Spontaneous subarachnoid hemorrhage: patients investigation in initial angiogram-negative cases

Gintautas Vaitkevičius, Antanas Romas Gvazdaitis, Saulius Lukoševičius
Department of Neurosurgery, Kaunas University of Medicine,
1Department of Radiology, Kaunas University of Medicine, Lithuania

Key words: subarachnoid hemorrhage, cerebral aneurysms, angiography, computed tomography angiography.

Summary. Aim of the study. To find out, which patients in case of subarachnoid hemorrhage and negative initial angiograms need a repeated investigation, when it should be repeated and what kind of angiographic investigation should be performed.

Materials and methods. Fifty seven patients with subarachnoid hemorrhage and negative initial angiograms were investigated in Department of Neurosurgery of Kaunas University of Medicine Hospital from January 2001 to August 2002. They underwent a repeated angiography (digital subtraction or computed tomography angiography) generally in the period of 10 days.

Results. Repeated cerebral angiography revealed saccular aneurysms of various locations in 23 patients. Perimesencephalic hemorrhage was present in 24 cases and no aneurysms were detected in these cases. Aneurysm was suspected in initial angiography in 14 cases and 10 of them were confirmed after second angiography. In all cases of application computed tomography angiography provided equal or more information for neurosurgeon compared to digital subtraction angiography. Nearly half of the detected aneurysms (n=11) were small (<5 mm).

Conclusions. Repeated angiography is not recommended in case of perimesencephalic pattern of spontaneous subarachnoid hemorrhage. In case of suspicion of aneurysm in initial angiography, computed tomography angiography could be a method of choice performed immediately.

Introduction

Spontaneous subarachnoid hemorrhage (SAH) according to etiology, clinical course, diagnostic findings and outcome could be divided into two groups: perimesencephalic and aneurysmatic (1). Perimesencephalic SAH occurs in case of rupture of small veins or capillaries. Status of these patients is usually satisfactory, outcome is more favorable, less complications, as well as negative angiographic findings. In case of aneurysmatic SAH status of the patient is usually worse, with more complications and high mortality rate (2). Cerebral aneurysms are detected by means of cerebral angiography, applying contrast media, however in 15-20% of such cases no vascular abnormalities are detected angiographically (3). In such cases further tactics of patient management differs: some authors recommend 2nd and 3rd angiography (4-6). Other authors report that single angiography but of high quality is enough (7). Though aneurysms are detected after repeated angiography in 2-24% of cases (8,9) and it is agreed that an untreated aneurysm may re-bleed, what will significantly deteriorate patients’ status and outcome (10). The traditional and “golden standard” tool for investigation of patients with suspected cerebral aneurysms has been catheter subtraction angiography (DSA). This method of investigation is quite expensive, sometimes long-lasting and of course, involves some risk (1-2%) of complications (11). In recent decade less invasive imaging techniques were implemented into practice. One of such methods – computed tomography angiography (CTA) – a quick, providing sufficient information, less invasive and safer imaging modality (12). Nevertheless possibilities of diagnosis of spontaneous SAH are increasing, the discussion on tactics after negative initial
angiogram in case of SAH is still on.

Aim of the study. To find out, which patients in case of subarachnoid hemorrhage and negative initial angiograms need a repeated investigation, when it should be repeated and what kind of angiographic investigation should be performed.

Clinical material and methods
Between January 2001 and August 2002, 246 patients with SAH, detected on CT and/or verified by lumbar puncture, were treated in Department of Neurosurgery of Kaunas University of Medicine Hospital. Patients with ruptured arterio-venous malformations or stroke were not included. DSA was performed in 235 patients (95.5%) during the first day of admission, in 10 patients (4.1%) – later due to bad condition or technical reasons. In 1 case (0.4%) DSA was not performed – the patient died and cerebral aneurysm was detected at autopsy. Aneurysms of different locations were detected in 160 patients (65%). The rest 86 (35%) possessed no vascular abnormalities, thus cause of SAH remained unclear. 57 patients (66.3%) underwent a repeated cerebral angiography (37 female, 20 males, with age ranging from 19 to 82 y., average 52.2 y.). In 37 cases DSA was repeated in the period of 10-14 days after the initial procedure, 1 patient had two repeated DSAs. CTA was performed in 9 cases – usually in the period of 7 days after initial DSA with suspicion of an aneurysm. CTA and DSA both were performed in 11 patients – 3rd angiography during 7 days after the 2nd procedure with suspected aneurysm, and during 1-3 week period after 2nd procedure, if no suspicion of aneurysm was present. Angiography was not repeated in 29 cases (33.7%), including 19 cases of perimesencephalic hemorrhage, 6 cases of absence of SAH on CT and 4 cases of diffuse SAH on CT (1 patient died before repeated angiography, 1- refused to undergo the procedure, 1- pregnant woman and 1 – was admitted 2 months later after repeated SAH).

DSA was performed in Interventional radiology department of Radiology clinic of Kaunas University of Medicine Hospital, by using the Seldinger technique and femoral percutaneous catheterization, employing Advantx (GE) angiography unit. The patients underwent four-vessel, multiple projection angiography with 4-6 ml of high-density contrast media, injected into each vessel.

CTA was performed in Tomography department of Radiology clinic of Kaunas University of Medicine Hospital, employing Siemens Somatom Plus 4 (Siemens AG) CT unit. 100 ml of contrast media were injected via antecubital vein by means of power injector with the injection rate of 2.8 ml/s. Images were postprocessed applying MIP, SSD and VRT techniques.

DSA and CTA images were evaluated by radiologists and neurosurgeons.

Results
Fifty-seven patients (66.3%) with absence or suspicion of aneurysms on initial angiograms underwent repeated cerebral angiography. In 3 cases of initial DSA four-vessel catheterization was not possible due to anatomical reasons, in 4 cases severe vasospasm was observed, in 14 cases cerebral aneurysm was suspected (in 10 cases aneurysms were detected during repeated examinations).

Twenty-three patients harbored saccular aneurysms of different location – mostly of ACoA, ACA, ACI (Table 1). This makes up to 40.4% of all repeatedly investigated patients (9.3% of all patients

Table 1. Comparison of the most intensive SAH site on CT and repeated angiography results

<table>
<thead>
<tr>
<th>The most intensive SAH site</th>
<th>Ruptured aneurysm detected</th>
<th>No aneurysm detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior interhemispheric fissure</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Sylvian fissure</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Posterior fossa</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Diffuse SAH</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Perimesencephalic pattern</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>No SAH signs</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>


with SAH). In 22 cases of detected aneurysms repeated angiography was performed during 10 days after initial DSA, in 1 case – during 16 days.

Aneurysm was evident in 18 patients (31.6%) after second angiography, while in 4 (7%) it was only suspected again: 1 patient was operated after two DSA, the suspected region accessed and aneurysm confirmed, 3 patients underwent 3rd angiography by means of CTA. CTA confirmed aneurysms in all this cases and provided more diagnostic information compared to both previous DSA (Figures 1-4). One patient (1.8%) underwent 3rd DSA – aneurysm, which was not seen on previous DSA images, was revealed (Table 2).

Aneurysm was confirmed after second angiography (CTA) in 3 cases, but a repeated DSA was
**Table 2. Value of repeated angiography in the group of patients with detected aneurysms**

<table>
<thead>
<tr>
<th>Information value</th>
<th>2nd angiography</th>
<th>3rd angiography</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DSA</td>
<td>CTA</td>
</tr>
<tr>
<td>Enough information</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Not enough information</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>No valuable information</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>7</td>
</tr>
</tbody>
</table>

performed – in these cases diagnostic information was similar and sufficient.

Nearly half of all detected aneurysms (n=11) were small (<0.5 cm).

The site of most intense bleeding on CT and the site of detected aneurysm coincided in 14 cases (60.9%), in other cases SAH was diffused or absent on CT.

In 34 cases (59.6%) the cause of SAH remained unclear even after 2nd and 3rd angiography, including 24 cases (42.1% of all repeatedly investigated patients), which were regarded as perimesencephalic pattern of SAH.

One patient showed perimesencephalic pattern of SAH on CT. ACI aneurysm was suspected on DSA image, while infundibular dilatation of ACI on CTA image. The suspected site was accessed at surgery, but no aneurysm detected. Thus, CTA provided a true negative result.

One patient was present with intensive SAH in the right Sylvian fissure on CT, but no vascular abnormalities on DSA. The suspected site was accessed at surgery, and ACM aneurysm was detected.

Four patients after negative initial angiography had re-bleeding: 1 patient died without repeated angiography (no autopsy performed), 3 patients underwent repeated angiography and aneurysms were detected in all cases.

Two patients developed signs of cerebral ischemia due to vasospasm immediately after repeated DSA – this was regarded as DSA complication. No complications appeared after CTA.

**Discussion**

Angiogram-negative spontaneous SAH appears in 15-20% of cases. Aneurysms are detected after repeated angiography in 2-24% of cases. We detected aneurysms in 23 cases – 40.4% of all repeatedly investigated patients. Aneurysms may thrombose after rupture or even destruct (in case of microaneurysms), as well as become angiographically occult due to severe vasospasm or compression from hematoma (4 patients from our study presented with severe vasospasm on angiograms, while large hematomas were absent).

Many authors suggest performance of the 2nd angiography after 10-14 days and performance of the 3rd one – after 4-8 weeks (13,14). We suspected aneurysms in 14 cases, and in 10 cases aneurysms were confirmed by repeated DSA or CTA. Thus, based on our results, in case of suspicion of aneurysm on initial angiograms and absence of vasospasm, angiography could be repeated as soon as possible – during several days, as undetected and untreated aneurysm could re-rupture. The chance of re-bleeding is 4-5% in the first twenty-four hours, 20% in two weeks and even 50% in 6 months (10).

In our study group 4 patients (7%) with negative initial angiograms had re-rupture in 1-9 days, 1 patient (1.8%) with diffuse SAH on CT and negative initial angiograms was admitted to the department again because of rebleeding after 2 months (ACI aneurysm was detected in this case).

Some authors presume that SAH pattern on CT could indicate when it is possible to detect aneurysm by means of repeated angiography. In case of perimesencephalic pattern of SAH and thorough four-vessel catheterization there is no need of repeated angiography (15). In our study 24 patients (42.1%) with perimesencephalic pattern of SAH on CT underwent repeated angiography and no aneurysm was confirmed in this group. In case of diffuse SAH or site of intensive SAH (especially with intracerebral hematoma) the chance of detecting of an aneurysm is high. The most intensive SAH in the anterior interhemispheric fissure was seen in 11 cases in our study, 6 ACoA and 5 ACA aneurysms were detected after repeated angiography. The most intensive SAH in the site of Sylvian fissure was seen in 2 cases and ACM aneurysms were confirmed in both.

Some authors indicate uselessness of repeated
angiography in case of coincidence of intensive SAH site and suspected aneurysm location (14), as surgical intervention is favored in such case. One patient from our study group was operated without repeated angiography and ACM aneurysm was confirmed. If intensive SAH site and suspected aneurysm location do not coincide, there is a chance of not detecting of any ruptured aneurysm at surgery (13).

In recent time some authors propose CTA as repeated angiography procedure in case of negative initial angiography: CTA is quicker, less invasive, cheaper and involves smaller risk of complications (16-18). Based on our results, there were no complications after CTA, while 2 patients developed cerebral ischemia due to vasospasm after DSA. CTA is capable to detect even ≤3 mm aneurysms that were missed on initial angiography (16,18), though other authors indicate that the majority of all CTA missed aneurysms are 2-3 mm or smaller (19).

Eleven patients from our study group with negative initial DSA underwent repeated DSA and CTA both. Aneurysms were confirmed in 6 cases: in 3 cases CTA was superior providing information regarding aneurysm location and anatomy, in the rest 3 cases – both modalities provided sufficient information. Thus, in case of insufficient information on DSA angiograms, CTA could be the method of choice, especially if intensive SAH site on CT and suspected aneurysm location coincide.

Conclusions
1. There is no need of repeated angiography in case of perimesencephalic pattern of spontaneous subarachnoid hemorrhage and negative initial angiography. Angiography must be repeated in all other cases.
2. Repeated angiography could be performed immediately in case of aneurysm suspicion on initial angiograms and absence of vasospasm, while if there is no suspicion of aneurysm – in the period of 10-14 days.
3. CTA could be the method of choice as repeated angiography, especially if intensive SAH site on CT and suspected aneurysm location coincide.

Spontaninė subarachnoidinė hemoragija. Ligonio tyrimo taktika neradus aneurizmos pirminėse angiogramose

Gintautas Vaitkevičius, Antanas Romas Gvazdaitis, Saulius Lukoševičius
1 Kauno medicinos universiteto Neurochirurgijos klinika,
2 Kauno medicinos universiteto Radiologijos klinika

Raktažodžiai: subarachnoidinė hemoragija, galvos smegenų arterinės aneurizmos, angiografija, kompiuterinės tomografijos angiografija.


Tyrimo medžiaga ir metodai. Išsirinkti Kauno medicinos universiteto Neurochirurgijos klinikoje 2001 m. sausio – 2002 m. rugpjūčio mėn. gydyti 57 ligonių po įvykusios subarachnoidinės hemoragijos ir pirminės angiografijos be pakitimų. Šiems ligoniams buvo kartojama skaitmeninė subtrakcinė angiografija ir (arba) kompiuterinės tomografijos angiografija (dažniausiai per 10 dienų nuo pirmosios angiografijos).


References


Received 16 September 2002, accepted 15 October 2002