International Journal of Anatomy and Research,
Int J Anat Res 2016, Vol 4(2):2316-19. ISSN 2321-4287
DOI: http://dx.doi.org/10.16965/ijar.2016.204

Original Research Article

STUDY OF INCIDENCE OF ACCESSORY FORAMINA IN CERVICAL VERTEBRAE IN NORTH INDIAN POPULATION

Poonam Verma *[1], Seema [2], Monika Piplani [3].

[*1] Associate Professor, Department of Anatomy, Sri Guru Ram Das Institute of Medical Sciences and Research ,Vallah, Amritsar, Punjab, India.

[2] Professors, Department of Anatomy, Sri Guru Ram Das Institute of Medical Sciences and Research ,Vallah, Amritsar, Punjab, India.

[3] Assistant Professors, Department of Anatomy, Sri Guru Ram Das Institute of Medical Sciences and Research ,Vallah, Amritsar, Punjab, India.

ABSTRACT

Introduction: Foramen transversarium develops by vestigial costal element fused to the body and the true transverse process of cervical vertebra. Foramen transversarium transmits the vertebral artery, vertebral vein, and sympathetic nerves except C7 vertebra which transmits vertebral vein. These foramina are known to exhibit variations in size, shape and number. Sometimes these foramina may also found to be absent, incomplete or even duplicate which may lead to various symptoms.

Materials and METHODS: Our study included 200 dried human cervical vertebrae of unknown age and sex .Among them 30 were C1 atypical cervical vertebrae 30 were C2 atypical cervical vertebra and 40 were C7 cervical vertebrae 100 were typical cervical vertebrae. All the cervical vertebrae were observed macroscopically for the presence of accessory foramen on both the sides.

Results: Accessory foramina were observed in 8% (16 vertebrae). Accessory foramina found were smaller as compared to normal regular foramina.

Conclusions: Under such circumstances path of vertebral artery may be altered which is significant for neurosurgeons and radiologists during surgeries in cervical area and while doing CT and MRI scans respectively.

KEY WORDS: Foramina transversarium, Atypical Cervical Vertebrae, Neurosurgeons.

Address for Correspondence: Dr Poonam Verma, Associate Professor, Department of Anatomy, Sri Guru Ram Das Institute of Medical Sciences and Research, Vallah, Amritsar, Punjab, India. Ph. No.: +918283816579 **E-Mail:** poonamabrol1@gmail.com

Access this Article online

Quick Response code

DOI: 10.16965/ijar.2016.204

Web site: International Journal of Anatomy and Research
ISSN 2321-4287
www.ijmhr.org/ijar.htm

Received: 10 Apr 2016 Accepted: 23 Apr 2016
Peer Review: 16 Apr 2016 Published (O): 31 May 2016
Revised: None Published (P): 31 May 2016

INTRODUCTION

The cervical vertebrae are recognized by the presence of foramen transversarium in their transverse processes. This foramen transversarium is formed by the vestigial costal element fused to the body and the true transverse process of the vertebra during its formation. The vertebral vessels and nervous plexus are held between these two osseous bars and closed laterally by the costotransverse bar which is a thin plate of bone which joins the rib element to the original transverse process of the vertebra [1]. This foramen transversarium conveys the vertebral artery, vertebral vein and sympathetic

fibers from inferior cervical ganglion. Foramen transversarium of C7 vertebra transmits only the vertebral vein. Double foramina transversarium is a rare condition and this type of variation may disturb the passage of vertebral artery. Variation in the number and size of foramen transversarium of cervical vertebra may result in headache, migraine and unconsciousness due to compression of vertebral artery [2]. The vertebral vessels in such circumstances may give rise to vascular insufficiency [3]. Surgical anatomy and morphology is advantageous to the spine surgeons and radiologists while doing computed tomography and magnetic resonant imaging scans. Maintaining the vertebral artery is an important alarm during cervical spine surgeries since even minor lesions will lead to serious hemorrhage or can even result in death [4]. There are anatomical studies undertaken to minimize such unintentional intra operative injuries of these arteries. The objective of the present study was to find the incidence of accessory foramina transversaria in the cervical vertebrae and their morphological, clinical and surgical importance for neurosurgeons.

MATERIALS AND METHODS

Our study was conducted on 200 dried human cervical vertebrae of unknown age and sex obtained from Department of Anatomy, Government Medical College, Amritsar. Each cervical vertebra was examined macroscopically for the presence of the accessory foramina or double foramen transversarium (FT) either unilateral or bilaterally and photographed. In cases of double Foramen transversarium if present larger foramen is considered as main FT and smaller Foramen was considered as accessory FT. The data was tabulated, analysed and compared with previous studies performed by other authors. Vertebrae having double FT are shown in figures (1,2,3 4 and 5) and results of incidence are shown in Table 1 and 2.

RESULTS

Out of 200 dried human cervical vertebrae, accessory foramina were observed in 16 vertebrae. Normally one foramina is present in transverse process of all the cervical vertebrae. But as a variation more than one foramina are eminent in 16 vertebrae. In C1 vertebrae post facetal foramina were observed bilaterally in two vertebrae (6.6%). In C2 no variation in foramina are noted in C7 double foramina are present in 6 vertebrae (15%). While in typical cervical vertebrae double foramina are present in 8 vertebrae (8%). All the variations observed were bilateral in atypical vertebrae while in typical vertebrae unilateral variations were also recorded. Out of 8 typical vertebrae showing variations 3(3%) vertebrae showed unilateral and 5(5%) exhibited bilateral variations.

Fig. 1: C1 vertebra showing accessory foramina.

Fig. 2: C7 vertebra showing double foramina transversarium.

Fig. 3: Typical vertebra showing double foramina transversarium on right side.

Fig. 4: Typical vertebra showing bilateral double foramina transversarium.

Fig. 5: Typical vertebra showing double foramina transversarium on right side.

Table 1: Showing incidence of accessory foramina and double foramina transversarium.

Type of vertebra	No. of vertebra examined	No. of vertebra with unilaterally accessory Foramina	No. of vertebra with bilaterally accessory Foramina	Rate of incidence
C1	30	Nil	2	6.60%
C2	30	Nil	Nil	Nil
C3-C6	100	3	5	8%
C7	40	Nil	6	15%
C1-C7	200(Total)	3	13	8%

Table 2: Showing prevalence of accessory foramen and double foramina transversarium in different populations.

Author	Year of study	Incidence of double foramina	no of vertebra taken for study	Population observed
Taitz et al. [11]	1978	7%	480	Indian
Nagar et al [12]	1999	8.60%	1388	Roman
Das et al [13]	2005	1.50%	132	Indian
Kaya et al [14]	2011	22.70%	262	Jewish
Chaudhary et al [15]	2013	23.15%	133	Indian
Present study	2016	8%	200	North Indian

DISCUSSION

Various studies has been conducted on structural variations of foramen transversarium. In our work on 100 typical and 100 atypical cervical vertebrae the incidence of double foramen observed was 16 (8%). Out of these 16 vertebrae 2 vertebrae were atlas vertebrae, 8 were typical vertebrae and 6 were C7 vertebrae. No double foramina was noted in axis vertebrae. Murlimanju et al, done his work on 363 vertebrae, observed 6 vertebrae (1.6%) having accessory foramina. Among them five (1.4%) had double foramen and only one (0.3%) had three foramina [5]. While Sharma et al studied 200 cervical vertebrae and observed accessory foramina in 16 vertebrae [6]. Wysochiet et al. done work on 100 cervical vertebrae and they found the divided foramen more commonly at C6 (4.5-6%) [7].

Embryological development of vertebral artery may be closely related with development of these variations. As vertebral artery is developed from the fusion of longitudinal anastomosis that tie the cervical intersegmental arteries, which branch off from the primitive dorsal aorta. These intersegmental arteries eventually regress, except for the seventh artery, which forms the proximal portion of the subclavian artery, including the commencement of the vertebral artery [8]. The duplication of vertebral artery is thought to represent the failure of controlled regression of two intersegmental arteries and a segment of the primitive dorsal aorta. Bilateral occurrence of these failures is the etiology behind bilateral. It can be also supposed that variations in the presence and passage of the vertebral vessels will manifest as variant foramen transversarium. In contrast, variations of the foramen transversarium can be useful in approximating the variations of the vessels. An absence of foramen transversarium could mean absent vertebral artery. While the narrowing of the foramina indicates narrowness of the vessels and so on [9]. But Epstein in their study also observed that vertebral artery run along the transverse process not through foramen transversarium and in double foramen transversarium, one of the foramen may be occupied by the artery and other by vein or it may be occupied by branches of both vessels [10]. The morphological knowledge of this type of variation is clinically important because the path of the vertebral artery may be affected under such condition. The compression of

artery may lead to neurological symptoms like headache, migraine, fainting attack and hearing disturbances. Also the awareness of this type of variation is essential for the neurosurgeon during posterior cervical surgery. It is also beneficial for radiologist during CT and MRI scan for reporting. Our study will provide further information on incidence and morphological basis of double foramina transversarium.

CONCLUSION

Out of 200 cervical vertebrae, we found accessory foramen transversarium in 16 vertebrae (8%). Double foramina were observed in the atypical cervical vertebrae (C1,C7) and in 8 typical cervical vertebrae.No accessory foramina was observed in C2 vertebrae The percentage of occurrence of double foramen transversarium found was higher in cervical 7 vertebra in comparison to other atypical cervical vertebrae. The morphological knowledge of this type of variation is clinically important because the course of the vertebral artery may be distorted under such circumstances. The compression or other pathology of artery may lead to neurological symptoms. Also the knowledge of this type of variation is important for the neurosurgeon during posterior cervical surgery and radiologist during CT and MRI scan. Our study will offer further evidence on incidence and their basis of foramina transversarium.

Conflicts of Interests: None

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How to cite this article:

Poonam Verma, Seema, Monika Piplani. STUDY OF INCIDENCE OF ACCESSORY FORAMINA IN CERVICAL VERTEBRAE IN NORTH INDIAN POPULATION. Int J Anat Res 2016;4(2):2316-2319. **DOI:** 10.16965/ijar.2016.204