DOI: JCDR/2012/3580:1950

Case Report

Anatomy Section

Bilateral Musculus Sternalis: A Case Report

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ABSTRACT

The finding of the sternalis muscle is a rare entity of the anterior chest wall that challenges our understanding of the anatomy of the parasternal region. When it is present, it lies superficial to the pectoralis major and parallel to the sternum, and it extends from the jugular notch to the costal region. In the present study, a bilateral case of the sternalis muscle has been reported, which was noticed in a 60-year old male cadaver. On both the sides, the muscle was extending from the level of the sixth costal cartilage to the front of the manubrium sterni and it was even continuing with the ipsilateral sternocleidomastoid. This rare anomaly has puzzled radiologists and surgeons with respect to the confirmation of its diagnosis, where there was a chance of missing it all together or mistaking it for tumour on mammography or CT scan. The sternalis muscle may be important for reconstructive surgeons who perform mastectomy and for radiologists who interpret mammograms. Thus, the sternalis muscle is academically, anthropologically and surgically important.

Key Words: Sternalis, Pectoralis major, Aponeurosis, Mammography, Breast Tumour

INTRODUCTION

An unusual variation creates interest among anatomists, but it is a cause of concern among clinicians when it mimics the pathology [1]. One such anatomical variant of the anterior thoracic region musculature is the sternalis muscle, which is well documented and familiar to anatomists but which is quite unknown among the clinicians and radiologists [2]. It is located sub-cutaneously over the pectoralis major and it ranges from a few short fibers to a well formed muscle, lying parallel to the sternum, and extending from the jugular notch to the costal region [1].

The sternalis muscle was first coined by Cabrolius in 1604 and subsequently by Du Puy in 1726. The first report by Roubinowitch in 1888, described it in live subjects [3]. Subsequently, it has been termed variably as 'episternalis', 'presternalis', 'sternalis brutorum', 'rectus thoracis', 'rectus sterni', 'superficial rectus abdominis', 'japonicus' [4] abdomino guttural, abdomino cutaneous and cutaneous pectoris [5].

Although it was first described about four centuries ago, its origin is still unclear. While some authors opine that it originates from the adjacent muscles such as the sternocleidomastoid, the rectus abdominis and the remnant of the panniculus carnosus, etc, [6] others believe that it is derived from the pectoralis major muscle [7].

The muscle sternalis has been reported in either sex, and in blacks, whites as well as Asians [8,9]. Its incidence in various ethnic groups ranges from less than 0.5% in the Taiwanese to 17.3% in the Chinese [9].

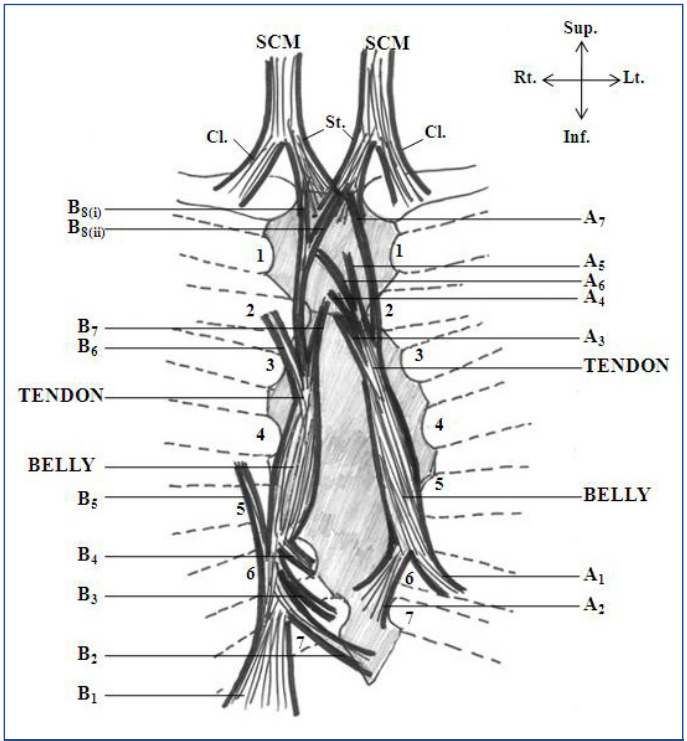
In the clinical practice, it is essential for the radiologists and the surgeons to acknowledge this anomaly as it may pose a diagnostic dilemma, by mimicking a malignant breast mass on mammography, CT scan or MR imaging and thus an unnecessary exploratory surgery can be avoided [1]. Additionally, it provides potential surgical benefits as it can be used as a flap in the reconstruction surgery of the head and neck, the anterior chest wall and the breast [6].

CASE REPORT

During the routine undergraduate dissection of the thoracic region in a 60-year old male cadaver, a bilateral sternalis muscle was seen (See [Table/Fig-1 & 2].

The left sternalis muscle, at its inferior end, was attached laterally to the sixth costal cartilage (A_1) but medially, it formed an aponeurosis which merged with the fascia over the xiphisternum (A_2). Beginning from the level of the sixth costal cartilage, the belly extended upwards and medially and became tendinous at the level of the third costal cartilage. It continued upwards further and medially for its superior attachment, where it gave off six slips- (i) One medial most slip in front of the sternal angle (A_3) (ii) Two slips to the anterior surface of the manubrium (A_4 and A_5). (iii) A fourth slip which was continuous with a fellow of the opposite side. (A_6) (iv) A fifth slip which was continuous with the sternal head of the ipsilateral sternocleidomastoid muscle (A_7).

On the other hand, the right sternalis gave off five slips at its inferior end, which were attached as follows- (i) One lateral slip merged with the pectoral fascia (B_1) (ii) A second slip merged with the fascia over the xiphisternum (B_2) (iii) A third slip was attached to the anterior surface of the seventh costal cartilage (B_3) (iv) A fourth slip was attached to the anterior surface of the sixth costal cartilage (B_4). The aponeurosis formed a belly at the level of the fifth intercostal space. The belly extended upwards and medially and formed a tendon at the level of the third costal cartilage. (v) A slip from the belly went laterally to merge with the pectoralis major muscle (B_5). Superiorly, the muscle showed three attachments which were as follows: (i) One lateral most slip was merging with the pectoral fascia at the level of the second



[Table/Fig-1]: Figure Showing attachments of Sternalis muscle
A_1 – A_7 : Attachments of Left Sternalis (Detailed vide text)
B_1- $B_{8\,(ii)}$: Attachments of Right Sternalis (Detailed vide text)
1-7 : Right & Left Costal Cartilages
SCM: Sternocleidomastoid Muscle
St. & Cl.: Sternal & Clavicular Heads of SCM

costal cartilage (B_6) (ii) A second medial most slip was attached to the front of the manubrium sterni (B_7) (iii) The middle fibers went upwards and bifurcated (B_8). Out of these, the right half joined the sternal head of the ipsilateral sternocleidomastoid muscle ($B_{8\,(i)}$), while the left half joined the sternal head of the left sternocleidomastoid muscle ($B_{8(ii)}$).

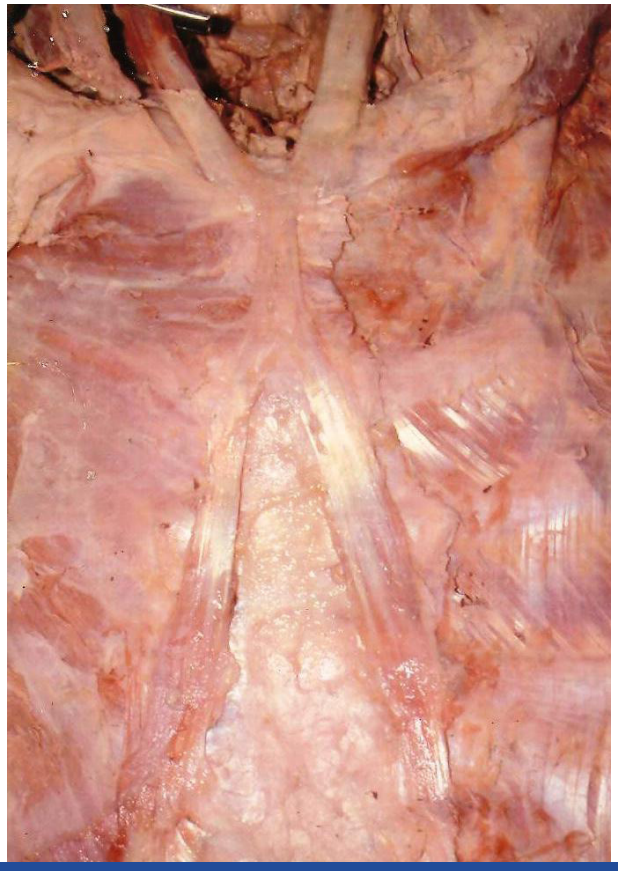
Nerve Supply: Both the sternalis were supplied by the perforating branches of the anterior cutaneous nerves.

DISCUSSION

The sternalis muscle, an uncommon anatomical variant, located superficial to the pectoralis major; has been reported both in males and females; and in blacks, whites and Asians with a frequency which ranges from < 0.5% in the Taiwanese [9] to 23.5 % in the Chinese [10]. All the studies which were done were silent about its bilateral presentation, except the findings of Raikos et al [2], which reported it to be present bilaterally in 1.7 % of the dissections. Such a high variability in its prevalence rates has been reasoned out by Jelev et al [4], due to the existence of small ill defined muscles or tendinous fibers which may or may not be accepted for the sternalis muscle. They threw a flood of light on the earlier literature and suggested that to accept a muscle as the sternalis, it had to have the following criteria:

1. Location between the superficial fascia of the anterior thoracic wall and the pectoral fascia.
2. Origin from the sternum or the infraclavicular region.
3. Insertion into the lower ribs, the costal cartilages, the rectus abdominis sheath or the aponeurosis of the external oblique.
4. Innervation by the intercostals or the pectoral nerves

On the basis of the morphology of the muscle bellies and its 'uni' or 'bi' laterality, Jelev et al [4] classified the sternalis muscle into the following types:



[Table/Fig-2]: Showing Biltateral Sternalis Muscle

Type I: Unilateral sternalis muscle

1. Simple unilateral belly
2. Two or more unilateral bellies.
3. Muscle belly crossing the median line.
4. Unilateral belly passing into another muscle or into a well defined muscle bundle of any of these muscles:
   - preclavicularis medialis
   - sternocleidomastoideus
   - pectoralis major

Type II: bilateral sternalis muscle

1. Two simple symmetric bellies
2. Two simple asymmetric bellies
3. Two bellies which were connected with the pectoralis major on the same side
4. **Two bellies:** one simple unilateral and the other one which was connected with both the left and the right pectoralis major muscles.

The sternalis muscle which was seen in the present cadaver didn't fit completely into any of the above types. Firstly, it was a bilateral case and so it had to be of Type II, but since it was continuous with the sternocleidomastoid on both the sides (Slip No. A_7 and B_8 in [Table/Fig-1]), with the pectoralis major on the right side (B_5 in [Table/Fig-1]) and with the pectoralis fascia on the left side (A_8 in [Table/Fig-1]), it was thought to be unique and it remained unclassified as per the above classification. So, we propose to modify the above classification by adding another type II-5 which consisted of two bellies which were continuous with the sternocleidomastoid above and with the pectoralis major below, as was seen in the present case.

The function of the Sternalis: The sternalis muscle has no known function. Generally speaking, when a muscle contracts, the insertion is pulled by the origin. Therefore, the contraction of the

sternalis, because of its particular location, could elevate the lower chest wall, an action which was achieved by other muscles in those without it. Thus, the sternalis, at the most, played only an accessory role in this function [11].

Ontogeny: There are many theories which have explained the embryological origin of the sternalis muscle. Developmentally, the sternalis represents a remnant of a thoracic rectus muscle which was being derived from the same ventral longitudinal sheet. The nerve supply from the intercostal nerves provided evidence for this derivation. The sternalis is known to be a derivative of the myotonic hypomeres, which form muscles of the ventral and the lateral body walls in the thorax and abdomen. These include the intercostals, the obliquii and the rectus abdominis muscles [12].

Other authors have supported the fact that the muscle develops either from the rectus abdominis sheath or from the pectoralis major due to a defect in the muscle patterning. Particularly, in the later case, the defective precursor migration of the prepectoral mass which gives rise to the pectoralis major and the minor muscles may also contribute to the sternalis muscle development, while mechanical disturbances may lead to an atypical clockwise rotation of the muscle fibers [2].

The morphological relevance of any muscle reflects upon its innervations, as the nerve supplies that muscle which it is destined to deliver and this is obviously determined at the beginning of its development. Hence, the corresponding embryonic segment may be ascertained [12]. But the sternalis muscle innervations were quite enigmatic, implying that the rule of the close relationship between the muscle ontogeny and the innervations may not apply for this muscle. O' Neil MN and Curran F [13] reported that in 55% of the cases, the muscle was innervated from the external or the internal thoracic nerves and that in 43% of the cases it was supplied by the intercostals nerves, while the remaining cases, it was supplied by both the nerves [2].

Clemente [14] considered the sternalis to be a misplaced pectoralis major, while Sadler [15] claimed that the sternalis was represented by the rectus abdominis in the abdominal region and by the infrahyoid musculature in the cervical region; in the thorax, this layer usually disappears, but it occasionally remains as a sternalis muscle. Barlow [8], on the other hand, claimed that the sternalis represents the remains of the panniculus carnosus [13].

Phylogeny: According to another study, the occurrence of the sternalis was regarded as a demonstration of the atavism of the pectoral musculature in lower mammals [12].

Clinical Importance: With the use of sophisticated diagnostic and therapeutic tools, there is a need to record and discuss the unusual anatomical variants. They may appear to be pathological, thus making the diagnosis difficult for the radiologist or the surgeon. The sternalis muscle can be easily overlooked during breast surgeries, and it often causes a diagnostic dilemma on mammography or CT scan, as it may mimic a malignant breast mass on mammography [1].

The presence of the sternalis may suggest a diagnosis of hernia of the pectoralis major to the examining physician. It may cause breast or chest asymmetry or deviation of the ipsilateral nipple-areola complex, while it may coexist with the other pectoralis major defects [2].

Also, the sternalis can present alterations on the ECG or occasionally be wrongly interpreted as a mass which requires surgical resection. Its presence may interfere with the sub-muscular pocket dissection when an intraalveolar or submammary approach is used, it can be used to cover the prosthesis in its most medial part and it can also be used for reconstruction surgery after mastectomy [6]. Since it has an insignificant function on the anterior chest wall, it may be used as a pedicle flap or as a flap with microvascular anastomosis in plastic and reconstructive surgeries of the head and neck region.

Another pertinent alteration which arises from this muscle is the depth at which the internal mammary nodes are irradiated in case of carcinoma of the breast, especially in those lesions which infiltrate the medial quadrants [12].

It is true that the solitary existence of this accessory muscle may not present with clinical repercussions. Yet, a notification of its association with several clinical conditions such as anencephaly in 48% and anomalies of the adrenal gland is unavoidable and hence it warrants documentation [12].

CONCLUSIONS

The sternalis presents a vertical strap like a muscular variant of the anterior chest wall, with an uncertain teleology, function and origin, which is well known to anatomists, but quite unknown to the clinicians. Hence, this muscle must be amply described in the anatomical literature in order to create and reinforce the much needed awareness about such anomalies among the clinicians. Hopefully, the knowledge of the precise anatomical details of such morphological variants would contribute a great deal towards carrying out successful reconstructive procedures.

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FINANCIAL OR OTHER COMPETING INTERESTS:
None.

Date of Submission: **Aug 31, 2011**
Date of Peer Review: **Oct 30, 2011**
Date of Acceptance: **Dec 22, 2011**
Date of Publishing: **May 01, 2012**