

# A prospective double-blind clinical trial, comparing the sharp Quincke needle (22G) with an "atraumatic" needle (22G) in the induction of post-lumbar puncture headache

Braune H-J, Huffmann G. A prospective double-blind clinical trial, comparing the sharp Quincke needle (22G) with an "atraumatic" needle (22G) in the induction of post-lumbar puncture headache. *Acta Neurol Scand* 1992; 86: 50-54.

Posture-dependent, post-lumbar puncture headache is most likely caused by continuous leakage of cerebrospinal fluid through the dura mater perforation with a consecutive downward sagging of the intracranial content and an irritation of pain-sensitive structures of meninges and blood vessels. A psychogenic co-factor may also play a role. It is generally acknowledged that the incidence and intensity of the headache correlate significantly with the diameter of the needles used. A second factor, the shape of the needle point plays a crucial role as is shown in our prospective, double-blind, clinical trial with 75 patients: employment of the "atraumatic" Sprotte needle with a rounded off point significantly reduced the incidence of postpuncture headache from 36% to 4%. Beside the discussion of pathogenic factors, remarks on a rational therapy are made.

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Key words: post-lumbar puncture headache; CSF leakage; shape of needle point; atraumatic needle

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Accepted for publication December 9, 1991

Lumbar puncture is indispensable for the diagnosis of inflammatory diseases of the central nervous system (CNS) and important for the proof of a sub-arachnoidal hemorrhage. One hundred years after the first puncture for clinical purposes by Quincke (1) this procedure is an unchallenged important auxiliary examination in clinical neurology. Normally, it can be performed easily and quickly. No serious after effects and complications may be expected if performed correctly. High intracranial pressure or more than a slight reduction in coagulation factors are all that need be ruled out before lumbar puncture (2, 3).

## Post-lumbar puncture headache

Nevertheless, there can occasionally be an undesired side-effect: ordinarily within the first 48 h post-puncture a headache appears. The pain is usually occipital, but may be bifrontal, bitemporal or mixed. In most instances it is described as a dull ache, but sometimes may be throbbing. The most conspicuous feature is its gait dependence, being worsened by sitting or standing, and ameliorated, partly or totally,

by lying down (4-6). Jugular compression and head jolting can exasperate the pain. This characteristic headache is distinct and rarely imitated by any other pathologic process. Seldom, it is accompanied by a constellation of other symptoms like nausea and vomiting, neck pain and slight neck stiffness, tinnitus and unsteadiness. Mostly, these headaches are harmless and only occasionally persist for more than a week, especially after myelography (7).

## The leakage hypothesis

In 1918, it was a postulate of MacRobert (8), that leakage of cerebrospinal fluid (CSF) from the dural and arachnoidal defect after lumbar puncture plays a crucial role in triggering the headache. The dura mater of adults contains only a small fraction of elastic components. Therefore, in contrast to the blood vessels, it cannot sufficiently seal a puncture defect. This widely accepted "leakage theory" was substantiated by the detection of post mortem defects in the dura mater after lumbar punctures (9). A CSF oozing via the needle conduit could be observed in patients receiving laminectomy shortly after

a lumbar puncture (10). With myelographic administered radioisotopes a drainage into the epidural space could be shown to last longer than 36 h (7, 11, 12). Within the first hours CSF evades at a rate of 5 to 30 ml per h (13). After perforation with a thicker needle the typical headache occurs more frequently due to the greater lesion of the dura mater. In a thorough review of the relevant literature Diener et al. (4) found that the incidence of postpuncture headache increases significantly with needle thickness: the average incidence of 25.7% following a puncture with a thick needle (15–19 gauge) falls to 2% after a perforation with a very thin 27–32 gauge needle. It was shown that other factors like body posture during or after the procedure, the technique or location of the puncture, or the application of drugs or solutions before or after the procedure had no significant influence on the incidence and intensity of postpuncture complaints (14). The continued leakage of CSF through the dural rent made by the needle exceeds the production rate thus leading to a state of low spinal fluid volume and pressure. In upright posture, gravitational forces divert the relatively small remaining volume of the fluid down through the foramen magnum into the spinal subarachnoidal space leaving the cerebrum devoid of its hydraulic cushion. This causes a downward sagging of the brain that creates tension on pain-sensitive structures which lie in the meninges and around larger blood vessels (15–17). Furthermore, the equilibrium between intravascular and extravascular pressure is disturbed (5). Since veins are thin walled and, within certain limits, adapt passively to the pressure in and around them, a dilatation of veins within the cranium and the spinal canal occurs (18), which was shown by direct observation of pial vessels through cranial windows in cats (19).

Another argument supporting the importance of venous dilatation as a cause of postpuncture headache via a CSF drainage through the cisterna magna was brought forward by a controlled double-blind prospective study. It showed that caffeine sodium benzoate which may lead to vasoconstriction of cerebral vessels dramatically improved the postpuncture headache in 75% of patients after a single dose of 500 mg. An additional equivalent dose 2 h later increased the response rate to 85% (20, 21). Dilatation of arterial vessels also plays an important role. *In vivo* such a dilatation cannot be examined by direct observation. But the blood flow velocity is reduced in dilated arterial vessels which can be measured by transcranial Doppler ultrasound recording (22). Göbel et al. (15) compared the thus-measured cerebral blood flow velocity before and two days after a lumbar puncture. In patients with a typical syndrome a marked decrease of cerebral blood flow velocity was observed. In patients without headache

no significant difference of cerebral blood flow velocity could be found in the arteria cerebri media before and after the puncture.

#### Psychogenic factors

Some authors have noted that suggestion and apprehension increase the incidence and intensity of post-lumbar headache. In the Kaplan study (23) 100 healthy volunteers were divided into 2 equivalent groups, 50 individuals underwent routine lumbar puncture followed by 4 h of bed rest. The other group had an identical procedure, but without dural perforation. The needle was advanced only as far as the ligamentum flavum. There was no significant difference in the incidence of headache between the two groups, being 28% and 22% respectively. There was a 47% incidence in a subgroup of individuals who prior to the procedure expressed apprehension about the development of headaches. Kaplan therefore concluded that psychogenic factors were crucial in the development of the post-puncture syndrome. Daniels & Sallie (24) showed that the headache can be provoked by suggestion: a subgroup of their patients were expressively warned about the possible occurrence of headache after a lumbar puncture; 46% of this group developed corresponding complaints. But only 6% of the subgroup without any notification suffered from post-puncture headaches. These findings were not left unchallenged as the results of other studies practically ruled out a mere psychogenic origin. Patients ignorant about a lumbar puncture carried out in general anaesthesia complained about headache as frequently as patients who were informed (25). In 1985 Diener et al. (4) pointed out that a pure psychogenic provocation is most doubtful since complaints after peridural anaesthesia, a procedure without lesion of the dura mater, are infrequent and less accentuated. Typical postural dependence of headaches was found in no case after peridural anaesthesia. Nevertheless, a co-determination of post-puncture complaints by psychogenic factors cannot generally be excluded. Widespread apprehension of this procedure, accentuated by vivid accounts of patients' roommates leads, as Diener stated, to a greater acceptance of cerebral angiography, for example, a procedure of greater risk and more pain than lumbar removal of CSF.

#### Relevance of the configuration of the needle point

Beside the diameter of the needle, the extension of the dura mater lesion depends on the configuration of the needle point. Needles with a sharp cut Quincke point lead to a clear dissection of dura mater fibres. Conversely, needles with rounded points do not cut the fibres, but push them asunder so that after a

puncture the fibres can switch back and close the leakage. The needle designed by Sprotte et al. (26) is based on this principle (Fig. 1)\*. Two studies in recent years indicate that using this type of needle helps to diminish the post-puncture headache (27, 28). We wanted to confirm these findings.

#### Material and methods

In a prospective, double-blind clinical trial 75 patients underwent a lumbar puncture with either the Quincke needle ( $n=25$ ) or the Sprotte needle ( $n=50$ ). Subsequently, clinical examination and an interview were done by a member of our staff. Neither he nor the patients were informed of the type of needle used. The patients were all in-patients of our neurological department. In all, the puncture was performed to exclude any inflammatory disease of the CNS. All were fully conscious and cooperative, none had headaches before the procedure, all were informed in a standardized way about the procedure and possible after effects. For all of them it was the first lumbar puncture. It was performed without local anaesthesia. A total of 25 patients (men: 19, women: 6, mean age: 55.6 y) were treated with a sharp Quincke needle of 0.7 mm diameter (22 gauge). In 50 patients (men: 36, women: 14, mean age: 53.2 y) the procedure was carried out with a so-called "atraumatic" Sprotte needle with a rounded point, but the same diameter (0.7 mm, 22 gauge). Skin perforation is difficult with this kind of needle, therefore an introducer is used, and the needle itself advanced through it.

From all patients 8–10 ml CSF were removed. They were advised to stay in a prone position for 2 h after the puncture. No further instructions were given and the patients could move in accordance with their clinical status.

#### Results

In the subgroup of patients punctured with the sharp Quincke needle 44% had no complaints at all afterwards; 20% complained about slight headaches for one or two days which were easy to tolerate. The remaining 36%, a quota in accordance with the figures found in literature (6, 29, 30), had more than mild to severe typical headaches, clearly accentuated



Fig. 1. The point of the "atraumatic" needle (modified from (26)).

\* Made by HELL & Cie., W-8531 Diespeck, Germany.

in a vertical body posture. They were most harassed after 24 h. The pain faded away in the following days.

In the subgroup of patients punctured with the "atraumatic" Sprotte needle 60% had no discomfort at all; 36% complained of slight disturbance tolerable without further discussion. Only two patients (4%) suffered from typical, but by no means severe post-puncture headache lasting for two days. No analgesic treatment was necessary. The difference between the two subgroups was highly significant ( $p<0.001$ ).

Expectancy, pain sensitivity, mobility or underlying neurological disorder had no significant influence on the development of the headaches.

#### Discussion

As in the studies of Jäger et al. (27) and Engelhardt et al. (28) our clinical trial confirmed the effect of the "atraumatic" Sprotte needle: typical post-puncture headaches were found in only 4%, compared with 36% of the group treated with the sharp Quincke needle. Therefore, it can be concluded that not alone the diameter of the needle plays a significant role in the pathogenesis of these headaches, as shown in former trials. The shape of the needle point also plays a crucial part. The clear reduction in incidence and intensity of complaints by using the "atraumatic" needles excludes the pathogenic relevance of such other factors as technique of puncture, volume of CSF removed and post-procedural bed rest. In 1902, Sicard (31) demanded strict bedrest for 24 h. But controlled clinical trials indicated that this and such similar advice as resting in a prone position had no significant effect (29, 30, 32–34). Thus, there are no striking arguments against a quick mobilisation without further ado. In a study of 45 patients Göber & Schenkl (35) measured movement in the first 24 h after puncture with a pace counter. A negative correlation between movement and headaches was found: the more the patients moved, the less accentuated were the headaches.

#### Therapy

If, however, a patient occasionally complains about headaches, they should stay in bed in a horizontal position. This is the most effective and safest measure to cope with this kind of trouble. Forced drinking or intravenous solutions have no proven effect, and nor do analgesics (6). Patients with a severe syndrome may find relief from 500 mg caffeine as recommended by Sechzer & Abel (20). In cases with longer-lasting trouble, an epidural blood patch can be tried to "close up" the dural leakage. In 1960, Gormley (36) treated 6 patients like this for the first



time with positive effect. Subsequently, these results have been confirmed with larger patient groups and positive results in over 90% (37-39).

### Conclusions

From the literature and our study the following conclusions can be drawn:

1) Post-lumbar puncture headache is most probably the consequence of continuous oozing of cerebrospinal fluid through the dura mater perforation.

2) The diameter and shape of the needle's point play a crucial role in the incidence and intensity of the headache. A thin needle with a rounded point is recommended, for instance the "atraumatic" Sprotte needle. This procedure reduces the incidence of post-lumbar puncture complaints so dramatically that it can also be done with out-door patients.

3) A psychogenic origin of such headaches is improbable, however, too much information before the puncture may lead to apprehensiveness that can accentuate slight problems, especially in young and anxious patients, so that a psychogenic cofactor must be assumed.

4) Influence of body posture after the puncture is not proven. There is evidence that the incidence of headache is diminished in patients who keep moving in the hours and days after the puncture.

5) If ever a post-lumbar puncture headache occurs, horizontal body posture is the accurate and most effective remedy. In more severe cases, 500 mg caffeine or an epidural blood patch should be considered. Such measures as analgesics or oral or intravenous solutions have no proven effect.

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