CASE REPORT

Internal jugular vein cannulation complications and elimination of the muscular triangle of the neck due to aberrant infrahyoid muscles

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Abstract

We report on a rare case of anatomical variations of the infrahyoid muscles with prominent clinical significance. The aberrant anatomy was on the right side of the neck and involved the omohyoid and sternohyoid muscles. The superior belly of the omohyoid was duplicated in width due to an aberrant belly anteriorly and merged with fibers of the inferior belly inferiorly and the sternohyoid muscle medially. An additional aberrant muscle slip extended between the inferior third of the sternohyoid muscle and united with the inferior belly of the omohyoid. The intermediate tendon between the two bellies of the omohyoid was absent, whereas the so-called muscular triangle of the neck was diminished. Due to the arrangement and fusion of myofibers the muscle could be termed as omo-sternohyoid muscle. A profound hematoma was noted in the aberrant muscle at the area overlying the internal jugular vein indicating difficulty in obtaining jugular venous access for catheter placement. Clinicians and surgeons should be aware of muscular anatomic variations when intervening in the lateral neck area as the classical anatomical landmarks might be misinterpreted and confuse.

Keywords: defect reconstruction, infrahyoid muscles, internal jugular vein, omohyoid muscle, IJV puncture, sternohyoid muscle.

Introduction

The omohyoid is a muscle of the lateral neck consisting of two bellies; an inferior and a superior, which are united at an angle by an intermediate tendon. The inferior belly originates from the upper border of the scapula near the scapular notch, running superomedially deep to the sternocleidomastoid to form the intermediate tendon superficial to the internal jugular vein (IJV). The intermediate tendon then progresses to become the superior belly, which passes cranially to attach to the inferior surface of the hyoid bone. The superior belly acts as the border between the carotid and muscular triangle of the neck. The omohyoid muscle has been known to depress the hyoid bone, although physiologically the role of the muscle is not well understood. While it has been put forward that the omohyoid muscle is keeping the lumen of the IJV open, others suggest that contraction of the muscle compresses the IJV to limit venous return. Moreover, the omohyoid has clinical relevance for surgery, as the superior belly of the muscle acts to define the muscular and carotid triangles of the neck [1, 2].

A wide spectrum of omohyoid variations have been described in the literature. This includes variation in the origin and insertion of the muscle bellies, hypoplasia, hypertrophy, absence or doubling of the superior and/or inferior belly, multiple bellies, attachment of the inferior belly directly to the clavicle, aberrant origin from the transverse process of C6 vertebra, aberrant position in relation to IJV, and fusion of the superior belly to the sternohyoid muscle [2–7]. Absence of the omohyoid is more prevalent in the superior belly. Doubling refers to either bellies splitting to create two distinct muscle heads. Duplication of the omohyoid also occurs more often in the superior belly than the inferior.

Variations of the omohyoid muscle have clinical and surgical significance due to close relationship with the IJV. Particularly the right IJV serves as a favorable position for central venous catheter placement. Surgeons intervening in the lateral neck region for oropharyngeal cancer resection utilize the omohyoid as an anatomical landmark to define the border between level III and IV lymph nodes [8]. It is frequently used as myocutaneous flap for reconstruction of small and middle-sized defects after trauma or cancer resection in the head and neck region [9–11]. Additionally, the omohyoid has been used to create a loop around tracheoesophageal shunt as a method of voice restoration for patients who have had total laryngectomy [12].

Materials, Methods and Results

During routine dissection for educational purposes in a 73-years-old male cadaver, an aberrant morphology was observed on the right lateral neck region involving the omohyoid and sternohyoid muscle (Figure 1a). Specifically, the inferior belly of the omohyoid originated typically from the superior border of the scapula, near the supra-scapular notch, coursed medially and superiorly. The distal part of the inferior belly fused directly with the superior belly without an intermediate tendon in between. An additional broad muscle slip originated from the inferior third of the sternohyoid muscle, ran laterally and fused with the proximal portion of the inferior belly of the omohyoid. The superior segment of the omohyoid...
was duplicated, having a normal and an aberrant belly and inserted onto the hyoid bone. Characteristically, it had a bigger external and a smaller internal belly running in parallel and united distally with the inferior belly and the described lateral slip, whereas it was fused medially with the sternohyoid muscle. Due to the aberrant arrangement of the muscle slips, the space in the muscular triangle was diminished. Instead, it was completely occupied with muscle tissue.

The sternohyoid appeared with normal origin and insertion, however approximately 80% of its lateral aspect was fused with the aberrant omohyoid resulting in a flat strap-like muscle. A schematic drawing of the variant is depicted in Figure 1b. Due to its pattern, the strap-like muscle could be termed as omo-sternohyoid muscle.

An additional interesting finding was observed in the aberrant strap-like muscle. A large full muscle thickness hematoma was found in the area covering the IJV (Figure 2, a and b). No disruption of the IJV was noticed; suggesting that the blood caused the hematoma arose from the microcirculation of the muscle itself rather than the IJV. There is strong evidence that the hematoma was the result of repeated attempts to catheterize the IJV for placement of central venous catheter for parenteral administration of drugs and fluids during hospitalization. The rest of the lateral neck and larynx area was free from any other pathology and variation.

**Discussion**

Variations of the omohyoid can be found in up to 15% of the population [4] or up to 20% according to a second study [13]. Complete absence of the superior belly has been reported as it is been replaced by a broad tendon (2.5 cm wide) from the inferior belly [14]. The intermediate tendon may be restricted to a narrow tendinous inscription, while it was found absent in 10% of cases [15]. In a study on 30 cadavers, the inferior belly of the omohyoid was found attached to the scapular notch in all cases. Secondary insertions onto the superior transverse scapular ligament were noticed in 20%, the clavicle in 10%, the coracoclavicular ligament in 6.7%, and onto the coracoid process in 6.7% of specimens [16]. Rai et al., in a study on 35 male cadavers found a normal muscular pattern in 85% of cases and classified the variants into four types. A double omohyoid was observed in 3% of cases (Type I), an inferior belly from
the clavicle and a superior belly attached to hyoid bone (cleido-hyoid muscle) in 6% (Type II), an inferior belly of omohyoid originating from the clavicle and the superior belly merging with the sternohyoid in 3% (Type III), and a superior belly receiving muscle slips from the sternum with normal inferior belly in 3% of cases (Type IV) [4].

Sukekawa and Itoh presented a detailed description about variants of the superior belly of the omohyoid muscle and classified them into four types. In Type 1, there is a single superior belly composed of underdeveloped myofibers or there are underdeveloped muscle slips between the medial border of the superior belly and the lateral border of the sternohyoid. In Type 2, there is a double superior belly, specifically a larger external and a smaller internal one. In Type 3, there are multiple muscle slips (three to five) extending from the hyoid bone and the sternohyoid to the intermediate tendon. In Type 4, the inferior belly of the omohyoid is partially fused with the superior belly, while a small portion of the intermediate tendon still exists [5].

The presented case has some similarities with the case described by Kim et al. where two muscle bellies were found, one superior resembling to a normal superior belly of omohyoid and one inferior, inserting independently onto the inferior third of the lateral border of the sternohyoid. The authors described the second belly as an inferior omohyoid muscle [17]. In our case, a transverse muscular belly inserted in a similar pattern onto the lateral border of the sternohyoid but the upper margin was completely fused with the double belly lying superiorly. The area between the omohyoid and sternohyoid was occupied by muscle fibers instead of connective tissue as has been described in the past from Bergman et al. [7].

The omohyoid has classically been utilized as a landmark from surgeons conducting radical and selective neck dissections for the removal of oropharyngeal cancers, as well as in lymphadenectomies [16]. The omohyoid is being used as a favorable myocutaneous flap donor for reconstruction of small and medium sized defects in the head and neck area. Infrahyoid muscle flaps are used as an alternative muscle graft for defects reconstruction. There are reports where the infrahyoid muscle has been used for reconstruction of tongue defects after resection of lingual tumors [18]. In a second study, it has been used successfully to reconstruct tissue defects in 32 patients with squamous cell carcinoma of the upper aerodigestive tract [10]. Contrasting with the presented case the use of the omohyoid as an anatomical landmark would not be possible due to its inconsistency and variable morphology. The bilateral omohyoid has been used to create a loop around the tracheoesophageal shunt to restore voice function and decrease aspiration rate in patients with total laryngectomy due to laryngeal cancer [12].

The morphology of the aberrant omohyoid and the absence of intermediate tendon presented in our case could potentially create many difficulties if encountered in the surgical field. The muscle cannot be used effectively to create the necessary loop in the tracheoesophageal shunt leading to failure of the technique. Similar outcome might be expected for other muscular variations of the omohyoid. Furthermore, the large full-thickness hematoma noted in our case suggests a failure to obtain access to the right IJV. This is of prominent clinical significance especially for interns and junior doctors, when asked to insert central venous catheters as in dialysis or where peripheral venous access is unattainable.

The reports on the clinical representation of a double omohyoid muscle are very limited. In a symptomatic case of a 42-year-old woman, the authors refer that the patient present a hen-egg-size lump (3.5×5 cm) in the lower neck during swallowing and occasionally had dysphagia and discomfort [19]. Moreover, in a study on 30 cadavers and 88 patients who had lateral neck dissections for oncological management, the distance between the intermediate tendon of the omohyoid and the clavicle varied considerably and could not be predicted. The morphology, position, and attachments of the muscle also varied between cases. This led to the conclusion that the muscle is not dividing the jugular lymph nodes into three equal levels as believed and serves as an unreliable surgical landmark for neck dissection [16].

Accurate identification of aberrant omohyoid anatomy can be facilitated with ultrasound, electromyography, thyroid 99Tcm scintiscan, CT, and MR imaging studies. Differential diagnosis should be made from other benign pathologies such as laryngeal cyst, cervical cyst hygroma, esophageal diverticulum, cervical brachial cleft cyst, phlebectasia of the IJV, muscle fiber inflammation of the area, thyroclus, and from other aberrant muscular variants of the neck [19, 20].

Conclusions

Hereby, we report on a rare case of anatomical variation of the infrahyoid muscles involving the omohyoid and sternohyoid muscles. Due to the arrangement and fusion of myofibers the aberrant muscle could be termed as omo-sternohyoid muscle. The altered muscular anatomy on the right side of the neck was responsible for the failure of attempted IJV puncture resulting in a profound hematoma. Implication in catheterization of the internal jugular vein is possible due to aberrant infrahyoid muscles. Clinicians and surgeons should be aware of muscular anatomic variations when intervening in the lateral neck area as the classical topographical landmarks might be altered leading to misinterpretation, confusion, and complications.

References


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**Received:** April 19, 2014

**Accepted:** August 19, 2014