ABSTRACT

It is essential and imperative to humanely use live animals in research and teaching activities and consequently, to search for alternative methods that do not prejudice academic or scientific efforts. The objective of this work was to evaluate the opinions of veterinary undergraduate students as to the acceptability of using chemically prepared dog cadavers to teach surgical methods. To evaluate the opinions, the students were asked to complete an evaluation form at the end of the surgery classes for one semester. The resistance of the skin, muscles, stomach, intestine, and urinary bladder to incision/suture and the malleability of intestines, spleen, and liver were evaluated. The students assigned a score of 1 (very bad) to 10 (excellent) to each of these characteristics for an average score of 7.32 ± 1.63, and 75.67% of the students were found to be in favor of the use of cadavers. In addition, over 80% of the students favored initial surgical training with chemically preserved cadavers, followed by classes including live animals from the Veterinary Hospital who came for elective surgery, such as an orchietomy or ovariohysterectomy.

Keywords: anatomy, conservation, education, student perception, surgery

INTRODUCTION

In 2008, to regulate the use of animals in research and teaching in Brazil, Pub. L. No. 11.794 was passed. This Law establishes that Committees on Ethics in the Use of Animals control teaching and research activities at universities, assist professionals in the biomedical area, and register the institution with the National Council for the Control of Animal Experimentation [1].

For university students, surgical training in corpses may be used. There are several examples of fixative solutions capable of preserving corpses for this purpose, including Thiel solution (composed of boric acid, ethylene glycol, potassium nitrate, (chloromethyl) phenol, sodium sulfate, and formaldehyde) [2], Klotz solution (sodium chloride, sodium bicarbonate, chloral hydrate, formaldehyde, and water), and Jores' solution (distilled water, formaldehyde, sodium sulfate, potassium sulfate, sodium chloride, sodium bicarbonate, glycerin, and sodium or potassium acetate) [3], all which contain formaldehyde.

The Laskowski solution contains 800 ml of glycerin, 200 ml of ethanol, 50 g of phenolic acid, and 50 g of boric acid, but requires keeping the corpses at a temperature of 0° C until used in class. Between classes, they must remain frozen and then thawed in water 24 hours before class. With this solution, the tissues become excessively dark ([4].

Larssen’s solution is described as best preservative for maintaining the original consistency, color and characteristics of the biological material and can remove blood clots [5]. The original Larssen solution formula contains no liquid glycerin [6].
The use of a 30% aqueous sodium chloride solution for the preservation of anatomical pieces previously fixed by formaldehyde was successfully evaluated for 5 years, with no visual contamination, presence of putrefaction odors, or alteration of color and softness [7]. The successful use of a hypersaturated sodium chloride solution in the pericardium [8] and the diaphragm of dogs [9], both for surgical purposes, have also been described.

More humane teaching methods in veterinary medicine oppose the teaching of surgical techniques using live animals. Alternatives, such as the use of cadavers, promote greater learning, increase efficiency, reduce costs, and allow for customization and repetitiveness of the exercise. Increased student confidence and satisfaction due to reduced stress during the practice surgical procedure benefits the whole process, if the source of corpses is ethical and the animals are subjected to euthanasia for medical reasons, or natural death and accidents [10].

In an evaluation carried out on veterinary surgical techniques [11], students showed great acceptance for first performing the training on chemically preserved cadavers and then on live animals, performing castration in population control programs of population control. There was a 93.29% acceptance rate in favor of this teaching method, demonstrating the need for further creation and improvement of alternative surgical teaching methods.

Because of this preference, there is a need to find a technique that preserves the body for a long time and in a realistic way. This preservative technique must work for anatomical, surgical, and clinical studies, radiographic equipment testing, and minimally invasive surgery as well as encourage further experimental science to develop protocols that will aid anatomists in the preparation of chemically preserved cadavers [12].

The objective of this paper was to evaluate the acceptance levels of veterinary undergraduate students during surgical training on chemically prepared dog cadavers.

**PREPARATION AND EVALUATION**

Ten dog cadavers were fixed in ethyl alcohol with 5% glycerol via the common carotid artery and then placed in ethyl alcohol tanks for 30 days. After 30 days, the corpses were stored in tanks containing a 30% aqueous sodium chloride solution for up to 4 months. During this conservation period, surgical training was carried out by 50 sixth-semester students in the Veterinary Medicine Course of the São Paulo State University - Veterinary College - Jaboticabal Campus, São Paulo, Brazil, during the Surgical Technique course, after experience with surgeries in alive animals. At the end of each class, students received a form (Figure 1).

All cadavers came from the Zoonoses Control Center of Ribeirão Preto, São Paulo, Brazil, after approval by the Municipal Law Department (process 02.2014/000027-1). The selected animals had a body weight between 4.3 and 12.5 kg and a body score of to 5, where 4 to 5 is considered the ideal body score on a scale of 1 to 9 [13].

The results regarding the completion of the form are set out in the table 1. Regarding the form completed by the students, 75.67% approved the use of chemically preserved cadavers in the teaching of surgery, and 81.08% were in favor of the initial surgical training on cadavers, followed by practice on animals submitted for elective surgery at a Veterinary Hospital. This is similar to the one reported in the literature by other authors [11], who found the majority of students (93.29%) prefer to perform initial surgical training on cadavers.

The use of toxic preservatives generates both contaminated effluents [14] and hazardous fumes, such as those released by formaldehyde [15]. These harmful by-products increase both the financial and environmental costs for the institution. Therefore, it is necessary to search for lower-cost and less risky alternatives [16].

Conventional cadaver fixing mainly uses formaldehyde for preservation and it is of limited use for surgical practice because it profoundly alters the resistance and fragility of organs and tissues. One alternative to this is artificial anatomical models, which can be used several times, unlike fresh cadavers [2].
However, in this work, each cadaver, chemically prepared without the use of formaldehyde, could be used throughout the academic semester for training on several surgical techniques and provided good softness and tissue malleability.

The use of chemically prepared corpses for surgical training by graduates of the Veterinary Medicine course is perfectly in line with Brazil Pub. L. No. 11.794, that is, it provides an alternative and ethical method for teaching. Surgical training with chemically prepared cadavers reduced costs and provided repeatability of the exercise. In addition, there was good undergraduate receptivity and satisfaction to the surgical training with cadavers [10]. This is a worldwide trend, with almost all universities in Canada and the United States using alternative teaching methods to minimize the use of live animals for surgical training and thereby preventing thousands of dogs from being euthanized, as occurred with more than 16 thousand animals from 1983 to 1984 [17].

The anatomical technique used has satisfied the desired requirements [12] of preserving corpses for up to 4 months, in a realistic manner, for use in surgical training, similar to the reports about biomechanical effects on skin and intestines [18], common carotid artery [19] and external jugular vein [20] of dogs’ corpses during the same time.

**CONCLUSIONS**

There was a great acceptance by students from the Veterinary Medicine Course as for using chemically prepared corpses for surgery practicing before performing surgical procedures on alive animals.

**CONFLICTS OF INTEREST**

The authors declare no conflicts of interest.

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**REFERENCES**

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operation and of its Executive Secretary, creates the Register of Institutions for the Scientific Use of Animals - CIUCA, through the regulation of Pub.


RESUMO

Cadáveres de cães preparados quimicamente no ensino da técnica cirúrgica – avaliação dos estudantes de um curso de medicina veterinária

É essencial e imperioso ter muito critério quanto ao uso de animais em pesquisa e atividades de ensino e, consequentemente, a busca por métodos alternativos que não tragam prejuízo acadêmico ou científico. Objetivou-se, com este trabalho, avaliar a aceitação de graduandos do curso de medicina veterinária durante o treinamento cirúrgico em cadáveres de cães quimicamente preparados. Para isto, um formulário era preenchido sempre ao final das aulas da disciplina de Técnica Cirúrgica, durante o semestre de aulas. Foram avaliadas a resistência da pele, músculos, estômago, intestino, bexiga urinária quanto à incisão/sutura, e a maleabilidade dos intestinos, baço e fígado. Os alunos atribuíram, em escala de 1 (péssimo) a 10 (excelente), nota média de 7,32 ± 1,63, e 75,67% se mostraram a favor da utilização de cadáveres no ensino da técnica cirúrgica. Mais de 80% dos alunos foram a favor do treinamento inicial em cadáveres quimicamente conservados, seguido por aulas incluindo animais do Hospital Veterinário e que vieram para uma cirurgia eletiva, por exemplo, orquiectomia ou ovariosalpingohisterectomia.

Palavras-chave: anatomia, conservação, educação, percepção dos estudantes, cirurgia