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Vascular Corrosion Casts of Dromedary Camel Organs

Moldes de Corrosión Vascular de Órganos de Camello Dromedarioa

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SUMMARY: Vascular corrosion casting is a well-established technique for investigating the vascular architecture and morphological characteristics of organs. This method enables the creation of accurate three-dimensional (3D) representations of vascular networks and cavities, thereby providing valuable insights into anatomical structures. The present study aimed to produce vascular casts from selected dromedary camel (Camelus dromedarius) organs to facilitate 3D visualization and to reassess existing knowledge of their vascular anatomy. Hearts, kidneys, livers and lungs from ten adult camels were obtained from the Buraydah slaughterhouse. Major blood vessels and cavities were injected with polyurethane and epoxy resins, followed by maceration of soft tissues using hydrochloric acid. The resulting casts were photographed from multiple angles using a high-resolution digital camera to document internal vascular structures. These images will serve as the basis for generating 3D models intended for veterinary anatomical education and for improving morphological imaging quality.

KEY WORDS: Vascular corrosion casting; Dromedary camel; Vascular anatomy; 3D visualization; Morphology.

INTRODUCTION

Understanding the vascular architecture of organs is fundamental to veterinary anatomy, surgical planning, and comparative morphological studies (Bordes Jr. *et al*., 2025). Vascular corrosion casting is a specialized technique that provides detailed visualization of the blood supply and internal cavities by creating durable replicas of vascular networks (Reyes *et al*., 2022). This approach has been widely applied in various species to produce three-dimensional (3D) models that enhance anatomical comprehension and educational outcomes (Cornillie *et al*., 2019).

In camels (*Camelus dromedarius*), which are of significant economic and cultural importance in arid regions, comprehensive data on vascular anatomy remain limited. Existing studies have primarily focused on gross anatomical descriptions, with few employing advanced imaging or casting techniques (Nawal & Maher, 2018; Al Aiyan *et al*. 2019, 2021; Müller *et al*., 2024). The application of vascular corrosion casting in camels offers an opportunity to generate precise anatomical models that can support veterinary education, improve diagnostic imaging, and inform surgical interventions.

The present study aims to construct vascular casts of key camel organs—heart, kidneys, livers and lungs—using polyurethane and epoxy resins. By documenting these casts through high-resolution photography and developing 3D visualizations, this research seeks to enhance the understanding of camel vascular anatomy and contribute to the refinement of morphological teaching tools.

MATERIAL AND METHOD

Sample Collection

Ten adult dromedary camels (*Camelus dromedarius*) were selected for this study. Hearts, kidneys, livers and lungs were collected immediately post-slaughter from the Buraydah slaughterhouse in Al-Qassim, Saudi Arabia. Organs were rinsed with tap water to remove residual blood and stored at 4 °C until processing.

Vascular Injection

Major blood vessels and cavities of each organ were cannulated and flushed with warm saline to clear clots. Polyurethane resin mixed with a suitable hardener was injected into the vascular system to fill arterial and venous networks. Epoxy resin was used for selected specimens to enhance structural integrity.

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Corrosion Process

After resin polymerization (24–48 hours), organs were immersed in 30 % hydrochloric acid solution for 5–7 days to macerate soft tissues. The solution was replaced every 48 hours to ensure complete tissue digestion. Casts were thoroughly rinsed under running water and air-dried.

Photography and Documentation

The vascular casts were photographed using a high-resolution digital camera (Canon EOS series) under controlled lighting conditions. Multiple angles were captured to document internal vascular architecture. Images were processed using Adobe Photoshop for clarity and will be utilized for 3D reconstruction using specialized software (e.g., Blender or MeshLab).

RESULTS

Casting is the filling of anatomical cavities with specific materials to reproduce a 3D version. To be complete, the casting process must be accompanied by additional processes such as soaking in chemical solutions. There are many objectives for the use of casting materials; creating specimens to teach anatomy or help students advance their knowledge, getting museum specimens ready for display and conservation, and creating specimens for basic research.

The type of specimen research and the final intended use are just two of the many variables that influence the selection of the best impression material. Where materials selected in casting may be hard or low-viscosity, depending on organ nature and study procedures, such as casting of the respiratory system. Two types of casting materials were used in this study; the first is specific to blood vessels and is represented by Polyurethane (foam), the second by epoxy resins. The cast material must be able to penetrate the capillaries for macrostructure studies.

The vascular corrosion casting technique produced clear and durable casts of the heart, kidneys, liver and lungs from ten adult dromedary camels. The polyurethane and epoxy resins successfully filled major blood vessels and cavities, preserving fine vascular details. After maceration, the cast revealed the following:

Heart: Well-defined coronary arteries and major venous channels, with clear branching patterns (Figs. 1 and 2).

Kidneys: Complete visualization of renal arteries and veins, with detailed cortical and medullary vascularization (Figs. 3-6).

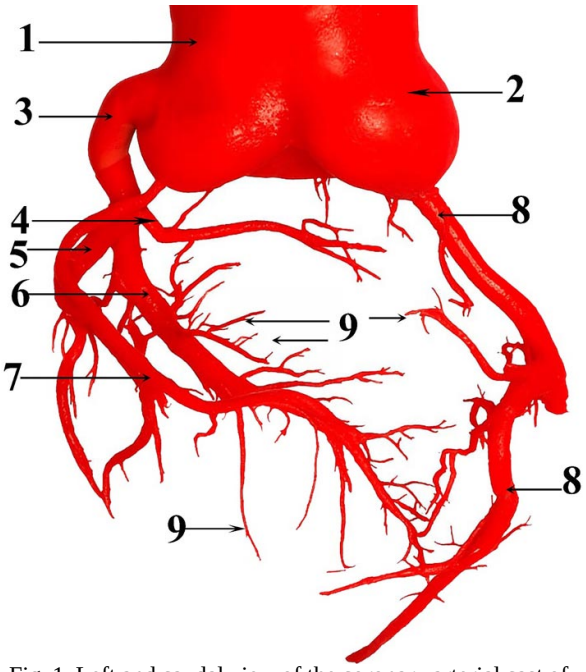

Fig. 1. Left and caudal view of the coronary arterial cast of the heart filled with polyurethane. 1. Aorta; 2. Right bulb: 3. Left coronary artery; 4. Artery of the left atrium; 5. Origin of the left circumflex artery; 6. Paraconal interventricular artery; 7. Left circumflex artery; 8. Right coronary artery; 9. Collateral branches.

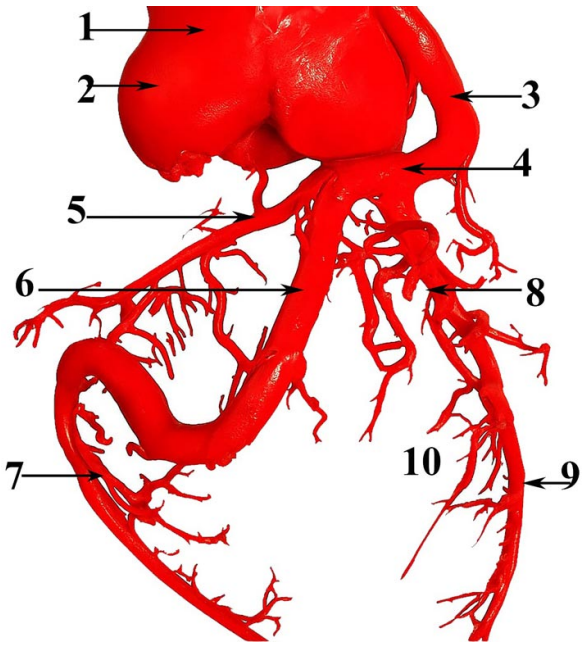

Fig. 2. Right and cranial view of the coronary arterial cast of the heart filled with polyurethane. 1. Aorta; 2. Cranial bulb; 3. Right coronary artery; 4. Right circumflex artery; 5. Artery of the right atrium; 6. Right circumflex artery (continuation); 7. Right descending artery; 8. Left circumflex artery; 9. Paraconal interventricular artery; 10. Collateral branches.

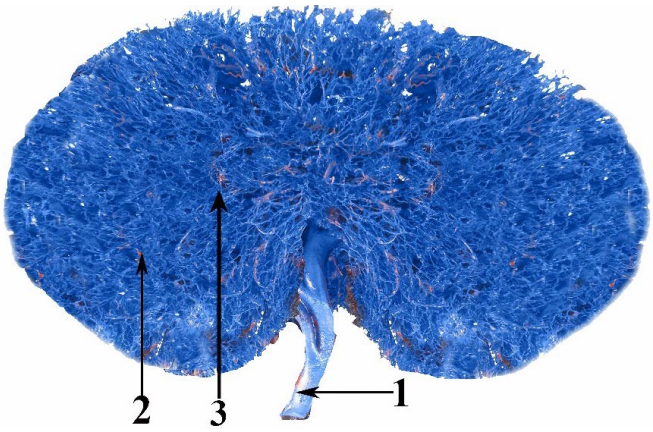

Fig. 3. Cast of the renal arterial and venous vessels of the dromedary camel kidney. 1. Renal vein; 2. Venules draining into the renal vein; 3. Arterioles of the renal artery (highlighted in red).

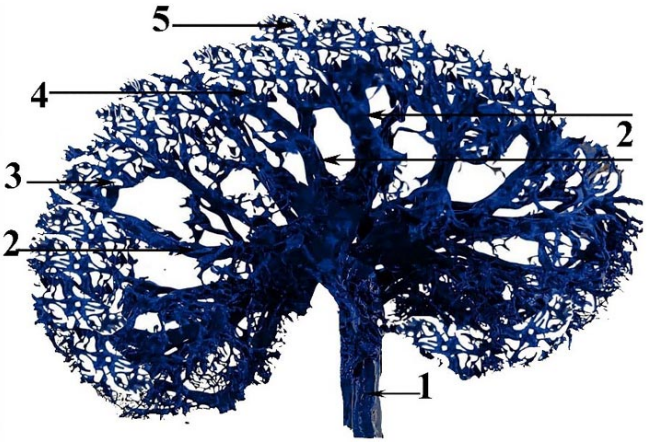

Fig. 4. Cast of the renal venous system of the dromedary camel kidney filled with polyester (epoxy). 1. Renal vein; 2. Interlobar vein; 3. Arcuate veins; 4. Interlobular vein; 5. Dorsal vein of the cortex

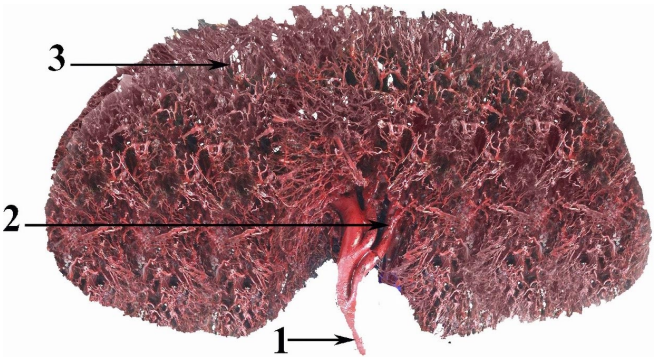

Fig. 5. Cast of the renal arterial system of the dromedary camel kidney filled with polyester (epoxy). 1. Renal artery; 2. Interlobar artery; 3. Arcuate arteries; 4. Renal vein.

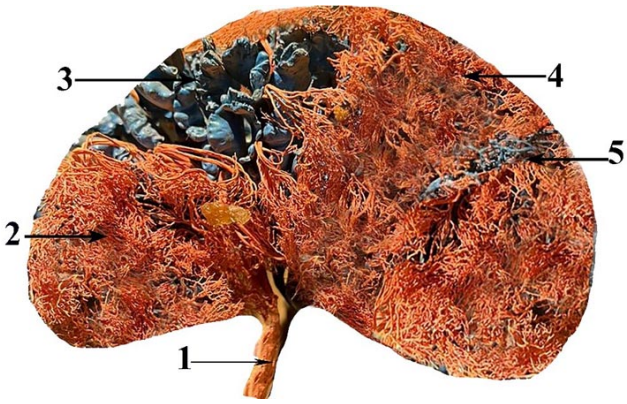

Fig. 6. Cast of the renal arterial and venous microvasculature of the dromedary camel kidney filled with polyester (epoxy). 1. Renal artery; 2). Arteriolar capillaries; 3. Renal recesses (12 in number); 4. Additional arteriolar capillaries; 5. Venular capillaries.

Liver: Distinct portal vein and hepatic artery networks, including intrahepatic branching (Figs. 7 and 8).

Lungs: Pulmonary arterial and venous systems displayed extensive branching and alveolar-level detail (Fig. 9).

Photographs captured from multiple angles demonstrated the three-dimensional complexity of the vascular architecture. The casts were structurally intact, allowing for accurate imaging and subsequent digital modeling. Color differentiation between arterial and venous systems enhanced anatomical clarity.

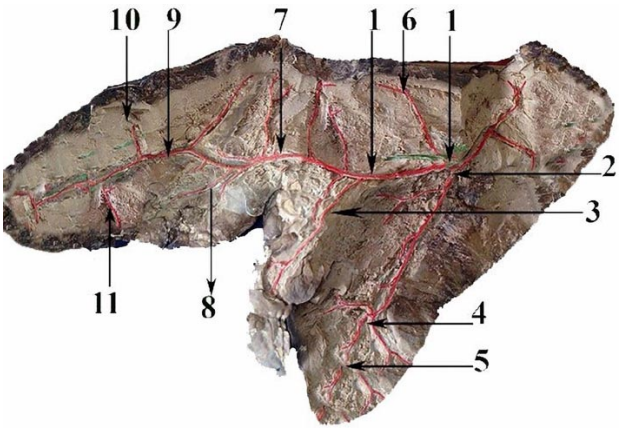

Fig. 7. Cast of the hepatic artery and its branches within the liver of the dromedary camel, filled with red-colored epoxy. (1) Hepatic artery; 2. Right hepatic artery; 3. Quadrate lobe artery; 4. Right lateral artery of the right lateral lobe; 5. Right medial artery of the right medial lobe; 6. Caudate lobe artery; 7. Left hepatic artery; 8. Left medial artery of the left medial lobe; 9. Left lateral artery of the left lateral lobe; 10. Dorsal branch; 11. Ventral branch.

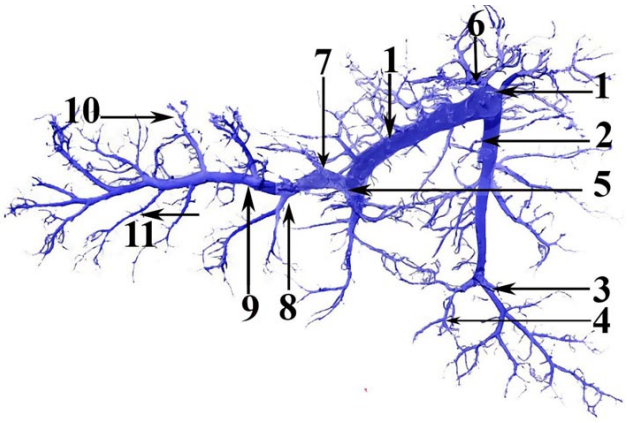

Fig. 8. Cast of the portal vein and its branches within the liver of the dromedary camel, filled with blue-colored epoxy. 1. Portal vein; 2. Right portal branch; 3. Right lateral branch; 4.Right medial branch; 5, Quadrate portal branch; 6. Caudate branch; 7. Left portal branch; 8. Left medial branch; 9. Left lateral branch; 10. Dorsal branch; 11. Ventral branch.

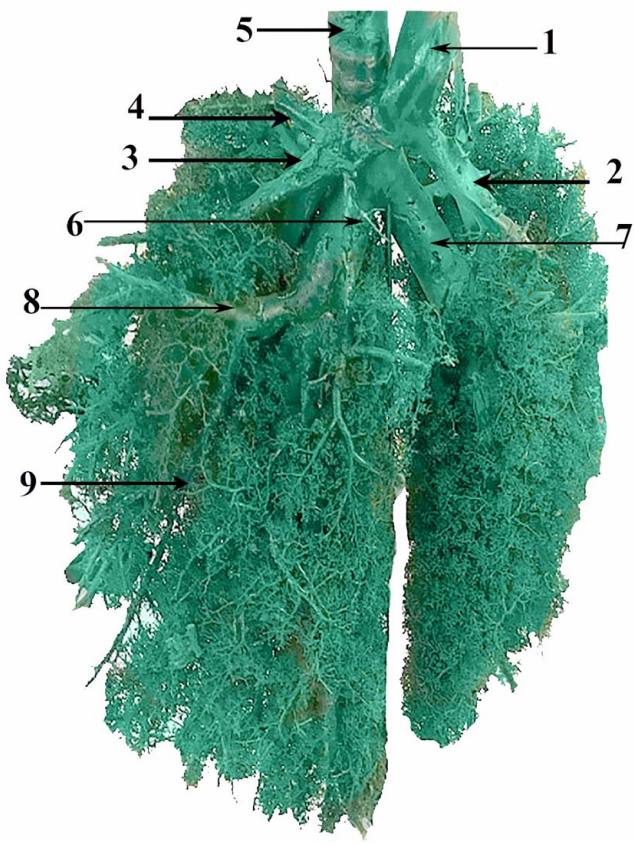

Fig. 9. Cast of the pulmonary arteries, bronchial tree, and alveolar structures of the dromedary camel lung filled with polyurethane. 1 Pulmonary artery; 2. Left pulmonary artery; 3. Right pulmonary artery; 4. Accessory pulmonary artery; 5. Trachea; 6. Primary right bronchus; 7. Primary left bronchus; 8. Secondary right bronchus; 9. Segmental and subsegmental bronchi.

DISCUSSION

This study demonstrates the effectiveness of vascular corrosion casting in visualizing the vascular architecture of dromedary camel organs. The technique provided high-resolution anatomical detail, surpassing traditional dissection methods in spatial accuracy and structural preservation. Similar findings have been reported in other species, including humans, pigs and horses, where corrosion casting has been widely used for anatomical and educational purposes (Lorentziadis *et al*., 2005; Jiang *et al*., 2022; Velásquez *et al*., 2025).

The application of this technique in camels fills a critical gap in veterinary anatomical literature. Previous camel studies have primarily focused on gross anatomy and histology, with limited emphasis on vascular networks (Tharwat, 2020; Kandeel *et al*., 2023). Our results reveal intricate branching patterns and organ-specific vascular arrangements that can inform surgical procedures and improve diagnostic imaging.

Future directions include integrating these casts with digital 3D modeling and virtual reality platforms to enhance interactive learning (Rueda-Esteban *et al*., 2017). Comparative studies across camel breeds and age groups could provide insights into anatomical variations and their functional implications. Limitations of this study include the relatively small sample size and the absence of quantitative morphometric analysis, which should be addressed in subsequent research.

CONCLUSION

The present study successfully applied vascular corrosion casting to visualize the vascular architecture of key dromedary camel organs, including the heart, liver, kidneys, and lungs. The technique produced durable and detailed casts that revealed complex vascular networks and organ-specific branching patterns. These findings provide valuable anatomical insights that can enhance veterinary education, improve diagnostic imaging, and inform surgical interventions in camel medicine. Furthermore, the generated images and subsequent 3D models represent an important step toward integrating advanced visualization tools into veterinary curricula. Future research should focus on quantitative morphometric analysis, expanding sample size, and exploring digital reconstruction for interactive learning platforms.

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RESUMEN: La técnica de modelo por corrosión vascular es un método consolidado para investigar la arquitectura vascular y las características morfológicas de los órganos. Este método permite crear representaciones tridimensionales (3D) precisas de redes y cavidades vasculares, lo que proporciona información valiosa sobre las estructuras anatómicas. El presente estudio tuvo como objetivo producir moldes vasculares de órganos seleccionados de camello dromedario (*Camelus dromedarius*) para facilitar la visualización 3D y reevaluar el conocimiento existente sobre su anatomía vascular. Se obtuvieron corazones, riñones, hígados y pulmones de diez camellos adultos del matadero de Buraydah. Los principales vasos sanguíneos y cavidades se inyectaron con resinas de poliuretano y epoxi, seguido de la maceración de los tejidos blandos con ácido clorhídrico. Los moldes resultantes se fotografiaron desde múltiples ángulos con una cámara digital de alta resolución para documentar las estructuras vasculares internas. Estas imágenes servirán de base para generar modelos 3D destinados a la enseñanza de la anatomía veterinaria y para mejorar la calidad de las imágenes morfológicas.

PALABRAS CLAVE: Moldes de corrosión vascular; Camello dromedario; Anatomía vascular; Visualización 3D; Morfología.

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