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ORIGINAL ARTICLE

Is There Any Association Between the Jugular and Sigmoid Notch Areas and Intracranial Hemorrhage Side?

Juguler ve Sigmoid Çentik Alanları ile İntrakranyal Kanama Tarafı Arasındaki İlişkinin Değerlendirilmesi

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ABSTRACT

Purpose: This study aims to evaluate the association between the side of the spontaneous intracranial hemorrhage (sICH) and the jugular and sigmoid notch areas.
Methods: A total of 265 patients (111 women and 154 men) with a mean age of 68.8±11.7 years (range between 50 to 90 years) and with sICH, were retrospectively enrolled. Control group included 45 patients (19 women and 26 men) with a mean age of 68.3±11.9 years (range between 50 to 90 years). Jugular and sigmoid notch areas were measured on axial plane CT images, for both the right and left side in the study and control groups. The association between ICH and sigmoid/jugular notch areas were assessed by student t test. The correlation between right/left sigmoid and right/left jugular notch areas were assessed by Pearson correlation.
Results: There was a significant difference between right and left sigmoid/jugular notch areas in patients with right sided ICH (P<0.001) and left sided ICH (P<0.001). No significant difference was found in terms of right sigmoid and right jugular notch areas between patients with right sided ICH and control group (P=0.156 and P=0.483, respectively). No significant difference was detected in terms of left sigmoid and left jugular notch areas between patients with left sided ICH and control group (P=0.118 and P=0.449, respectively).
Conclusion: There was no direct association between the sigmoid and jugular notch areas and intracranial hemorrhage side.

Keywords: Brain; Computed tomography ; Intracranial hemorrhage; Jugular vein;

ÖZ

Amaç: Sigmoid ve juguler çentik alanları ile spontan intrakranyal kanamanın (IKK) geliştiği taraf arasında ilişki olup olmadığını saptamak.
Yöntem: Spontan intrakranyal kanama tanısı alan ve ortalama yaşları 68.8±11.7 (50 ila 90 yaş) olan toplam 265 hasta (111 kadın ve 154 erkek) retrospektif olarak çalışmaya dahil edildi. Kontrol grubu, ortalama yaşı 68.3±11.9 (50 ila 90 yaş) olan 45 (19 kadın ve 26 erkek) hastadan oluşmaktaydı. Sigmoid ve juguler çentik alanları, çalışma ve kontrol grupları için sağ ve sol hemikranyumdan aksiyal düzlem bilgisayarlı tomografi (BT) kesitlerinde ölçüldü. IKK ile sigmoid ve juguler çentik alanları arasındaki ilişki student t test ile değerlendirildi. Sağ ve sol sigmoid çentik ile sağ ve sol juguler çentik arasındaki ilişki Pearson korelasyon kullanılarak değerlendirildi.
Bulgular: Sağ ve sol sigmoid ve juguler çentik alanları ile sağ taraflı IKK tanısı olan hastalar ve sol taraflı IKK tanısı olan hastalar arasında anlamlı ilişki bulundu (sırasıyla p<0.001 ve p<0.001). Ancak kontrol grubu ile sağ taraflı IKK tanısı olan hastalar arasında sağ sigmoid ve sağ juguler çentik alanları açısından anlamlı ilişki bulunmadı (sırasıyla p=0.156 ve p=0.483). Benzer şekilde, kontrol grubu ile sol taraflı IKK tanısı olan hastalar arasında sol sigmoid ve sol juguler çentik alanları açısından anlamlı ilişki bulunmadı (sırasıyla p=0.118 ve p=0.449)
Sonuç: Sigmoid ve juguler çentik alanları ile intrakranyal kanama tarafı arasında anlamlı ilişki bulunmamıştır.

Anahtar Kelimeler: Beyin, İntrakranyal kanama, Juguler ven

Introduction

Spontaneous intra-cerebral hemorrhage (sICH) is a serious non-traumatic, non-surgical cerebrovascular disease associated with poor prognosis and designates as bleeding in the brain parenchyma (1). Clasically the etiology of sICH includes chronic arterial hypertension, cerebrovascular amyloid deposition, coagulopathies, tumors, vascular malformations and use of oral anticoagulants. Besides arterial hypertension, venous hypertension and venous outflow obstruction are also risk factors for ICH. In dural arterio-venous fistulas, normal antegrade flow of related cortical veins/ cerebral sinuses are reversed and venous pressure increases (2). This increased venous pressure results in ICH. Impaired venous outflow including narrowing and obstruction in the dural sinuses may cause increased intracranial vascular pressure resulting in ICH, too (3,4). Internal jugular veins are being the potential sources of venous hypertension in this scenario and therefore, sigmoid sinus notch and jugular vein notch are the gates for brain venous outflow. There is probably not only one reason for the etiology of sICH, but narrower notches or grooves may be associated with the ipsilateral sICH. As well in other words; sigmoid and jugular notch areas may have the potential to predict the side of ICH.

The aim of this study is to evaluate the association between the side of the ICH and the sigmoid and jugular notch areas.

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Materials and Methods

Study population

Local Institutional Review Board (IRB) approved this single center study and the requirement for informed consent was waived. This retrospective study includes adult patients referred to the neurology department with sICH between 1 January 2020 and 31 December 2020. Patients with intracranial tumor, previous history of intracranial surgery, bilateral ICH and traumatic cerebral hemorrhage, intracranial venous thrombosis history and venous vascular malformations were excluded. A total of 265 patients (111 women and 154 men) with a mean age of 68.8±11.7 years (range between 50 to 90 years), were enrolled. Loss of conciousness, hemiparesis and headache were the main clinical findings. Etiological finding is mainly the systemic arterial hypertension. Control group included 45 patients (19 women and 26 men) with a mean age of 68.3±11.9 years (range between 50 to 90 years).

CT technique and image analysis

All cranial CTs were obtained with a 128-slice multi-detector CT (Aquillion, Canon Medical Systems). Cranial CT examinations were reviewed on Picture Archiving and Communication System (PACS). Jugular and sigmoid notch areas were calculated for both the right and left side in the study and control groups. Measurements were made on the axial images with a slice thickness of 0.625 mm under bone window (Fig1a and Fig1b). Window width and window level were 2500 and 500, respectively.

Statistical analysis

Mean, standard deviation and range were analyzed for all the demographic data. Chi square test,and paired samples t-test were used for categorical and continuous variables. The association between ICH and sigmoid/jugular notch areas were assessed by student t test and multivariate logistic regression analysis was performed. The correlation between right/left sigmoid and right/left jugular notch areas were assessed by Pearson correlation.

Results

There was no significant difference between study and control groups in terms of sex and age (P=0.682 and P=0.571, respectively). Mean sigmoid and jugular notch areas showed no significant difference between study and control groups (Table 1). Right and left sigmoid notch areas were correlated high positively with the right and left jugular notch areas (R=0.796; P<0.001 and R=0.855; P<0.001, respectively) (Fig2a and Fig2b). 141 right and 124 left sided ICHs were present. All hematomas were supratentorially located and 78 thalamic, 119 lobar and 68 lentiform nucleus hematomas were detected. There was no patient with venous outflow obstruction and all of the patients had increased intracranial pressure findings as stenosis of the ipsilateral ventricle, but no transtentorial herniation. No significant difference was found in terms of right sigmoid and right jugular notch areas between patients with right sided ICH and control group (P=0.156 and P=0.483, respectively). No significant difference was detected in terms of left sigmoid and left jugular notch areas between patients with left sided ICH and control group (P=0.118 and P=0.449, respectively). There was a significant difference between right and left sigmoid/jugular notch areas in patients with right sided ICH (P<0.001) and left sided ICH (P<0.001) (Table 2).

Table 1. Mean sigmoid and jugular notch areas.

	Study group (n=265)	Control group (n=45)	P value
Right jugular Notch (mm^2)	0.62±0.25	0.60±0.32	0.483
Left jugular Notch (mm^2)	0.50±0.19	0.51±0.22	0.449
Right sigmoid Notch (mm^2)	0.71±0.24	0.62±0.24	0.156
Left sigmoid Notch (mm^2)	0.56±0.20	0.51±0.21	0.118

Table 2. Mean sigmoid and jugular notch areas and significance within the study group.

	Right sided ICH (n=141)	P value	Left sided ICH (n=124)	P value
Right jugular Notch (mm^2)	0.59±0.24		0.66±0.26	
Left jugular Notch (mm^2)	0.50±0.19	<0.001	0.51±0.19	<0.001
Right sigmoid Notch (mm^2)	0.70±0.25		0.72±0.23	
Left sigmoid Notch (mm^2)	0.58±0.21	<0.001	0.53±0.18	<0.001

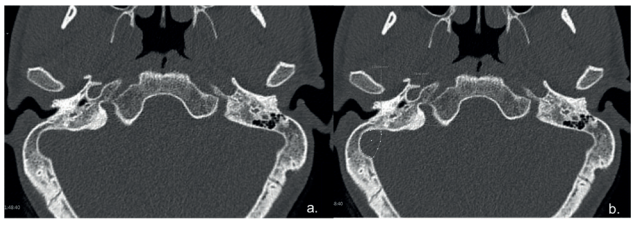

Fig1. Axial plane cranial CT under bone window shows the right sigmoid and jugular notches (a), and the area measurements (b)

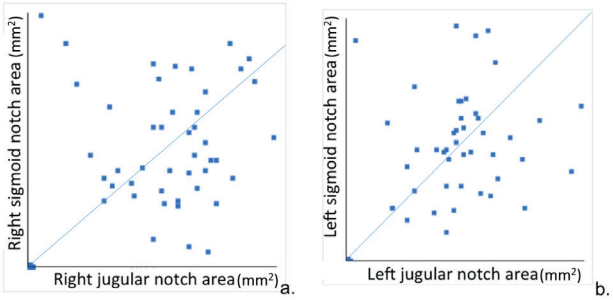

Fig2. The correlation between the right sigmoid and right jugular notch areas (a) and the left sigmoid and left jugular notch areas (b)

Discussion

Spontaenous ICH is the second leading cause of stroke after ischemic stroke and is an important reason for morbidity and mortality (5). Around 10-15% of all strokes are sICH and it has a worse prognosis than ischemic stroke and subarachnoid hemorrhage (6). Chronic hypertension is the most remarkable cause of sICH and small penetrating arteries which are originating at 90 degrees from the parent vessel are more prone to the effects of hypertension and rupture (6,7). Cerebral amyloid angiopathy is an important cause of sICH in older adults and is identified by the deposition of congophilic material in small- to medium-sized arteries of the brain and leptomeninges. This impairs the structure of the vessel walls and predisposed to bleeding.

In this study, we hypothesized that the side of the cerebral parenchymal hematoma might be anticipated by measuring the sigmoid and jugular sulci areas on axial plane CT images. The hypothesis was that the cerebral hematoma would be occurred on the side of the narrower sigmoid and jugular fossas. The current study demonstrated that there was a significant association between right and left sigmoid/jugular notch areas in patients with the right and also the left sided ICH. However, for both group of patients with right and left sided ICH, the right sided notches were wider than the left side. In addition, when compared with the control group, the difference between the notch areas and right/left ICHs became insignificant. In other words, although a significant relation was detected between right and left sigmoid/jugular notch areas and both sided ICH, the side of ICH could not be predicted by only using sigmoid & jugular notch areas. Therefore, the detected statistical significance became clinically irrelevant. Patients with the right and the left sided hemorrhages, both sigmoid and jugular notch areas were narrower on the left side than the right side. As in our study and control group, left sided sigmoid and jugular sulci were reported narrower than the right side in previous papers (8-11). Sigmoid and jugular notches or grooves show significant variations in terms of size, area and shape (8-15) and the measurements done in this study,could be effected by the venous anatomical variations. In a study made with skull specimens, they revealed that superior sagittal sinus groove continued with right transvers sinus in 41% of cases and continued with left transverse sinus in 10%.(16) Saiki et al. found mean caliber of right internal jugular vein wider than the left side in their study on cadavers.(17). Significant correlation was found between sigmoid and jugular notch areas in these series. In a cadaveric anatomical study, Kayalioglu et al. (8) did not find significant correlation between jugular foramen and sigmoid sulcus in terms of size. On the contrary, Uysal et al. (11) as in the current study, found significant correlation between jugular and sigmoid foramina in a cadaveric study including 179 skulls.

There were several limitations in this series. First of all, sigmoid and jugular notch areas were measured from CT scans. There was no performed autopsy and skull evaluation in the study group. Retrospective study design and small number of control group were the other drawbacks.

In conclusion, although there was a significant association between right and left sigmoid/jugular notch areas in patients with the right and also the left sided ICH in these series, for both group of patients with right and left sided ICH, the right sided notches were wider than the left side. There was no direct association between the sigmoid/jugular notch areas and the intracranial hemorrhage side.

Declaration of Conflicting Interests:

The Author declares that there is no conflict of interest.

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