The reaction of cerebral arteries to non-ionic contrast media during cerebral angiography

P.H. Nakstad

Department of Radiology, Section of Neuroradiology, Rikshospitalet, The National Hospital, University of Oslo, Norway

Summary. The purpose of this study was to evaluate possible vasoconstrictive or vasodilator effects of the low osmolar non-ionic contrast medium iohexol (Omnipaque) on the calibre of cerebral arteries. The diameters of respectively 5 and 6 different locations of the vertebral and carotid arteries were recorded from angiograms of 3 successive injections. The material consisted of 18 patients. It could not be shown that Omnipaque induced vasoconstriction or vasodilatation when normal doses and adequate technique was applied. The difference in diameters found were not statistically significant and are probably due to natural pulsations and to the difficulties in performing exact measurements.

Key words: Cerebral angiography – Contrast medium – Iohexol – Vasoconstriction – Vasodilatation

Animal as well as human studies [1–4] have shown that ionic hyperosmolar contrast media have a vasodilator effect on arteries. Animal studies with lowosmolar contrast media, however, have shown both vasoconstrictive and vasodilator effects [5–7]. Vasoconstriction could explain sudden ischemic incidents during cerebral angiography in man. Such incidents are usually believed to be of embolic origin. A constrictive effect might of course deteriorate the diagnostic quality as well [8]. It was therefore our aim to evaluate possible vasoconstrictive or vasodilator effects of a low osmolar contrast medium in man.

Materials and methods

Due to ethical considerations a potentially dangerous examination such as cerebral angiography had to be evaluated from routine examinations and not from experimental studies.

The material consists of eighteen patients undergoing cerebral angiographies performed with iohexol (Omnipaque) 300 mg I/ml. Seven females and 11 males aged between 21–67 years (range 49).

The inclusion criteria for the study were that the first three successive injections were done in the same carotid (n= 11) or vertebral (n= 7) artery without changing the catheter position, injected volume, injection rate or contrast medium concentration. The injection volume was always 10 ml in the carotid and 7 ml in the vertebral artery with an injection rate always of 7 ml/s and 5 ml/s respectively. Only angiographies with excellent image quality were included. Alterations in the projections between the injections were accepted if the cranial or caudal angulation and the obliquity of the frontal x-ray tube was not changed more 10 degrees. The time interval between the injections was always recorded (Table 1).

Only the frontal angiograms were used for the calibre measurements. All measurements were performed on the original angiograms and not on the subtracted images that were often less accurate due to blurred contours. In order to improve the accuracy the angiograms were optically magnified by the factor of four. The measurements were done at six different extra-and intracranial locations of the carotid artery and at five locations of the vertebral arteries (Figs. 1, 2).

The most peripheral branches of the arteries were not used since the possibility of inaccurate measurements seemed too great; despite the magnification technique. A reproducability test was evaluated by two independent colleagues.

Table 1. Clinical diagnosis

<table>
<thead>
<tr>
<th>Clinical diagnosis</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aneurysm (with SAH)</td>
<td>10</td>
</tr>
<tr>
<td>Arteriosclerosis (TIA)</td>
<td>3</td>
</tr>
<tr>
<td>Tumor</td>
<td>2</td>
</tr>
<tr>
<td>Arteriovenous malform.</td>
<td>1</td>
</tr>
<tr>
<td>Operated aneurysm</td>
<td>1</td>
</tr>
<tr>
<td>SAH without aneurysm</td>
<td>1</td>
</tr>
</tbody>
</table>
Results

The clinical diagnoses appear in Table 1. Increase of the arterial diameter at one or more locations was found in 9 (50%), decrease in 13 (72%) and both in the same patients in 9 (50%) after one injection with Omnipaque. After two injections the numbers were 6 (33%), 12 (67%) and 4 (22%) respectively. Decrease was less frequent in the vertebral (33%) than in the carotid vascular region (66%). Increase was more common in the vertebral region. Arteries with similar calibre changes at several of the measured points were rare. In no case were calibre changes found at all measured locations (Fig. 3).

Changes from the first to the second injection were similar to those between the first and the third. In several cases identical calibers were found at the first and the third registration while differences were seen between the first and the second. Most calibre changes were slight, that is 1–5%. Changes of more than 20% were not found. The few changes of more than 10% were almost exclusively found at only one location of the arterial region.

Statistical evaluation did not establish any significant vasoconstrictive or vasodilator properties of the contrast medium used. No differences with regard to calibre changes could be related to the time intervals between the injections, long or short. The time intervals was usually slightly longer between the first and the second injection than between the second and the third. The mean time intervals appear in Table 2. Reproducibility tests of the calibre measurements showed a maximum error of ±5%.

No differences in the image quality from the first to the following injections were seen. Complications during or after angiography did not occur.

Discussion

Since du Boulay and Wallis [6] have shown that vasoconstriction of the arteries of baboons appears already after 90 s it is of concern that our time intervals were not smaller.

As every additional injection should be the consequence of thorough diagnostic considerations, it seems impossible to obtain an ethically defensible