

## Spontaneous brain and arachnoid herniation into the dural venous sinuses: a rare anatomic variation or clinical entity?

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### ABSTRACT

**Aim** To investigate the presence, type and distribution of spontaneous brain and arachnoid herniation into the dural venous sinuses as well as a clinical significance of these herniations.

**Methods** This retrospective – prospective, non-randomised anatomical and clinical study included 990 patients who were referred to Magnetic Resonance Imaging at the Department of Radiology of the Cantonal Hospital in Zenica in the period from January to December 2016. The T1 and T2 sequences in axial, sagittal, and coronary section were used for brain or arachnoid herniation analysis. In all patients with intra-sinusal herniation health records were analysed and symptoms and reasons to refer for MRI examination were evaluated.

**Results** In 26 (2.6%) patients (19 females; 73.08%) the arachnoid or brain herniation was found. Average age of patients was 40.269±16.496 years. Arachnoid herniation was presented in 15 (57.69%) and brain herniation in 11 (42.31%) patients. Statistical significance in relation to type of herniation was not found ( $p=11.070$ ). Statistical significance between the symptoms and localisation of herniation (except for nausea and vomiting and posterior fossa herniations) ( $p=0.05$ ) as well as between symptoms and type of herniation was not found ( $p>0.05$ ).

**Conclusion** The results suggest that there is a possibility of interconnection between arachnoid or/and brain herniations and some clinical symptoms such as nausea and vomiting.

**Key words:** dural thinning, sinus abnormality, clinical significance

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## INTRODUCTION

Brain and/or arachnoid herniation into the venous sinus is a rare condition. The incidence is not known (1). The precise mechanism of brain or arachnoid herniation is not known (2). Progressive dural thinning secondary to elevated intracranial pressure, inflammation, aging and erosive arachnoid granulation are among the etiologic causes (2,3). Herniation is usually localized in the upper sagittal sinus, transverse sinus, occipital sinus, the sinus rectus etc. (1,4). The clinical significance of these herniations is questionable. According to the literature some patients have symptoms such as headache, dizziness, walking disorders, epilepsy, etc. (3,5).

In the literature, some cases have been described only in light of accidentally found anomaly (1,6). Studies with description of larger patient sample with types, distribution and symptoms of herniation are scarce, and mainly related to the patients with verified anomaly (2).

The aim of this study was to investigate the prevalence, type and distribution of spontaneous brain and arachnoid herniation into the dural venous sinuses as well as the clinical significance of these herniations.

## PATIENTS AND METHODS

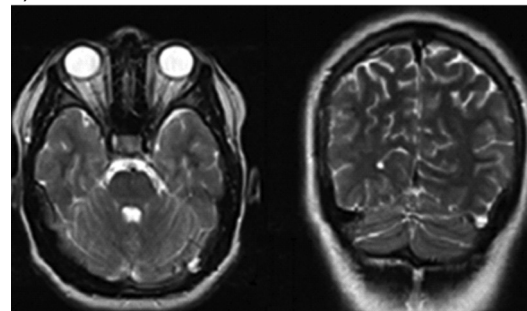
### Patients and study design

The research included 990 patients who submitted to magnetic resonance imaging (MRI) (Siemens Magnetom Avanto 1,5 T, Erlangen, Germany) at the Department of Radiology, Cantonal Hospital in Zenica in the period January to December 2016. The patients made the MRI because of different symptoms. The brain or arachnoid herniation was presented in 26 (2.6%) patients (Figure 1).

### Methods

In all patients with brain or arachnoid herniation the MRI was reviewed two times by a neurosurgeon and neuroradiologist. The MRI scans were evaluated in Impax System (Agfa Healthcare Impax 6.5.3.2525) of the Cantonal Hospital Zenica. To analyse brain or arachnoid herniation T1 and T2 sequences in axial, sagittal, and coronal section were used. In some patients, T1 sequences with gadolinium contrast were applied. In patients with intra-sinus herniation medical records

A)



B)

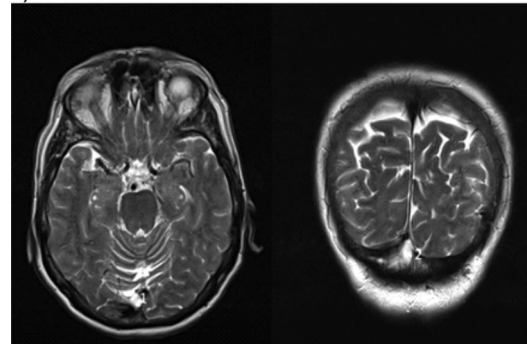


Figure 1. Magnetic resonance of brain. A) arachnoid herniation in the left transversal sinus: T2 axial scan (left); T2 coronal scan (right), B) arachnoid herniation in the occipital sinus: T2 axial scan (left); T2 coronal scan (right) (arrows) (Department of Radiology, Cantonal Hospital Zenica, 2016)

were used in order to evaluate clinical characteristics, symptoms and reasons to refer for MRI.

### Statistical analysis

Methods of descriptive and comparative statistics were used ( $\chi^2$  test). The presence, type, localisation and clinical characteristic of arachnoid herniation were analysed. The results are presented in tables and expressed by relative and mean value. Statistically significant difference was set to  $p < 0.05$ .

## RESULTS

This study included 990 patients. In 26 (2.6%) patients (19 females; 73.08%) arachnoid or brain herniation into the dural venous sinuses was verified. Average age of patients was  $40.269 \pm 16.496$  years. The youngest patients were 16 and the oldest 67 years old.

Arachnoid herniation was found in 15 (57.69%) and brain herniation in 11 (42.31%) patients ( $p = 11.070$ ). Partial herniation of the left temporal lobe into the ST (transversal sinus) was the most common type of brain herniation, in 6 (54.55%) cases (Table 1).

Partial herniation into the SS (sigmoid sinus) and arachnoid herniation in the left region of the temporal lobe were the most common types of arachnoid herniation, in six (40%) cases each. Partial herniation of arachnoidea into the occipital and sagittal sinus were rare forms of herniations, in one (6.7%) and two (13.3%) cases, respectively (Table 1).

**Table 1. Anatomic localisation of the brain herniation**

| Localisation of herniation   | No (%) of patients |
|--|--------------------|
| <b>Brain herniation</b>  |                    |
| Left temporal lobe into the ST (Supratentorial)                          | 6 (54.55)          |
| Right temporal lobe into the ST (Supratentorial)                         | 3 (27.28)          |
| Cerebellar herniation into the SS (Infratentorial)                       | 2 (18.18)          |
| <b>Total</b>   | <b>11 (100)</b>    |
| <b>Arachnoidal herniation</b>  |                    |
| Herniation into the SS (Infratentorial)                                  | 6 (40.00)          |
| Herniation in the region of the left temporal lobe (ST) (Supratentorial) | 6 (40.00)          |
| Herniation into the OS (Infratentorial)                                  | 1 (6.67)           |
| Herniation into the SSS (Supratentorial)                                 | 2 (13.33)          |
| <b>Total</b>   | <b>15 (100)</b>    |

ST, transversal sinus; SS, sigmoid sinus;

Herniation of brain or arachnoidea in the supratentorial compartment was found in the 17 (65.38%) patients, and herniation in the infratentorial compartment was found in the nine (34.61%) patients. Examination of the health records of the patients with brain or arachnoid herniation showed persistent headache in 11 (45.83%) and 13 (54.16%), vertigo in 10 (41.66%) and six (25%), nausea and vomiting in two (8.33%) and one (4.16%) patients, respectively; epilepsy was presented in two (7.69%) patients with brain herniation.

There was no statistically significant difference between prevalence of headache ( $p=0.05$ ), vertigo ( $p=0.05$ ), and epilepsy ( $p=0.05$ ) and localisation of herniation.

Statistically significant difference between the prevalence of nausea/vomiting and posterior fossa localisation of herniation was found ( $p<0.05$ ).

## DISCUSSION

Our research showed low prevalence of spontaneous brain and arachnoid herniation. This corresponds with the literature (7-9). The herniation is more often found in middle aged females than in males (8,10), which corresponds with our research.

According to our results, arachnoid is more often found than brain herniation and arachnoid herniation in the region of the left temporal lobe, which was the most common type of herniation. Arachnoid and/or brain herniation is often presented in supratentorial rather than infratentorial compartment, which corresponds with the literature (11-18)

Brain and arachnoid herniation into dural sinuses may be associated with different symptoms such as headache, syncope, dizziness and imbalance. The relationship between these symptoms and brain or arachnoid herniation is unclear (19,20). The most common symptoms in patients included in our study were headache and vertigo (with no significant difference in the occurrence between supratentorial and infratentorial herniation), and nausea and vomiting were very rare (but with statistically significant difference in relation to infratentorial localisation of herniation).

The differential diagnosis of arachnoid and/or brain herniation includes dural sinus thrombosis, arachnoid granulations and tumour (1,15,21). Arachnoid granulations are isointense with cerebrospinal fluid in all MRI sequences (21,22). Brain herniation is isointense with brain and it is surrounded with cerebrospinal fluid (CSF) rim. These morphological characteristics of herniations are crucial for differential diagnostics (1).

Results of this study have shown a vast number of patients diagnosed with arachnoidal granulations on brain found by MRI, who had headache and vertigo, whilst only a small number had vomiting and epilepsy along with arachnoidal granulations, suggesting a possibility of interconnectivity between herniation and the symptoms.

This is the first investigation analysing prevalence and clinical significance of brain/arachnoidal herniation. Due to the fact that the triggering mechanism of brain and/or arachnoid herniations is still unknown (we suspect it is due to the increased intracranial pressure) it is necessary to carry on with the research in order to discover etiological factors and pathophysiological mechanisms.

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## TRANSPARENCY DECLARATIONS

Competing interest: none to declare.

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