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ALTERNATIVE SUBSTANCES FOR HIGHLIGHTING ANATOMICAL STRUCTURES: EXPERIENCE REPORTS

SUBSTÂNCIAS ALTERNATIVAS PARA EVIDENCIAÇÃO DE ESTRUTURAS ANATÔMICAS: RELATOS DE EXPERIÊNCIA

SUSTANCIAS ALTERNATIVAS PARA RESALTAR ESTRUCTURAS ANATÓMICAS: INFORMES DE EXPERIENCIA

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ABSTRACT

Anatomical filling techniques is a generic, technical, and appropriate term used to describe any substance employed to fill a cavity or lumen within a body system, being highly relevant for teaching and research in anatomy. This experience report describes the use of alternative substances for performing the technique, with the aim of facilitating the learning process of Veterinary Medicine students and enabling people outside the field to access anatomical content with clear visualization of blood vessels. A commercial waterproofing agent combined with red dye was used. Additionally, the respiratory tract was filled using a fast-drying, cyanoacrylate-based acrylic adhesive, which allowed easy control of leakage, strong tissue adhesion, and excellent cost-effectiveness. The results indicate that this technique

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represents a viable alternative for anatomical teaching and outreach, expanding access to high-quality filling methods.

Keywords: Angiotechnique. Anatomical Technique. Instant Glue. Anatomy. Waterproofing Agent.

RESUMO

Técnicas de repleção anatômica é um termo genérico, técnico e apropriado para utilizar qualquer substância responsável por preencher um leito de qualquer sistema corporal, sendo de grande relevância para o ensino e a pesquisa em anatomia. Este relato de experiência descreve o emprego de substâncias alternativas na realização da técnica, com o propósito de didatizar a aprendizagem dos estudantes de Medicina Veterinária e possibilitar que pessoas fora da área tenham acesso ao conteúdo anatômico com evidência dos vasos sanguíneos. Foi utilizado um impermeabilizante acrílico comercial associado a corante vermelho. Além disso, houve, também, preenchimento do trato respiratório, empregando-se adesivo acrílico de secagem rápida à base de cianoacrilato, com fácil controle de extravasamentos, boa aderência aos tecidos e excelente custo-benefício. Os resultados indicam que a técnica representa uma alternativa viável ao ensino e a extensão em anatomia, ampliando o acesso a métodos de repleção de alta qualidade.

Palavras-chave: Angiotécnica. Técnica Anatômica. Cola Instantânea. Anatomia. Impermeabilizante Acrílico.

RESUMEN

Las técnicas de relleno anatómico constituyen un término genérico, técnico y apropiado para cualquier sustancia utilizada para rellenar el lecho de cualquier sistema corporal, y son de gran relevancia para la enseñanza e investigación en anatomía. Este informe de experiencia describe el uso de sustancias alternativas para realizar dicha técnica, con el fin de hacer más didáctico el aprendizaje de los estudiantes de Medicina Veterinaria y permitir que personas ajenas al campo accedan a contenido anatómico con evidencia de vasos sanguíneos. Se utilizó un agente impermeabilizante acrílico comercial asociado con un tinte rojo. Además, el tracto respiratorio también se rellenó con un adhesivo acrílico de secado rápido a base de cianoacrilato, que ofrece un fácil control de las fugas, buena adhesión a los tejidos y una excelente relación costo-beneficio. Los resultados indican que la técnica representa una alternativa viable para la enseñanza y la divulgación en anatomía, ampliando el acceso a métodos de relleno de alta calidad.

Palabras clave: Angiografía. Técnica Anatómica. Pegamento Instantáneo. Anatomía. Impermeabilización Acrílica.

1 INTRODUCTION

The visualization and demarcation of structures, especially vascular structures, are essential in anatomical and morphological studies, both in academic settings and in clinical and experimental contexts (Fernandes; Pacheco; Gomes, 2022). The vascular repletion technique uses the injection of substances into blood vessels, as well as other anatomical structures, to improve visualization, and can be used in teaching and research (Bombonato; Cruz, 2007; Brougham; Thompson; Gauthier, 2020). In the routine, the use of plastic resins, colored latex, gelatin and other materials are widely used, however, some are expensive, difficult to handle, long drying time and need specific equipment, where such limitations compromise the preparation and didactic applicability of anatomical specimens, especially in institutions with scarce resources (Melo; Scallop; Oliveira, 2010).

The choice of material is extremely important and influences the quality of vascular repletion, the preservation of morphology, and the durability of the specimens, which directly affects the efficiency of practical and teaching activities (Reyes *et al*., 2022; Souza; File; Monteiro, 2020). On the other hand, recent studies have explored innovative and sustainable alternatives, as well as the use of thermoresponsive animal lards, i.e., which allow efficient perfusion for surgical training in cadavers (Zuo; Xiao, 2025), in addition to techniques that combine latex injection and radiological evaluation to study the anatomy of arteries (Manon *et al*., 2024; Pérez-Cruz *et al.*, 2024).

Based on the above, the present study aims to describe and evaluate, as an experience report, the use of the technique for repletion using acrylic waterproofing stained with commercial dyes for use in civil construction and commercial instant glue, applied to blood vessels and trachea of rabbits, respectively. The proposal emerges as a low-cost, practical and easy-to-maintain alternative, capable of being used in teaching and extension actions in anatomy, which facilitates accessibility to anatomical knowledge inside and outside Universities.

2 METHODOLOGY

The pieces were prepared at the Laboratory of Anatomy of Domestic and Wild Animals (LAADS) and later sent to the Didactic Museum of Animal Anatomy (MUDAA), both located at the Federal University of Vale do São Francisco (Univasf) at the Agrarian Sciences Campus (CCA).

2.1 ANGIOTECHNICS

To highlight the blood vessels of the two selected animals, a dog and a boa constrictor, cannulation of the most caliber and traction-resistant vessels was carried out, in order to ensure continuous flow and without resistance, which avoided possible damage to the pieces. A commercial acrylic waterproofing agent (BFM - TEC®) was used with water dilution in the proportion of 5%, as described by the manufacturer; and Water-Based dye in red (Coral®), so that the anatomical path of the vessels remains intact. In cases of extravasation, to avoid unnecessary loss of material, acetic acid was used to coagulate the material. Then, the organs were frozen to ensure the polymerization of the material at low temperature and were immersed in an aqueous solution of 10% formaldehyde, where it was maintained.

2.2 ANGIOTECHNIQUE FOR THE STUDY OF ARTERIAL VASCULARIZATION IN BOA CONSTRICTOR

In order to elucidate the complexity of arterial vascularization in *Boa constrictor*, the procedure began with the access and incision of the heart, for the isolation of the structures and direct access to the ventricular cardiac chamber. For the cannulation, a 40x12mm needle without a bevel was used, followed by the injection of the dyed acrylic waterproofing agent with a 20ml syringe. In view of the anatomical particularity of the circulatory system of the snakes, two cannulations were performed: the first, from the left antimere of the ventricle, directed to the right aorta; and the second, from the right antimere of the ventricle, directed to the left aorta. Cannulations require caution due to the proximity and communication with the sinus venosus, and it is essential to ensure transfixation of the cannula to prevent the reflux of the injected material.

After the injection of the acrylic waterproofing agent, the polymerization protocol was followed by freezing the specimen for a period of 24 hours. Then, the animal was thawed in water and room temperature and, finally, formalized in an aqueous solution of 10% formaldehyde, being kept immersed in the same solution for a period of 72 hours.

2.3 BRONCHIAL TREE REPLETION

To demonstrate the course of the bronchi, eight sets of rabbit lower airways were used, tracheal cannulation was performed with a 40x12 mm needle without a bevel, and a 20 mL syringe was injected with an undiluted acrylic adhesive with® medium viscosity. The application occurred until the lungs were completely filled, using the total contents of each syringe. After perfusion, the structures were bonded with multifilament cotton thread (Coats

Corrente®) to prevent backflow of the material, and then the lungs were placed for maceration in water.

3 RESULTS AND DISCUSSION

3.1 ANGIOTECHNICS

The application of the substance in the pieces is in line with the proposal of Brougham *et al.* (2020), as it represents an alternative capable of being molded in a practical way and without the need for complex utensils. In addition, drying, staining, tactile aspect and durability characteristics of the specimens are essential for the teaching of anatomy, as the visualization of the structures and the conservation of the samples are indispensable. In this bias, the use of the material demonstrated notable advantages when compared to traditionally explored resources, such as stained latex and acrylic resin in an economic scenario, as its commercial value is more cost-effective, which is present in the statements of Souza, Lima and Monteiro (2020).

However, acrylic waterproofing for the use of angiotechnique has never been reported, so investigations into the toxic potential and dilution capacity are still necessary in order to improve the procedure.

Regarding the technique, the injection of stained acrylic waterproofing and instant adhesive proved to be highly effective for the repletion of vessels and anatomical structures, since it brought the following results:

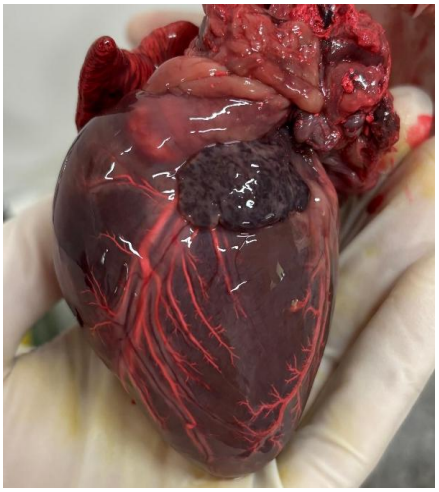
With repletion, an improvement in vascular visualization was observed, with evident contrast between the vessels and adjacent tissues, allowing clear distinction and vibrant staining (Figure 1).

The filling was satisfactory, although the application of digital compression was necessary to ensure adequate perfusion of the material in regions of difficult access (Figures 2A and 2B).

Another relevant aspect was the control of the extravasation of the acrylic waterproofing agent, which proved to be reduced and easily manageable with the use of acetic acid (commercial vinegar), a substance of wide availability, low cost and without toxic effect. In addition, it was observed the polymerization of the compounds without the use of catalysts, accompanied by the reduction of the temperature during the process, which contributed to the efficiency and safety of the handling.

Figure 1

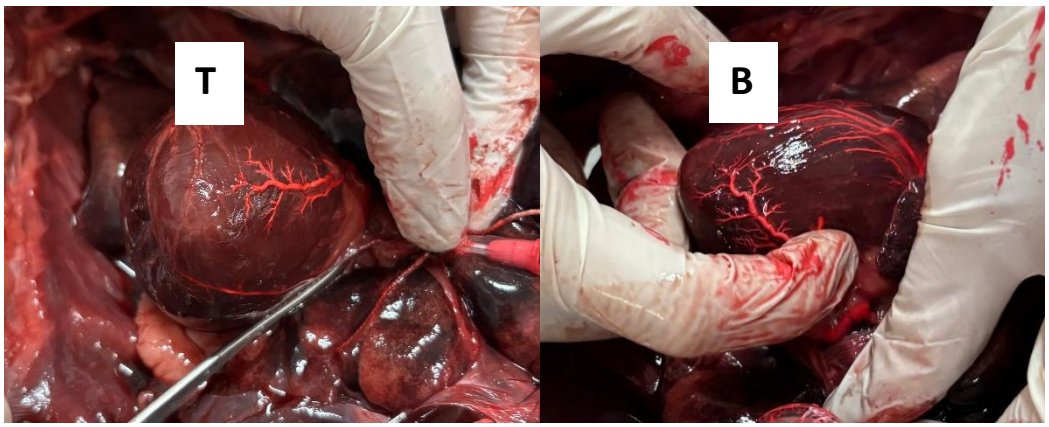
Fresh dog heart, showing the maximum, medium and minimum cardiac veins filled after the use of stained commercial acrylic waterproofing – Petrolina (PE), 2025



Source: Personal archive.

Figure 2

Fresh dog heart, still in the chest cavity, showing repletion of the maximum, medium and minimum cardiac veins with stained commercial acrylic waterproofing (A) and digital compression to ensure the continuous flow of the material (B) – Petrolina (PE), 2025



Source: Personal archive.

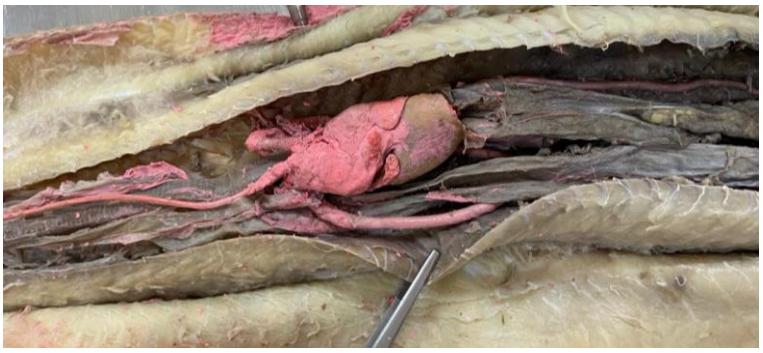
3.2 ANGIOTECHNIQUE FOR THE STUDY OF ARTERIAL VASCULARIZATION IN BOA CONSTRICTOR

Initially, it should be emphasized that, in this report, the intention is to describe the injection technique with alternative material and not the behavior of vascular beds. Perfusion of the acrylic waterproofing agent resulted in successful and comprehensive arterial filling. By means of cannulation of the right aorta, the perfusion of the material effectively reached the cervical and cranial regions, made possible by branching to the carotid artery (Figures 3

and 4). Cannulation in the left aorta was essential not only to fill the corresponding aortic antimere, but also to promote adequate pressure to ensure complete irrigation of the middle third and caudal regions of the animal, since the left and right aorta unite at the level of the middle third of the esophagus, culminating in the common abdominal aorta (Figure 5). This main artery, in turn, runs through the coelom dorsally, giving rise to the branches responsible for the vascularization of adjacent organs.

Figure 3

Image of Boa constrictor's heart and basal vessels after the angiotechnic procedure and formaldehyde fixation, showing repletion with stained acrylic waterproofing – Petrolina (PE), 2025



Source: Personal archive.

Figure 4

Specimen of Boa constrictor after angiotechnics and formaldehyde fixation, detailing vascular filling in the submental (arrows) and cervical (stars) regions – Petrolina (PE), 2025.

Source: Personal archive.

Figure 5

Detail of arterial vascularization in Boa constrictor, showing the repletion of the acrylic waterproofing agent in the left (black arrow) and right (red arrow) aortas and its fusion at the level of the middle third of the esophagus (black star), originating the common abdominal aorta (red star) – Petrolina (PE), 2025

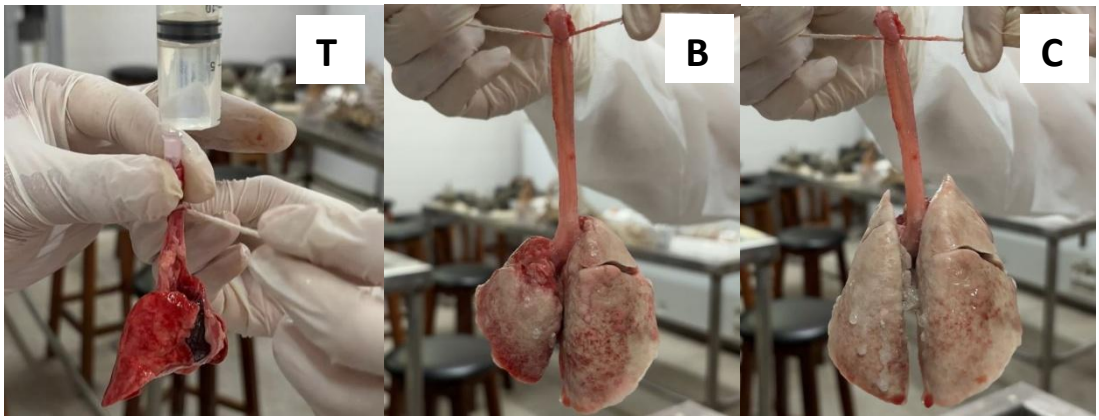
Source: Personal archive.

3.3 BRONCHIAL TREE REPLETION

The cyanoacrylate repletion technique made it possible to preserve the anatomical integrity of the organ and also fits the ideals proposed by Brougham *et al.* (2020) in terms of practicality in use, good adhesion of the material to the fabrics and extra-fast drying, eliminating the use of physical catalysts and the need for chemical substances for pre-treatment before its injection. Thus, the method became favorable to the teaching and understanding of the morphology of the structures involved (Figures 6 and 7).

Figure 6

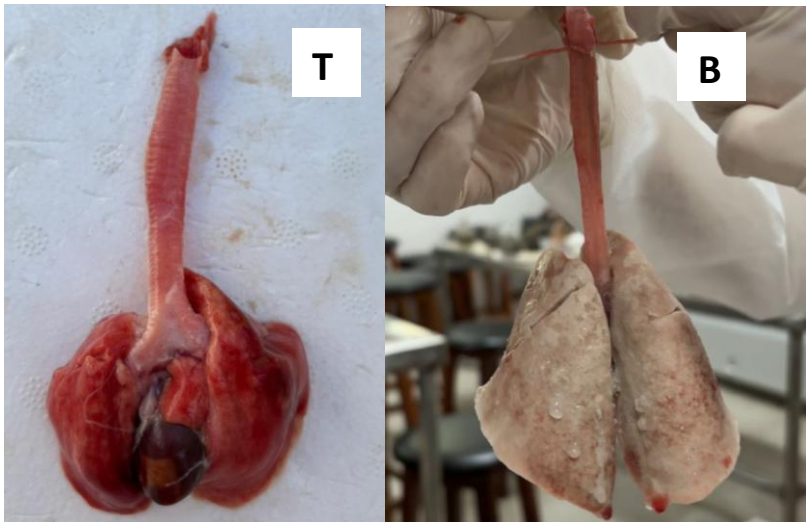
Cannulation for injection of cyanoacrylate-based adhesive glue into the trachea and lungs of rabbits (A) up to average (B) and maximum repletion (C) – Petrolina (PE), 2025



Source: Personal archive.

Figure 7

Comparison between fresh organ (A) and after injection of the instant patch (B) into the trachea and lungs of rabbits – Petrolina (PE), 2025



Source: Personal archive.

Therefore, even with the benefits highlighted above, the technique requires attention to the viscosity and toxicity of the substances, in addition to the quality of cannulation and control of the injected volume, in order to avoid rupture of vessels and tissues and extravasation in adjacent areas.

4 CONCLUSION

The use of commercial acrylic waterproofing agent dyed with water-based dye in red color and adhesive glue based on cyanoacrylate medium viscosity proved to be economical and efficient alternatives for vascular and tissue repletion in anatomical studies. In this way, the technique is recommended and improved for teaching, research and extension centers, as they require low financial investment and adapt to other species and organs. The adoption of the repletion technique expands access to anatomical specimens with higher quality and aesthetics, which contributes significantly to the teaching of anatomy, training of professionals in the medical and biological areas, and the popularization of science.

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