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CLINICAL STUDY

Evaluation of cerebrovascular insult types and their localization in patients due to the presence of elevated body temperature

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Abstract: *Background:* The Aim of our study was to present and analyze the distribution of cerebrovascular insult types and their localization in patients with normal body temperature by means of computerized tomography, and in those with elevated body temperature by means of neuroradiographic findings.
Methods: In our study we evaluated 103 patients that suffered a cerebrovascular insult and were treated at Special Hospital for Cerebrovascular disorders "Saint Sava" in Belgrade. All patients were divided into two groups due to the presence of elevated body temperature.
Results: Fever as a complication in period after acute cerebrovascular insult is presented in almost every fifth patient. In the group of patients with fever, the most common presentation was acute ischemic cerebrovascular insult, namely in 45.63 %, while in the group of patients with normal body temperature, the most common presentation was lacunar infarction, namely in 46.60 % of participants. The most frequent localization of cerebrovascular insult is in cortex and subcortex regions.
Conclusions: It should be stated that some patients with specific types of cerebrovascular insult as well as their localization are at higher risk for development of complications. This study suggests that appropriate diagnostics as well as prevention and management of in-hospital complications could improve the short-term and long-term prognoses after stroke *(Tab. 3, Ref. 14).* Full Text (Free, PDF) *www.bmj.sk.*
Key words: cerebrovascular insult, fever, computerized tomography.

Cerebrovascular insult (CVI) is characterized either by the presence of hemorrhagic event (HCVI) or by that of inadequate perfusion by blood vessels due to a significantly diminished flow bringing about ischemia and thus referred to as being ischemic (ICVI). In ICVI, the main reason is the presence of thrombotic plaque or embolus (1, 2).

Neuroradiographic evaluation of endocranium that is mainly done either by computerized tomography (CT) or magnetic resonance imaging (MRI), is of great importance in the diagnosis of cerebrovascular diseases. Such diagnostic tools help us to confirm the diagnosis of CVI, differentiation of HCVI from ICVI and identification of important characteristics of CVI that include lesion size, vascular distribution and presence of multiple lesions (3, 4).

Potential complications that could present after the acute phase of CVI can be lethal or can reduce the success of rehabilitation program (5). Since the mortality few days after CVI is a direct consequence of brain tissue damage, in the later phase, it is due to complications that include infections, thromboembolism and cardiac rhythm disbalances (6).

The aim of our study was to present and analyze the distribution of CVI types and CVI localizations in patients with normal body temperature by means of computerized tomography and in those with elevated body temperature (fever) by means of neuroradiographic findings.

Methods

Study group

We recruited and evaluated 103 patients who suffered CVI, and were treated at Special Hospital for Cerebrovascular disorders "Saint Sava" in Belgrade, Serbia. All patients fulfill the criteria of World Health Organization for CVI.

Clinical examination at admission was done by a Neurologist and patients were sent for further diagnosis to neuroradiology department for CT of endocranium. Imaging results were described by a Neuroradiologist.

Every patient was evaluated on a daily basis for the presence of potential complications during neurological treatment and rehabilitation. For the objective clinical status in these patients we used biochemical findings that included (complete blood cells count, sedimentation and inflammatory markers), auscultatory and physical examination and imaging techniques. For the detection of possible thrombosis we used ultrasound.

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Tab. 1. Number of participants and age structure in both groups of patients.

Evaluated parameters	Group of participants	
	with fever	with NBT
Number of participants (%)	21.36	78.64
Age structure (median value±SD)	68.00±10.54	69.63±10.38

All patients were divided into two groups due to the presence of elevated body temperature. The criterion for elevated body temperature was the presence of temperature above 37.5 °C. Temperature being elevated for a period exceeding 24 hours was recorded on 3 occasions.

Neuroradiological findings on CT were divided into 7 groups, namely acute ICVI (aICVI), intracerebral hemorrhagic lesion (IHL), SAH, lacunar infarct (LI), brain atrophy (corticoreductive changes) (BA), unclassified pathological findings (UPF) and normal findings (NF).

Evaluated localization of affected brain tissue included 4 types, namely that within cortex, subcortex, cortex and subcortex and infratentorial region.

Statistical analysis

The description of proportion of evaluated parameters was presented in percent of total, and for every group separately. Median value with value for standard deviation was used to describe the age of participants in both groups.

For evaluation of statistical significance of evaluated parameters between two evaluated groups of participants we used hi square test.

Results

In our study, we evaluated 103 patients who suffered from some type of CVI that was diagnosed and treated at Special Hospital for Cerebrovascular disorders "Saint Sava" in Belgrade. All patients were with symptoms that lasted for more than 24 hours. The duration of symptoms is one of essential criteria for establishing the diagnosis of CVI. In Table 1 we present the proportion of participants expressed in percent, and distribution of age structure of participants in both groups of patients, namely in those with fever and those with normal body temperature (NBT).

In Table 2 we present the distribution of evaluated parameters by CT of endocranium expressed in percent that included aICVI, IHL, SAH, LI, BA, UPF and NF in the group of patients with fever, as well as in the group with normal body temperature (NBT).

In Table 3 we present the distribution of evaluated parameters by localization according to CT of endocranium findings expressed in percent that include cortex, subcortex, cortex and subcortex (CS) and infratentorial region (IR) in the group of patients with fever as well as in the group with normal body temperature (NBT).

Tab. 2. Type of CVI and CT of endocranium findings in both groups of participants.

Evaluated parameter	Type of CVI	Group of participants (%)	
		with fever	with NBT
CT of endocranium findings	aICVI	45.63	24.27
	IHL	22.33	11.65
	SAH	4.85	2.91
	LI	18.45	46.60
	BA	4.85	11.65
	NF	0	0.97
	UPF	4.85	3.88

Tab. 3. Localization of CVI in both groups of participants.

Evaluated parameters	Localization	Group of participants	
		with fever	with NBT
CT of endocranium findings	Cortex	26.21	13.59
	Subcortex	15.53	21.36
	CS	58.25	50.49
	IR	0	13.59

Discussion

Epidemiological studies indicate that stroke is the third most frequent cause of deaths in general population after cardiovascular diseases and cancers (7). Proper and on-time diagnosis can improve the prognosis especially if treatment begins within the first three hours after stroke onset (8, 9).

Advances in technology and in medicine changed the role of neuro-imaging in the evaluation of acute stroke. At the beginning such tools were used to provide anatomic imaging that pointed out the presence or absence of acute cerebral ischemia and excluded the lesions mimicking the clinical presentation of stroke, such as hemorrhage and neoplasms (10).

By implementation of thrombolysis, the goals of neuroradiographic evaluation has changed from providing the anatomic information to providing the physiologic information for physicians.

For urgent and quick evaluation of CVI, CT is a most sensitive diagnostic tool since it can detect the possible intracranial hemorrhagic states. Early signs of ischemic lesions can be detected as soon as 2 hours after CVI (11). The latter imaging technique is reliable in differentiating old from new hemorrhagic lesions. It is a gold standard in diagnostic evaluation of subarachnoidal hemorrhages (SAH), but it is not reliable in people with low hemoglobin count (12, 13).

From our results, according to the number of participants, fever as a complication in the period after acute CVI is presented in almost every fifth patient. This proportion of patients is not to be overviewed when taking into consideration the treatment protocols and prognosis. It also suggests that everyday monitoring of such patients is necessary.

Age structure of patients who suffered CVI is not significantly different in both evaluated groups.

In the group of patients with fever, the most common presentation of CVI was aICVI. The high frequency suggests that almost every second patient with fever as a complication after CVI has suffered from aICVI. Subarachnoidal hemorrhage, corticoreductive changes and unclassified changes are not that common with less than 5 % of frequency.

In the group of patients with normal body temperature, the most common presentation of CVI was lacunar infarction. This leads as to the deduction that patients without fever as a complication who suffered CVI are more likely to be of lacunar infarction type.

When we compare the types of CVI in both groups we can conclude that there is a statistical difference for aICVI and IHL, which is more frequent in patients that will develop fever as a complication within the period after CVI event.

There is also a statistical difference when types of CVI are compared between these two groups of patients for LI and BA, suggesting that these types of CVI are not at high risk of developing fever as post-CVI complication. Such findings correlate with studies of other authors especially for lacunar infarction distribution in non-febrile group (14).

The localization of CVI is also one of important factors that can influence the patient's recovery and prognosis. In our study, namely in the group of patients with fever, the most common localization was cortex and subcortex while we found no lesion within the infratentorial region in these patients. Frequency of CS lesion in other group of patients is without statistical significance, pointing out that CVI in both, cortex and subcortex regions is not a risk factor for the development of fever as a complication.

When we compare the localization of CVI in both groups of patients it can be seen that there is a statistical difference for the localization at cortex region in the group of patients with fever, whereas the lesions within the infratentorial region is significantly frequent in patients that were without fever.

In conclusion it should be stated that some patients with specific types of CVI as well as their localization are at higher risk for the development of complications. With the implementation of modern diagnostic tools, namely CT and MRI in first instance, intensive monitoring is essential in order to prevent the onset of complications, or in case the complications have already developed these tools help in their early recognition, and enable us to initiate the administration of proper treatment.

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