Microvasculature of the Subglottic Larynx – A Human Cadaveric Micro-CT Study

Jonathan J. Romak, M.D., Ian J. Lalich, M.D., Jan L. Kasperbauer, M.D., Division of Otorhinolaryngology – Head and Neck Surgery
Mayo Clinic, Rochester, MN

Abstract

Introduction/Objective: Knowledge of the anatomy of the subglottic larynx is essential for the understanding and treatment of diseases affecting this region. The microvascular anatomy of the subglottis has not been extensively described in the literature. Delineating this anatomy may aid in understanding the pathophysiology of subglottic diseases and will be important for the future application of regenerative medicine and tissue engineering techniques in this area. This study demonstrates the feasibility of micro-CT for vascular studies of the subglottis and documents the unique microanatomy thereof.

Methods: Bilateral dissection of fresh frozen human cadaver necks was performed to identify arterial and venous blood supply. The superior thyroid arteries were cannulated and all other vessels were ligated. Microfil (Flow Tech, South Windsor, CT) silicone rubber injection compound was obtained and prepared according to the manufacturer’s instructions. Microfil was then loaded in a 10cc syringe and connected to the cannulated vessels. The bilateral superior thyroid arteries were then injected with Microfil at an injection rate of 1-3 ml per minute and maintained at approximately 100 mmHg using a pressure monitor to ensure physiologic conditions. When material was observed filling the subglottic vessels, the injection was terminated. The injection material was allowed to set for 24 hours. Larynges were then carefully removed with the thyroid gland attached, potted in wax and scanned in the micro-CT scanner.

Results: Filling of the subglottic vasculature was achieved via injection and visualized on micro-CT. Feeding vessels to the subglottis enter both laterally through the cricothyroid membrane and inferiorly along the posterior tracheal wall. Vessels then form a submucosal plexus with greatest vessel density laterally and posteriorly. Foramen laryngis and feeding vessels are vital to the vascular arcade and feeding vessels is vital to the management of diseases of the subglottic larynx. Knowledge of the microvascular anatomy of the subglottis has not been extensively described in the literature. Delineating this anatomy may aid in understanding the pathophysiology of subglottic diseases and will be important for the future application of regenerative medicine and other regenerative medicine techniques in this region.

Conclusions: Microfil injection and Micro-CT is a feasible, safe and effective technique for studying the microvasculature of the subglottic larynx. Knowledge of the microvascular anatomy of the subglottis is germane to the understanding of disease processes affecting this unique region and their medical and surgical management.

Methods

Six fresh frozen cadaver necks were obtained according to institutional protocol. Anatomic dissection was performed to isolate the bilateral superior thyroid arteries, which were cannulated (Figure 1). All other feeding vessels were ligated. Microfil (Flow Tech, South Windsor, CT) silicone rubber injection compound was obtained and prepared according to the manufacturer’s instructions. Microfil was then loaded in a 10cc syringe and connected to the cannulated vessels. The bilateral superior thyroid arteries were then injected with Microfil at an injection rate of 1-3 ml per minute and maintained at approximately 100 mmHg using a pressure monitor to ensure physiologic conditions. When material was observed filling the subglottic vessels, the injection was terminated. The injection material was allowed to set for 24 hours. Larynges were then carefully removed with the thyroid gland attached, potted in wax and scanned in the micro-CT scanner.

Figure 1: Injection of the right superior thyroid artery.

Discussion

Precise definition of the microvasculature of the subglottis, including the location of the vascular arcade and feeding vessels is vital to the management of diseases of the subglottic larynx. This knowledge is necessary for surgical treatment of such diseases, and will provide invaluable information as we look ahead to application of tissue engineering and other regenerative medicine techniques in this region.

Figure 2: In the initial pilot study, the hemisubglottis was removed before scanning. The removal process caused cracks in the polymer as seen above. Subsequent larynges were scanned in their entirety.

Results

Figure 3: Final micro – CT images. A) AP view of vasculature (purple), hyoid bone and calcified thyroid cartilage (white). B) Inferior oblique view of laryngeal vasculature. C) Axial view with vessels within 2 mm of the lumen colored red. D/E) AP and lateral view with vessels within 2 mm of the lumen colored red.

Figure 4: In the initial pilot study, the hemisubglottis was removed before scanning. The removal process caused cracks in the polymer as seen above. Subsequent larynges were scanned in their entirety.

References

Title Safe Area: Title text should appear within this area

Author/Affiliation Area: Authors, affiliations and subbrand names should snap to the top of this area and flow downward.

Brand Safe Area: The upper title banner section of the poster provides a brand safe area for the logo, title and author/affiliation text. No photos, illustrations, patterns, high-contrast backgrounds, or graphics are allowed within this area. A logo representing another non-Mayo listed contributing affiliation may be placed in upper right corner within green guideline space.

Poster Body Area: Research text, figures, tables and graphs should appear within this area. No photos, illustrations, patterns, high-contrast backgrounds, or graphics are allowed in the margins. Use the text boxes in the template when possible.

Copyright Line: Copyright graphic should appear at bottom right under last text/figure box. Recommend graphic be placed no more than 1.5” from bottom of poster.