Presence of Bilateral Rectus Sternalis Muscles in an 88-Year-Old White Female Donor

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ABSTRACT

The rectus sternalis muscle is a rare anatomical variant present in the anterior chest wall of humans. This study presents a case of rectus sternalis muscles found in an 88-year-old White female donor during an anatomy course. The embryology and function of this vestigial muscle remain unclear. The muscle has clinical significance in breast augmentation surgery and mammography. In surgery, the muscle can be used to improve the end quality of breast augmentations. In mammography, the rectus sternalis muscle can mimic irregular masses in the breast, leading to misdiagnosis. Advanced imaging techniques such as magnetic resonance imaging and computed tomography scans can confirm the presence of rectus sternalis muscle. Lack of awareness of this muscle can result in surgical complications and unnecessary procedures. Physicians should be aware of this anatomical variation to ensure accurate diagnosis and appropriate surgical planning.

Keywords: Bilateral rectus sternalis muscles; Rectus sternalis muscle; Sternalis muscle; Chest muscle anatomical variations

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INTRODUCTION

The rectus sternalis muscle (RSM) is an anatomical variant found in the anterior chest wall, superficial to the pectoralis major muscle (PMM) and often parallel with the sternum. Similar muscles are well-developed in some mammalian quadrupeds [1], but only present in 7.8% of humans [2]. Bilateral RSMs were found in an 88-year-old female donor during routine medical student dissection at Uniformed Services University of the Health Sciences. Both the embryology and the potential function of this vestigial muscle in humans are yet to be determined. In recent cadaveric studies, this muscle occurs unilaterally and bilaterally at approximately the same rate [3]. The RSM has clinical significance with potential to improve the results of breast augmentation surgery and potential for repercussions stemming from the lack of awareness of its existence in mammography.

CASE DESCRIPTION

The bilateral, asymmetric RSMs of an 88-year-old White female donor were dissected by first-year medical students attending the Uniformed Services University of the Health Sciences during the musculoskeletal module in the Fall of 2022 (Figures 1 and 2). Students assigned to the donor began the dissection and identified the rectus sternalis muscle. Anatomy lab instructors assisted with further dissection and documentation after the muscle was identified.

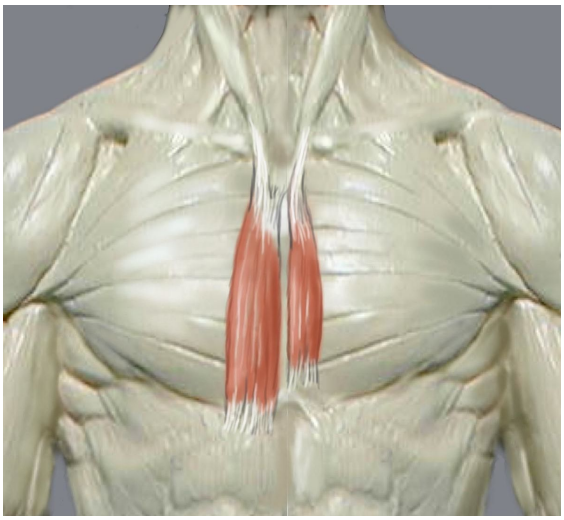

Figure 1: Schematic of the bilateral asymmetric rectus sternalis muscles representing this case study.

The bilateral RSM muscles were found crossing vertically over the PMMs and deep to the superficial fascia layer during dissection of the anterior chest. Muscle fibers were observed oriented parallel to the sternum and nearly perpendicular to the PMM fibers (Figure 2). The muscles did not cross over the sternum. The right RSM originated primarily at the continuation of the right sternocleidomastoid muscle (SCMM) and secondarily from the midline of the manubrium. It then inserted on ribs four through ten and the fascia of the rectus abdominis muscle. The right RSM was measured at 2.7 cm wide and 19 cm long. The left RSM originated at the continuation of the left SCMM and inserted at the distal sternum. The left RSM was measured at 1.3 cm wide and 10 cm long. This example would best fit subtype A of the classification system suggested by Raikos et al. [3], which was simplified from the system proposed by Jelev et al. [4] as shown in Figure 4. Lastly, our cadaver underwent a thoracotomy that was closed with wire, and this may have altered the RSM from its original development in our donor.

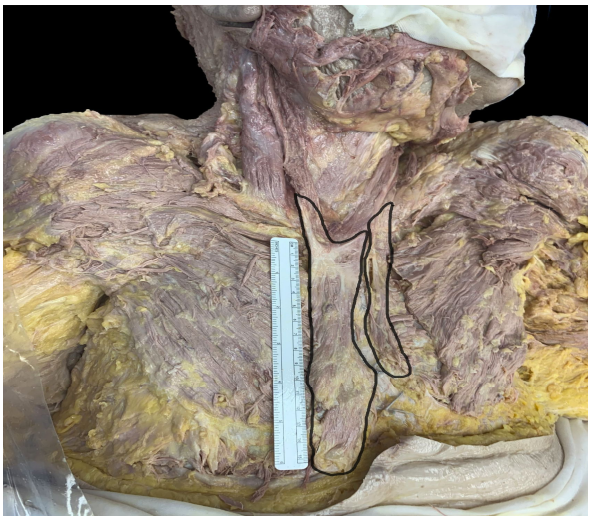

Figure 2: Notably asymmetric bilateral sternalis muscles originate from the inferior sternocleidomastoid tendon sheath.

Figure 3: Lateral view of the bilateral sternalis muscles demonstrating fiber orientation parallel to the sternum and nearly perpendicular to the pectoralis major muscle.

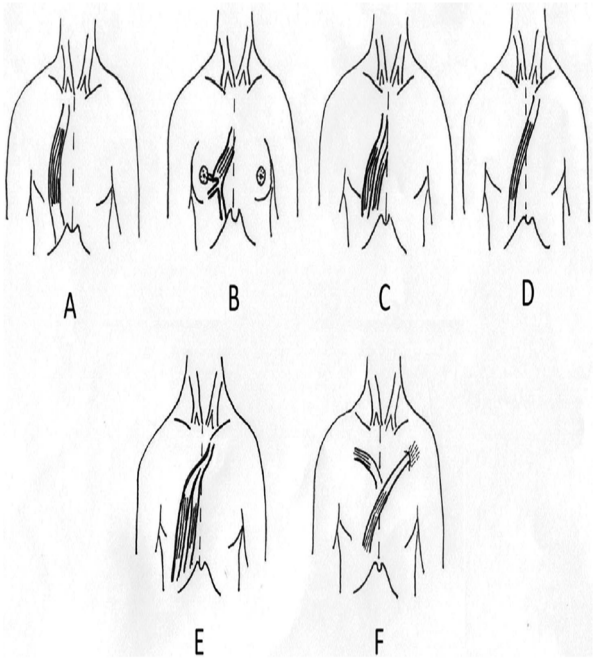

Figure 4: Raikos et al. (2011b) classification of RSM subtypes.

DISCUSSION

Evolutionary and Comparative Anatomy

The RSM was first discovered by Cabrolius in 1604, as noted in his book *Anatomy Elenchus Accuratissima* [5]. Although it has been repeatedly observed by anatomists and clinicians for centuries, much mystery surrounds its function and evolutionary history. Interestingly, our donor displayed widespread muscular atrophy, but still maintained a well-developed RSM. The most commonly documented innervation and blood supply typically involve either the intercostal or medial pectoral nerve, along with the intercostal artery and vein, respectively [6].

The RSM has been suggested as atavistic; a muscle that has largely disappeared through evolutionary history, but occasionally resurfaces due to unknown and infrequent causes. Many ideas have circulated over the centuries as to the developmental origin of the muscle, from descriptions as a vestige of the *cuticular muscle*, irregular growth of parts of the PMM, or simply part of the ventral longitudinal muscle column [7].

Functional comparisons of the RSM based on its anatomical position have sparked hypotheses that evolutionarily older iterations of the muscle may have served as inspiratory accessory muscles, helping to elevate the rib cage [8]. A similar muscle in horses, the *rectus thoracis muscle*, has been noted to assist during inhalation as well [1].

Other reports postulate that RSM is a vestigial remnant of the *panniculus carnosu*s, a sheath of striated muscle that only remains in a few locations in the human body, such as the platysma and palmaris brevis muscles [9]. Our case study, due to its origin in the SCMM and insertion into rectus abdominis sheath, could support this hypothesis. This layer of tissue provides many animal species with the ability to twitch their outer surface to remove insects or other pests from the skin. It may also serve as a proprioceptor to coordinate the movements of the thoracic cavity during respiration similar to the action of the serratus posterior superior muscle [10].

Clinical Significance - Surgery

Multiple operations can be altered by the presence of RSM. One such operation is breast augmentation. In approaches near the midline, RSM may impact the ability of surgeons to enter and create the submuscular pouch necessary for prosthesis placement [11]. Khan reports two cases where the RSM was identified in the midst of breast augmentation procedures and subsequently used as a flap to help cover the breast implants. It was determined that this flap use ultimately improved the outcomes of the procedures. The RSM, if its presence is known, can also be used as a relatively convenient flap for various reconstructive

head and neck surgical operations [3,12]. The well-developed RSM found in our case study appears as though it would support this use. Even when found incidentally, however, RSM may be harvested with minimal impact on the patient owing to its lack of functional significance [13].

Interestingly, Kale et al. [14] reported a case of the "sternomastalis" muscle , or the type B RSM variant under the Raikos et al. [3] classification system, where the presence of unilateral RSM may have caused significant inward deviation of the areola and nipple on the corresponding side [3,14]. In this case then, the B subtype of RSM may have caused the need for elective surgery rather than improving its outcome.

Clinical Significance - Radiology

Though the RSM is not often associated with clinical symptoms, in the field of radiology, it holds significant value as its presence can have an impact on image interpretation, differential diagnosis, and patient management. The RSM's parasternal location can prove problematic for radiologists, as it can appear as an irregular mass in the medial breast on mammograms. Lack of anatomical variant awareness and imaging misinterpretation can lead to breast tumor misdiagnosis [15,16] or hematoma misdiagnosis [2]. On craniocaudal mammography projections, the RSM often appears as a flame-shaped or triangular structure in the medial aspect of the breast, clearly separated from the underlying thoracic wall and distinguishable from portions of the PMM []15,17]. Recognizing this rare anatomical variation can help reduce the chances of misdiagnosis and unnecessary procedures, such as biopsies [12], as well as prevent any undue stress placed on the patient. It is unknown if the RSM was identified on preventive or perioperative imaging in our female donor. If a suspicion arises regarding the RSM, which can mimic a focal density, confirmation can be obtained through magnetic resonance imaging (MRI) or computed tomography (CT) scans.

MRI was successfully used by Goktan et al. [15] to confirm the presence of bilateral RSMs after identifying suspicious structures on craniocaudal mammograms. The MRIs showed vertically oriented muscle masses ventral to and separated from the PMMs by fatty tissue [15]. Multidetector computed tomography can also be employed to visualize a flat to oval structure located anterior to the medial border of the PMM with an identical attenuation coefficient to PMM [18,19]. The muscle shape can be influenced by the patient's position, appearing flattened when supine and rounder when in the prone position. In some cases, the RSM may be pulled away from the thoracic wall by the weight of the breast tissue [17,18]. On axial CT images, the RSM is often separated from the underlying PMM by fatty tissue, similar to what is observed on MRI. However, small and slender RSMs may lack noticeable fat spaces, making their detection more challenging, as they may only appear as irregular surfaces or small protuberances on the surface of the PMM [12].

CONCLUSION

RSM is a common muscular variant that can be present in up to 8% of the population, often presenting with numerous subvariants, differing blood supply, and indefinite innervation. The ambiguous embryological origins of this muscle are still being debated by anatomists. Despite that uncertainty, awareness and use of the muscle by surgeons may improve the cosmetic quality of breast augmentations. This muscle can mimic malignancies on radiography and potentially lead to misdiagnosis and unnecessary biopsies. Ultimately, the unexpected appearance of the

RSM has led to a higher risk of morbidity during surgical procedures, misdiagnosis, and undue stress on patients. Physicians should be aware of this pertinent anatomical variation, especially if they are involved with imaging and procedures in the chest.

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DISCLAIMER

The opinions or assertions contained herein are the private ones of the author/speaker and are not to be construed as official or reflecting the views of the Department of Defense, the Uniformed Services University of the Health Sciences or any other agency of the U.S. Government.

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