PCCDI/2018 (IMPROVE)

Conflict of interest

The authors report no conflict of interest.

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