COMPARATIVE ANALYSIS BETWEEN TRANSCRANIAL COLOR DUPLEX SONOGRAPHY AND MAGNETIC RESONANCE ANGIOGRAPHY IN PATIENTS WITH STROKE

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A b s t r a c t: Background: Cerebrovascular diseases are among the most frequent diseases of the central nervous system. There are several diagnostic methods for cerebral blood vessels evaluation. The optimal test is characterized with low risk, availability and diagnostic certainty. Lately, the rapid development of transcranial color duplex sonography (TCCS) and magnetic resonance angiography (MRA) have shown that they are the most useful techniques for non-invasive investigation of cerebral blood vessels.

Purpose: To compare transcranial color duplex sonography (TCCS) and magnetic resonance angiography (MRA) in the evaluation of patients with stroke.

Methods: Using TCCS, hemodynamic parameters were measured in intracranial arteries in 50 patients with ischemic stroke. Magnetic resonance angiography (MRA) was carried out in all patients during 1–5 days after sonography. According to TCCS findings, patients were divided into the following groups: I) group with normal findings; II) group with occlusion of middle cerebral artery (MCA) branches; III) group with MCA stenosis and IV) group with occlusion of MCA trunk. TCCS findings were compared with MRA findings, which were considered as a golden standard.

Sensitivity, specificity, positive predictive value, negative predictive value and the overall accuracy of the test were determined.

Results: In all groups of patients, high levels of sensitivity, specificity, positive and negative predictive value were obtained. The certainty of TCCS in determining normal and pathologic findings of the intracranial arteries was at risk level less than 1%.
**Conclusion:** TCCS is a safe and secure diagnostic modality which serves for fast and recurrent evaluation of intracranial vessels patency in the acute stroke phase and it is an imaging method with high sensitivity and specificity in determining the steno-occlusive intracranial lesions.

**Key words:** intracranial occlusion, transcranial color coded sonography, ischemic stroke.

**Introduction**

Cerebrovascular diseases are among the most frequent diseases of the central nervous system [1]. There are several diagnostic methods for cerebral blood vessels investigation [2]. In the modern hospital settings, different imaging procedures are available for evaluation of patients with stroke. The latest diagnostic methods are more precise and less invasive, and the physician is the one who decides which method to choose and how to apply it. The optimal test is characterized with low risk, availability and diagnostic certainty.

During the last years, as a result of technological advancement, a development of transcranial color duplex sonography – TCCS and magnetic resonance angiography-MRA has occurred. They have shown to be the most useful techniques for non-invasive investigation of intracranial hemodynamic changes [3]. Imaging of the brain blood vessels should localize the place, the degree and the nature of the lesion (stenosis, occlusion, presence of arteriovenous malformation or aneurysms). Such information would help in the therapeutic process and could contribute in the prevention of recurrent stroke.

Aim of this paper was to compare TCCS and MRA in the evaluation of patients with stroke, to determine sensitivity, specificity, positive predictive value, negative predictive value, as well as the overall accuracy of the test.

**Material and Methods**

**TCCS examination**

TCCS was performed in 50 patients with ischemic stroke and adequate bone acoustic window. It was performed on Toshiba SSH-140A, with linear array probe of 2.5 MHz.

All ultrasound examinations were performed by a single experienced sonographer, who was not aware of the patient’s stroke scale score and computed tomography data.

Transtemporally, bilaterally, in the orbito-meatal line projection, with scanning depth of 16–20 cm, brain stem was visualized in the butterfly shape, to
give orientation on B-mode picture. Then, color was turned on and the following arteries were visualized: anterior cerebral artery (ACA) (A1 segment), middle cerebral artery (MCA) (M1 segment), precommunicant (P1) and postcommunicant (P2) segment of posterior cerebral artery (PCA) with the patient in supine position. Intracranial segments of vertebral arteries (VA) were examined through the occipital window according to the technique of Aaslid et al; [4].

The following hemodynamic parameters were measured in the intracranial arteries, according to the previous established criteria [5]: peak systolic velocity-PSV, end-diastolic velocity-EDV, mean velocity-MV, flow direction, pulsatility index-PI and asymmetry index-AI. Angle correction was made when Doppler sample volume was located in the straight segment of the blood vessel in length ≥ 20 mm, and insonation was with an angle less than 60°.

Our standard parameters were obtained from routine measurement of blood flow in a sample of 40 healthy persons with mean age 63 ± 10 years, without intracranial or extracranial vascular pathology. Obtained values correlated with the ones reported in the literature [6].

Higher or lower values than the mean ± 2 SD were considered out of normal range of the respective hemodynamic parameters. According to this, the blood flow velocity was determined as normal, absent, decreased or increased.

Determining of blood vessel stenosis or occlusion was made according to previously established criteria. [7]. Intracranial stenosis was diagnosed when spectral Doppler sonography showed focal increase of PSV and/or EDV, and presence of low frequency high intensity Doppler signals. Criteria for hyperperfusion and stenosis exclusion were increased blood flow velocity in the whole blood vessel and absence of turbulence in the spectral Doppler examination.

Intracranial occlusion was diagnosed when color Doppler signal of the artery was missing, while other brain arteries were identified [7].

Pulsatility index was measured according to the following formula:

\[ PI = \frac{SV- DV}{MV} \]

Values that were > 1.2 were considered as pathological, i.e. they represented increased resistance.

Interhemispheric index of asymmetry (AI) was calculated according to the formula [6]

\[ AI = \frac{|MV1-MV2|}{(MV1+MV2)/2} \times 100, \]

where MV1 and MV2 represented mean values of the homologous arteries.

Threshold values for determin this asymmetry (21% for MCA, 27% for ACA and 28% for PCA) were determined as the upper limit of the confidence interval (5% of the distribution in the right tail) in the reference sample of the normal subjects [7].
TCCS examination was carried out in the period of 24 hours after hospitalization.

Temporal acoustic bone window was defined as absent if on native scanning neither vascular nor parenchyma structures could be identified. If brain stem, contralateral scull, or both structures could fairly be seen, without visualization of vascular structures, then bone window was defined as insufficient. In 9 patients (18%) due to insufficient temporal window, a contrast agent was applied (Levovist) in the dose of 5 to 16 ml with concentration of 200–400 mg/ml, depending on the Doppler signal. Intravenous injection was given continuously (about 1–2 ml/sec) in order to obtain homogenous Doppler signal enhancement.

According to TCCS findings, the patients were divided into the following groups: I) group with normal TCCS findings; II) group with occlusion of middle cerebral artery (MCA) branches; III) group with MCA stenosis and IV) group with occlusion of MCA trunk.

**MRA examination**

In all patients MRA was performed during 1–5 days period after the sonographic examination and it was considered as a golden standard to which TCCS findings were compared.

All MRA examinations were performed with a 1.0–T scanner (Philips Gyroscan T10–NT).

A 3-dimensional (3D) time-of-flight sequence was acquired in the axial plane. The images were reconstructed with maximum intensity projection. Another observer, who was blinded to the results of TCCS, assessed all MRA films. Abnormal MRA was defined as lumen artery reduction ≥ 50%, and normal MRA was defined as lumen reduction < 50% (including normal-mild stenosis), because the flow velocity usually remains the same when the reduction of lumen diameter is less than 50%, modified by a previously published method [9]. The percentage of stenosis was determined according to the following principle: percentage of stenosis = \[1 – (D_{stenosis}/D_{normal})\] × 100, where D_{stenosis} represents the diameter of the artery at the stenosis and D_{normal} represents the diameter of the proximal normal artery [10].

According to MRA distribution of lesions, the patients were divided into the following groups: I) group with normal MRA findings; II) group with occlusion of middle cerebral artery (MCA) branches/trunk; III) group with MCA stenosis and IV) group with stenosis of the carotid siphon.

**Statistical analysis**

Statistical analysis was performed with a statistical program STATISTICA 7.1 / 2005 and Epi 6.0 by an experienced specialist in the field of biostatistics. The following parameters were analysed:
1) In the series with numeric parameters, mean value, standard deviation, ± 95.0 % confidence interval, minimal and maximal value of the analyzed parameters were determined;

2) In the series with numeric values, data distribution was tested with K-S test; Lillefor Test and Shapiro W test;

3) The difference among the values of analyzed parameters in two independent samples, where the data distribution did not step out of the normal, was tested with t-test for Independent Samples;

4) In case of stepping aside of the normal distribution, the difference was tested with Mann-Whitney U test;

5) The difference between the values of the analyzed parameters in four samples was tested with Kruskal-Wallis test;

6) Structure percentage was determined in the series with attributive values;

7) Sensitivity (TP/TP+FN), specificity (TN/TN+FP), positive predictive value (TP/TP+FP), negative predictive value (TN/TN+FN) and the overall accuracy of the test of TCCS were determined.

Results

I) Group of patients with normal TCCS findings

TCCS showed normal findings in 16 patients. In 14 patients the findings were confirmed, while in the other two the findings were falsely negative. In 1 patient MRA showed occlusion of MCA branches, although with TCCS there was a normal blood flow velocity in MCA trunk. So, TCCS was with limited possibility for visualization of the more distal parts of ACM, and that is why branch occlusion of this artery was not visualized. MRA showed MCA stenosis in the other patient. This patient also had a significant ipsilateral internal carotid artery (ICA) stenosis (> 70%) which could have decreased the blood flow velocity in the intracranial arteries. Therefore in this case, TCCS showed normal instead of increased blood flow velocity.

Statistical analysis was performed for symptomatic and asymptomatic side and it showed that there was no significant difference between hemodynamic parameters of both sides (p > 0.05). These data correlate with the literature [6], and suggest that the variation of parameters is a safe instrument in the evaluation of hemodynamic changes.

Sensitivity, specificity, positive and negative predictive value of TCCS normal findings are shown in table 1. The overall accuracy of the test is 88%.
TCCS showed certainty of establishing the diagnosis of normal findings at risk level less than 1%.

Table 1 – Таблица 1

<table>
<thead>
<tr>
<th>TCCS/MRA – normal findings (I group)</th>
<th>TCCS/MRA – нормален наоѓ /прва група</th>
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<td>TCCS</td>
<td>MRA</td>
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<tr>
<td>Positive</td>
<td>Positive</td>
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<td>Positive</td>
<td>14</td>
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<tr>
<td>Negative</td>
<td>4</td>
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<tr>
<td>Sum</td>
<td>18</td>
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</table>

| Sensitivity | 77.8% | 51.9 – 92.6 |
| Specificity | 93.8% | 77.8 – 98.9 |
| Predictive Value Positive | 87.5% | 60.4 – 97.8 |
| Predictive Value Negative | 88.2% | 71.6 – 96.2 |

II) Group of patients with occlusion of MCA branches

TCCS in 8 patients with stroke discovered decreased blood flow velocity in MCA trunk, finding concordant with distal branch occlusion of these arteries. These findings were confirmed in 7 patients with MRA. In 1 patient the finding was falsely positive, i.e. with MRA it was confirmed that the finding was actually normal. It is well known that acute stroke phase is characterized with unstable perfusion picture [11]. In this case MRA was performed 5 days after the TCCS examination, so it is possible that recanalization had occurred [12]. Also, neurological status of the patient improved and the motor deficit was reduced. It has been known that it is not always possible to visualize M2 MCA branches with TCCS [6]. This happens due to the slower flow in these branches compared with M1 segment and probably due to the increased angle that the branches have in relation to the probe. In those cases, TCCS diagnostics indirect criteria are used, that is presence of decreased blood flow velocity in MCA trunk and low AI.

The lower blood flow velocity in this patient is a probable reflection of flow disturbances in distal MCA.

Occlusion of limited number of branches probably wouldn’t greatly affect MCA hemodynamics, while in patients with 3 or more occluded vessels TCCS shows reduction of MCA blood flow velocity compared to the contra-lateral side [12].
It has been obvious that the patients in the second group had lower absolute MCA values on the symptomatic hemisphere. MV1MCA in the second group varied in the interval 35.25 ± 2.71 cm/s, that is mean MCA velocity was out of normal reference range (< 40 cm/s). The study of Zanette et al.; [6] which had compared transcranial Doppler with intraarterial arteriography showed that multiple occlusions of MCA branches were associated with low AI. This has been confirmed in the present study, where all 7 patients with branch occlusion had low AI that varied in the interval -34.08 ± 27.38. Negative AI has been a reflection of mean blood flow velocity on symptomatic side.

A statistical analysis of the hemodynamic parameters for both sides was performed. It was shown that for $Z = -3.360$ and $p < 0.001$, there was a significant difference between PSV1MCA and PSV2MCA (1-symptomatic side, 2-asymptomatic side). Also, for $Z = -2.888$, i.e. -3.360 and $p < 0.01$ and $p < 0.001$ respectively, there was a significant difference between EDV1ACA / EDV2ACA, and EDV1MCA / EDV2MCA. Significant differences existed between MV1MCA / MV2MCA (for $t = -5.189$ and $p < 0.001$) and PI1MCA / PI2MCA (for $Z = 2.467$ and $p < 0.05$). MV2MCA in the second group varied in the interval 53.12 ± 9.35 cm/s, and neither of these patients had mean MCA velocity below 40 cm/s on the asymptomatic side. The analysis of the difference between other hemodynamic parameters did not show any significance.

Sensitivity, specificity, positive and negative predictive value of TCCS findings for decreased blood flow velocity are shown on table 2. Overall accuracy of the test is 96%. TCCS showed certainty of establishing the diagnosis of decreased blood flow velocity at risk level less than 1%.

Table 2 – Таблица 2

| TCCS/MRA – decreased blood flow velocity (II group) |
|---|---|---|
| TCCS/MRA – Namalena brzina na yprőjők (війора єрўйа)|

<table>
<thead>
<tr>
<th>TCCS</th>
<th>MRA</th>
<th>Sum</th>
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<tbody>
<tr>
<td>Positive</td>
<td>Negative</td>
<td>Sum</td>
</tr>
<tr>
<td>Positive</td>
<td>7</td>
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</tr>
<tr>
<td>Negative</td>
<td>1</td>
<td>41</td>
</tr>
<tr>
<td>Sum</td>
<td>8</td>
<td>42</td>
</tr>
</tbody>
</table>

Sensitivity 87.5% 46.7 – 99.3
Specificity 97.6% 85.9 – 99.9
Predictive Value Positive 87.5% 46.7 – 99.3
Predictive Value Negative 97.6% 85.9 – 99.9
In table 2, "positive" means that the result of TCCS investigation (i.e. decreased blood flow velocity) was confirmed with the MRA investigation.

### III) Group of patients with stenosis of MCA trunk

TCCS discovered stenoses in 15 patients. In 13 patients these findings were confirmed, while in 2 patients the findings were falsely positive, i.e. MRA showed normal findings. In these patients MRA was performed 5 days after the TCCS examination, so probably recanalization of the artery occurred; other explanation is that maybe due to artery tortuosity higher values of hemodynamic parameters were obtained, concordant with stenosis. Intracranial stenoses could regress due to recanalization of emboli or thrombus degradation [13]. Also, inadequately high insonation angle could result in measurement of high blood flow velocities and obtaining falsely-positive findings of stenosis [14]. There is a trend of the patients with additional ≥ 70% stenosis, to have lower average degree of MCA stenosis [15]. In the present study, in only two patients with MCA trunk stenosis, there was a presence of significant carotid stenosis.

TCCS measurement of PSV is useful in the evaluation of intracranial artery stenosis [16]. In the present study, PSV ranged between 220–400 cm/s in the stenotic lesion of MCA trunk. AI and PI were also increased (> 21%, range between 61–100%) and > 1, 2, respectively. High grade MCA stenoses could be suspected in the presence of increased ACA blood flow velocity, which is related to the leptomeningeal anastomotic collaterals. Such a case was not registered in the present study.

Statistical analysis of the hemodynamic parameters of symptomatic and asymptomatic side showed that for \( Z = 4.666 \) and \( p < 0.001 \), there was a significant difference between PSV1MCA and PSV2MCA. Also, for \( t = 5.873 \) and \( p < 0.001 \), there was a significant difference between EDV1MCA / EDV2MCA. Significant differences were recorded between MV1MCA / MV2MCA and PI1MCA / PI2MCA (for \( Z = 4.666 \) and \( p < 0.001 \)). Also, MCA ACM of the symptomatic side was significantly higher related to the other groups (\( p < 0.01 \)). Other characteristics of arterial stenosis include turbulence, increased end-diastolic velocity and reversible flow [17]. In the present study, all patients in the III group had turbulence and increased EDV in the MCA stenotic region.

Statistical analysis of other hemodynamic parameters of the symptomatic and asymptomatic side did not show any significant difference.

Sensitivity, specificity, positive and negative predictive value of TCCS findings of increased blood flow velocity are shown in table 3. Overall accuracy of the test is 90%. TCCS showed certainty of establishing the diagnosis of increased blood flow velocity at risk level less than 1%.
Table 3 – Таблица 3

**TCCS/MRA – increased blood flow velocity (III group)**

<table>
<thead>
<tr>
<th>TCCS/MRA – зголемена брзина на још боок (трећа група)</th>
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<tbody>
<tr>
<td><strong>TCCS</strong></td>
</tr>
<tr>
<td>Positive</td>
</tr>
<tr>
<td>Positive</td>
</tr>
<tr>
<td>Negative</td>
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<tr>
<td>Sum</td>
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</tbody>
</table>

Sensitivity 81.3% 53.7 – 95.0
Specificity 94.1% 78.9 – 99.0
Predictive Value Positive 86.7% 58.4 – 97.4
Predictive Value Negative 91.4% 75.8 – 97.8

In table 3, "positive" means that the result of TCCS investigation (i.e. increased blood flow velocity) was confirmed with the MRA investigation.

**IV) Group of patients with occlusion of MCA trunk**

TCCS showed occlusion of MCA trunk in 11 patients. MRA confirmed these findings in 8 patients. In 1 patient MRA showed normal findings. Probably in this case recanalization of the artery occurred, because MRA was performed 4 days after TCCS. Occluded intracranial arteries recanalize in most of the cases, which can be detected with ultrasound and confirm the diagnosis of a previous occlusion [18].

In other 2 patients MRA showed stenosis of the left carotid siphon. The visualisation of the carotid siphon can be difficult with TCCS, and if there is a stenosis or occlusion in this area, the ipsilateral MCA can not be visualized with TCCS and no spectral Doppler wave can be obtained in this artery.

Statistical analysis showed that for Z = -2.692 and Z = -3.972, respectively and p < 0.001, there was a significant difference between PSV1ACA and PSV2ACA, and PSV1MCA and PSV2MCA, respectively. Also, for t = -2.725 and t = -3.972, respectively, and p < 0.001, there was a significant difference between EDV1ACA/ EDV2ACA, and between EDV1MCA / EDV2MCA. Significant differences existed between MV1ACA / MV2ACA, MV1MCA / MV2MCA and PI1MCA / PI2MCA (for Z = -2.725 and Z = -3.972, respectively and p < 0.001). Statistical analysis of other hemodynamic parameters of the symptomatic and asymptomatic side did not show any significance. TCCS studies have shown that absence of Doppler signals of the brain arteries in
patients with adequate acoustic windows, and at the same time with a detection of at least one ipsilateral brain artery allows diagnosis of intracranial occlusion [19].

A collateral flow may develop below the occlusion [20]. In the present study, 5 patients had a collateral flow (4 patients with ICA occlusion and 1 patient with significant > 70% ICA stenosis). Occlusion of MCA was registered, with reversible flow in the ipsilateral ACA, increased velocity in the contralateral MCA and AI -200% as a result of blood flow velocity 0 cm/s. Two of these patients had lethal outcome.

Sensitivity, specificity, positive and negative predictive value of TCCS findings of occlusion are shown on table 4. Overall accuracy of the test is 92%. TCCS showed certainty of establishing the diagnosis of occlusion at risk level less than 1%.

Table 4 – Таблица 4

<table>
<thead>
<tr>
<th>TCCS/MRA – occlusion (IV group)</th>
<th>TCCS/MRA – оклузия (четврта група)</th>
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<td></td>
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<tr>
<td>TCCS</td>
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</table>

Sensitivity 88.9% 50.7 – 99.4
Specificity 92.7% 79.0 – 98.1
Predictive Value Positive 72.7% 39.3 – 92.7
Predictive Value Negative 97.4% 84.9 – 99.9

In table 4, "positive" means that the result of TCCS investigation (i.e. occlusion) was confirmed with the MRA investigation.

Discussion

The results obtained in this study correlate well with the ones that have been reported in the literature. For example, in their study, Baumgartner et al. [7] also found that TCCS was a very safe method for determining normal findings in patients with ischemic stroke (p < 0.001).
Concerning the findings of decreased blood flow velocity, which was registered in the patients of the second group, similar findings were obtained by Alexandrov et al. [8], where sensitivity was 87.5%, specificity 88.6%, positive predictive value 87.5%, while negative predictive value was 88.6%.

Concerning the obtained values of the patients of the third group, i.e. with MCA trunk stenosis, one can find the following data in the literature. In the study of De Bray et al. [13], i.e. Ley-Pozo et al. [21], it was reported that sensitivity of TCCS in the detection of ACM stenosis (≥ 50%) ranges between 75%–86%, and specificity is above 93%. In the study of Gao et al., TCCS criteria compared with MRA had sensitivity of 91.4% and specificity of 82.7% in the diagnosis of > 50% MCA stenosis [22]. Baumgartner et al. in their TCCS study have evaluated PSV that allows safe detection of intracranial stenoses [7]. According to these criteria, TCCS have detected all > 50% stenoses with sensitivity, specificity, positive predictive value of 100%, and negative predictive value of 91–100%.

Referring to the patients of the fourth group, i.e. with occlusion, Kenton et al. [3] in their study have shown that TCCS diagnosis of M1 MCA occlusion with implementation of predefined criteria has sensitivity, specificity, positive and negative predictive value of 100% in patients with acute ischemic stroke and adequate acoustic window.

Table 5 – Таблица 5

<table>
<thead>
<tr>
<th>Author</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
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<tr>
<td>Alexandrov et al.</td>
<td>87.5%</td>
<td>88.6%</td>
<td>87.5%</td>
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<tr>
<td>De Bray et al.</td>
<td>75%–86%</td>
<td>93%</td>
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<tr>
<td>Ley-Pozo et al.</td>
<td>75%–86%</td>
<td>93%</td>
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<tr>
<td>Gao et al.</td>
<td>91.4%</td>
<td>82.7%</td>
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<td>Baumgartner et al.</td>
<td>100%</td>
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<td>Kenton et al.</td>
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To the present day, this has been a first study in R. Macedonia which compares the two non-invasive methods for evaluation of intracranial hemodynamics in patients with stroke. The author is the only one experienced and certified sonographer who works with TCCS in R. Macedonia, so unfortunately, inter-rater reliability for TCCS could not have been done. In this study TCCS was more sensitive in the detection of steno-occlusive changes of MCA compared to the stenosis or occlusion in proximal ICA or distal MCA, concordant with the previously published studies [23]. TCCS has been conducted in the
acute stroke phase, while MRA has been performed 1–5 days afterwards. This has been done mostly due to technical reasons, because in our institutions these methods may not be readily available immediately after admission of acute stroke patients. This fact could have certainly affected the final results, giving disconcordant conclusions. However, it is well known that intracranial stenosis is a dynamic lesion with rapid flow velocity change during the acute stage [24]. The clinical course of stroke may include either spontaneous improvements or deterioration related to dynamic changes in brain perfusion. These changes are associated with spontaneous thrombolysis, reocclusion, microembolism, thrombus propagation, and/or collateralization [19]. Even the time frame for the initial TCCS evaluation within 24 hours after symptom onset might presumably miss early modifications of intracerebral hemodynamics within hours after stroke.

The only known study that had compared serial Doppler findings with a single MRA study was done by Akopov et al. [25] and it showed that serial Doppler examination may reveal dynamic changes in cerebral circulation that may be missed on a single MRA study. Therefore, serial Doppler examinations are recommended in order to assess cerebral circulation.

The present study might be limited by the small number of patients with each category of hemodynamic abnormality. Only results of the symptomatic side were reported, because the results of the asymptomatic side did not have any significant difference, and actually had a very high sensitivity and specificity (100%).

We would certainly recommend further studies in this field, which would include more patients, and also more frequent TCCS examinations. Continuous or rapid, repeatable evaluations of cerebral hemodynamics may offer new insights into acute ischemic stroke pathogenesis and provide guidance for therapeutic interventions in relation to particular hemodynamic patterns.

**Conclusion**

1. TCCS has high sensitivity and specificity in determining the intracranial hemodynamic changes in patients with ischemic stroke;
2. TCCS has highly positive and negative predictive value related to the pathological blood flow which confirms the diagnosis of ischemic stroke;
3. Certainty of TCCS method in determining normal and pathological changes in the intracranial blood vessels is at risk level less than 1%.

**Abbreviations:** TCCS, transcranial colour coded duplex sonography; MRA, magnetic resonance angiography; MCA, middle cerebral artery; ICA, internal carotid artery. anterior cerebral artery (ACA), posterior cerebral artery (PCA), vertebral arteries (VA).
REFERENCES


Резиме
Komparativna analiza pomegu transkranijalna kolor duplex sonografiia i magnetnata resonantna angio grafiia kaj pacientite so mozochen udar

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Цел: Да се спореди транскранијалната колор дуплекс сонографија (Transcranial color duplex sonography – TCCS) и магнетната резонантна ангио-
грافيја (magnetic resonance angiography – MRA) во евалуацијата на пациентите со мозочен удар.

Методи: Со помош на TCCS беа одредени хемодинамските параметри кај интракранијалните артерии кај 50 пациенти со исхемичен мозочен удар. Кај сите пациенти беше изведена MRA во тек на 1-5 дена по сонографијата.

Пациентите беа поделени во следниве групи: I) група на пациенти со уреден TCCS наод; II) група на пациенти со оклузија на гранките на артерia cerebri media (ACM); III) група на пациенти со стеноза на стеблото на ACM и IV) група на пациенти со оклузија на стеблото на ACM. Наодот на TCCS беше спореден со наодот на MRA, кој беше земен како златен стандарт. Беа одредени сензитивноста, специфичноста, позитивната и негативната предиктивна вредност, како и глобалната точност на тестот.

Резултати: Во сите групи на пациенти беа добиени високи вредности на сензитивност, специфичност, позитивна и негативна предиктивна вредност.

TCCS покажа сигурност во утврдувањето на нормален и патолошки наод на интракранијалните артерии, наод на ниво на ризик помал од 1%.

Заклучок: TCCS е сигурен и безбеден дијагностички модалитет кој служи за брзо и по потреба повторно изследување на продоцност на интракранијалните артерии во акутината фаза на мозочниот удар и претставува техника со висока сензитивност и специфичност во одредувањето на стеноклузиивите интракранијални заболувања.

Клучни зборови: транскранијална колор дуплекс сонографија, магнетна резонантна ангиографија, исхемичен мозочен удар.

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