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The importance of the greater occipital nerve in the occipital and the suboccipital region for nerve blockade and surgical approaches – An anatomic study on cadavers

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ABSTRACT

Objective: Greater occipital nerve (GON) blockade is an effective method for treatment of occipital neuralgias. Occipital neuralgia or neuropraxis of this region may be seen particularly as a result of compression of the GON. This study shows the relationship between the GON and its external bone landmarks, in order to prevent complications and to perform nerve blockades safely. The study also defines the points where the GON pierces the semispinalis capitis (SSC) and the trapezius, and where the GON passes the obliquus capitis inferior (OCI), and identifies bone landmarks for places where the GON may be entrapped.

Materials and methods: In the laboratories of Dokuz Eylül University, Faculty of Medicine Department of Anatomy, 12 GON's belonging to male adult cadavers fixed in formaldehyde were dissected. Colored silicone was injected to all cadavers and then microdissections were performed under a dissection microscope. The lesser occipital nerve, the GON, the greater auricular nerve, and the occipital artery (OA) were dissected. All measurements were made with a 0.1 mm sensitive calipometer.

Results: The GON's diameter at the point where the GON pierces the SSC was found to be 2.5 ± 0.3 mm. The distance between the point where the GON pierces the SSC and the external occipital protuberance (EOP) was 53.6 ± 5.0 mm. The distance between this point and the midline was 9.0 ± 1.9 mm, the distance between this point and the intermastoid line was 11.5 ± 3.9 mm and the distance between this point and the mastoid process was 65.5 ± 5.9 mm. The distance between the midline and the point where the GON pierces the aponeurosis of trapezius (AT) was 47.9 ± 8.0 mm, the distance between this point and the EOP was 15.1 ± 7.0 mm, the distance between this point and the intermastoid line was 17.1 ± 2.8 mm, and the distance between this point and the mastoid process was 59.4 ± 2.3 mm. We measured the distance between the OA and the intermastoid line to be 8.5 ± 6.1 mm vertically and 32.3 ± 3.9 mm horizontally to the midline.

Conclusion: In this study, we define the GON's route in the suboccipital and the occipital region where the nerve pierces the SSC and the AT and where blockade or surgery can be performed. These data will help the surgeon and clinician to avoid complications in this region.

1. Introduction

The medial branch of the dorsal ramus of the second cervical nerve is referred to as the greater occipital nerve (GON) [1]. This nerve may also have fibers derived from the dorsal ramus of the C3. It has connections with the third occipital nerve medially and the lesser occipital nerve laterally [2,3]. The GON ascends between the obliquus capitis inferior (OCI) and semispinalis capitis (SSC) and then pierces the latter muscle. After piercing the aponeurosis of trapezius (AT), it travels with the occipital artery to supply the integument of the scalp as far anterior as the vertex of the skull [3,4].

Compression of the GON in specific neck positions has been proven anatomically. Flexion of the cervical spine stretches the GON where it passes the OCI [5] and extension of the neck causes parestesia and pain because the GON stretches at the point it pierces the AT and the SSC [1,4,6,7]. We may see occipital neuralgia due to nerve damage after posterior cervical or cranial surgical aprroaches [3,4]. Although specific causes, such as whiplash injury, prior skull base surgery, rheumatoid arthritis, nerve entrapment by hypertrophied atlantoaxial ligaments, compression of the GON by an anomalous ectatic vertebral artery, and degenerative C1–C2 arthrosis, are known, most cases are idiopathic [8,9].

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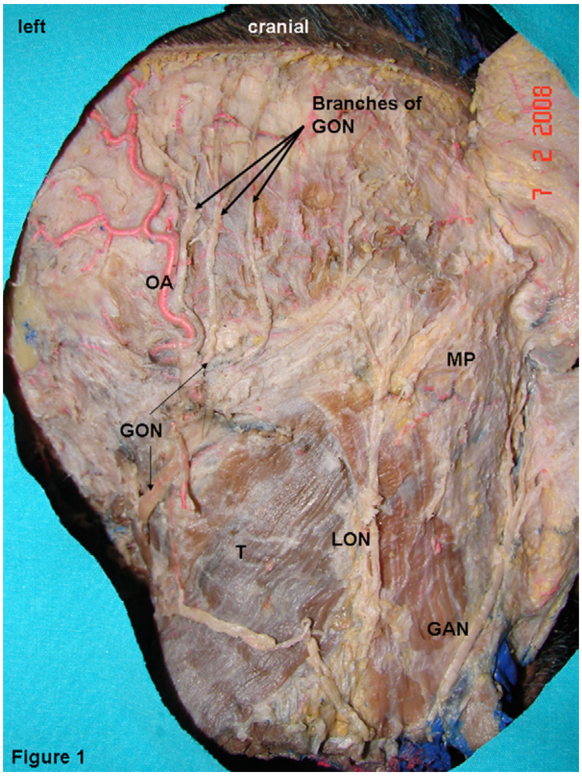

Fig. 1. The GON's route in the suboccipital and occipital region and its relationship to the OA, the LON and the GAN. GON: greater occipital nerve, OA: occipital artery, LON: lesser occipital nerve, GAN: greater auricular nerve, T: trapezius, MP: mastoid process

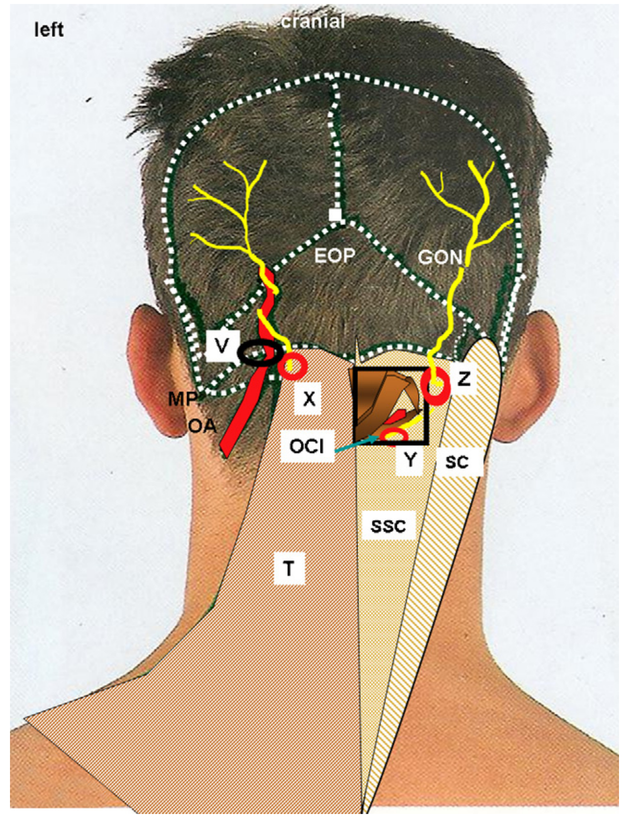

Fig. 2. Schematic drawing of the occipital and suboccipital region showing the GON's relationship to the SSC, the AT and the OCI. V: point where the OA pierce the AT, X: point where the GON pierces the AT, Y: the transmission point of the GON on the lower border of the OCI, Z: point where the GON pierces the SSC, EOP: external occipital protuberance, GON: greater occipital nerve, OA: occipital artery MP: mastoid process, AT: aponeurous of trapezius, SSC: semispinalis capitis, OCI: obliquus capitis inferior, SC: splenius capitis

During posterior cervical and cranial surgery, neck and posterior fossa decompression, surgery of tumours located at the posterior fossa, cerebellopontine angle tumour surgery, aneurysm surgery and other surgical procedures in this region, surgeons may damage the GON and cause postoperative occipital neuralgia [3,4,8,10].

In addition to these surgical approaches, procedures such as halo pin and Mayfield pin placement and nerve blocks for occipital neuralgia require good knowledge of the cutaneous nerves in this region so as to minimize complications such as severe dysesthesias following their injury [3,11].

Occipital neuralgia is characterized by paroxysmal or continuous jabbing pain located in the occipital area [9] usually innervated by the GON [12].

Nerve blocks for pain [6,9,13–15] and surgical decompression for muscle entrapment may be needed [5,6,9]. In his studies, Antony focused on irritation of the GON in primary headaches; it can be said that GON blockade in primary headaches was pioneered by Antony [16].

In cases of occipital neuralgia, many types of conservative or surgical treatments have been tried, including analgesics and antimigraine agents, cervical collars, transcutaneous nerve stimulation, occipital nerve blocks with or without glucocorticoid, chemical or radiofrequency occipital nerve ablation, dorsal rhizotomy, and surgical release for nuchal muscles entrapping the nerves, but the effects have varied [9,12,15].

Patients undergoing thyroidectomy with the neck fully extended usually experience occipital headache and posterior neck pain. Han et al. have attempted to evaluate the effect of a preoperative GON block on occipital headache and posterior neck pain after thyroidectomy [17].

The GON blockade was well tolerated with no adverse events. Headache intensity, frequency and duration were significantly decreased comparing the week before with the week after the nerve blockade. The GON blockade is a therapeutic option for the transitional treatment of cluster headache [18,19]. Scattoni et al. strongly recommend the use of the GON blockade in emergency departments for cluster headaches with cervico-occipital spreading [15].

It is important to define the places where the GON pierces the muscles, in order to prevent complications and to perform nerve blockades and decompression safely. For these reasons, this study aims to define in detail with bone landmarks the course of the GON in the occipital and the suboccipital region, its relationship to the OCI and the places where it pierces the SSC and the AT.

2. Material and methods

As there were no suitable female cadavers in our laboratory for our study, only male cadavers were used. 12 GON's belonging to male adult formaldehyde fixed and colored silicon-injected cadavers which had no pathology and no surgical scars were dissected in the laboratories of Dokuz Eylül University, Faculty of Medicine, Department of Anatomy. Colored silicon injection was performed after canulation of cadavers from bilateral the vertebral artery, the common carotid artery and the internal jugular vein. All specimens were found to have the greater occipital nerve (GON), the lesser occipital nerve, the greater auricular nerve and the occipital artery (OA). Microdissections of the nerves and OA were performed under a Zeiss dissection microscope (Fig. 1). The relationships between the GON and the SSC, the aponeurosis of trapezius (AT) and the OA were evaluated. The points where the GON pierces the SSC and the AT were determined on the cadavers (Fig. 2). The GON was