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Is Obligatory Bed Rest After Lumbar Puncture Obsolete?

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Summary. After lumbar puncture (LP) an epidural CSF leakage caused by delayed closure of a dural defect leads to a decrease in CSF pressure. The resultant venous dilatation as well as downward shift of the brain with traction on pain-sensitive blood vessels and nerves frequently evokes post-lumbar puncture headache (PLPH), when the patient assumes the upright position. In previous studies differing opinions have been expressed about the prophylactic value of the posture taken by the patient after LP. The present study was designed to evaluate the benefit of the decrease of hydrostatic CSF pressure on the dural rent, when the patient lies down in a prone position with the head tilted down at an angle of 10° for 30 min immediately after LP: is it possible to accelerate the closure of the dural defect in this way and prevent PLPH? One group of patients ($n = 78$) lay in a prone position with the head tilted down at an angle of 10° for 30 min, the other group ($n = 82$) rose immediately after LP. PLPH was found to be independent of the posture in both groups and affected 44% and 41% of the patients, respectively, so that there is no longer any justification for requiring patients to remain in bed after LP.

Key words: Post-lumbar puncture headache – Posture

Introduction

Post-lumbar puncture headache (PLPH) syndrome is usually an occipital or frontal headache with neck stiffness and sometimes accompanied by nausea, numbness and blurred vision. It typically starts within a few hours, most often 24 to 48 h after puncture, independently of the volume of CSF removed. Young adults (women > men) are particularly affected, whereas children (<10 years) and older patients (>60 years) are less susceptible (Dripps and Vandam 1954). Pathogenetically a continued epidural CSF leakage caused by delayed closure of the dural defect leads to a decrease in CSF pressure (Kadrie et al. 1976). When the patient is in a horizontal position the lumbar, cisternal and intracranial CSF pressures are equal (approximately +50 to +150 (+200) mm H_2O). In the upright position they increase to positive values of about +500 mm H_2O at the lumbar level, and decrease to zero at the cisternal level and to negative values of about −300 mm H_2O maximally at the intracranial niveau. These cisternal/intracranial negative and lumbar positive CSF pressures imitate the physical principle of a hanging drop, which applies to the venous pressure in a similar way (Kunkle et al. 1943). Headache does not directly correlate with the lumbar or intracranial CSF pressure, but is closely associated with a change in the normal difference of the intra-extravascular pressure of the intracranial veins (Kunkle et al. 1943). Resulting venous dilatation and downward descent of the brain with subsequent stretching of pain-sensitive structures such as dura, nerves and blood vessels cause the PLPH. The ninth and tenth cranial nerves and the upper three cervical nerves below the tentorium cerebelli transmit pain from the suboccipital region and the neck; the second and third divisions of the fifth cranial nerve above the tentorium cerebelli transmit frontal pain (Pickering 1948; Wolff 1972). Psychogenic factors, frequently considered to be of major importance (Kaplan 1967; Daniels and Sallie 1981; Paulley 1980), are of subordinate significance.

Because of this pathogenesis it would appear sensible to prescribe prophylactic bed rest after LP in order to decrease the hydrostatic CSF pressure on the dural defect, and consequently accelerate the spontaneous closure of the lengthwise running dural fibres and therefore reduce the CSF leakage into the subarachnoid space.

Sicard's publication (1902) was the first of some older studies which claimed to have proved the advantage of 24 h bed rest. On the other hand Jones (1974) and Carbaat and van Crevel (1981) showed that a post-lumbar puncture bed rest for 24 h only delays the onset of headache but does not prevent its development. In view of the results of these studies 24 h bed rest no longer seems advisable. In 1958 Brocker described in his study a lower incidence of headache after lying on the abdomen for 3 h than on the back for the same time before ambulation. Smith et al. (1980) reported on the favourable influence of 30 min 30° head down tilt followed by $3^3/_4$ h supine bed rest versus 4 h supine bed rest only. In contrast Hilton-Jones et al. (1982) found the procedure with a 30 min head down tilt position to be of no benefit. There was however a relatively high incidence of 47% (20SWG).

Doubts remain as to whether an immediate prone position with head down tilt for 30 min can support the spontaneous closure of the dural defect by reducing the hydrostatic CSF pressure and can therefore be preferred to direct mobilisation.

To examine the prophylactic efficacy of this postural manoeuvre in a prospective study patients were randomly allocated to one of two groups: the members of one group were to lie with their heads tilted down at an angle of 10° for 30 min, the members of the other group were to get up immediately after LP.

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Methods

Patients. Diagnostic LP was performed on 160 neurological patients (age: a range of 12 to 82 years; average age: 46 years; 51% were female, 49% were male).

Posture. Eighty-two patients were mobilized immediately (sitting, standing, walking); 78 patients were mobilized after 30 min in a prone position with head down tilt at an angle of 10°.

Excluding Criteria. All patients were excluded who (a) had undergone a LP in the last 4 weeks, (b) had an increased intracranial pressure, (c) could not be mobilized, (d) had a psychoorganic disease or disturbance of consciousness.

Patients receiving regular analgesic or psychotherapeutic treatment and patients, who had headache before LP, or patients, where the needle's introduction was corrected a few times before finding the proper position, were also excluded.

LP Technique. Lumbar puncture was performed in a sitting position using a 20 SWG needle (110 patients) or a 22 SWG needle (50 patients). Access was via the L3/4 or L4/5 interspace and 8 to 10 ml of CSF was removed.

Informing the Patients. All the patients were informed in the same way without being told about the characteristics of the PLPH.

Evaluation. The intensity of the PLPH was rated by the patients according to the following three grades:

0 no complaints
I minor complaints
II major complaints.

Symptoms were recorded only if they could credibly be reproduced by changing the position and typically improved by bed rest. The kind, localisation and duration of the PLPH were registered. After LP the patients were told to drink about 3 l of fluids a day during the next 5 days.

Results

Postural Manoeuvres

The incidence of PLPH was independent of postural manoeuvres: 44 (56%) of the 78 patients who lay down in a prone position with their heads tilted down at an angle of 10° for 30 min had no PLPH; 48 (59%) of the 82 patients who were directely mobilized had no PLPH. There was no significant difference in the percentage of minor (grade I) and major complaints (grade II) in both groups with 30% versus 23% (grade I) and 14% versus 18% (grade II) (Fig. 1).

Needle Size

As opposed to previous studies, in which the incidence of PLPH was found to be significantly lower when using a smaller needle calibre [20/22 SWG: 35% to 40%, 24/27 SWG: 5% to 12%, (Tourtellotte et al. 1972; Dripps and Vandam 1954)], in our own study there was a higher rate of complaints with the smaller 22 SWG needle.

After LP with a 22 SWG needle 62% developed headache (36% grade I, 26% grade II), only 38% had no complaints. When using the 20 SWG needle we found a frequency of headache in 34% (22% grade I, 12% grade II) while the majority (66%) felt well (Fig. 2).

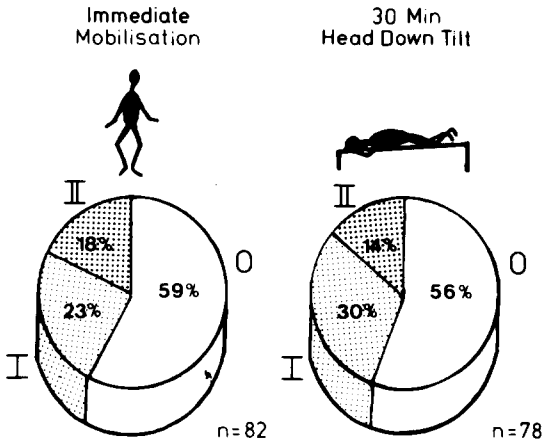

Fig. 1. Influence of post-lumbar puncture posture on the incidence (%) and severity (classified in grade I and II) of PLPH in two groups. One group of patients (n = 82) rose immediately after LP, the other group (n = 78) lay in prone position with the head tilted down at an angle of 10° for 30 min. There was no significant difference in the incidence and severity of PLPH in either group

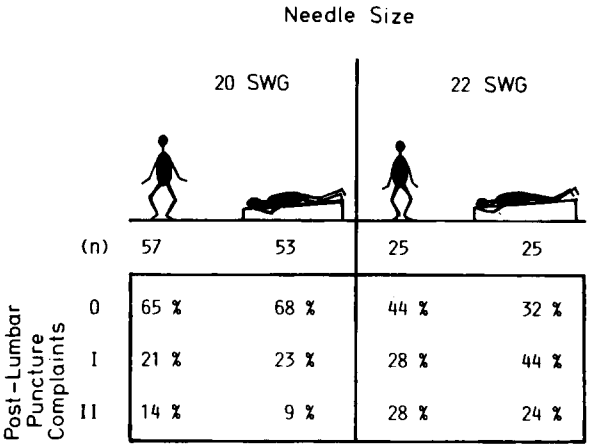

Fig. 2. Influence of needle size and posture on the incidence (%) and severity (classified in grade I and II) of PLPH in two groups. One group of patients rose immediately after LP, the other group lay in prone position with the head tilted down at an angle of 10° for 30 min

Sex

Women complained more often of PLPH than men (51% versus 39%).

Patients with Multiple Sclerosis (MS)

A diagnosis could be made in 106 of the 110 patients randomly assigned to the 20 SWG needle group, 11 (10%) of them had multiple sclerosis, 95 (90%) another disease. The incidence of PLPH in patients with MS was 18% (2 out of the 11 patients), in the others 32% (30 out of the 95 patients). There seems to be a lower incidence of PLPH in MS patients, even if the small number of these patients is taken into consideration.

Discussion

Postural Manoeuvres

A review of the literature and our own experience indicate that the posture taken by the patients after LP seems to have the following value.

A particular posture assumed after LP, such as 24 h bed rest (Jones 1974; Carbaat and van Crevel 1981), 4 h in the prone or supine and horizontal position (Hilton-Jones et al. 1982; Handler et al. 1982), head tilted down at 30° for 30 min (Easton 1979; Hilton-Jones et al. 1982; Handler et al. 1982), 30 min in the prone position with the head tilted down at 10° cannot prevent the development of PLPH or reduce it significantly, but only delay its onset. The common incidence of headache (35% to 40%) following diagnostic LP with a 20 SWG needle was confirmed in our own study (35% after direct mobilisation and 32% after 30 min in the prone position with the head tilted down). Posture did not make a significant difference in the frequency of PLPH.

The failure of prone head down tilt posture to facilitate the closure of the dural defect in our patients may be due to a erroneous assumption of decreased (hydrostatic) CSF pressure on the dural rent in this position. Because downward tilt of the head leads simultaneously to an increased hydrostatic pressure on intracranial veins which enlarge and occupy space and can thereby maintain pulsating CSF leakage even in the prone head down tilt position.

So there is no longer any justification for requiring patients to stay in bed after LP as is the rule in many hospitals. Older studies that claimed to have proved the contrary have been convincingly disproved. Thus all patients should be told to rise immediately after LP.

But when headache has been established, lying down relieves it within minutes. An intermittent bed rest adjusted to the complaints makes sense as symptomatic therapy, but not as physical prevention. The question of whether posture has an influence on the duration of the headache has not yet been answered. Perhaps horizontal bed rest or tilting the head down can reduce the period of PLPH.

We believe from our clinical experience that a classification of symptoms into 4 grades (0–III) having regard to their severity, which can be differentiated by the latency of the symptoms onset after mobilisation, may prove useful:

0 normal, no complaints;
I mild postural headache, occurring after 30 min of mobilisation with normal daily activity ($\geq$30 min);
II postural headache, occurring within the first 30 min after mobilisation and severe enough to make the patient lie down several times a day (<30 min);
III postural headache, occurring within a few seconds to 10 min after mobilisation and severe enough to make the patient lie down in bed in a horizontal position for the rest of the day ($\leq$10 min).

Needle Size

The definite correlation between the incidence of headache and needle size in LP [16–18 SWG: 70%, 20–22 SWG: 35%–40%, 24–27 SWG: 5%–12% (Tourtelotte et al. 1972; Smith et al. 1980; Hilton-Jones et al. 1982)] demonstrates the efficient "prophylactic therapy" in preventing headache by the use of an especially small needle (Tourtelotte et al. 1972; Spielman 1982). According to this cannules of 22 to 26 SWG are suitable or so-called "Dattner" needles, in which the blunt mandrin is replaced by a smaller and longer tube after inserting an introducer into the epidural space. Unfortunately there are disadvantages in using fine calibre needles: the needle's flexibility makes it more difficult to guide during the puncture and a very slow rate of fluid flow lengthens the procedure considerable. These facts limit the choice of needle size in diagnostic LP especially as nowadays the frequent immunological analysis of CSF necessitates the removal of 10 ml or more CSF. CSF pressure measurements, such as the Queckenstedt test, will be inexact if fine calibre needles are used. Nevertheless in our own study we found a higher incidence of headache and more frequent "major" complaints with the smaller 22 SWG needle, a phenomenon we have so far been unable to explain.

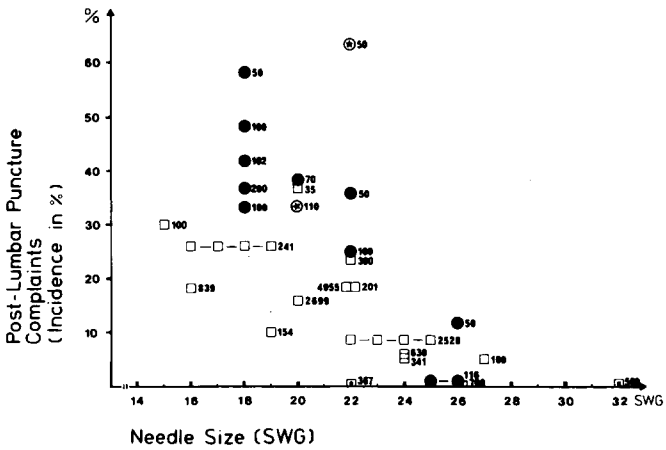

Fig. 3. Frequency of PLPH (%) with respect to the needle size (SWG) in diagnostic LP (●) and spinal anaesthesias (□) in review of the literature and our own studies (○). There is a definite correlation between the incidence of headache and needle size: the smaller the bore of the needle the lower the incidence of PLPH. The figures represent the numbers of patients in each study. (Cann and Wycoff 1950; Dripps and Vandum 1954; Smith et al. 1980; Lange 1978; Sciarra and Carter 1952; Brocker 1958; Carbat and van Crevel 1981; Cowan et al. 1980; Hilton-Jones et al. 1982; Greene 1950; Tourtelotte et al. 1972; Kaplan 1967; Pfeffer 1953; Rosser and Schneider 1956; Gerner 1980; Frumin 1969)

Not only the size of the needle may be important, but also the tip of it—some investigators prefer cone-nose shaped tips (Bergmann 1972; Wiggli and Oberson 1975)—and the direction of insertion. The longitudinally running dural fibres should not be cut by introducing the needle bevel at right angles but separated. Hatfalvi (1977) noted in 600 spinal anaesthetics and in cadavers a greater leakage if a needle inserted perpendicularly in the mid-line entered the dura at right angles, whereas a needle from a lateral approach entered the dura tangentially. Perhaps this tangential insertion is another reason for the lower incidence of PLPH following the use of fine calibre needles, which are more flexible and thus more often diverted by structures between skin and dura—even if inserted in the mid-line—and enter the dura tangentially.

In spinal anaesthesia the lower average incidence of headache of 16%–18% [16–19 SWG: 10%–30%, 20–22 SWG: 16%–18%, 24–27 SWG: 5%–8.5% (Greene 1950; Cann and Wycoff 1950; Dripps and Vandam 1954; Kortum et al. 1979)] (Fig. 3) results not only from the use of smaller needles, but from some other factors not applicable to diagnostic LP: (1) The fluid introduced is an anaesthetic. (2) More fluid is introduced than removed. (3) Post-operative patients usually stay in bed longer, so that headache is not noticed during this period. (4) The majority of the patients is older which causes a lower susceptibility (Dripps and Vandam 1954).

Therapy

If self-limiting PLPH has occurred, then the best symptomatic treatment consists of a pain-adapted bed rest for several days in the horizontal position (and the prolonged oral administration of fluids?), which normally makes the administration of various analgesics, anti-emetics and sedatives redundant. In patients with "major" complaints and who are unable to drink fluids i.v. half isotonic fluid is usually administered.

Other therapeutic possibilities such as anti-diuresis with desmopressin, a synthetic analogue of the natural hormone arginine-vasopressin (Aziz et al. 1968; Cowan et al. 1980), infusions of fluids containing sodium chloride into the epidural space (Crawford 1972; Craft et al. 1973), or the use of an abdominal binder (Rosher and Kaye 1956) to raise the epidural pressure have been described. Because of undesirable side-effects or the lack of proof of their efficacy these procedure cannot be recommended.

In the rare individual cases of severe chronic complaints caused by a persistent dural defect the technique of an epidural autologous blood patch (EBP), introduced by Gromley in 1960, should be considered. Aseptic autologous blood (7 to 15 ml) is injected through a needle into the same epidural space as in the previous LP and the patient lies down on his back for approximately 30 min. The EBP relieves PLPH by forming a gelatinous tamponade which seals the dural rent successfully in 80%–95% of cases (Abouleish et al. 1975). Mild, transient lumbar backache or neckache (Cornwall and Dolan 1975; Wilkinson 1980) but no severe long-term complications have been observed (Di Giovanni and Dunbar 1970; Di Giovanni et al. 1972; Ostheimer et al. 1976; Kiss et al. 1982).

Obviously the CSF deficiency is compensated after EBP within the surprisingly short time of 1 to 2 h which can be explained by physiological CSF dynamics: the continuous liquor flow into the epidural space leads to a significant reduction of the normal total CSF volume (100 to 160 ml) of more than 30 ml and (secondary to the decrease of intracranial CSF pressure) to a compensatory reduction of the CSF resorption, while the CSF production remains the same. The resorption mainly takes place in Paccioni's granulations, which function like valves sensitive to pressure and only open if the CSF pressure exceeds the opening pressure of the resorption system of about 70 mm H_2O (Key and Retzius 1875; Welch and Friedman 1960). By ventriculo-cisternal perfusion—the most exact method nowadays of finding the rate of CSF production and resorption—the resorption of CSF was found to be sensitive to pressure (Heisey et al. 1962; Prockop and Schanker 1962; Prockop et al. 1962; Bering and Sato 1963; Rubin et al. 1966; Calhoun et al. 1967; Hochwald and Wallenstein 1967; Cutler et al. 1968; Lorenzo et al. 1970a, b; Page et al. 1973). Elevated CSF pressures—above the opening pressure—force the fluid resorption in the ventriculo-subarachnoid space, whereas low intracranial CSF pressures reduce the resorption (Pappenheimer et al. 1962), while the rate of production is normally independent of the CSF pressure (Bering and Sato 1963; Cutler et al. 1968). The system is in equilibrium at a pressure of 112 mm H_2O, the theoretical "normal" CSF pressure, with an equivalent rate of resorption and production of about 0.35 ml/min (Cutler et al. 1968).

This means, that a loss of 30 ml CSF, for example, due to a persisting dural defect can be totally compensated in about 85 min after the closure of the dural rent. In addition the injected EBP of about 10 ml can shorten the resulting phase of PLPH by its volume which reduces the net CSF volume that has to be replaced in order to elevate the intracranial pressure to normal.

In the elderly production of CSF decreases, but at the same time the volume of the ventriculo-subarachnoid space is increased by brain involution. In this way a relatively small loss of CSF perhaps causes less dilatation of the blood vessels and downward descent of the brain with subsequent stretching of pain-sensitive structures, which might explain the lower incidence of PLPH in old age.

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