Original article

The suprascapular vein: A possible etiology for suprascapular nerve entrapment and risk of complication during procedures around the suprascapular foramen region

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ABSTRACT

Introduction: Nerve can be compressed when traveling through any osteo-fibrous tunnel. Any eventual anatomic structure limiting this passage increases the risk of neuropathy. During dissection of the shoulder region we recognized a vein travelling on the inferior border of the suprascapular notch together with the suprascapular nerve. The aim of this work was to evaluate the morphological characteristics of this vein in cadaveric material.

Materials and methods: The suprascapular notch (SSN) region was dissected in 60 cadaver shoulders. The course, number and diameter of nerve and vessels in the suprascapular notch region were evaluated. Length, proximal and distal width of the superior transverse scapular ligament were measured. Photographic documentation was taken to evaluate the suprascapular nerve passage area.

Results: The vein identified was named as the suprascapular notch vein. It was present in 58.3% of shoulders. In 11 specimens, it was double. Its mean diameter was 1.7 mm (SD 0.7 mm) and did not correlate with the suprascapular nerve passage area. A suprascapular notch vein co-occurred more often with the anterior coracoclavicular ligament (ACSL). In comparison with the SN without the ACSL, it has a significantly greater diameter (2 mm; SD 0.7 mm vs 1.5 mm; SD 0.6 mm, respectively; P = 0.021).

Conclusions: The suprascapular notch vein was a common structure that did not replace the suprascapular vein. Its presence correlated with the occurrence of the ACSL and was independent of body side, STSL type and SN type.

Type of study: Observational anatomic study.

1. Introduction

The suprascapular notch (SSN) is the incisure at the upper border of the scapula. It is bridged by the superior transverse scapular ligament (STSL) creating an osteo-fibrous tunnel whose area ranges from 4.6 mm² to 85.4 mm² [1]. Anterior coracoclavicular ligament (ACSL) is independent fibrous band extending on the anterior side of the suprascapular notch, below the superior transverse scapular ligament (Fig. 1). Such structured tunnel usually holds the suprascapular nerve (SN) and the suprascapular vein. The suprascapular artery only occasionally runs below the STSL [2,3]. The suprascapular nerve innervates the supraspinatus and infraspinatus muscles and also provides sensory branches to joints (acromioclavicular and glenohumeral); ligaments (the coracohumeral and coracoacromial); subacromial bursa [4] and to a variable area of the overlying skin and soft tissues [5].

Structures passing below the STSL through the osteo-fibrous tunnel may increase the risk of neuropathy by limiting the space available for the SN. This can result in suprascapular nerve entrapment syndrome which was described in 1936 by André Thomas'a [6] and usually occurs in the SSN [7].

During dissection of the shoulder region, we found an unusual vein that passed through the SSN on its inferior border. Because this vein may restrict the passage for the SN, we aimed to determine its morphology and the prevalence.

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2. Materials and methods

The shoulder region was dissected in 60 formalin-fixed cadaveric shoulders, 30 left and 30 right, derived from a Polish population (age and sex unknown). The humeral attachment of the subscapularis muscle was cut and the muscle was retracted medially. The fasciae were cleaned, revealing the anterior side of the scapula. When the SNV was present, its course was traced from the SNN to the upstream veins. The arrangement of the suprascapular artery, vein and SN was also noted. Afterwards, the posterior aspect of the SSN was exposed. The attachment of the trapezius and deltoid muscles were separated from the spine of the scapulae. The supraspinatus muscle was cut distally and bluntly dissected from the supraspinatus fossa. The suprascapular notch vein was followed to the site of its emptying.

The dissected scapulae were fixed at a standardized distance from the camera, and their anterior aspect was photographed in the coronal plane. The ten millimeter long scale was placed at the level of measured structures and served for further calibration of measuring tool. The dimensions of the STSL, the anterior coracocapular ligament (ACSL) and the areas of the SSN and the SN passage were measured using MultiScanBase 18.03 software (Computer Scanning System II, Warsaw, Poland). The diameter of the SN, suprascapular vessels and SNV were also evaluated. In further analysis, the STSL was classified as either fan- or band-shaped [1] and the SSN to one of the 5 types [8].

For the purposes of statistical analysis, P<0.05 was regarded as statistically significant. Data is presented as a mean ± standard deviation, unless stated otherwise. A comparison of the prevalence of SNV between body sides, STSL types and SSN with or without the ACSL was performed with the χ² test. Differences in SNV diameter between those variables was estimated with Student’s t test for independent samples. This test was also employed to compare areas of the SSN and the SN passage between specimens with and without the SNV. The relationship between SNV diameter and the number of its upstream veins was evaluated by means of one-way Anova with dedicated post-hoc tests. This method was also used to compare SNV diameter between types of the SSN. Correlations of the SNV diameter and areas of the SSN and the SN passage were evaluated by means of the Spearman’s rank correlation coefficient.

3. Results

The suprascapular notch vein was present in 35 shoulders (58.3%) (Fig. 2). In 11 specimens, it was double (Fig. 3). It originated from 3 veins in 20 cases, 4 veins in 11, 2 veins in 3, and 5 veins in 1 case. Veins of origin arose on the anterior side of the scapula, inferior to the SSN, from a bone-nutrient vein of the scapula and/or veins laying beneath the fascia of the subcapularis muscle. All SNVs emptied into the suprascapular vein immediately after passing the SSN. After exclusion of a single case with five upstream veins, the diameter of the SNV differed significantly between three groups (P=0.0274) and tended to increase as the number of upstream veins increased (Table 1) (Fig. 4).

In all cases, the SN (diameter = 2.1 mm; SD = 0.4 mm) travelled below the STSL. The diameters of the suprascapular artery and vein were 2.3 mm (SD = 0.6 mm) and 3.4 mm (SD = 0.7 mm), respectively. In two cases, the suprascapular artery accompanied the SN beneath.

![Fig. 1. Schematic arrangements of the superior transverse scapular ligament (STSL) and anterior coracocapular ligament (ACSL) at suprascapular notch.](image1)

**Table 1**

<table>
<thead>
<tr>
<th>Number of veins</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.3449</td>
<td>0.0493</td>
<td>0.0493</td>
</tr>
<tr>
<td></td>
<td>0.3449</td>
<td>0.1018</td>
<td>0.1018</td>
</tr>
</tbody>
</table>

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the STSL. The suprascapular vein passed below the STSL in 40 cases. A double suprascapular vein was found in 15 specimens. In 11 of them, one vessel passed inferior to the STSL and the other superior. In the remaining 4 shoulders, both veins ran over the STSL. Fig. 5 depicts the arrangement of SN and suprascapular vessels when the SNV was present.

The SN area was 87.5 mm² (SD = 33 mm²) and area of SN passage was 25.3 mm² (SD = 15.9 mm²). The diameter of the SNV ranged from 0.5 mm to 3 mm (mean = 1.7 mm; SD = 0.7 mm) but did not correlate with neither the SN area (P = 0.645) nor with the SN passage area (P = 0.8686). Furthermore, the areas of the SN and the SN passage did not differ significantly according to the presence of the SNV (P = 0.3601 and P = 0.7022, respectively). The differences in SNV diameter between body sides, STSL types and SNV types were also insignificant (data not presented). However, the SNV co-occurred more often with the ACSL (P = 0.0001) (Fig. 6). In those cases, diameter of the SNV was greater than in SSNs without the ACSL (2 mm; SD 0.7 mm vs 1.5 mm; SD 0.6 mm, respectively; P = 0.021). Table 2 shows differences in the prevalence of the SNV according to the body sides and the arrangement of structures occupying the SNV.

4. Discussion

The arrangement of vascular structures in the SSN is highly variable. The suprascapular artery incidentally travels together with the SN below the STSL. We observed this pattern in 3.3% of the...
Table 2
Differences in prevalence of the SNV between: body sides, types of the STSL, occurrence of the ACSL and presence of the suprascapular vein below the STSL.

<table>
<thead>
<tr>
<th>Compared parameters</th>
<th>SNV present [Number]</th>
<th>SNV absent [Number]</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body sides [Number]</td>
<td>Right (30)</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Left (30)</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>STSL type [Number]</td>
<td>Fan-shaped (29)</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Band-shaped (31)</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td>ACSL [Number]</td>
<td>Present (31)</td>
<td>27</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Absent (29)</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td>Suprascapular vein below the STSL [Number]</td>
<td>Present (40)</td>
<td>29</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Absent (20)</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

STSL: superior transverse scapular ligament; ACSL: anterior coracocapular ligament; SNV: suprascapular notch vein.

cases. Tubss et al. [3] found this arrangement in 3 out of 120 cadaveric shoulders (2.5%) and Reinecke et al. [2] in 3 of 100 specimens (3%).

Variations in suprascapular vein anatomy occur more often. Yang et al. [9] reported that the SN was accompanied either by the suprascapular vein or artery in 25.2% of 103 cadaveric shoulders, and by both vessels in 14.6%. Furthermore, a double suprascapular vein was present in 19.4% of shoulders and a triple one in 1.9%. As far as the suprascapular vein is concerned, our results are similar, however, Yang et al. [9] did not describe any vein resembling the SNV. It is possible that, in this case, the SNV could have remained unrecognized as the SSN had been dissected from the posterior aspect.

The suprascapular notch vein is common, however it is not well studied because more attention is generally paid to the posterior aspect of the scapulae. In this location, the SN is often compressed by a mass (e.g. ganglion/labral cyst, tumor) [10,11] or retracted and irritated due to a rotator cuff tear [12]. It can also be entrapped in a spinoglenoid notch by the spinoglenoid ligament [13].

The previously-described variations of the suprascapular vein concern mainly the number of vessels and their arrangement in the SSN. Usually, the suprascapular vein starts in the infraspinatus fossa, approaches the supraspinosa fossa through the spinoglenoid notch and ascends to the SSN. After passing the SSN, typically under the STSL, it travels with the suprascapular artery and finally empties into the external jugular vein. It drains the same region as the corresponding artery, however the dorsal scapular vein and the circumflex scapular branch of the subscapular vein may also receive blood from this region [14]. In contrast to the suprascapular vein, the SNV originates from veins emerging directly from bony foramina on the anterior side of the scapula (nutrient veins) or veins running under the fascia of the subscapularis muscle. Moreover the SNV, traveling from anterior to posterior, crosses the SSN in the opposite direction to the suprascapular vein. Finally, the SNV was always found to co-occur with the suprascapular vein, never replacing it. All the above implies that the SNV is not a variant of the suprascapular vein but a separate structure.

Although the SNV was usually found to have a small diameter, in 4 specimens it was wider than the suprascapular vein. Despite the fact that a suprascapular artery travelling together with the SNV can cause its neuropathy [15], it is uncertain whether a large notch vein might increase this risk. Carroll et al. [16] reported the presence of a venous varix in the spinoglenoid notch in six patients with symptoms of suprascapular nerve entrapment syndrome. Furthermore, mechanical nerve irritation by venous dilatation has been described in patients with tarsal tunnel syndrome [16]. These reports indicate that the distended vessel can compress the nerve when the two structures travel together through the osteo-fibrous tunnel. However, the diameter of the SNV did not correlate with the SN passage area and no varix of the SNV was found. Hence, the smooth wall of the SNV, which lines the bony floor of the SSN, might protect against the irritation of the SN that is kinked by the border of the SSN.

The anterior coracocapular ligament may also play an ambiguous role in the development of SN neuropathy. On the one hand, it may increase the risk of SN neuropathy by obstructing the nerve passage [17]. On the other hand, the ACSL separates the SN from the bone and prevents the SNV from intruding into the SN passage space. Moreover, the presence of an ACSL was not found to decrease the SN passage area [18].

Considering all the above we suppose that the SNV, together with the ACSL, may support a cushion mechanism for the SN, protecting it against repeated micro-trauma.

The limitation of this study is that no conclusions can be derived regarding the symmetry of SNV occurrence, as separate limbs were dissected and the data for left and right sides was pooled. However, Yang et al. [9] reported that body side is not associated with different frequencies of vascular anomalies. Our observation that SNV prevalence is non-side specific supports this theory. Another limitation is that veins were not injected with medium, decreasing accuracy of vein diameter measurements. However, in formalin-fixed shoulders, that we used, veins of a small diameter were filled with clothed blood that was not flushed during embalming procedure. Clothed blood distended vein lumen enabling reliable measurements. Finally, proposed protective role of the SNV and the ACSL against the SN irritation cannot be confirmed based on anatomic description and should be further tested in clinical setting.

Information about the relationship between the SN and vessels in the SSN region is of paramount importance for classical [19,20] and endoscopic surgical approaches [21,22]. Awareness of anatomical variations in this region has become vital due to the increasing number of ultrasound-guided SN block procedures [23,24], combined with the placement of a perineural catheter below the STSL [24,25]. Sonoanatomy of the SSN region has been recently described, however, the precise orientation of anatomical landmarks is challenging and results of examination are subjective [22,24]. In those procedures, the transducer is placed over the SSN in almost coronal plane. If the transducer is too anterior, the ACSL, together with the SNV below it, may be mistaken with the suprascapular vein passing below the STSL. Thus, the needle might be inserted too deeply, injuring the SN or suprascapular vessels. This likelihood is even more increased by the limited visibility of the SN in the SSN requiring neighbouring structures to be used as landmarks in estimating the localization of the SN [26].

5. Conclusions

The suprascapular notch vein is a common structure that was found in 58.3% of the cases. It never replaces the suprascapular vein and courses against it. Its presence correlates with the occurrence of the ACSL and is independent of body side. Although its role in the development of SN neuropathy remain uncertain, knowledge about it may help to prevent unexpected bleeding while performing procedures around the SSN region.

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Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References