

Original Contributions

Headache in Stroke

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Background and Purpose: The etiology of headache in stroke is not known, and its relation to migraine and tension-type headache is unclear. The aim of our study was to investigate and classify headache appearing in stroke patients prospectively, using the new headache classification as determined by the Headache Classification Committee of the International Headache Society (1988).

Methods: Two hundred eighty consecutively admitted patients aged younger than 81 years with acute stroke were examined and questioned about headache and prior headache complaints; 238 (85%) were able to communicate.

Results: Sixty-five (27%) of the 238 patients experienced headache from 3 days before to 3 days after stroke. Headache occurred in 50% of patients with intracerebral hemorrhage, in 26% with infarction, and in 15% of patients with lacunar infarction. Headache was more common when stroke occurred in posterior circulation than anterior circulation ($P < .02$). Fifty-six patients were able to give further information about headache characteristics. The headache in thromboembolic stroke was classified as tension-type headache (25 patients), migraine-like headache (14 patients), and other headache (12 patients). Migraine was more frequent in vertebrobasilar stroke. Headache was lateralized in 33% of cases. In patients with unilateral headache and unilateral stroke lesion, the headache was ipsilateral in 14 of 17 cases. In infarction, severity of headache showed no relation to lesion size or lesion localization. Patients with previous tension-type headache and migraine experienced reactivation of known headache equally often.

Conclusions: (1) Headache occurs in one fourth of patients with acute stroke. (2) Unilateral headache is usually ipsilateral to stroke lesion. (3) Headache severity is not related to size of ischemic stroke lesion. (*Stroke*. 1993;24:1621-1624.)

KEY WORDS • cerebral arteries • cerebrovascular disorders • headache • migraine

Headache is a common symptom in stroke, but the incidence rate is not known. Numerous reports have dealt with headache caused by different cerebrovascular lesions,¹⁻¹² but only a few prospective studies have been done,^{5,9-12} and they differ with respect to patient sampling.

The mechanisms underlying headache are not known. However, new observations of headache pain in migraine may be relevant to headache in stroke. Recent studies have suggested that the headache is associated with dilatation of certain arteries at the base of the brain.¹³ If intracerebral arteries are involved in migraine pain, one would assume that headache is a major problem in patients with stroke, particularly ischemic stroke, in which occlusion of one or several arterial branches is present and changes in vascular perfusion are evident.

The aim of our study was to investigate headache characteristics prospectively in acute stroke and to classify the headache according to the newly established criteria of the International Headache Society (IHS).¹⁴

Subjects and Methods

All patients admitted consecutively to either of two hospitals or an outpatient clinic with acute stroke during a 1-year period (February 1, 1991, to January 31, 1992) were examined within 7 days after onset of stroke. The patients were admitted to two hospitals, Farsoe Hospital (a local hospital) and Aalborg Hospital (a regional hospital), that serve a total population of 250 000 persons.

Stroke was defined according to the criteria of the World Health Organization.¹⁵ Age limits were 25 and 80 years. All patients had a computed tomographic (CT) scan done between day 5 and day 10, and diagnosis was made from the clinical examination and the CT scan. The size of the stroke lesion was rated blindly by an experienced radiologist. Patients with primary subarachnoid hemorrhage and Binswanger's disease were excluded. Binswanger's disease was defined as a syndrome of hypertension, dementia, focal neurological deficits, and a CT scan showing periventricular leukodystrophy with or without localized lesions.

According to the CT scan, two vascular events were defined: (1) parenchymal hemorrhage and (2) infarction (including patients with a normal CT scan). As a subgroup of infarctions, lacunar infarction was defined as a clinical syndrome with pure motor or sensory symptoms, where CT scan revealed either a small hypodense hemispheric lesion or no lesion.

Lesion site was defined as either hemispheric, with a subgrouping according to the distribution within the

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anterior (ACA), middle (MCA), or posterior cerebral arteries (PCA), or as a brain stem lesion, including cerebellar lesions. In patients in whom no lesion was present on CT, lesion site was based on clinical grounds.

All patients were interviewed regarding headache complaints appearing from 3 days before to 3 days after onset of stroke symptoms, using a standardized questionnaire. Patients were questioned about headache characteristics such as time of onset, duration, localization (frontal, occipital, diffuse), side, quality, severity (1, mild; 2, moderate; 3, severe), phonophobia and photophobia, and nausea and vomiting. Patients with headache were further asked about previous episodic headache, and, if present, the same detailed headache information was obtained.

From the records data were collected on various risk factors such as previous hypertension (diastolic pressure greater than 95 mm Hg), diabetes, and heart disease (the latter defined as signs of arrhythmia, cardiac decompensation, recent or former myocardial infarction, or valve disease).

The study was approved by the local ethical committee. All patients fulfilling the inclusion criteria gave informed consent to participate.

The following nonparametric tests were used for data analysis: the χ^2 test and, when numbers were too small, Fisher's exact test, the Kruskal-Wallis test, and the Mann-Whitney test. Values of $P < .05$ were considered to be statistically significant.

Results

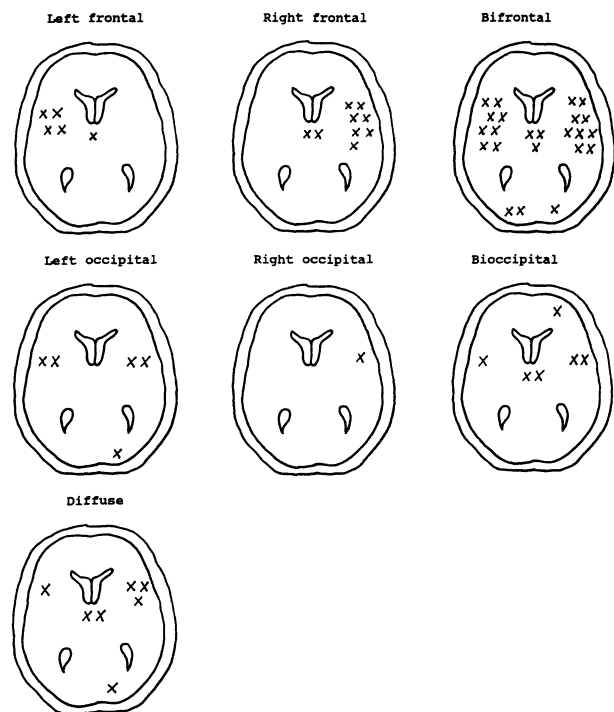
Two hundred eighty patients with acute stroke were included. Of these, 10 patients were seen in an outpatient clinic. Two hundred thirty-eight patients (132 men and 106 women) were able to communicate. The median age was 69 years (range, 29 to 80 years).

Infarction occurred in 214 (90%) of the 238 patients. Seventy-eight (33%) patients had lacunar infarction, and 16 (7%) had parenchymal hemorrhage. In 8 (3%) patients no CT scan could be done, either because the patient could not participate or the patient died. Lesions were distributed as follows: 2 cases in ACA circulation, 196 in MCA circulation, and 39 in vertebralbasilar artery circulation, which were subdivided into 29 cases in brain stem/cerebellum and 10 in the occipital lobe (PCA distribution). One case could not be classified.

Headache was reported by 65 (27%) of the 238 patients with stroke. Fifty-six (86%) patients could give further information about their headache, while 9 were unable to do so because of altered consciousness or dementia. The frequency of headache in infarction was 26% (56/214), in lacunar infarction 15% (12/78), and in parenchymal hemorrhage 50% (8/16).

When stroke occurred in the basilar artery distribution (in occipital lobe, brain stem, or cerebellum), headache was found in 46% (18/39) of patients. This is significantly more frequent compared with stroke in the MCA distribution, where 23% (46/196) reported headache ($P < .02$). The frequency of headache in PCA stroke (in occipital lobe) was 70% (7/10), which is more frequent than in the MCA circulation ($P < .02$).

The Figure shows stroke lesion in relation to headache localization. Headache was located bifrontally in 23 (41%) of the 56 cases; 20 (36%) patients reported



Schematic representation of stroke localization related to headache localization. Each lesion is marked in the respective vascular lesion with an X. X in center refers to brain stem lesions.

lateralized headache. In patients with lateralized headache, 14 had an ipsilateral stroke lesion, 3 had a contralateral lesion, and 3 had a brain-stem lesion (Table 1 and Figure). There was no difference between the two sides with respect to lateralization of headache, and there was an equal distribution between frontal and occipital headache in carotid and vertebralbasilar stroke. The headache started before stroke onset in 24 (43%) patients, occurred simultaneously with stroke in 17 (30%) patients, and started after stroke in 15 (27%) patients. In patients in whom headache onset preceded the stroke, the time interval differed from a few hours to several weeks before stroke. Seven patients (13%) reported headache onset more than 3 days before stroke.

Twenty-five patients reported severe headache, 19 patients reported moderate headache, and 12 patients had mild headache. Headache severity was not significantly related to size of infarction, as measured from the

TABLE 1. Localization of Headache

	No.	%
Right-sided	10*	18
Left-sided	10†	18
Frontal	23	41
Occipital	6	11
Diffuse	7	13
Total	56	101

*In 8 cases the headache was ipsilateral to stroke lesion.

†In 6 cases the headache was ipsilateral to stroke lesion.

TABLE 2. Headache Severity in Relation to Infarct Size

Infarct Size, mL	Headache Severity			Total
	Mild	Moderate	Severe	
0 (No visible lesion)	4	8	13	25
1-5	3	6	4	13
>6	4	2	6	12

There was no significant relation between infarct size and headache severity (Kruskal-Wallis test).

CT scan (Table 2). In 25 cases no visible lesion was present on CT scan. Headache severity was not related to localization of stroke, but headache was more severe when headache was located occipitally than when located frontally.

Headache was described as pressing by 41 patients, throbbing by 10 patients, and stabbing by 5 patients. In 25 patients with headache there was associated nausea, and of these patients, 13 also had vomiting. Fourteen patients reported concomitant phonophobia or photophobia.

Twenty-four patients (43%) reported previous episodic headache: 14 patients reported tension-type headache and 10 reported migraine. Of these, 13 (54%) experienced the actual headache in stroke similar to their known episodic headache. Patients with previous tension-type headache and migraine experienced reactivation of known headache equally often.

According to the IHS criteria, using the fourth digit code number,¹⁴ headache in infarction was classified as tension-type headache in 25 patients and as migraine in 14 patients. In 12 patients none of these two sets of criteria were fulfilled (Table 3). Migraine was more often a reactivation headache (5/14) than tension-type headache (6/25), but the difference was not significant. Headache fulfilling the migraine criteria was significantly more common than tension-type headache in vertebrobasilar stroke ($P<.01$) (Table 4).

Headache showed no relation to vascular risk factors such as hypertension, diabetes mellitus, or heart disease, but headache was significantly less common in smokers compared with nonsmokers and exsmokers combined ($P<.02$) (Table 5). There was no difference in

TABLE 3. Classification of Headache in Stroke, Using Fourth Digit Code Number of the International Headache Society, 1988¹⁴

Headache Type	No. With New Headache	No. With Known Headache	Total
Infarction			
Tension	19	6	25
Migraine	9	5	14
Other	12	0	12
Hemorrhage			
Tension	1	2	3
Migraine	1	0	1
Other	1	0	1
Total	43	13	56

TABLE 4. Headache Type by International Headache Society Criteria¹⁴ in Relation to Localization of Stroke

Headache Type	Stroke Localization	
	Carotid Artery Distribution	Vertebral Artery Distribution
Migraine	8	6*
Tension	27	2
Other	6	7
Total	41	15

* $P<.01$ compared with tension-type headache (Fisher's exact test).

frequency of headache between men and women. Headache was more common in the younger age group (younger than 71 years) compared with elderly patients (71 to 80 years) ($P<.02$). A history of migraine did not predispose to headache in stroke.

Discussion

This study confirms that headache is a relatively common phenomenon in cerebrovascular disease. The present frequency of headache in infarction of 26% is similar to that reported in other prospective studies. Portenoy et al⁹ found the frequency of headache in infarction to be 27%. Other studies differ in patient sampling.

There is a general consensus in the literature that headache in lacunar infarction is less common. We found the frequency of headache in lacunar infarction to be 15%. Similar frequencies have been observed by others; Portenoy et al⁹ found that 17% with lacunar infarction had headache, and Koudstaal et al¹² found the frequency to be 13%.

This study also confirms that stroke in the basilar distribution area, especially the posterior cerebral circulation, more often is associated with headache than stroke in the carotid distribution area.^{9,10,12} The reason for this difference is not known. One possibility may be that the cerebral vasculature of meninges in the posterior circulation is more heavily innervated by nociceptive afferents than the carotid circulation area.

In patients with unilateral cerebral lesions and unilateral headache, the headache was ipsilateral to the

TABLE 5. Vascular Risk Factors For Headache Occurrence Among 238 Stroke Patients

Risk Factor	Headache (n=65)	No Headache (n=173)	OR	P*
Hypertension	16	49	0.8	NS
Diabetes mellitus	10	20	1.4	NS
Heart disease	21	58	1.0	NS
Migraine	9	24	1.0	NS
Smoking	20	83	0.5	<.02
Age <71 years	45	87	2.3	<.02
Sex (male)	26	86	0.7	NS

OR indicates odds ratio; NS, not significant.

* χ^2 test.

cerebral lesion in most cases. This observation suggests that headache is linked to an activation of ipsilateral nociceptive fibers. Ray and Wolff¹⁶ observed in 1940 that stimulation of single vessels in the meninges and at the base of the brain gave rise to an ipsilateral headache. The present findings are in accordance with these classic studies and also with new and extensive studies carried out in migraine. Olesen et al¹⁷ prospectively examined headache in migraine. In patients with unilateral headache and aura, the aura was contralateral to the headache in 35 (ie, headache was located over the affected hemisphere) and ipsilateral in three.

Recently, Friberg et al¹³ have shown that migraine pain is associated with an ipsilateral dilatation of arteries at the base of the brain and a normalization of vascular diameter when headache disappears. The present observation that headache is not related to the size of the ischemic lesion suggests that ischemia and parenchymatous damage per se are not the main factors for the presence of headache. The present findings are therefore in line with the notion that mechanisms at the surface of the brain (for example, the vasculature) may play a role in the pain.

We suggest that headache is related to activation of nociceptive trigeminovascular afferents and that pain ensues when a sufficient amount of nociceptors have been recruited.¹⁸ Because arteries at the base of the brain are more densely innervated by trigeminovascular fibers, one may speculate that headache is more commonly observed in basal lesions than in lesions distributed over the hemisphere.

Fischer¹ found that carotid stroke usually gives rise to frontal headache and that vertebrobasilar stroke causes occipital headache. We found almost exactly the same distribution of headache localization in carotid and vertebrobasilar stroke.

In our study we found that headache started before stroke in 43% of subjects. This observation is in accordance with previous studies^{9,10} and indicates that headache in stroke often has an organic rather than a psychogenic etiology. It is conceivable that the final stroke in many cases is a result of a long pathological vascular process, in which headache merely serves as a warning sign of ischemic stroke.

According to IHS criteria, using the fourth digit to classify headache in stroke, the most common type of headache was a tension-type headache. Portenoy et al⁹ found that throbbing headache occurred in 50% of their patient group, but their study did not use the new IHS criteria. They also found that previous throbbing headache was related to headache in stroke. This has not been confirmed by others,⁵ and we failed to find a significant relation between a history of migraine and headache in stroke.

There is still an ongoing debate regarding whether the neurological symptoms in migraine are due to a primary neurological disturbance or a primary ischemia. The present data are not sufficient to answer that question in detail. However, the fact that headache was

only present in a minor proportion of patients with infarction suggests that an ischemic mechanism is less likely to be the cause of headache. In addition, the lack of correlation between size of infarct and severity of headache is also evidence against an ischemic hypothesis.

The observations that headache was more common when stroke occurred in the posterior circulation and that the headache in vertebrobasilar stroke more often was of a migraine-type than of a tension-type headache do suggest that migraine and stroke share pathological mechanisms. We therefore suggest that a neural mechanism is the most likely cause of headache in stroke, and it is possible that more detailed pathophysiological studies of headache in stroke may help to clarify headache mechanisms in migraine.

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