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Human Body Preservation via Left Common Carotid Artery: Anatomical Considerations, Embalming Techniques, and Comparative Preservation Methods

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Abstract: Introduction: Human cadaveric preservation is fundamental to anatomical education, surgical training, and forensic research. Effective preservation facilitates prolonged study of anatomical structures, enables surgical skill acquisition, and supports experimental investigations. Arterial embalming provides uniform distribution of chemical solutions throughout the vascular system, maintaining tissue integrity and preventing decomposition. The left common carotid artery (LCCA), arising directly from the aortic arch, offers a reliable and accessible conduit for perfusion, particularly of the head and neck region. Methods: It details LCCA anatomy, carotid triangle boundaries, surface landmarks, vascular and neural relations, and stepwise dissection techniques for safe cannulation. The review also evaluates traditional formalin-based solutions and alternative preservatives, including N-vinyl-2-pyrrolidone, phenoxyethanol, and saturated salt methods, assessing their effects on tissue integrity, flexibility, and toxicity. Additional preservation strategies—such as Thiel embalming, plastination, immersion, and cryopreservation—are examined comparatively to highlight advantages and limitations in educational and research contexts. Results: Precise identification of the LCCA and meticulous dissection through the carotid triangle facilitate safe cannulation and effective perfusion. Formalin remains the standard for long-term preservation with excellent tissue fixation, while alternative solutions reduce toxicity and enhance pliability, improving dissection and surgical simulation outcomes. Combining arterial embalming with complementary methods can further optimize cadaver quality. Conclusion: Embalming via the LCCA represents a reliable and effective approach for human body preservation. Thorough understanding of anatomical landmarks, relations, and dissection techniques, coupled with informed selection of embalming solutions, enhances procedural safety, preserves tissue fidelity, and maximizes educational and research utility across anatomical, surgical, and forensic disciplines.
Keywords: Left Common Carotid Artery (LCCA), Arterial Embalming Human Body Preservation, Formalin Embalming, Carotid Triangle, Alternative Embalming Solutions.

I. INTRODUCTION

Cadaveric preservation is a cornerstone of medical education, surgical training, and anatomical research. It enables prolonged study of human structures, facilitates the development of surgical skills, and provides an essential foundation for experimental and forensic investigations. Among various preservation techniques, arterial embalming is widely regarded as one of the most effective methods. This technique involves introducing chemical solutions directly into the arterial system, ensuring that tissues throughout the body are uniformly fixed. Arterial perfusion not only maintains the structural integrity of muscles, vessels, and organs but also prevents decomposition, microbial growth, and enzymatic tissue degradation[1]. The left common carotid artery (LCCA), arising directly from the arch of the aorta, offers a particularly advantageous route for arterial embalming, especially for the head and neck regions. Its relatively superficial course in the neck, enclosed within the carotid sheath alongside the internal jugular vein and vagus nerve, allows for reliable identification and safe cannulation. Compared to other arteries, such as the femoral or right common carotid, the LCCA provides direct and efficient perfusion of the left cerebral and facial territories, making it ideal for cadaveric studies that require detailed anatomical exploration[2]. Knowledge of the LCCA's anatomical course, relations, and surrounding landmarks, including the boundaries of the carotid triangle, is critical to performing safe and effective embalming. Precise dissection techniques minimize the risk of damaging adjacent structures, such as the vagus nerve or sympathetic trunk, and ensure optimal flow of preservative solutions. Moreover, combining traditional formalin-based embalming with modern alternative solutions can enhance tissue flexibility, reduce toxicity, and maintain color and texture for educational and surgical simulations. Overall, the LCCA serves as a highly effective conduit for arterial embalming, supporting high-fidelity preservation of cadavers and providing invaluable resources for anatomy teaching, surgical practice, and research purposes. Mastery of this technique allows for consistent, safe, and high-quality preservation outcomes[3].

II. ANATOMY OF THE LEFT COMMON CAROTID ARTERY

A. Origin and Course

1) Origin: Arises directly from the arch of aorta, medial to the left subclavian artery. Course: Ascends in the superior mediastinum, lateral to trachea and esophagus, entering the neck at the left sternoclavicular joint. Bifurcation: At C3–C4 level (upper border of thyroid cartilage), into:
2) External carotid artery (ECA): Supplies superficial head and face. Internal carotid artery (ICA): Supplies brain and deeper head structures.

B. Dimensions

Length: ≈13–14 cm**,** Diameter: ≈6–8 mm**,** Enclosure: Carotid sheath with internal jugular vein and vagus nerve[4].

III. CAROTID TRIANGLE

A. Boundaries

Boundaries of the Left Common Carotid Artery.

Anterior:	Superior belly of omohyoid muscle
Posterior:	Anterior border of sternocleidomastoid muscle
Superior:	Posterior belly of digastric muscle

Table no.01

B. Floor

Thyrohyoid, hyoglossus, and middle pharyngeal constrictor muscles

C. Roof

Skin, superficial fascia, platysma

D. Contents

Common carotid artery (proximal), internal jugular vein, vagus nerve.
Branches (post-bifurcation): superior thyroid, lingual, facial, ascending pharyngeal[5].

IV. RELATIONS of the LCCA

Relations of the Left Common Carotid Artery.

Relation	Structures
Anterior	Sternocleidomastoid, ansa cervicalis, platysma.
Posterior	Phrenic nerve, prevertebral fascia, vertebral bodies.
Lateral	Internal jugular vein, sympathetic trunk.
Medial	Trachea, esophagus, thoracic duct (left), vagus nerve.

Table no.02

Clinical Note: Understanding these relations prevents injury during dissection or embalming.

V. DISSECTION METHOD FOR CANNULATION

Materials Scalpel, scissors, forceps, Arterial cannula (20–22 Fr), Embalming machine or gravity perfusion system, Formalin-based or alternative solutions.

A. *Procedure*

1) Position cadaver: Supine, neck slightly extended.
2) Surface marking: Along anterior border of sternocleidomastoid.
3) Incision: Vertical incision from sternoclavicular joint to thyroid cartilage.
4) Superficial dissection: Reflect platysma and fascia.
5) Expose carotid sheath: Identify LCCA.
6) Isolate artery: Retract internal jugular vein laterally, vagus posteriorly.
7) Cannulation: Insert cannula, secure with ligature.
8) Perfusion: Introduce preservative solution under controlled pressure.
9) Drainage: Open right internal jugular or external jugular vein.
10) Monitor: Ensure perfusion of head, neck, and upper thorax[6].

VI. EMBALMING SOLUTIONS

A. *Formalin-Based Solutions*

10–15% formalin with methanol, glycerin, phenol.
Advantages: Effective preservation, bactericidal.
Disadvantages: Toxic, tissue rigidity

B. *Alternative Solutions*

N-vinyl-2-pyrrolidone (NVP): Maintains pliability, less toxic.
Phenoxyethanol solutions: Flexible tissues.
Saturated salt solutions: Inexpensive, reduces formalin exposure.

VII. ADVANTAGES OF LCCA EMBALMING

Direct perfusion of left head and neck. Alternative when right carotid is inaccessible
Ensures uniform tissue fixation. Facilitates detailed anatomical study

VIII. COMPLICATIONS & PRECAUTIONS

Vagus nerve injury → vocal cord paralysis
Sympathetic trunk injury → Horner's syndrome
Venous cannulation → inadequate perfusion
Tissue rigidity with formalin → mitigated by alternatives[7].

IX. OTHER HUMAN BODY PRESERVATION TECHNIQUES

Technique	Method	Advantages	Disadvantages	Applications
Arterial Embalming	Injection via arteries (LCCA, femoral)	Uniform perfusion, long-term preservation	Formalin toxicity, tissue rigidity	Medical education, surgical training.
Cavitary Embalming	Inject preservative into cavities	Preserves organs	Does not fix all tissues uniformly	Autopsy, organ-specific study.
Immersion	Submerge in formalin/alcohol	Long-term storage	Slow penetration, odor	Museums, teaching specimens.
Thiel Embalming	Low-formaldehyde solution with salts	Maintains color & flexibility	Complex, short shelf-life	Surgical simulation, realistic dissection.
Saturated Salt Method	NaCl + phenol	Simple, inexpensive	Less durable, tissue shrinkage	Teaching, low-resource settings.
Plastination	Replace water/fat with silicone/epoxy	Permanent, odorless	Expensive, time-consuming	Museums, anatomical demonstration
Cryopreservation	Freezing (-20°C to -80°C)	Maintains tissue architecture		Research, organ studies
Alcohol Preservation	Immerse in ethanol		Formalin toxicity, tissue rigidity	Teaching collections
Formalin-Phenol-Glycerin	Combination solution	Uniform perfusion, long-term preservation	Does not fix all tissues uniformly	Teaching & research cadavers

X. EDUCATIONAL AND RESEARCH IMPLICATIONS

Ensures lifelike cadavers for dissection and surgical training. Alternative solutions improve safety and tissue quality. Combination techniques provide optimal preservation for teaching and research.

XI. CONCLUSION

The left common carotid artery (LCCA) represents a highly reliable and effective conduit for cadaveric preservation, particularly for the head and neck regions. Its direct origin from the aortic arch, consistent anatomical course, and relative accessibility in the neck make it ideal for arterial embalming, ensuring comprehensive perfusion of critical structures. Successful cannulation and perfusion through the LCCA require thorough understanding of its anatomy, including its course, dimensions, and surrounding structures, as well as knowledge of the carotid triangle and associated vascular and neural relations. Mastery of these anatomical landmarks and meticulous dissection techniques minimizes the risk of injury to vital structures such as the vagus nerve, sympathetic trunk, and internal jugular vein, thereby ensuring safe and effective embalming. Formalin-based solutions continue to be the standard for cadaveric preservation due to their excellent fixation properties and long-term stability. However, modern alternative solutions, including N-vinyl-2-pyrrolidone, phenoxyethanol, and saturated salt formulations, offer advantages such as reduced toxicity, improved tissue flexibility, and maintenance of natural color and texture. Awareness of these options allows anatomists, educators, and researchers to tailor preservation methods according to specific educational, surgical, or research objectives. Furthermore, knowledge of complementary preservation techniques, including Thiel embalming, plastination, immersion, and cryopreservation, enables the selection of the most appropriate approach to meet diverse teaching and research requirements. In conclusion, arterial embalming via the LCCA, when performed with precision and guided by detailed anatomical knowledge, ensures high-quality cadaveric preservation that supports advanced anatomical education, realistic surgical simulation, and forensic investigations. The integration of safe dissection practices, careful selection of embalming solutions, and consideration of alternative preservation methods enhances the overall quality of preserved specimens while minimizing health risks to students, instructors, and laboratory personnel. Mastery of these techniques is therefore essential for maximizing the educational and research value of cadavers.

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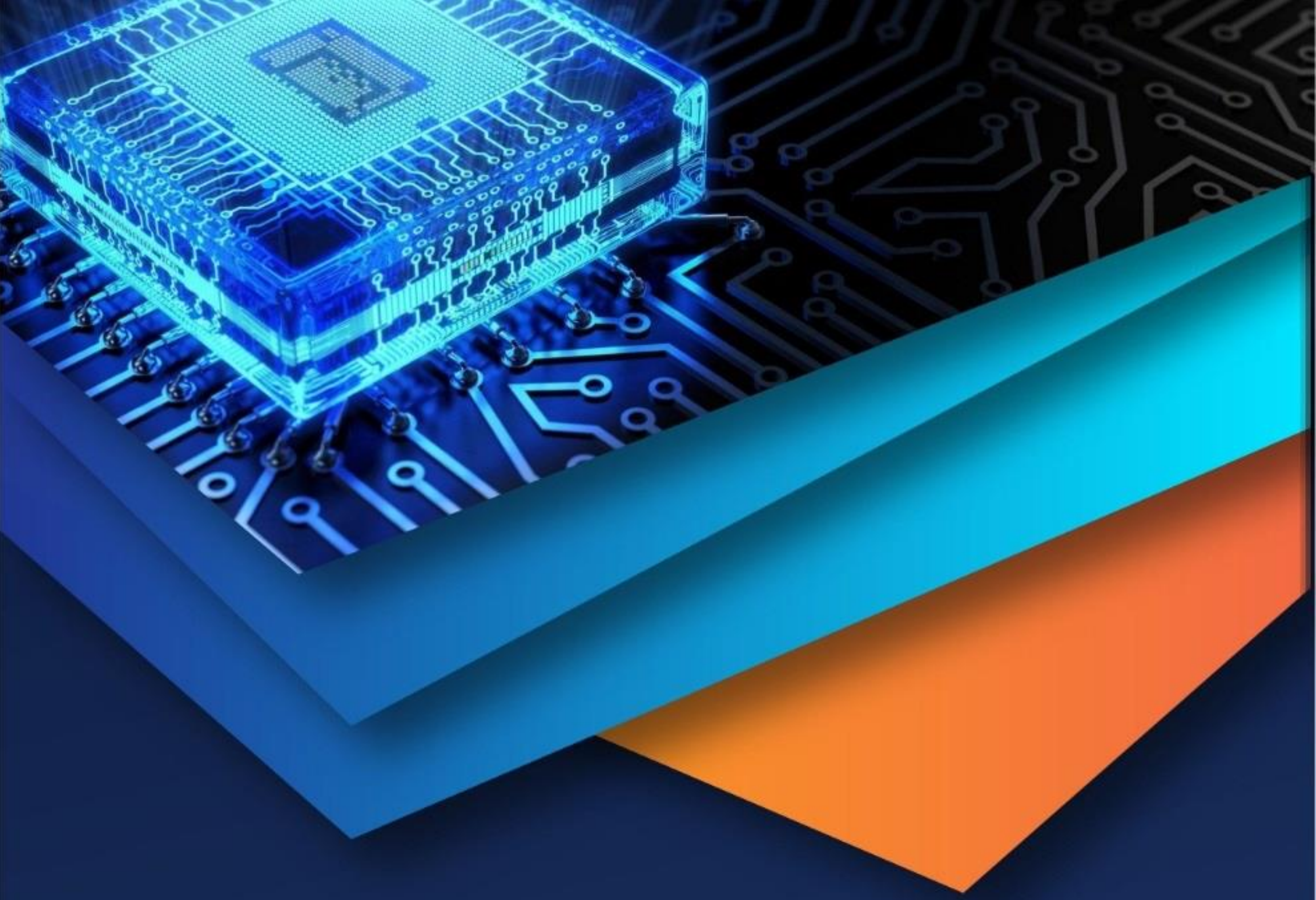

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