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Making A Real Three-Dimensional Sheep Stomach Model to Be Used in Veterinary Anatomy Education

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ABSTRACT: *One of the most important courses is anatomy in veterinary medicine education. A good understanding of this course is crucial for clinicians and surgeons. Laboratory applications are important in learning this course, especially to see cadavers of bones, joints, and organs. Accordingly, it is of utmost importance to see some organs in three dimensions. As one of these, ruminant stomachs have an important place in veterinary medicine. In classical education that takes place in the laboratory, students working with an empty stomach laid on the table cannot fully grasp the posture and size of the stomach. In addition, the location and boundaries of the stomach should also be well-known for operations and some applications. The organs used in the study were obtained from local enterprises in Balikesir province. The process of filling the stomach was carried out in three stages. These stages are cleaning of the stomachs, filling of the stomachs with polyurethane material, and drying and protection of this material. The results showed that the materials obtained were satisfactory, the stomach was seen with all sections, and the connections of the sections were followed in a good way. Accordingly, it is thought that the model will help to increase the comprehension and understanding of veterinary faculty students.*

Keywords*: Anatomy, education, sheep stomach, three-dimensional model.*

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I. INTRODUCTION

Humans use the five senses in acquiring, storing, and remembering information. Within this scope, it can be thought that three-dimensional models can be used outside the laboratory environment, which increases learning performance by enabling them to be used in theoretical and analytical training courses in veterinary medicine and anatomy. In addition, complex anatomical structures that cannot be demonstrated on cadavers can be explained to students more easily and student comprehension may increase in a positive manner with these models. Traditional veterinary anatomy applications use cadavers fixed with 10% formaldehyde and stored in the same solution.

In anatomy learning, visual methods are more effective than non-visual auditory, and other methods in the teaching-learning process [1-3]. The foundations of anatomy education are based on cadaver studies [4, 5]. In addition, methods such as books, atlases, models, visualization, and simulation are also used in anatomy education [3, 4, 6-9]. In anatomy education, the use of new methods is becoming more and more widespread [10-15]. Furthermore, studies have been conducted to measure the effectiveness of the methods used in anatomy education [2, 12, 16-19].

II. MATERIALS AND METHODS

In this study, the stomachs of Karacabey Merinos were used. The organs were obtained from local enterprises of Balikesir province. No attention was paid to gender in the samples. The average weight of the animals whose stomachs were taken was around 60-80 kg and no negative findings were found in the health status before slaughter.

The process of filling the stomachs was carried out by following roughly 3 stages; detailed cleaning of the stomachs, filling the stomachs with polyurethane material, and the drying of this material. The equipment in the study included a scalpel, forceps, scissors, sewing thread, containers for washing, polyurethane spray, and wooden sticks.

III. RESULTS

The stomachs were taken from the slaughtered animals from the appropriate parts of the esophagus and duodenum by double ligature and cutting in the middle of the ligatures. The contents of the stomach were then cleaned, and some parts were cut for complete washing, provided that they were sutured afterward (Fig. 1.). The cleaned stomach sections were checked for tissue integrity. The stomach contents that might be present in the stomach were checked very carefully since they might cause deterioration. Tissue tears and cuts formed after cutting and washing were sutured (Fig. 1.). Thus, the polyurethane material was made ready for filling. Since the material is fresh, i.e. without being fixed with formaldehyde, this procedure should be performed quickly, and the procedure should be completed within a day if the material is not stored at + 5°C. Therefore, the stomach will naturally expand and take its normal volume

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Fig. 1 View of the stomach of cleaned Karacabey Merino.

Fig. 2 Image of the stage of the planting of ruminant stomach sections.

After the tear control was completed, the stomachs were filled with polyurethane material (Fig. 3.). Before filling, the polyurethane spray should be shaken for 10-15 minutes. Then, it should be given with the mouth downwards and if possible, without stopping. Therefore, the places where polyurethane will be given to each section piece by piece should be prepared by making a small incision. By acting quickly, it should be ensured that the polyurethane is given completely into the stomach sections without freezing. After the polyurethane is given, it is necessary to ensure that the polyurethane material reaches the parts that are not reached by hand by pushing and rubbing from the outside. Since polyurethane material may expand after filling, more polyurethane material should not be given after the stomach is filled. In this case, the stomach may expand disproportionately, and a different organ model may appear from the real situation, which may also cause mislearning. Because when the material is given, polyurethane material is given to the inner part through holes opened from different points to reach each section, not from a single point. Whichever of the stomach sections with elastic fibers is given more polyurethane material, that section will be more voluminous.

Fig. 3 Image of filling the ruminant stomach with polyurethane material

Tearing was observed in some parts during the application of polyurethane material to the stomachs and these torn areas were sutured appropriately. Leaking areas were dozed with clamps. In the laboratory, two or three wooden sticks of appropriate size were placed to support the transitions between compartments in materials that did not stand in a fixed place. Thus, the material became more stable. Afterwards, the material was left to dry in a warm and humidity-free environment, and from time to time the material was moved so that the part in contact with the ground was upwards. Faster results are obtained in summer or in hot weather. In winter, keeping the material in a warm environment or next to a heat source such as a radiator will accelerate its drying. After drying, the material is sprayed for external parasites and this process should be repeated from time to time. If desired, the material can be polished to give a shiny appearance and protection.

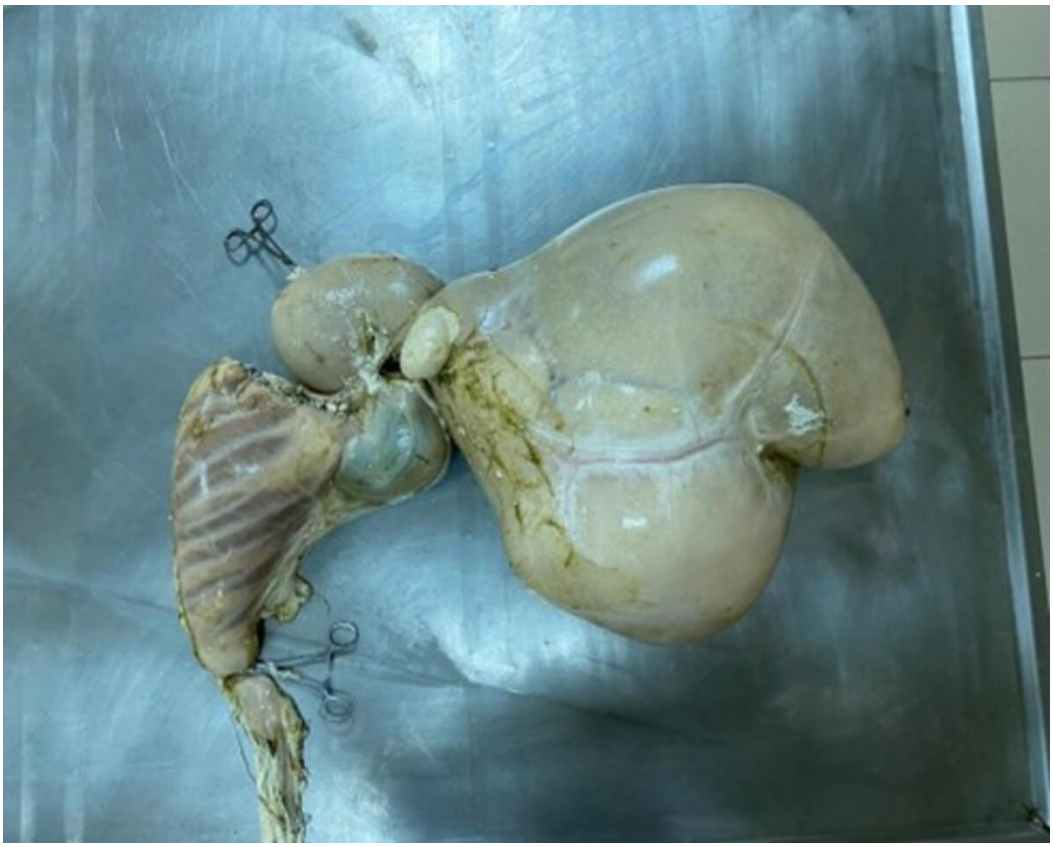

Fig. 4 Image of the final versions of the model

Fig. 5 Dried stomach model.

IV. DISCUSSION

All 118 participants were students who had received or were receiving veterinary anatomy education. While 94 (79,7%) agreed with the question of the necessity of the stomach model for stomach teaching, (1,7%) disagreed. The results of the study showed that 100 (84.7%) participants agreed but 2 (1.7%) disagreed with the statement 'The use of the stomach model helps to facilitate the learning process." In the answers to the statement 'Since it is 3-dimensional, it gives an idea in terms of its width and the space it occupies', 2 (1.7%) students disagreed whereas 101 (85.6%) agreed. For the statement 'It is an alternative method when you are disgusted with the cadaver', 75 (63.6%) of the participants agreed while 3 (2.5%) disagreed. Regarding the statement 'Since it is odorless, light, and dry, it is easier to work on', 2 (1,7%) disagreed but 92 (78%) agreed. As for the statement, 'Since it does not contain chemicals, it is more suitable for health.', 1 (0,8%) participant disagreed while 93 (78,8%) agreed. According to the statement, "It is easy to hold and carry', 2 (1,7%) participants disagreed while 88 (74,6%) agreed. Regarding the statement, "There is no need for formaldehyde material except for learning the inner surface of the ruminant stomach.', 7 (5,9%) participants disagreed but 72 (61%) agreed. 'Agree' or 'Disagree' was accepted as a response to the items in the questionnaire. Other responses are shown in Table 1.

Laboratory courses are crucial in anatomy. It is inevitable to use cadavers and models especially to see the organs in the body in posture and to understand the neighborhood. In this study, the stomach of a sheep was filled to be used in the anatomy laboratory and a shape dose to the posture position in the living animal was given. Thus, students will be able to work on a three-dimensional observable material that is suitable for the posture position in the animal and resembles a kind of model and learn the mucosa patterns with the stomach laid on the table. Rumen and other models are also used in anatomy education.

Our findings are also consistent with those of Atwa et al. (2021), who found that students preferred plastic models for ease of handling and transport. Similar to previous findings Cho and Hwang (2013), Davis et al. (2014), and Krishnaveni et al. (2019) reported that the highest preference was for classical formaldehyde specimens due to a better understanding of the anatomy. In another study, Atwa et al. (2021) showed that more than half of the students (54.5%) agreed that classical formaldehyde specimens improved their knowledge of anatomy in a clinical context, 74.3% found classical formaldehyde specimens useful for those considering a surgical career, and 60.4% agreed that these specimens increased motivation to learn anatomy. Nearly two-thirds of students thought that platinated specimens are more useful for distinguishing structures (34%) and more practical to keep in the laboratory (39.2%).

Table (1). Survey results regarding the use of a real three-dimensional sheep stomach model in classes

A total of 118 students participated in the study.	Disagree %0	%25	%50	%75	Agree %100
The stomach model is essential for stomach teaching.	2 (%1,7)	1 (%0,8)	2 (%1,7)	19 (%16,1)	94 (%79,7)
It helps make the learning process easier.	2 (%1,7)	2 (%1,7)	6 (%5,1)	8 (%6,8)	100 (%84,7)
Its three-dimensional structure gives an idea about its width and the space it covers.	2 (%1,7)	1 (%0,8)	8 (%6,8)	6 (%5,1)	101 (%85,6)
It is an alternative method when you are disgusted with cadavers.	3 (%2,5)	6 (%5,1)	16 (%13,6)	18 (%15,3)	75 (%63,6)
It is odorless, light and dry, making it easier to work with.	2 (%1,7)	2 (%1,7)	4 (%3,4)	18 (%15,3)	92 (%78)

Since it not contains chemicals, its use is more convenient for health.	1 (%0,8)	1 (%0,8)	9 (%7,6)	14 (%11,9)	93 (%78,8)
It is easy to hold and carry.	2 (%1,7)	3 (%2,5)	11 (%9,3)	14 (%11,9)	88 (%74,6)
There is no need for formaldehyde material except for learning the inner surface of the ruminant stomach.	7 (%5,9)	11 (%9,3)	16 (%13,6)	12 (%10,2)	72 (%61)

Various methods with relatively low economic burdens using various everyday items have also been incorporated into anatomy education. For example, simple tools such as an apron and a large rectangular piece of cloth were used to demonstrate midgut rotation and the relationship between the uterus and peritoneum [24]. A specially designed eyeball model was used to explain the movements of individual extraocular muscles based on the cranial innervations of the brain [22], a functional model of the digital extensor mechanism using hair bands [25], the thoracic skeleton, respiratory muscles and facial mimic muscles drawn on T-shirts [26], as well as day modelling of anatomical structures such as the brain, heart, and larynx [27-30]. The study materials did not pose any financial problems for the instructor or students.

V. CONCLUSION

Studies have also suggested alternative methods, mostly models, in anatomy practice education. However, in our study, an alternative was presented without using plastic, daily items, stationery materials, or unreal anatomical models. Our model is made from a real anatomical organ; it is light and almost identical to its posture in the animal. In addition, it does not cost much. As a result, it was concluded that this study is important in terms of providing information about rumen, reticulum, omasum, abomasum anatomy, and neighbourhoods, which have an important place in veterinary anatomy education by filling sheep stomachs. Additionally, the study can be a guide for future studies which will use similar materials as models. Finally, it is evaluated that such stomach models can be used as materials for the existing museums and museums to be built.

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