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Learning transrectal palpation in horses: comparison of two teaching methodologies.

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Complete List of Authors:	Vitoria, Arantza; Universidad de Zaragoza Facultad de Veterinaria, Patología Animal Romero, Antonio; Universidad de Zaragoza Facultad de Veterinaria, Patología Animal Manero, Cristina; Universidad de Zaragoza Facultad de Veterinaria, Patología Animal Fuente, Sara; Universidad de Zaragoza Facultad de Veterinaria, Patología Animal Barrachina, Laura; Universidad de Zaragoza Facultad de Veterinaria, Anatomía, Embriología y Genética Animal Vázquez Bringas, Francisco José; Universidad de Zaragoza Facultad de Veterinaria, Patología Animal
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Authors

Arantza Vitoria; Facultad de Veterinaria C/Miguel Servet, 50013, Zaragoza, Spain. LV, CertEspCEq, PhD; Servicio de Cirugía y Medicina Equina, Hospital Veterinario (HVUZ), Departamento de Patología Animal, Universidad de Zaragoza; 0000-0003-1286-4968

Antonio Romero; Facultad de Veterinaria C/Miguel Servet, 50013, Zaragoza, Spain. LV, CertEspCEq, PhD; Servicio de Cirugía y Medicina Equina, Hospital Veterinario (HVUZ), Departamento de Patología Animal, Universidad de Zaragoza; aromerol@unizar.es; 0000-0001-7188-0461

Cristina Manero; Facultad de Veterinaria C/Miguel Servet, 50013, Zaragoza, Spain. LV; Servicio de Cirugía y Medicina Equina, Hospital Veterinario (HVUZ), Universidad de Zaragoza.

Sara Fuente; Facultad de Veterinaria C/Miguel Servet, 50013, Zaragoza, Spain. LV, CertEspCEq; Servicio de Cirugía y Medicina Equina, Hospital Veterinario (HVUZ), Departamento de Patología Animal, Universidad de Zaragoza; 0000-0002-6409-6000

Laura Barrachina; Facultad de Veterinaria C/Miguel Servet, 50013, Zaragoza, Spain; LV, MSc, PhD; Servicio de Cirugía y Medicina Equina, Hospital Veterinario (HVUZ), Departamento de Anatomía, Embriología y Genética Animal, Instituto Agroalimentario de Aragón (IA2), Universidad de Zaragoza; 0000-0001-9818-508X

Francisco J Vázquez; Facultad de Veterinaria C/Miguel Servet, 50013, Zaragoza, Spain. LV, CertEspCEq, PhD; Servicio de Cirugía y Medicina Equina, Hospital Veterinario (HVUZ), Departamento de Patología Animal, Instituto Agroalimentario de Aragón (IA2), Universidad de Zaragoza; pvazquez@unizar.es; 0000-0002-8712-2275

Abstract

Transrectal palpation (TP) is a basic skill in equine practice. Traditional TP learning methods includes the instructor-assisted TP in the live animals. This approach with live animals presents animal welfare concerns, especially when it must be used with large numbers of students. The main objective of this study is to compare two learning methods of TP: traditional methodology with live horses (LH) and alternative methodology using a cadaver with its flanks dissected (CDV). Twenty students with no equine TP experience were randomly assigned to two groups: LH (n=10) and CDV (n=10). Both groups received an initial theoretical training before the LH or CDV session. Learning outcomes were assessed in a new TP session with live horses. All students were asked about their success in palpating seven intra-abdominal structures and objective ultrasound confirmation (UC) was also performed. Success perception in palpation and UC was similar in both LH and CDV students' groups, without significant differences. Anonymous surveys answered by these 20 volunteers and by 126 students enrolled in the regulated course who received this training show a very positive feedback on the CDV methodology. Few students in each group and many of the results are based on subjective criteria. CDV is a useful tool for teaching TP, with good learning results, allowing the instructor to see what the student is touching and avoiding the LH disadvantages.

Key words: clinical skill education, cadaveric model, transrectal palpation training, equine abdomen, veterinary students

Introduction

Rectal palpation is a common diagnostic tool in most equine abdominal processes.[1] To recognize abnormal findings in TP, it is first necessary to recognize normal palpation by identifying the anatomical location and normal consistency of the accessible viscera. Thus, recognizing normal TP is a basic competency to be acquired by veterinary students.[2]

Traditional large animal TP learning methods includes the instructor-assisted TP in the live animals. This approach is a challenge, since the instructor is not able to verify what the student is feeling, therefore they cannot provide an accurate feedback.[3] In addition, the availability of animals for teaching is often limited due the large number of students and because the use of client-owned clinical cases is envisaged for these activities. It should not be forgotten that TP is not free of complications, as there is a possibility of iatrogenic rectal tears during palpation.[3,4] In addition, the society demands the reduction in the use of live animals for teaching or research purposes. The need to reduce the use of live animals has led to the implementation of pedagogical innovations,[5] such as computerized simulators, phantoms and haptic devices.[6,7] Veterinary simulators are available and can reproduce a wide variety of conditions [8] providing a uniform and safe experience for all students.[9] Haptic devices and computerized simulators ensure the opportunity to acquire the coordination necessary to perform the TP, with less risk than when performed on live animals.[10] However, many of these devices have certain limitations in representing some of the physical aspects of the real patients,[11] requiring expensive equipment and software to purchase and maintain [9] and cannot fully replace the use of live animals for teaching.[12]

A well-designed alternative teaching method has to reach a balance between a well-understood educational mission, animal welfare, and, at the same time, be economically sustainable.[4] With the aim of achieving these goals, in our veterinary faculty we have been developing a learning methodology based on using the corpse of a horse placed in standing position and with the abdominal flanks open to allow visualization of what the student is touching and to guide the student when necessary. When introducing new teaching methodologies like this, it is key demonstrating that the skills acquired are at least as good as those developed using the existing methods.[13] To our knowledge, there are no published works evaluating the effectiveness of learning TP in a standing corpse compared to the traditional method. Therefore, the main objective of this study was to determine the efficiency of TP training using this teaching method compared to the classical training method in LH. Our hypothesis is that this teaching approach allows students to achieve a similar level of learning to that obtained with the traditional LH-based methodology. The secondary objective was to analyze the degree of acceptance by veterinary students of this equine TP learning methodology using standing cadavers with open flanks.

Materials and methods

Study design

Blinded randomized controlled trial with two groups of 10 volunteer veterinary students of fourth year (of a five-year program) without previous equine TP experience. Both groups received the same initial theoretical training about equine TP. The participants were then distributed into two groups, using a free random group generator application. Each group was trained in TP using a different methodology, group LH: traditional methodology with live horses (session 1, S1) and group CDV: using standing horse cadaver with dissected flanks (session 2, S2). The sample size was determined based on the availability of suitable student volunteers and the number of students used in similar studies.[14–17]

After the training period, the learning outcome of both groups was evaluated by conducting two tests in live horse (session 3, S3). The students were asked about their perceived success in palpation of seven intrabdominal structures. To confirm this perception, objective ultrasound

confirmation of some of these structures was performed by the students and the success rate was recorded by a blinded instructor.

Finally, these voluntary participants as well as students who received the CDV training as part of their regulated education completed an anonymous survey on the degree of satisfaction with this learning modality with cadavers.

Animals

A total of three animals were used for this study: two of them (H1 and H2) were 16 and 18 years old crossbreed mares from the herd of teaching horses of the Faculty of Veterinary of the University of Zaragoza and were palpated using the traditional method (LH). H1 was palpated by the students of group LH (n=10) in the initial training. H2 was palpated and rectally ultrasound scanned by the students of both groups after corresponding LH or CDV training. Live horses (H1 and H2) were palpated for a maximum of five students per day. The different palpation sessions with the same animal were separated by at least 72 hours.

The third animal (H3) was a 22 years old crossbreed gelding that had to be euthanized for health reasons unrelated to this study, and donated for this work with the express and detailed informed consent of its owner. After being euthanized and appropriately prepared (kept standing, both flanks dissected), H3 was used to instruct the students in group CDV (n=10).

All procedures performed in this study were carried out under Project Licence PI58/14 and approved by the Advisory Ethics Committee for Animal Experimentation (CEAEA) from the Universidad de Zaragoza. The care and use of animals were performed accordingly with the Spanish Policy for Animal Protection RD 53/2013, which meets the European Union Directive 2010/63 on the protection of animals used for experimental and other scientific purposes. The horse H3 was euthanized according to CEAEA approval.

Theoretical teaching session

Both groups of students (LH and CDV) received the same initial theoretical training session. This 90-minute session consisted of a review of equine intra-abdominal anatomy, using multimedia files to review the normal topography and consistency of the abdominal viscera, the palpation technique, identifying the different palpable structures in the different abdominal quadrants, as well teaching safety measures and how to prevent iatrogenic complications.

Hands-on sessions

The study included three hands-on sessions (S1, S2 and S3). The initial theoretical session, S1 and S2 were taught by the same instructor.

S1: Traditional methodology technique (LH)

The first session (S1) was attended by the group LH with the live horse H1. The session was divided into two days. The first day five students of this group palpated the horse under the guidance of an experienced instructor. The rest of the students of the same group palpated the same animal 72 hours later).

To reduce discomfort during palpation in the live horse, the animal was tranquilized with an intravenous bolus of acepromacine[a] (0.03 mg/kg, i.v.), and sedated with romifidine[b] (0.04 mg/kg i.v.) and butorphanol[c] (0.02 mg/kg i.v). In addition to the abundant lubrication of the students' arm, hyoscine butyl bromhide[d] (0.3 mg/kg, i.v.) was administered to promote rectal relaxation [18].

The animal was restrained in a stock to facilitate TP by the students and to increase their safety. Once the horse was sedated and medicated (5 minutes after the administration of the drugs), the students began to perform the guided palpation with the instructor, who guided the student with gestures on how to locate the different viscera. The palpation time lasted 10 minutes per student.

S2: Alternative methodology with cadaveric model (CDV)

In the second session (S2), the group CDV (n=10) received TP training in the cadaveric model in the same day with the same instructor.

After the placement of an intravenous catheter and prior to euthanasia, the horse H3 was sedated as H1 and H2. A modified cattle hoof trimming restraining stock was used: wheels were added and the rear arch was cut off. Once the animal was placed in the stock, a restraint system was arranged. The aim of this system is that the horse remains standing after general anesthesia and euthanasia. It consists of a wide strap at chest level and a cow lifting frame on the hips (hip clamp), attached to a hoist.

After sedation and once the horse was placed and correctly restrained in the stock, two grams of intravenous pentothal[e] (2g, i.v.) were administered. Following the achievement of an anesthetic plane, a bolus of 4-6 ml/50 kg of embutramide[f] (6 ml/50 kg, i.v.) was administered to euthanize. After checking that the horse was dead, the abdominal flanks were dissected. Part of the abdominal wall and ribs were removed in such a way that the viscera remained in place but allowing access from the outside to verify what the student was palpating.[3]

The instructor also guided with the same gestures and explanations as in the traditional method. However, there are two main differences over the traditional method: first, in this method the instructor could visually check whether the trainee palpated the structure in question, and secondly, if the student was not correctly palpating a structure, the instructor could introduce his arm into the abdominal cavity to correct and move the student's arm towards the correct site. However, in order to homogenize the conditions of both teaching methods as much as possible, the students in the CDV group performed the palpation one at a time and without previously visualizing from the open flanks what their peers were palpating. As in the group LH, the palpation time lasted 10 minutes per student.

S3: Learning outcome and students´ feedback

The last session (S3) was performed with a live horse (H2) to assess the learning outcomes from groups LH and CDV. The S3 was divided into four different days, with 72 to 96 hours in between so only five students performed TP in H2 each day. Each day, the students were randomly selected from groups LH or CDV to palpate the horse, with the animal sedated as in S1. Students were allowed to rectally palpate the horse for 10 minutes, after which a questionnaire was completed. Questions were asked about the localization and evaluation of seven intrabdominal structures (aorta, caudal pole of left kidney, nephroesplenic ligament, spleen, caecum ventral tenia, faeces in small colon and urinary bladder). In addition, objective ultrasound confirmation of some of these structures (those listed above with the exception of ventral cecal tenia) was performed. To do this, the students placed a rectal ultrasound probe over the proposed structures, but without seeing the ultrasound screen, which only an instructor could see, recording the success rate. This instructor was a different person to the one who performed S1 and S2 and was blinded regarding whether the students were from group LH or CDV. The participating students were given precise instructions to not reveal to this instructor which group they were part of.

In order to determine if there was association between the learning methodology and learning outcome, Chi-squared tests were performed for two groups, for each structure within each type of evaluation. A p-value < 0.05 was considered as significant association between variables (i.e. the learning methodology differently influences the learning outcome). Statistical analysis was performed by GraphPad Prism 9.2 software (San Diego, CA, USA).

Student surveys

Aiming at finding out the students' opinions and perception on the CDV methodology, two voluntary and anonymous surveys were distributed.

The first of these surveys was conducted after the end of the study with the 20 participant students. This survey was completed on paper-based forms and consisted of seven questions related to the degree of satisfaction after the practical session, the development of skills and the

opinion on the use of a cadaver for this purpose in the syllabus for the degree in veterinary medicine (Table 1).

The second voluntary survey was distributed among the 140 veterinary students enrolled in the 5th year course in which they undertake a compulsory practical training of TP with standing cadavers. The questionnaire included the same questions as above but with three of them slightly different and there was also a space for comments (Table 2).

Results

Comparison of two teaching methodologies

Regarding the student´s perception of success in palpation, the overall results obtained in TP (adding all the successes from the 7 structures to be identified x 10 students) were quite similar between the two groups: 65 out of 70 (92.9%) of success in group LH, compared to 62 out of 70 (88.6%) in group CDV (Table 3). In both groups, all students reported that they had identified 5 of the 7 abdominal structures (aorta, left kidney, spleen, small colon and caecum ventral tenia). The least identified structures in both groups were the nephrosplenic ligament (14 out of 20) and the urinary bladder (13 out of 20). The success rate for the nephrosplenic ligament was the same in both groups and the only difference was found in the urinary bladder where there was a higher success rate in group CDV (8 out of 10) than in group LH (5 out of 10). Nevertheless, no significant association was found between learning methodology and learning outcome for any of the structures based on students' subjective perception.

The results of the objective ultrasound confirmation were also quite similar between the two groups: 42 total hits out of 50 (10 student x 5 structures scanned) in group LH, compared to 41 out of 50 in group CDV (Table 4). Similarly, to the subjective perception, no significant association was found between the learning methodology and the learning outcome for any structure based on the objective ultrasonography confirmation. Taken together, this points at no substantial differences with either methodology.

In the group LH 20% of the students obtained a success percentage of 60% (3 of the 5 structures correctly identified); 40% obtained a success percentage of 80% and the remaining 40% obtained 100% of correct answers. Both the left kidney and the spleen were the least correctly identified structures. Only two students did not identify the bladder. All students in this group correctly identified the small colon and the aorta artery.

Concerning the group CDV, 30% of the students got 60% of success, another 20% got 80% of correct palpation and the remaining 50% got 100% of success. Urinary bladder was the least identified viscera in this group. The aorta was the only structure that was identified by all students.

Students surveys

All 20 volunteer students who participated in the hands-on experimental study responded to the survey. All of them have medium to high professional interest in horses. All emphasized the usefulness of the previous theoretical session for the review of the intra-abdominal anatomy of the horse. Satisfaction with the skills acquired was identical in both groups: four students "quite a lot" and six "very much". All the students (except one student from the LH group), considered that they would be able to perform TP after their practical session. All the students answered that the use of a cadaver for this training was justified and that the activity should be kept in the curriculum.

Of the 140 students enrolled in fifth year, 128 (91.4%) responded to the survey. Of them, 90.6% considered that the training had changed their spatial perception of the equine abdomen "quite a lot" (72.6%) or "moderately" (17.9%). A 94.5% of the answers indicated that the activity provides basic skills for professional practice: "quite a lot" (89,0%) or "moderately" (5.5%). Only two students considered that the use of corpses from horses euthanized for unrelated reasons was not justified to maintain this practical training activity in the veterinary curriculum,

while 97.6% considered that the involvement of equine corpses is justified and stated that the activity should be maintained in the regulated teaching.

Discussion

Teaching TP in horses using standing cadavers with open flanks offers learning results comparable to those achieved with the traditional method in live horses. This approach using cadavers makes possible to provide an initial training with a large number of students but without the need to use a large number of live horses, with the ethical and safety implications of such approach.

There are several studies on methodologies for learning rectal palpation in cows, mainly at the reproductive level,[4,7,10,19–21] but they are scarce for the equine species.[22] The learning methodology with cadavers that we evaluate in this study is not new and has long been used for learning rectal palpation and abdominal anatomy of the horse.[3] However, to the best of our knowledge, the present work is the first report comparing the methodology with standing cadavers with live animal-based training and, in addition, testing the learning success on live animals with an objective system.

This objective testing was done by UC. Actually, students' perception of success was higher than the objective confirmation: the percentage of "hits" was higher in both groups (LH and CDV) in the subjective session than in the session with ultrasound verification (92.85% compared to 84% in group LH and 88.57% compared to 82% in group CDV). Despite the higher reliability of the UC assessment, the subjective perception without verification was also useful to obtain information on the success of identifying some palpable structures in the abdomen that cannot be recognized by ultrasound, such as the nephrosplenic ligament or the ventral tenia of the caecum. The ascending colon and small intestine were not selected for testing because these organs are often difficult to appreciate in the normal horse due to their flaccid texture. The structures included in the UC were chosen because they can be visualized in rectal ultrasound and for their involvement in colic. The ovaries and uterus could not be included in the test, because the cadaver used to teach the CDV group (H3) was a gelding.

Many of the palpable structures within the equine abdomen are often difficult for students to identify.[22] This may be due to a lack of understanding of the spatial location and characteristic texture of these anatomical structures which makes it difficult for students to translate their knowledge of anatomy to the identification of viscera in TP.[23] Despite of this, the detection and identification of these specific organs in TP is a fundamental skill that involves an understanding of normal equine abdominal anatomy and provides the necessary basis for the diagnosis of such important pathologies in equine practice as colic. Our results shows that the nephrosplenic ligament was difficult for the students to locate, probably due to the lack of precise knowledge of the anatomical topography of this structure and the need to reach deep into the arm and stretch the fingers to touch it. Regarding the urine bladder, five students in group CDV and two students in group LH did not palpate the urine bladder because it was empty at the time of palpation. The technique of TP in cadaver with open flanks should overcome these problems because the bladder can be maintained distended with water using a urinary catheter to facilitate its identification and, importantly, the students can observe from outside while another student palpates the area. Allowing visualization of what is being touched is one of the advantages of this method, especially because it enables the instructor to give feedback on student's performance. Furthermore, the learning outcome can be improved as the student is certain on what he or she is palpating. In fact, one of the most repeated comments from the students in the survey was "finally I was sure on what I was touching", to which could be added by the teachers "with this technique I can know what the students are touching". To this certainty it should be added that the learning process also combines tactile sensations (from what the student himself touches) and visual sensations (from what he/she has seen when other students touch from the flanks).

These important advantages are not available with traditional live horse methodology but can be achieved with the methodology based on learning rectal palpation while performing laparoscopy of the abdomen. However, it is a very expensive technique, not without complications, and when used with many students it requires a very large number of live animals.[22] This is in direct conflict with animal welfare guidelines to reduce the number of live animals used for research or teaching purposes.[24] The desirability of introducing simulators for the acquisition of many competencies in veterinary training has been emphasized, including the use of cadavers, organs and tissue.[24] The advantages of using these methodologies include a safe, low-risk environment that increases the potential for learning as students practice their skills and do not experience animal welfare concerns, iatrogenic complications or observation pressure from the horse owner.[8] This has also been observed using a reproductive palpation simulator in cattle.[25] For horses there are some similar simulators and phantoms that avoid the use of live animals or cadavers.[26–28] However, such type of simulators and haptic devices have some clear disadvantages, mainly related to the lack of realism.[19]

The use of cadavers can better achieve the realism that are lacking in haptic and phantom simulators. However, the main disadvantage centers on the need to use cadavers, so it is essential that these are ethically sourced.[24] Following these recommendations, cadavers used to perform TP on this study and in our school were from horses that had to be euthanized in response to natural terminal disease or non-recoverable situations. This is an important consideration, as the origin of the cadavers can make all the difference to whether such activities can be considered "animal-friendly" and "student-friendly",[19] or "obsolete" and "unacceptable", as the use of cadavers for teaching purposes is described in some work,[22] without taking into account the ethical conditions under which they were obtained. The students were informed about the conditions and reason why the horse was euthanized and the express consent of the owners is obtained, explaining specifically the intended use of the cadavers. This could explain the very high degree of students (124 of 126) who did consider justified the use of corpses for this practice. It should be noted that this survey was carried out with all fifth year students and not only with those who are highly motivated to learn in horses. However, in the hands-on study with 20 volunteers, all of them showed a high average interest in the equine species. This could have a direct influence on learning achievement, showing a higher performance than would have been obtained with a heterogeneous group consisting mainly of students with little motivation for horses.

Some limitations of this study are the small number of students in comparison trial as this may affect the statistical power of the results. In addition, the first part of this trial is based on the subjective perception of the students. The student volunteers who participated in this trial were all highly motivated by the equine species and this may have influenced a higher performance in the process. Some of these weaknesses have been attempted to be reduced by including a survey of a much larger population that completed this regulated practical session with cadavers. In order to homogenize the two methods compared, in the study with volunteers, the students in the CDV group were not allowed to observe from the outside and this could limit the full pedagogical potential of this open flank method.

Our results allow us to conclude that TP training based on cadavers is a useful tool for teaching veterinary students with good learning outcome, comparable to the traditional method with live horses and with the additional advantage of allowing the instructor to see what the student is feeling at all times and also avoiding all ethical, safety and economic considerations related to the use of live animals. This methodology is highly valued by students, affordable and respectful with animal welfare standards, which indicates its suitability as a teaching tool in the curricula of the Veterinary Degree. However, this should be used as a starting tool in the process of learning this clinical skill, and should be complemented, at more advanced levels of training, by instruction on live horses, healthy or with abdominal diseases.

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Competing interests statement

The authors declare no financial or other conflict of interest related to this report.

Author contributions

F.J. Vázquez and A. Vitoria and contributed to the study design and execution, data collection, analysis, interpretation and preparation of the manuscript and final approval of the manuscript. A. Romero and L Barrachina contributed to the study design and execution, manuscript preparation and final approval of the manuscript. S. Fuente and C. Manero contributed to study execution, data collection, data analysis, manuscript preparation and final approval of the manuscript.

Data availability

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Manufacturers' addresses

[a]Calmo Neosan, Boehringer Ingelheim Animal Health España, S.A.U, Sant Cugat del Vallès, Barcelona, Spain.

[b]Sedivet, Boehringer Ingelheim Animal Health España, S.A.U, Sant Cugat del Vallès, Barcelona, Spain.

[c]Torbugesic, Zoetis Spain S.L, Alcobendas, Madrid, Spain.

[d]Pasmopina, Fatro Ibérica S.L, San Just Desvern, Barcelona, Spain.

[e]Tiobarbital 1g Braun, Braun VetCare ES, Rubí, Barcelona, Spain.

[f]T-61, Merk Sahrp & Dohme Animal Health S.L, Carbajosa de la Sagrada, Salamanca, Spain.

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Tables

Table 1: Survey questions for student volunteers who participated in the hands-on experimental trial for the comparison of the two teaching methodologies.

In which group have you been trained?
☐ LH (live horse) ☐ CVD (standing cadaver with open flanks)
Question 1: What is your professional interest in horses?
☐ High ☐ Medium ☐ Low
Question 2: Do you think it is necessary to have a previous seminar for the anatomical review of the horse's abdomen?
☐ Yes ☐ NO
Question 3: How satisfied are you with the skills you have acquired after completing the assigned learning method?
☐ None ☐ Little ☐ Indifferent ☐ Quite a lot ☐ Very much
Question 4: Do you think you would have been able <u>before</u> the practical learning session to identify the structures: aorta, caudal pole of left kidney, nephrosplenic ligament, spleen, small colon, caecum and urinary bladder?
☐ Yes ☐ NO
Question 5: Do you think you would have been able <u>after</u> the practical learning session to identify the structures: aorta, caudal pole of left kidney, nephrosplenic ligament, spleen, small colon, caecum and urinary bladder?
☐ Yes ☐ NO
Question 6: Do you think it is justified to use a horse which for health or zootechnical reasons has to be euthanized and cannot be used for human consumption to carry out the cadaveric palpation training method?
☐ Yes ☐ NO
If your answer is no, please indicate why:
Question 7: Do you think this method of learning should be maintained in the veterinary curriculum?
☐ Yes ☐ NO

Table 2: Survey questions for students enrolled in the 5th year course of the veterinary degree in which they have to take this compulsory practical training session

Question 1: Has this training changed your spatial perception of the equine abdomen?

□ Nothing □ Moderately □ Quite a lot

Question 2: Do you consider that this activity provides basic skills for professional practice?

□ Nothing □ Moderately □ Quite a lot

Question 3: Do you think it is justified to use horses that for sanitary or zootechnical reasons have to be euthanized and cannot be used for human consumption to carry out the cadaveric palpation training method and to be permitted to maintain this activity in the veterinary curriculum?

□ Yes □ NO

If your answer is no, please indicate why:

Your additional comments:

Table 3: Number of structures that students in each group reported having identified.

	AO	UB	LK	NFL	SP	SC	CVT	TOTAL
LH (n=10)	10	8	10	7	10	10	10	65 (92.9%)
CDV (n=10)	10	5	10	7	10	10	10	62 (88.6%)
TOTAL	20	13	20	14	20	20	20	127 (90.7%)

LH: group trained with LH. CDV: group trained with standing cadaver with open flanks. AO: aorta. UB: urinary bladder. LK: caudal pole of left kidney. NFL: nephrosplenic ligament. SC: small colon. CVT: caecum ventral tenia.

Table 4: Number of students that correctly identified the structures by sonographic confirmation and number of students who have obtained the different percentages of correct answers.

	AO	UB	LK	SP	SC	TOTAL	SCORE		
							60%	80%	100%
LH (n=10)	10	8	7	7	10	42 (84%)	2	4	4
CDV (n=10)	10	6	8	8	9	41 (82%)	3	2	5
TOTAL	20	14	15	15	19	83 (83%)	5	6	9

LH: group trained with LH. CDV: group trained with standing cadaver with open flanks. AO: aorta. UB: urinary bladder. LK: caudal pole of left kidney. NFL: nephrosplenic ligament. SC: small colon. CVT: caecum ventral tenia.