Gross Anatomy of the Brachial Plexus Sheath in Human Cadavers

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Background and Objectives: Major nerves and vessels run alongside each other in a "neurovascular bundle" kept together by connective tissue that is often referred to by anatomists, surgeons, and anesthesiologists as the "sheath." Our goal was to macroscopically demonstrate the brachial plexus sheath in embalmed and fresh cadaver dissections.

Methods: Systematic dissections were performed on 11 embalmed cadavers (6 females and 5 males), plus one fresh, unembalmed male cadaver. Dissections were started in the arm, and progressed proximally to the axilla and the supraclavicular area. Notes and photographic documentation were obtained.

Results: A sheath around the neurovascular bundle of the brachial plexus was visible to the naked eye in every dissection. The sheath had a fibrous external appearance, and was filled with loose connective tissue. No evidence of septa was found.

Conclusions: We observed a macroscopic fibrous structure surrounding the plexus, which was filled with loose connective tissue lacking any apparent organization. *Reg Anesth Pain Med 2008;33:64-69.*

Key Words: Brachial plexus, Sheath, Anatomy.

The existence of the brachial plexus sheath is controversial. As a defined anatomical structure, this sheath has been described by various investigators in the anatomical, surgical, and anesthesiological literature.[1-10] Conversely, whether the sheath is a single-compartment or multicompartment structure,[11-15] or indeed even exists,[16] has been debated by different investigators. The clinical significance of the sheath is likewise the subject of debate.[13]

Our previous work in the gross anatomy laboratory supports the presence of a macroscopic sheath-like structure surrounding the brachial plexus. However, despite extensive discussion in the literature, no high-quality photographic documentation of the sheath exists to supplement schematic drawings.

Thus, we set out to perform systematic anatomical dissections of the brachial plexus in human cadavers, with the goals of demonstrating a sheath-like structure around the brachial plexus visible to the naked eye, and of subsequently producing photographic documentation. We also looked for any degree of connective-tissue organization around the plexus, in the form of septa or subcompartments.

Methods

Systematic dissections were performed on 11 adult embalmed cadavers (6 females and 5 males), and on a fresh, unembalmed male cadaver which was used for comparison and control. The dissections were performed at Rush University Medical Center and at the Uniformed Services University of the Health Sciences in compliance with institutional, state, and federal regulations. According to

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the Anatomical Gift Association of Illinois, the embalming solution in our embalmed specimens was composed of 34.5% water, 25% glycol, 25% alcohol, 12.5% phenol, and 3% formaldehyde. The cadavers were required to have at least the brachial plexus on one side undisturbed, and their tissues had to be supple and flexible. The unembalmed cadaver was fresh and had been refrigerated overnight, and both of its sides were intact. Standard tools for anatomical dissections were used, along with a surgical microscope (Leica M 500-N, Leica Microsystems, Heerbrugg, Switzerland). Every dissection was performed on a single day to prevent any distortion and desiccation that might follow skin removal.

Dissections were initiated with an incision over the biceps muscle, from shoulder to elbow. A flap containing the skin and subcutaneous tissue, all the way to the deep fascia, was constructed and carried out posteriorly toward the latissimus dorsi and triceps muscles, to expose the brachial plexus and surrounding tissues. The dissection was then extended proximally toward the supraclavicular area. Measurements of the sheath were taken at the level of the lateral border of the pectoralis major muscle on embalmed specimens. The axillary sheaths of four embalmed specimens were injected in the proximal arm with methylene blue (20 mL over approximately 1 minute), to observe its spread. The sheath on one side of the fresh cadaver was injected with saline, to demonstrate sheath expansion. Multiple photographs were taken. In keeping with the limited goals of our study, we did not look specifically into the relative positions of nerves and vessels within the sheath; nor did we take any measurements other than those mentioned above.

Results

A total of 17 sides met the criteria for inclusion: 15 from embalmed specimens, plus 2 from the unembalmed cadaver. The axillary vessels of sides that were rejected had been used for embalming. The brachial plexus sheath was easily identified by visual inspection in every specimen, whether embalmed or unembalmed. The sheaths on unembalmed and embalmed specimens were found to have similar characteristics, with a fibrous external appearance, as shown in Figures 1A, B, and 2A. The interiors were filled with loose connective tissue and variable amounts of fat, without any specific arrangement or septa. The sheath was continuous from the neck to the proximal arm (the distal end of the axilla), where it could be seen blending with the deep fascia. Scattered condensations or fibrosis of the loose connective tissue filling the sheath

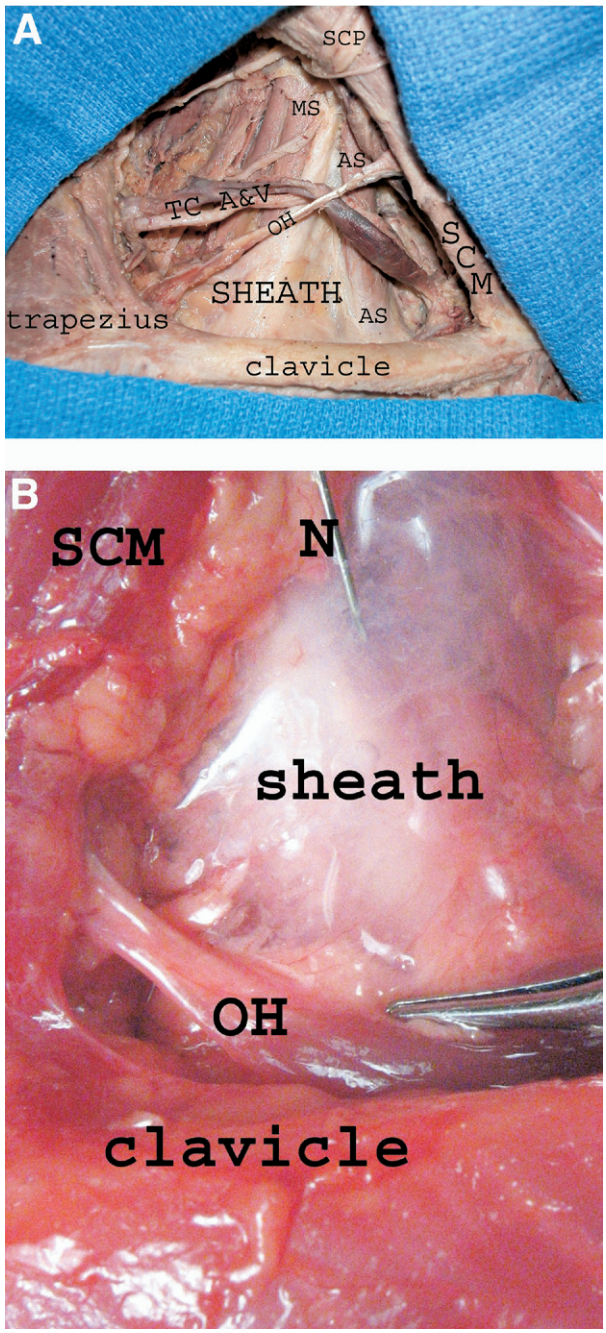

Fig 1. A: Right supraclavicular area, embalmed cadaver dissection. SCM, sternocleidomastoid muscle; OH, omohyoid muscle; TC A&V, transverse cervical artery and vein; AS, anterior scalene muscle; MS, middle scalene muscle; SCP, superficial cervical plexus. B: Left supraclavicular area, fresh cadaver dissection. Brachial plexus sheath in supraclavicular area after receiving 15 mL of normal saline injection. SCM, sternocleidomastoid muscle; OH, omohyoid muscle; N, needle used for injection. Note the bulging of sheath filled with saline.

were frequently present. The external wall of the sheath measured approximately 1 to 2 mm thick (Fig 2B), and was pierced only by vessels and nerve