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Anatomical study of sternalis muscle in cadaveric dissection

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Abstract
Variations in muscle topography are common in human body. They may or may not be associated with neuromuscular abnormalities. Variations, being common, increases their importance especially in the subjects like orthopaedics, CVTS, Plastic surgery and Physiotherapy. During routine dissection of a cadaver while teaching medical students in Government Medical College Jammu, We found muscle that runs along the anterior aspect of the body of the sternum. It lies superficially and parallel to the sternum. The knowledge of this muscle is crucial, especially among peoples involved in imaging of pectoral region. It is often associated with many congenital anomalies as well. The present study was conducted on 12 cadavers in the department of anatomy, Govt. Medical College, Jammu.

Keywords: pectoral region, rectus sternalis muscle, unilateral, rare chest wall muscle, Indian population

Introduction
The sternalis was first reported by Carbolius in 1604 and the name was first given by Turner in 1867 [1] Different terminologies have been given to the sternalis due to its highly varied morphology and the disagreement on its embryonic origin. The sternalis was referred to as the rectus sternalis, sternalis brutorum, musculus sternalis, episternalis, parasternalis, presternalis, rectus sterni, rectus thoracis, rectus thoracicus superficialis, superficial rectus abdominis, sternalis brutorum, japonicas, and thoracicus depending on studies [1, 2].
It is an anatomical variant of anterior thoracic region with incidence of 3-8 % approximately [3, 4]. Sternalis muscle has been classified as Unilateral and Bilateral [5]. Unilateral incidence of Sternalis Muscle has been found in 4.5% subjects and Bilateral in less than 1.7 percent of the subjects [6]. The sternalis muscle often originates from the upper part of the sternum and can display varying insertions such as the pectoral fascia, lower ribs, costal cartilages, rectus sheath, aponeurosis of the abdominal external oblique muscle. There is still a great deal of disagreement about its innervation and its embryonic origin [7].
Although, there is uniform opinion about the site and attachments of sternalis muscle, innervations issue is still a point of debate. It can get nerve supply by Pectoral nerves [8]. or can be innervated by anterior branches of the intercostals nerves [9]. It can get innervations from the combination of above two set of nerves altogether [10]. It may function as a proprioceptive sensor for thoracic wall movements [11]. It may also take part in the movement of the shoulder joint or have an additional role in elevation of the chest wall [12].
At times Sternalis is encountered as an irregular focal density in craniocaudal mammograms medially and may produce difficulties in mammographic interpretations [13, 14]. Many studies have suggested occurrence of sternalis muscle in fetuses with anomalies often fatal. Anencephaly, cleft palate and spina bifida are the common anomalies recorded in various studies with sternalis muscle.

Material & methods
Study design
This was a descriptive study carried out in Department of Anatomy, Govt. Medical College, Jammu.

Inclusion criteria
Cadavers received in Department of Anatomy from various sources (Unclaimed dead bodies provided by Government agencies and donated dead bodies) were studied. Both male and female cadavers were included in the study. Only adult cadavers were studied.

Exclusion criteria
Cadavers less than 18 years of age were excluded.

Study size
A total of 12 formalin fixed cadavers were dissected in the pectoral region and were studied.
Out of 12 cadavers, 10 were males and 2 were female. In cadavers where sternalis muscles were present were dissected carefully and cleared in search for neurovascular supply. In the doubtful case, tissue was taken and after processing Hematoxylin Eosin stained slides were prepared for final confirmation of tissue.

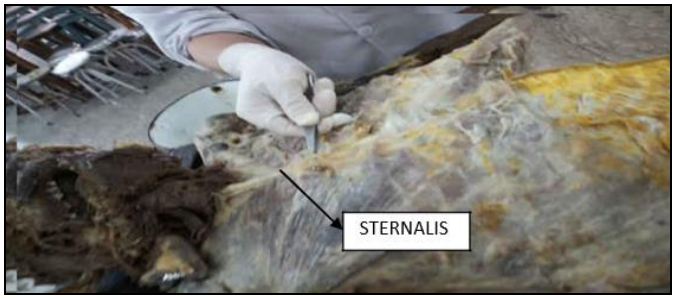

Fig 1: Showing Sternalis muscle

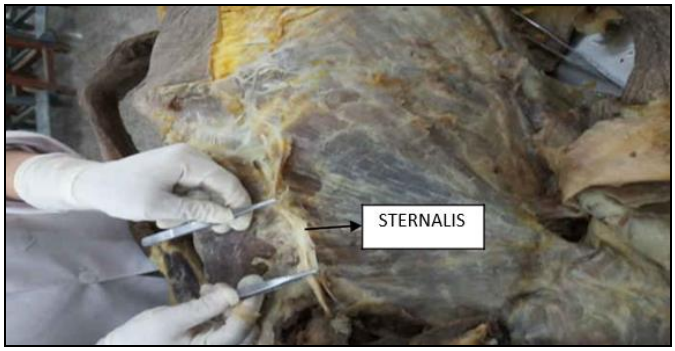

Fig 2: Showing Attachments of Sternalis muscle

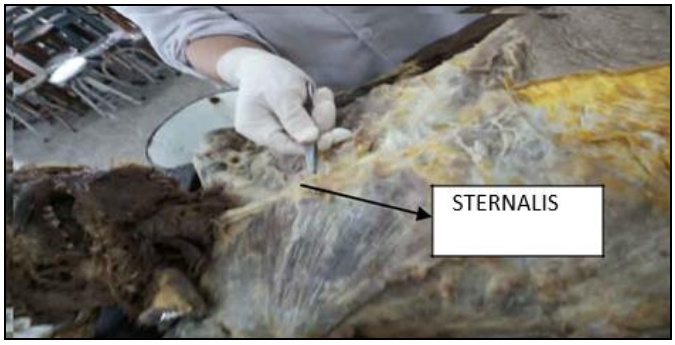

Fig 3: Showing morphology of Sternalis muscle

Discussion

General incidence varies between races [15]. In European population it varies from 2-3% [16] to 6.4% [17], about 11% in Africans, [18] and from 1% to 13.1% [17] in Asian population. In Indian context it varies from 2% to 8% [19, 20]. The incidence of unilateral Sternalis muscle in comparison to bilateral Sternalis muscle is twice as reported [21]. In our study we found only unilateral Sternalis muscle. The incidence of Sternalis muscle was recorded equal in males and females as reported by Barlow [17] while few studies recorded it more in females (8.7%) than in males (6.4%). The higher reporting of incidence in females may be confounded by high rates of surgery and medical imaging for breast related conditions in females [3]. In north Indian region the lack of female cadavers for dissection can also be a confounding factor for this higher incidence reported in females. Cadaveric studies showed that the sternalis muscle has a mean prevalence of around 7.8% in the population [22] with the range from 0.5% to 23.5% [23]. It has a slightly higher incidence in females. Though, It was proposed that a possible reason for the high prevalence may result from the existence of small, ill-defined or tendinous fibres, which could be misidentified for a sternalis muscle. [24]. A recent study [24] classified the sternalis into three types depending on morphology.

- Type I (single head and single belly)
- Type II (double-headed/multi-headed)
- Type III (double-bellied/multi-bellied)

Type I, the single head and single belly was seen in the majority of reported cases (58.5%), type II in 18.1%, and type III in 23.4%.

In addition to the above classification, triple-bellied/double-headed sternalis has also been reported [23].

Many theories regarding embryological origin of Sternalis muscle have been laid down. Many say it can be cranial extension of rectus abdominis or caudal continuation of sternocleoid or displaced pectoral muscle fibers or remnants of pannicules carnosus [25]. No single theory completely explains occurance of Sternalis muscle. As per Gray's Anatomy, Sternalis muscle /rectus sternalis is superficial vertical slip that ascends upwards from lower costal cartilage and rectus sheath to attach to the upper sternum or costal cartilage or sternocleidomastoid [26].

There is much discussion & debate about innervations of Sternalis muscle. Many reported it as pectoral nerves and others as intercostals nerves. In our first case with right sided unilateral Sternalis muscle, we found the innervation was provided by a branch of medial pectoral nerve. Researchers [27, 28] reported innervations of Sternalis muscle from either medial or lateral pectoral nerves. In our second and fourth male cadavers with Sternalis muscle we found that muscle was innervated by inter costal nerve. Similar observations were found in other studies [29-32]. In our third female cadaver with Sternalis muscle we reported dual nerve supply from branches of both medial pectoral nerve and third intercostals nerve. 55% Sternalis muscle were supplied by pectoral nerve, 43% by intercostals nerve and 2% from both pectoral and intercostals nerves. Dual nerve supply was also reported to be 4.8%, from intercostal nerves 26.7% and pectoral nerves 68.5% by [17]. Fine nerve fibres may lay difficulty in dissection and identification of innervations of Sternalis muscle [33].

Sternalis muscle is often associated with anomalies as nearly 50% incidence of Sternalis muscle is reported in anencephaly [34]. As per Harish and Gopinath, 2003 [35]; presence of Sternalis muscle is associated with anomales of the skull and adrenal gland. Two foetuses with anencephaly and three with spina bifida were reported with Sternalis muscle by Harper [36]. Anencephaly fetuses were observed by Sheppard [31] with Sternalis muscle, out of them 6 have had underdeveloped pectoralis major (strenomastoid part), 1 have had cleft palate and 7 have had spina bifida. In our study no such case of Sternalis muscle with C.T.E.V was reported. Most researchers emphasized the importance of and need for increased knowledge and awareness of Sternalis muscle [37]. Nuthakki et al. 2007 [38] and Goktan et al. 2006 [39] on mammography and MRI identified Sternalis muscle cases. Other authors also reported that proper identification of Sternalis muscle may avoid unnecessary exploratory surgery as it may mimic carcinoma on imaging [40].

Harish and Gopinath [41] recorded 8 out of 1152 patient's undergone radical mastectomy. Few researchers suggest that

Sternalis muscle must be removed in radical mastectomy in breast Carcinoma due to its closeness [42] while few are using it as tissue exapnders material for breast reconstitution after mastectomy [43]. Our study reported the Sternalis muscle cases on pure dissection of cadavers.

Conclusion

The presence of the sternalis is asymptomatic but aesthetic complaints have been reported as it was reported to cause chest asymmetry or deviation of the nipple-areola complex. The presence of the sternalis may cause alterations in the electrocardiogram or confusion in mammography. However, there is a potential benefit of the muscle as it can be used as a flap in a reconstructive surgery of the head and neck and the anterior chest wall.

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