

## Morphological Variation of the Carotid Artery Bifurcation Level

Satoshi Furukawa\*, Lisa Wingenfeld, Akari Takaya, Tokiko Nakagawa, Ikuo Sakaguchi and Katsuji Nishi

Department of Legal Medicine, Shiga University of Medical Science, Shiga, Japan

### Abstract

Knowledge of carotid bifurcation is important for vascular surgical procedures in the region, such as carotid endarterectomy or radical neck dissection, catheterization and aneurysms. Carotid sinus hypersensitivity is an exaggerated response to carotid sinus baroreceptor stimulation. Bradycardia, hypotension, and syncope are common manifestations of carotid sinus hypersensitivity. The aim of this study was to describe the common carotid artery bifurcation. 100 subjects were evaluated in computed tomography angiography (CTA) and the bifurcation level according to the cervical vertebra level was investigated. We showed the anatomical variation of carotid sinus location.

**Keywords:** Carotid artery bifurcation; Morphological variation; CT angiography

### Introduction

The common carotid artery, external carotid artery and internal carotid artery are the main arterial supplies to the head and neck [1]. In head and neck surgery, the common carotid arteries are important landmarks, defining the plane of the dissection during radical neck surgery [2]. Reported common causes for bradycardia include anesthetic agents, central neural blockage, and vagal reflex by surgical stimulus [3]. Compared to other causes, prediction of occurrence of the vagal reflex is difficult. Therefore, if procedures used during surgery involve the carotid sinus, innervated by the vagus nerve, the possibility of triggering arrhythmia or hypotension should be considered. Accurate evaluation of the carotid bifurcation level with non invasive techniques remains an important goal and external anatomical landmarks can be clinically useful in predicting the bifurcation level of the carotid artery. The objective of the present study was to correlate the common carotid artery bifurcation level with the cervical vertebra level. We examined the variability of carotid sinus location.

### Materials and Methods

100 subjects were randomly selected in in-patient and out-patient. All measurements were performed on 100 subjects (40 female and 60 male), ranging in age from 18 to 104 years. The subjects were candidates for computed tomography angiography (CTA). The study was approved by the ethical committee of our university. However, the ethics committee waived the need for consent from the patients' next of kin. Carotid bifurcation level was compared to the level of cervical vertebra. Most of carotid bifurcations (CB) were found at the level of C3. The vertebra level of CB was differently distributed in distance of the whole neck measured along the vertebral column between upper borders of C1-C2 to lower border of C5. (Figure 1) 54% of the level of CB was asymmetrical between the right and left side. To illustrate the diversity that may occur in the location of the carotid sinus, CTA of the carotid bifurcation were obtained and matched to the cervical vertebra images. (Figure 2) Anatomical locations of the carotid sinus bifurcation indicated wide variability.

### Discussion

In case of high bifurcation, the embolic material could extend into the common carotid artery instead of the external carotid artery with subsequent stroke [4]. Additionally, the exact bifurcation site and arterial variations of the common carotid artery are clinically

important in many other procedures, such as ligation of the external carotid artery, intra-arterial administration of chemotherapeutic agents, interpretation of digital subtraction angiography, and during radical neck dissection [5-7]. Investigations have observed that the ratio of mortality and morbidity of high-level carotid bifurcation cases after carotid endarterectomy attempt are quite high. They have noticed that especially nerve injury is too much when the surgical operation has been performed these cases [8]. Carotid sinus hypersensitivity is an exaggerated response of the carotid sinus baroreceptor to local stimulation. According to Kim et al. the incidence of intraoperative carotid sinus hypersensitivity was 28% in elderly patients, and 10% in young patients undergoing radical neck dissection. Therefore, tight monitoring of the patient's pulse rate and blood pressure is recommended in such surgery [9]. The carotid sinus is located on the internal carotid artery bifurcation and plays a central role in maintenance of homeostasis of blood pressure [10]. In the carotid sinus reflex, atrioventricular conduction delays, resulting in bradycardia



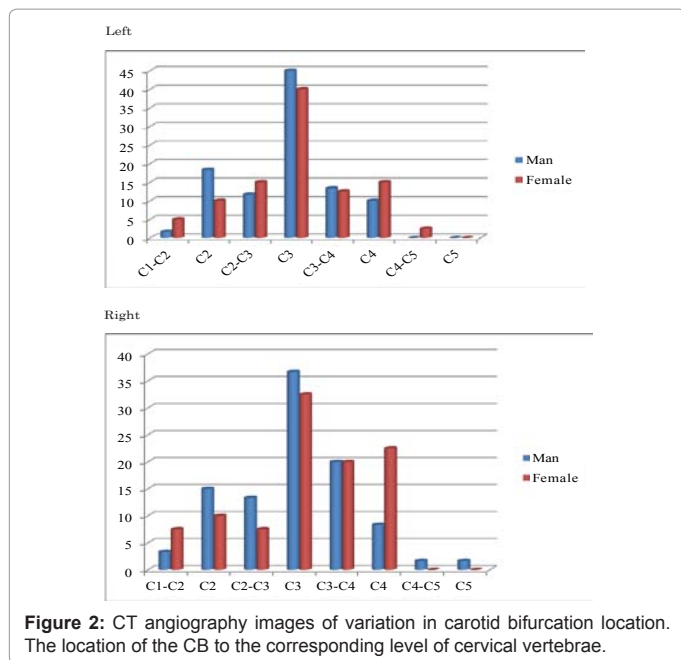
**Figure 1:** Distribution of the CB position in studied cases according to the cervical vertebrae level.

\*Corresponding author: Satoshi Furukawa MD, Department of Legal Medicine, Shiga University of Medical Science, Setatsukinowa, Otsu City, Shiga 520-2192, Japan, Tel: +81-77-548-2202; E-mail: [31041220@belle.shiga-med.ac.jp](mailto:31041220@belle.shiga-med.ac.jp)

Received February 16, 2012; Published July 03, 2012

Citation: Furukawa S, Wingenfeld L, Takaya A, Nakagawa T, Sakaguchi I, Nishi K (2012) Morphological Variation of the Carotid Artery Bifurcation Level. 1: 135. doi:[10.4172/scientificreports.135](https://doi.org/10.4172/scientificreports.135)

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and decreased sympathetic vascular tone, causing hypotension by enhancement of parasympathetics [11]. It is commonly accepted that the carotid artery bifurcation occurs about the level of C IV for radiological purpose [12].

The clinically relevant variations of the location of carotid bifurcation should be considered by surgeons performing procedures in neck area. Risky surgical processes for stimulation of the carotid sinus should also be discussed with the surgeon before and during surgery. Anesthesiologists should pay more attention to vital sign monitoring

and thorough preparations for emergency for surgical procedures that involve manipulation of the carotid sinus.

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