Risk vessels of retropharyngeal hematoma during stellate ganglion block

Kazunori Hirota, MD[1], Kazuhiko Hirata, MD[1], Shiho Shibata, MD[1], Kenji Shigematsu, MD[1], Kazuo Higa, MD[2], Ken Yamaura, MD[1]

[1]Department of Anesthesiology, Fukuoka University School of Medicine, Fukuoka, Japan

[2]Care Center Himawarien, Fukuoka, Japan

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Corresponding author:

Ken Yamaura, MD

Department of Anesthesiology

Fukuoka University School of Medicine

7-45-1 Nanakuma, Jonan-ku,

Fukuoka 814-0180, Japan

Phone: +81-92-801-1011

Fax: +81-92-801-1025

E-mail: keny@fukuoka-u.ac.jp

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Fukuoka University School of Medicine, Fukuoka, Japan

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Abstract

Background and Objective: Bleeding into the retropharyngeal space is a potential complication in stellate ganglion block (SGB). Hematoma formation is considered to be due to damage of small arteries in the region, though only scanty details of the region are available. The aim of this study was to map the risk blood vessels in the retropharyngeal space to avoid accidental damage during SGB.

Methods: Contrast-enhanced three-dimensional computerized tomographic (3D-CT) images performed for 80 patients were re-analyzed retrospectively to construct detailed map of cervical blood vessels that are prone to damage and bleeding during SGB.

Results: Of the 160 bilateral necks, six (3.8%) and 82 (51.3%) small arteries were identified in the medial portions of the ventral surface of the transverse processes of the 6^{th} and 7^{th} cervical vertebrae, respectively. In particular, 5 of the 6 small arteries detected in the medial portion of the ventral surface of the transverse process of the 6^{th} cervical vertebra were the inferior thyroid artery (ITA). Of the 160 vertebral arteries, 2 arteries were missing, 4 (2.5%) entered the transverse foramen of the 5^{th} cervical vertebra, while one (0.6%) entered the transverse foramen of the 4^{th} cervical vertebra.

Conclusions: 3D-CT identified the ITA in the medial portion of the ventral surface of the transverse process of the 6^{th} cervical vertebra. The risk vessels of retropharyngeal hematoma during stellate ganglion block could include the ITA.

(229 words)

Introduction

Hematoma in the retropharyngeal space is a serious complication of stellate ganglion block (SGB), and which can be fatal due to airway narrowing and closure by compression of the trachea[1-4]. Hematoma in the retropharyngeal space is thought to be caused by damage of small arteries, rather than large vessels, such as the internal carotid artery and vertebral arteries[5-6]. However, identification of small vessels is often difficult, even by ultrasonography, due to the anatomical relation with the thyroid gland and the complex courses of the blood vessels[7-8].

Three-dimensional computerized tomography (3D-CT) with a contrast medium has recently been introduced. This imaging modality allows identification of obscure blood vessels in the head and neck region. The purpose of this study was to identify hematoma risk blood vessels present in the retropharyngeal space as assessed by 3D-CT.

Methods

In this study, we reviewed and re-analyzed retrospectively the contrast-enhanced 3D-CT records of adult patients who underwent angiographic examination of the head and neck region at three hospitals (Baba Hospital, Fukuoka University Chikushi Hospital, and Fukuoka University Hospital) between December 2007 and December 2009. The CT apparatus used in these hospitals were Toshiba Aquilion 64 (Toshiba Medical System Corporation; Ohtawara, Japan) and Siemens SOMATOM Sensation Cardiac 64 (Siemens Healthcare; Erlangen, Germany). The imaging conditions were set at 120 kV, 300 mA, 0.5-0.75 sec, with slice thickness of 0.5 mm. The contrast agent was 65-75 mL of iopamidol 300 or 370. Image analysis was performed by radiologists using Ziostation (System 610; Ziosoft, Inc., Tokyo, Japan). The smallest blood vessels that could be identified were those with inner diameter of approximately 0.35-0.6 mm. Institutional Review Board approval for this retrospective study was obtained from Fukuoka University Hospital (IRB No. 7-03 08-25).

SGB is carried out using the transverse processes of the cervical vertebrae as guideposts. Accordingly, the 3D-CT images of the transverse processes were divided into different compartments for detailed examination of blood vessel distribution present in the vicinity of these processes (Figure 1). Specifically, the transverse processes of the 5^{th}, 6^{th}, and 7^{th} cervical vertebrae were divided into medial and lateral portions. For the 5^{th} and 6^{th} cervical vertebrae, the medial portion of each transverse process represented the area from the origin of the transverse process to the tip of the anterior tubercle, while the lateral portion represented the area from the tip of the

anterior tubercle to the tip of the posterior tubercle. For the 7th cervical vertebra, the anterior tubercle of the transverse process was not clear, and accordingly we divided the area from the origin of the transverse process to its tip into two halves; the medial and lateral portions. Thus, the three vertebral bodies were divided into 12 regions bilaterally. A single radiologist subjected the 3D-CT images of the neck to computer processing and manually excluded the thyroid and carotid arteries to clarify the relationships between the cervical vertebrae and the cervical arteries. The retropharyngeal space is located between the buccopharyngeal fascia on the dorsal side of the esophagus and the anterior lobe of the cervical fascia on the ventral side of the vertebral body. Next, the small arteries of interest represented those on the dorsal side of the trachea and the ventral side of the transverse process, while those on the ventral side of the posterior wall of the trachea were excluded. The carotid and vertebral arteries were also excluded from the small arteries of interest.

Results

The 3D-CTs of 80 patients (55 men, 25 women, age 71.2±9.0 years, mean±SD) were examined. Small arteries were identified on the ventral surfaces of the transverse processes of the 5th and 6th cervical vertebrae in 19 and 39 patients. There were 38 small arteries, (18 (22.5%) on the right side and 20 (25.0%) on the left side) on the ventral surface of the transverse process of the 6th cervical vertebra. Furthermore in the medial portion of the ventral surface of the transverse process of the 6th cervical vertebra, there were 6 (3.8%) small arteries in total, one (1.3%) on the right side and 5 (6.3%) on the left side. Many small arteries were identified on the medial portion of the ventral surface of the transverse process of the 7th cervical vertebra (82, 51.3% in total), including 43 (53.8%) on the right side and 39 (48.8%) on the left side, which were more than that of the 6th cervical vertebra (Table 1).

Based on anatomical positional relationship, five of the six small arteries detected in the medial portion of the ventral surface of the transverse process of the 6th cervical vertebra were the inferior thyroid arteries (ITA). These arteries passed on the cranial side of the normal position (Figure 2). The average diameter of all ITA was 1.26±0.21mm according to analysis of 3D-CT images. The remaining small artery could not be clearly identified due to a malformation.

The vertebral artery was missing in 2 patients (2 arteries) of the 80 patients. In 78 patients, 4 of 158 vertebral arteries entered the transverse foramen of the 5th cervical vertebra, 3 on the right side and one on the left side. One vertebral artery entered the transverse foramen of the 4th cervical vertebrae on right side. The rest 153 vertebral arteries entered the transverse foramen of the 6th cervical vertebra on both

sides.

Discussion

SGB is performed at the anterior tubercle of the transverse process of the 6th or 7th cervical vertebra. Accordingly, damage of small arteries located at the ventral surface of the transverse processes of these vertebrae with subsequent bleeding can potentially occur. During SGB through the anterior approach, blood vessels found by ultrasonography at the level of the 6th and 7th cervical vertebrae are at risk of bleeding by the puncture needle, but identification of the small arteries is often difficult[8]. Since the small arteries in this region show considerable variation in branching from the subclavian artery[9-10], their courses show great individual differences, and they can be obscured by the thyroid gland. The present study eliminated the thyroid and carotid arteries by digital image processing of the contrast-enhanced 3D-CT images. This allowed visualization of the small arteries and elucidation of the courses of the arteries on the ventral surface of the transverse processes of the lower cervical vertebrae[11].

Siegenthaler[8] employed ultrasonography and identified small arteries on the right side in 20% of the patients and on the left side in 28.3% of the patients, on the ventral surface of the transverse process of the 6th cervical vertebra, and, in 16.7% and 20.0% of the patients on the 7th cervical vertebra respectively. The present data show a smaller percentage of small arteries in close proximity of the 6th cervical vertebra and a higher percentage on the 7th cervical vertebra. This discrepancy can be attributed to difference in the examination methods. 3D-CT imaging allows the identification of the level of cervical vertebra. In the present study, a contrast medium was used in 3D-CT imaging, which made it easier and more accurate to detect small vessels.

The small arteries on the ventral surface of the transverse processes were ITA,

ascending cervical artery and transverse cervical artery which branches from the subclavian artery. Furthermore, five of six small arteries seen on the medial side of the ventral surface of the transverse process of the 6th cervical vertebra were identified ITA. The ITA has an internal diameter of about 1.5 mm and branches from the thyrocervical artery, which branches from the subclavian artery[12, 13]. In this present study, its diameter was 1.26±0.21mm according to analysis of 3D-CT images. It ascends, then courses medially and inferiorly in the vicinity of the medial portion of the ventral surface of the 7th cervical vertebra on the dorsal side of the common carotid artery, and it finally enters the inferior lobe of the thyroid gland posteriorly. The artery then travels medially and inferiorly, and enters the inferior lobe of the thyroid dorsally. In most cases, at its highest point, the ascending ITA does not reach over the 6th cervical vertebra.

Achievement of SGB through the inner side of the transverse process of the 6th cervical vertebra is considered to be rarely associated with accidental puncture of the ITA[14]. However, the present study showed that the left ITA passes on the rostral side of the transverse process of the 7th cervical vertebra and some of them reaches the medial portion of the ventral surface of the transverse process of the 6th cervical vertebra, which can be damaged by puncture needle even when SGB is performed at the level of the 6th cervical vertebra. The process of separation the tissues with the fingertips during insertion of the needle can result in lateral displacement of the small arteries in the anterior neck, in addition to displacement of the common carotid artery, or their medial displacement along with the thyroid. Accordingly, we speculate that such maneuver can potentially damage the ITA while it is being pulled from both sides

and its tension increased, with subsequent massive bleeding. Lateral approach with ultrasound guide may be better to avoid the risk of damaging inferior thyroid artery.

The vertebral artery typically enters the transverse foramen of the 6th cervical vertebra. However, in this study, 4/158 (2.5%) vertebral arteries entered the transverse foramen of the 5th cervical vertebra rather than the 6th cervical vertebra, which was slightly lower than the incidence of 8/120 (6.7%) reported by ultrasound imaging[8]. In addition, one vertebral artery entered the transverse foramen of the 4th cervical vertebra, and there were 5 vertebral arteries that were exposed on the ventral side of the transverse process of the 6th cervical vertebra. To our knowledge, there are no reports of deaths caused by vertebral artery damage following performance of SGB, but attention should be taken to avoid bleeding due to erroneous puncture. For a safe SGB, to avoid vessel puncture we recommend utmost care by using ultrasound guidance, consider approaches that are different from the conventional approach, and avoid placing strain on the ITA[15].

The present study has several limitations. First, it was retrospective in design, stressing the need to confirm the results in a prospective study. Second, the sample size was small to give a true results. Third, a single and independent radiologist analyzed the 3D-CT images, but in order to ensure reproducibility of the findings two independent assessors should have done it. Fourth, we supposed the respiratory obstruction in retropharyngeal hematoma is caused by mechanical compression of the rigid trachea due to damage of small arteries in this study. However, it could be state of obstruction by swelling of the pharyngolarynx due to venous and lymphatic congestion[5, 16], and we could not address it in this study. Fifth, the study patients had

head and neck disorders and one cannot rule out anatomical abnormalities, including the topographic distribution of brain and neck blood vessels, compared with healthy individuals.

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In conclusion, the number of small arteries in the medial portion of the ventral side of the transverse process of the cervical vertebra was smaller in the 6th cervical vertebra than the 7th cervical vertebra. The ITA could be easily injured during SGB, resulting in hematoma formation in the retropharyngeal space. This finding suggests that the risk of damage to blood vessels during the process of SGB may be lower using the approach of the 6th cervical vertebra. However, utmost care should be exercised even when SGB is performed through the medial portion of the 6th cervical vertebra to avoid injury of small arteries, such as the ITA.

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Legends for figures

Figure 1. (a) Schematic diagrams of the ventral surface of the 5th and 6th cervical vertebrae. The medial portion represented the area from the origin of the transverse process to the tip of the anterior tubercle. The lateral portion represented the area from the tip of the anterior tubercle to the tip of the posterior tubercle. (b) Schematic diagram of the ventral surface of the 7th cervical vertebra. The area between the origin and tip of the transverse process was divided into the medial and lateral portions.

Figure 2. Typical 3D-CT of neck vessels in a representative patient. Note that the left inferior thyroid artery at the ventral side of the 6th cervical vertebra transverse process passes on the cranial side of the normal position.

Table 1. Number and percentage (%) of small arteries identified in each region

	Right side (n=80)		Left side (n=80)	
	Medial (%)	Lateral (%)	Medial (%)	Lateral (%)
C5	0	10 (12.5)	0	9 (11.3)
C6	1 (1.3)	17 (21.3)	5 (6.3)	16 (20.0)
C7	43 (53.8)	38 (47.5)	39 (48.8)	38 (47.5)
Total	44	65	44	63

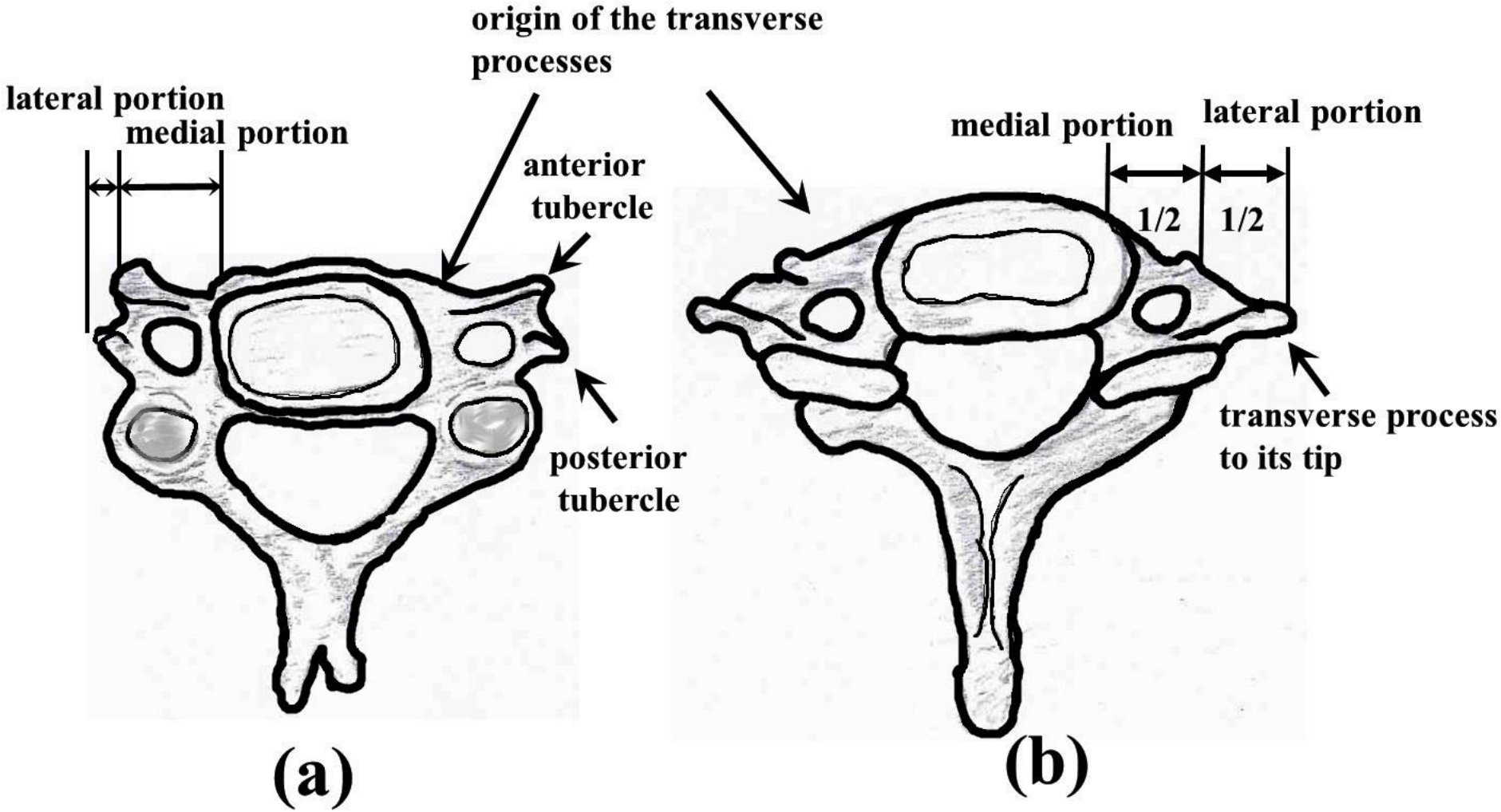
origin of the transverse processes
lateral portion
medial portion
anterior tubercle
posterior tubercle
(a)
medial portion
lateral portion
1/2
1/2
transverse process to its tip
(b)

Fig. 1

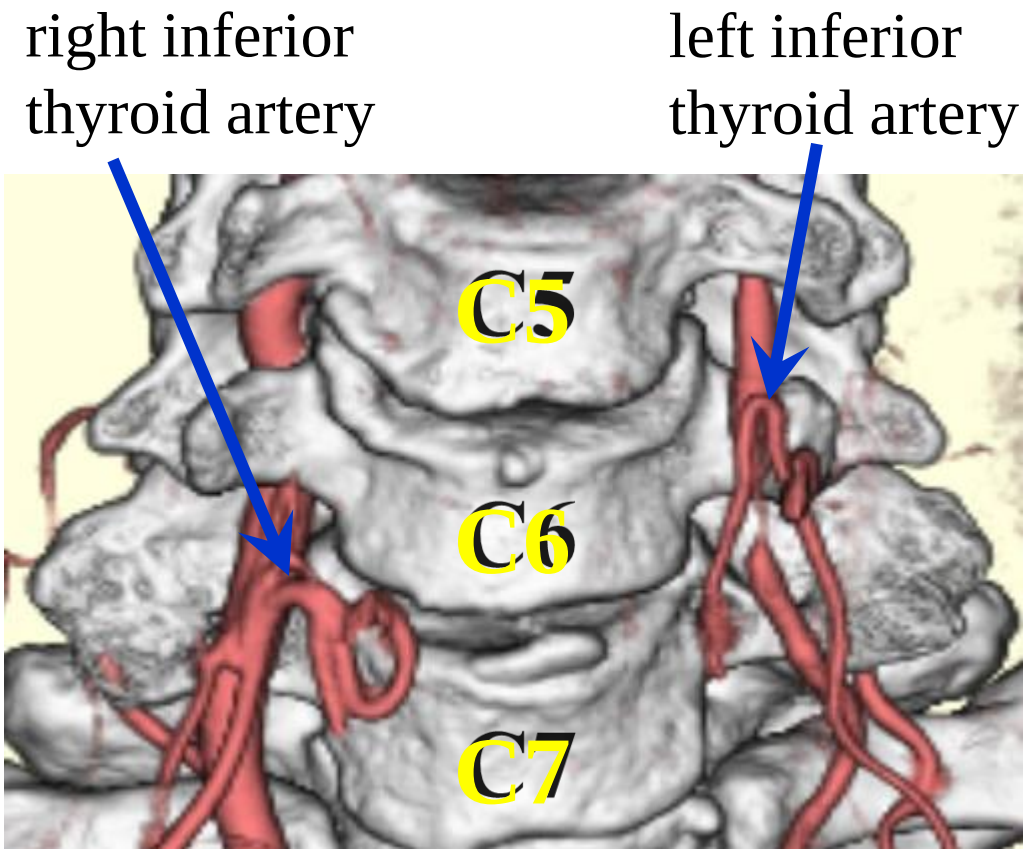
right inferior
thyroid artery
left inferior
thyroid artery
C5
C6
C7

Fig. 2.