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Posterior fossa emissary venous canal prevelance and visibility on standart computed tomography

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Abstract

The aim of this study is to investigate the emissary venous channel prevelance and the visibility of these emissary venous canals in the posterior cranial fossa on standard Computerized Tomography in patients without intracranial pathology. Unenhanced Standard Brain Computerized Tomography images of 79 patients (25 males, 54 females; mean age, 41 ± 11 years) with normal findings were evaluated retrospectively. Mastoid emissary venous canal and occipital emissary venous canal measurements and visibility were evaluated in these Computerized Tomography images. A p value of <0.05 was considered statistically significant. The prevelance of mastoid emissary venous canal was 78.48% in the study group. The right mastoid emissary venous canal prevalence was 73.4%, the mean diameter was 2.05 ± 0.60 mm and the left mastoid emissary venous canal prevalence was 67.1%, the mean diameter was 1.76 ± 0.48 mm calculated. The prevalence of occipital emissary venous canal was 38% and the mean diameter was 2.02 ± 0.44 mm. The mastoid emissary venous canal diameter was found to be statistically significant in the right side compared to the left side (p <0.05). Preoperative evaluation of posterior fossa major emissary veins and venous canals that frequently encountered by radiologists in cross-sectional imaging can be done in standard brain Computerized Tomography scan.

Keywords: Tomography, cranial fossa, posterior, cerebral veins, mastoid

Introduction

Cross-sectional imaging of the posterior cranial fossa mostly demonstrates the mastoid emissary veins efficiently. Posterior fossa emissary veins provide venous drainage to the venous plexus in the craniocervical junction from the dural venous sinuses through the cranial canals [1-4]. Flow direction of the blood within the emissary veins is usually from external to internal but it may change due to increased intracranial pressure or impaired cerebral venous drainage [5].

Posterior fossa emissary veins show variability in cross-sectional imaging. Posterior cranial fossa emissary veins / emissary canals and dural venous sinuses are important in transcondylar and lateral approach in posterior fossa surgery. To know the localization of these emissary veins reduces the complications (sinus thrombosis, bleeding, air embolism) that may be due to surgery [6]. The location and prevelance of emissary veins are important in temporal-occipital bone fractures and trauma. In the literature, thin slice thickness and contrast enhanced- Computerized Tomography are used in studies. In practice, non-contrast enhanced Computerized Tomography is used in emergency settings (e.g. trauma). Previously, similar studies in the literature have been performed on this subject and the number of radiologic studies investigating posterior fossa emissary canal diameter and visibility in brain Computerised Tomography(CT) imaging used in routine practice is insufficient. The aim of this study is to investigate the emissary venous canal prevelance and the visibility of these emissary venous canals in the posterior cranial fossa on standard CT in patients without intracranial pathology and to contribute to the literature.

Material and Methods

Study Group

Our study was initiated with the approval of the ethics committee of our university. Between May 2017 and October 2017, posterior fossa emissary venous canal prevelance and visibility in standard non-contrast enhanced brain CT were evaluated retrospectively in the patients with normal brain CT findings at our center. The most common complaints of the patients with normal brain CT findings were headache and dizziness. For this study, noncontrast brain CT scans of 100 patients was selected from our department's archive. Patients with tumors, trauma, ischemia, hemorrhage, metabolic bone disease, temporal bone infections, and history of previous

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posterior cranial fossa surgery were excluded from the study. CT images of 79 patients (25 males, 54 females; mean age, 41 ± 11 years; range, 20-68 years) were evaluated by a 15 year experienced radiologist.

CT

Standard non-contrast brain CT scans were performed on a 16-detector helical CT scanner (Brilliance 16, Philips Medical Systems, Best, The Netherlands). Imaging parameters: Tube voltage: 140 kV; section thickness: 3 mm; Tube current: 150-200 mAs; collimation: 16 x 1.5 mm; matrix: 512 x 512; rotation time: 0.5 sec; table speed: 15 mm / sec. CT images were evaluated on a Windows based workstation (MxViewexp; release 4.01, Philips Medical Systems).

Image analysis

In the study group, unenhanced brain CT scans of all patients were evaluated in a bone window (window width: 4000 HU, window center 500 HU). In these CT images, mastoid emissary venous canal (MEC) and occipital emissary venous canal (OEC) were evaluated (MEC; Figure 1, 2, OEC; Figure 3, 4). The prevelance and thickness(short axis size of emissary canals measured from 1/3 medial canal section in axial plan) of these emissary venous canals were measured for both sides. The prevalence and diameters of both emissary venous canals were compared by gender.

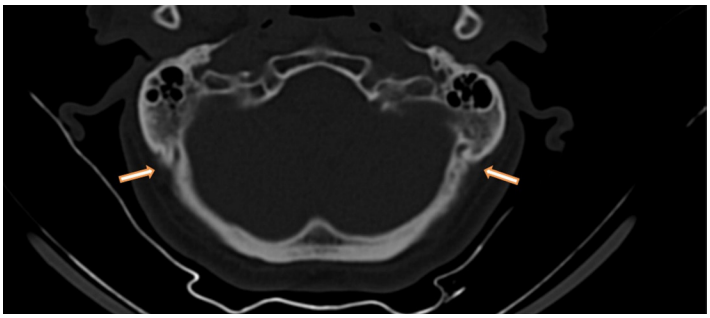

Figure 1. Non-contrast CT images of the posterior cranial fossa, Bilateral MEC

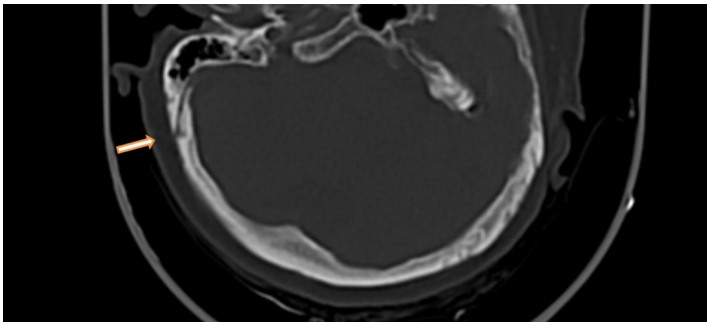

Figure 2. Non-contrast CT images of the posterior cranial fossa, Right MEC

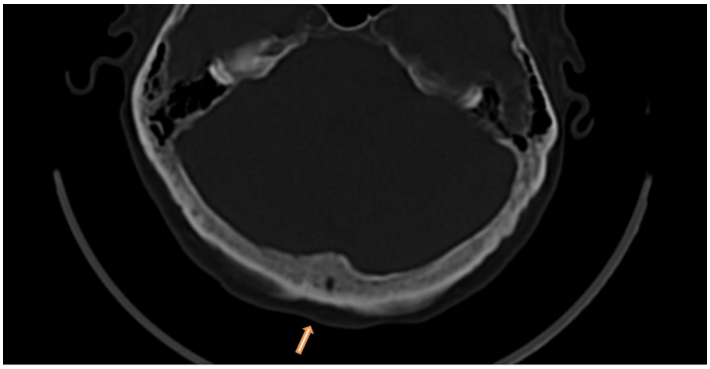

Figure 3. Non-contrast CT images of the posterior cranial fossa, OEC

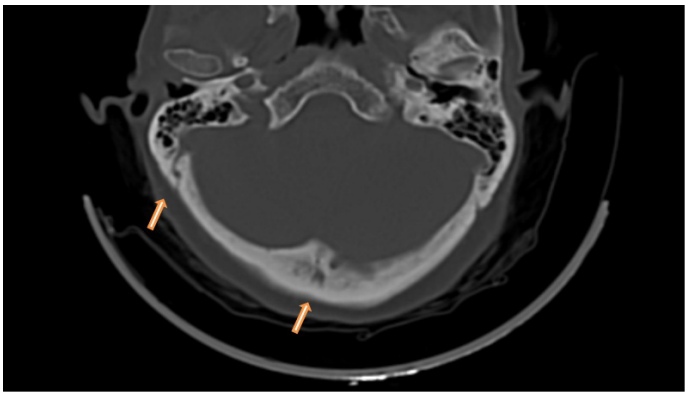

Figure 4. Non-contrast CT images of the posterior cranial fossa, Right MEC and OEC

Statistical analysis

Data analysis was performed on personal computer using statistical software (SPSS 16 for Windows, Chicago, IL). Descriptive statistics were shown as mean ± standard deviation in continuous variables and as % in categorical variables. Mc nemar test for categorical variables and Wilcoxon test for inter-variable correlations were performed. $p < 0.05$ was considered statistically significant.

Results

Mastoid emissary venous canal frequency was 73.4% on the right, 67.1% on the left and occipital emissary venous canal frequency 38%. Measured average emissary venous canal diameters MEC right: 2.05 ± 0.60 mm, MEC left: 1.76 ± 0.48 mm, OEC: 2.02 ± 0.44 mm was measured. The diagnostic properties of the emissary venous canals are shown in table 1.

Table 1. Diagnostic properties of emissary venous canals

EMISSARY VENOUS CANALS		MEC		OEC
		Right	Left	
Diameter (mm)	Women(n=54)	2.01±0.61	1.73±0.45	2.02±0.44
	Men(n=25)	2.14±0.59	1.81±0.55	1.79±0.54
	Study group (n=79)	2.05±0.60	1.76±0.48	2.02±0.44
Prevelance		73.4% (n=58)	67.1% (n=53)	38% (n=30)
Absent unilateral		26.6% (n=21)	32.9% (n=26)	62% (n=49)
Absent bilateral		21.52% (n=17)		

n: number of the patients; MEC:Mastoid emissary venous canal ; OEC: Occipital emissary venous canal.

Table 2. The comparison of MEC and OEC frequency

Studies	Type	N	MEC Prevelance(%)		OEC Prevelance (%)
			Right	Left	
Ruiz et al[2]	Cadaveric	12	63		8.3
Pekcevik et al[7]	CT	166	77.7		
Koesling et al8	CT	223	82		
Demirpolat et al[9]	CT	248	84.7	82.3	
Louis et al[12]	Cadaveric	200	98	72	
Kim et al[13]	Cadaveric	106	81	74	
Present study,	CT	79	73.4	67.1	28.6

N: number of the patients; MEC: Mastoid emissary venous canal ; OEC: Occipital emissary venous canal.

The MEC prevalence was increased on the right side. The MEC diameters were more observed in males than in females. The MEC diameters were higher on the right side than on the left side and statistically significant ($p < 0.05$). There was no statistically significant difference between mastoid emissary venous canal diameters, occipital emissary venous canal diameters and gender.

Discussion

Posterior cranial fossa emissary veins connect the dural venous sinuses to the suboccipital venous plexus. Different emissary vein / canal sizes and prevalence have been reported in previous studies [7-14]. In our study, we evaluated the frequency, size and visibility of emissary canals based on standard CT images with normal findings. Accordingly, MEC 62 (78.48%) patients and OEC 30 (38%) patients were found. In our study, the MEC frequency and average diameter were found more on the right side. Mastoid emissary venous canal diameters were more observed in males than in females.

CT and cadaveric studies of posterior fossa emissary canals are available in the literature [7-9,11-14]. In a study they evaluated the prevalence of mastoid emissary foramen (MEF) on the right and left where prevalence of MEF was 98% on the right and 72% on the left. They also calculated the average mastoid emissary vein (MEV) diameter as 3.5 mm (1.1-5.6 mm) [12]. Kim et al [13]. reported that the prevalence of MEF was 81% on the right, 74% on the left and average MEF diameter 1.73 mm on the right and 1.74 mm on the left. The prevalence of MEF was reported as 91.7% in another study (14). A study evaluating multislice computerized tomography (MDCT) of 248 patients reported MEC as 92.3% [9]. In this study, Demirpolat et al [9]. found the mean MEC diameter as 1.58 ± 0.86 mm on the right and 1.48 ± 0.79 mm on the left. In our study, the MEC prevalence was 73.4% on the right side, 67.1% on the left side and average diameter 2.05 ± 0.60 mm on the right side, 1.76 ± 0.48 mm on the left side. Demirpolat et al [9]. the prevalence of MEC in the temporal bone was higher than our study. In our study, the largest MEC diameter was 3.6 mm, OEC diameter was 2.9 mm.

The occipital emissary vein (OEV) is located between the transverse sinus / torcula and the occipital vein, which drains the vertebral venous plexus. It has been reported that occipital ven provides drainage of confluence sinus [15]. Occipital emissary vein can reach large dimensions [1,16]. Ruiz et al [2]. reported OEV in only 1 of 12 cadavers (8.3%). Louis et al [12]. found the prevalence of occipital foramen as 7% on the right and 4% on the left. In our study, we found the incidence of OEC as 38% and mean diameter as 2.02 ± 0.44 mm in 79 patients. But the number of studies on occipital emissary vein/canal in the literature is limited.

Emissary veins are surgical landmarks for venous sinuses. MEV can be a significant source of bleeding in the head or middle ear surgery, especially in retrosigmoid and far lateral approaches [6]. Hemorrhage from the emissary veins may cause postoperative epidural hematoma [17]. Air embolism is another complication of MEV laceration. However, vascular malformations can cause emissary venous canal expansion. Embolization of a dural arteriovenous malformation via enlarged MEV has also been reported [18]. There are case reports of vasculogenic causes of tinnitus that may suggest enlarged emissary veins [19-22]. Irmak et al [23]. reported that the emissary veins have a function as to cool the circulating venous blood in the cranial structures and protect the brain from thermal damage.

Pekcevik et al [7]. in their study using CT angiography, they found the prevalence of MEV to be 77.7% and this was found more frequently on the left. Koesling et al [8]. reported that the prevalence of MEV in their studies using temporal MDCT was 82% and Tsutsumi et al [10]. in their MRI study, the prevalence of MEV was found to be 87.5%. In our study, emissary veins were not assessed because the CT scan was not contrast enhanced. The comparison of MEC and OEC frequency with previous studies is presented in Table 2.

There are some differences in the prevalence of MEV among the studies performed in the literature using cadaver and imaging modalities. In studies using imaging modalities, MEC frequencies are close to each other [7-9]. Our study had the number of patients than these studies and, unlike these studies, had a thicker slice thickness. The prevalence of OEC was 28.6% in our study. In the literature, there is no CT imaging study about the prevalence of OEV / OEC.

Our study has some limitations. First, our study was retrospective. Second, we did not evaluate the other emissary canals and foramens except for three major emissary canal assessments in the posterior fossa. Finally, all CT images were evaluated by a single radiologist and interobserver changes were not evaluated.

Conclusion

As a result; posterior fossa emissary veins are often observed in cross-sectional imaging that can not be overlooked. To avoid surgical complications, preoperative evaluation of posterior fossa major emissary veins and canals can also be performed on a standard brain CT scan.

Competing interests
The authors declare that they have no conflicts of interest and no grants or funds were received in this study.

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Ethical approval
Local Ethics Committee was approved for the study (Number: 60116787-020/81519)

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