

## LUMBAR-PUNCTURE HEADACHE

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The headache which sometimes develops after a lumbar puncture has a dual interest, for not only is it important in the clinical management of the patient, but also it has stimulated enquiry into the causative mechanism of headache as a whole. Post-puncture headache has characteristic features. It may appear from a few hours to a few days after the puncture, and it is made worse by jugular compression and relieved by lying down.

Over a quarter of a century ago Jacobaeus and Frumerie (1923) reported low pressure of the cerebrospinal fluid in two patients with headache following lumbar puncture. Since their publication in 1923 low pressure of the cerebrospinal fluid as the cause of post-puncture headache has gained general acceptance. About a year ago Pickering (1948) published observations on seven patients on whom a second puncture was performed during a post-puncture headache. Six patients had a zero pressure, and one a pressure of 80 mm. Pickering pointed out that the converse, absence of a low pressure in patients who did not experience a post-puncture headache, had not been reported.

In the present study a second puncture was performed on 43 patients regardless of the presence or absence of headache. They were consecutive admissions to the Department of Neurology at the Manchester Royal Infirmary, but patients suffering from cerebral tumour, cerebral abscess, meningitis, or sub-arachnoid hæmorrhage were excluded.

### Technique

At the first puncture the patient was placed in the left lateral position and, after skin anæsthesia had been obtained by 1 % procaine, a No. 18 Howard-Jones needle was introduced between the third and fourth lumbar spines. A 2 mm.-bore Greenfield manometer was immediately attached and the initial pressure of the cerebrospinal fluid noted. Queckenstedt's test was then performed, after which approximately 10 ml. of cerebrospinal fluid was removed for analysis. Finally, the cerebrospinal fluid pressure was noted again. The

patient remained in bed supine throughout the day and was encouraged to drink freely. In the evening he was allowed up. Twenty-four hours after the initial puncture the patient was questioned as to the presence of headache in the supine and erect postures, and the effect of bilateral jugular compression was observed.

The lumbar puncture was then repeated employing the same technique, and the initial pressure was taken. A few drops of cerebrospinal fluid were removed for a comparative cell count.

### Results

The results of these observations are presented in Table I. Of the 43 patients examined, 6 developed headache and 37 remained free. The headache in one of these six (Case 1) did not fulfil the criteria of a post-puncture headache, being unrelieved by lying down. Moreover, it was accompanied by a brisk polymorphonuclear response in the cerebrospinal fluid, a count of 446 cells per c.mm. being obtained. This patient has, therefore, been excluded from the series.

The remaining five patients with headache comprised two patients with a zero pressure at the second puncture, one with a low pressure, and two with a pressure within the normal range of 60 to 160 mm. The 37 patients with no headache included Case 2 with a zero pressure at the second puncture, Case 30 with a pressure of 5 mm., Cases 3 and 19 with a pressure of 35 mm. and Cases 11, 20, and 29 with a pressure of 50 mm. The remaining cases had pressures between 50 and 170 mm. These facts are summarized in Table II. Testing for the departure from proportionality in this table gives  $p=0.078$ , that is, a discrepancy as great or greater could arise by chance eight times in a hundred trials. There is, therefore, no significant association between the cerebrospinal fluid pressure at the second lumbar puncture and the presence of headache.

An attempt was made to correlate the presence of headache with the degree of difference between the initial pressures at the first and second punctures. These figures are tabulated in Table III and sum-

TABLE I  
OBSERVATIONS ON CEREBROSPINAL FLUID PRESSURES AND HEADACHE IN THE 43 CASES

No.	Sex	Age (years)	Diagnosis	First Lumbar Puncture		Second Lumbar Puncture		Cells	
				Initial Pressure	Final Pressure	Headache	Initial Pressure	First Lumbar Puncture	Second Lumbar Puncture
1	M	42	Motor neurone disease .. .. .	115	—	+	150	1	446
2	F	67	3rd N. palsy .. .. .	50	—	0	0	7	13
3	M	58	Radiculitis .. .. .	45	35	0	35	3	82
4	M	41	Depression .. .. .	135	—	0	175	1	1
5	M	30	Syphilis .. .. .	95	0	0	150	201	478
6	M	48	Disseminated sclerosis .. .. .	95	40	0	150	1	11
7	M	45	Epilepsy .. .. .	110	50	0	110	1	3
8	F	26	Epilepsy .. .. .	90	60	+	105	1	4
9	F	42	Dementia paralytica .. .. .	100	70	0	110	24	8
10	F	46	Chorea .. .. .	120	85	0	90	3	1
11	M	56	Cerebral atrophy .. .. .	85	85	0	50	1	3
12	M	38	Cerebral aneurysm .. .. .	175	160	0	100	11	11
13	F	33	Sub-acute combined degeneration .. .. .	65	50	0	110	1	0
14	F	66	Cerebral arteriosclerosis .. .. .	115	90	0	80	1	4
15	F	51	Myopathy .. .. .	120	90	0	120	1	1
16	M	47	Epilepsy .. .. .	65	60	+	60	1	3
17	F	34	Exophthalmos .. .. .	90	70	+	35	2	2
18	M	49	Cerebral aneurysm .. .. .	130	110	0	70	1	—
19	F	18	Disseminated sclerosis .. .. .	80	0	0	35	33	38
20	F	46	Cerebral atrophy .. .. .	115	90	0	50	1	1
21	F	55	Vascular lesion .. .. .	115	100	0	70	1	3
22	M	27	Disseminated sclerosis .. .. .	175	140	0	130	3	7
23	M	55	Disseminated sclerosis .. .. .	95	75	0	120	—	—
24	M	64	Disseminated sclerosis .. .. .	100	—	0	160	1	3
25	M	15	Epilepsy .. .. .	90	35	0	100	5	3
26	M	51	Epilepsy .. .. .	130	—	0	170	1	5
27	M	64	Epilepsy .. .. .	60	40	0	70	1	200
28	M	39	Epilepsy .. .. .	105	95	+	0	1	6
29	M	47	Epilepsy .. .. .	95	45	0	50	1	1
30	F	28	Epilepsy .. .. .	40	30	0	5	1	—
31	F	50	Disseminated sclerosis .. .. .	80	25	0	130	2	1
32	M	36	Cerebral thrombosis .. .. .	75	45	0	140	1	1
33	F	49	Spinal neoplasm .. .. .	155	—	0	140	—	—
34	F	50	Tabes dorsalis .. .. .	130	—	0	130	1	1
35	M	43	Disseminated sclerosis .. .. .	80	60	0	130	—	—
36	F	67	Aneurysm .. .. .	150	105	0	130	12	—
37	F	54	Neuropathy .. .. .	130	60	0	135	1	1
38	F	17	Anaemia .. .. .	100	70	0	80	1	1
39	F	47	Optic atrophy .. .. .	90	60	0	80	1	1
40	F	35	Radiculitis .. .. .	155	40	+	0	1	—
41	M	47	Epilepsy .. .. .	150	140	0	130	—	—
42	F	56	Sub-acute combined degeneration .. .. .	145	130	0	80	—	—
43	F	38	Depression .. .. .	125	90	0	90	—	—

TABLE II  
RELATIONSHIP OF HEADACHE TO SECOND LUMBAR PUNCTURE PRESSURE

Headache	Second Lumbar Puncture Pressures		
	60 mm. and over	Less than 60 mm.	Total
Present ..	2	3	5
Absent ..	30	7	37
Total ..	32	10	42

marized in Table IV. The departure from proportionality test in this instance gives  $p=0.37$ , indicating again a lack of significant association between the pressure difference and the occurrence of headache.

The final correlation attempted was between the headache and the degree of fall in the cerebrospinal fluid pressure on withdrawing 10 ml. of fluid at the first puncture. The results are presented in Table V and summarized in Table VI. Here, testing for the departure from proportionality gives  $p=0.634$ , which is again without significance.

TABLE III

RELATIONSHIP OF HEADACHE TO DIFFERENCE BETWEEN CEREBROSPINAL FLUID PRESSURE AT FIRST AND SECOND LUMBAR PUNCTURE

Change in Pressure (mm.)	Patients without Headache	Patients with Headache
+ 65 to 75	1	—
+ 55 to 65	3	—
+ 45 to 55	3	—
+ 35 to 45	2	—
+ 25 to 35	—	—
+ 15 to 25	1	1
+ 5 to 15	4	—
— 5 to 5	3	—
— 15 to — 5	2	1
— 25 to — 15	4	—
— 35 to — 25	1	—
— 45 to — 35	4	—
— 55 to — 45	5	—
— 65 to — 55	1	1
— 75 to — 65	2	—
— 85 to — 75	1	—
—115 to —105	—	1
—165 to —155	—	1

TABLE IV

SUMMARY OF DIFFERENCE BETWEEN CEREBROSPINAL FLUID PRESSURE AT FIRST AND SECOND LUMBAR PUNCTURE IN RELATION TO HEADACHE

Headache	Pressure Decreased	Pressure Unchanged or Increased	Total
Present ..	4	1	5
Absent ..	20	17	37
Total ..	24	18	42

### Discussion

From these results it seems justifiable to conclude that while post-puncture headache is often associated with a low cerebrospinal fluid pressure, such a low pressure is not invariable, nor, on the other hand, is headache an inevitable accompaniment of a low pressure. The immediate cause of the headache is believed to be dilatation of intracranial vascular channels mainly on the venous side, and also traction on and displacement of these channels. It seems that while the hydrostatic disturbance induced by the removal of cerebrospinal fluid at lumbar puncture may sometimes be sufficient to cause headache, the degree of such a disturbance is not directly proportional to the cerebrospinal fluid pressure.

This would accord with the work of Kunkle and others (1943). They measured the cerebrospinal fluid pressure at the vertex in erect healthy subjects. The initial pressure was —160 mm. They then removed cerebrospinal fluid until the pressure was

TABLE V

RELATIONSHIP OF HEADACHE TO FALL IN PRESSURE ON REMOVING 10 ML. OF CEREBROSPINAL FLUID AT FIRST LUMBAR PUNCTURE

Fall in Pressure	Patients without Headache	Patients with Headache
0	1	—
5-	3	2
15-	8	1
25-	7	1
35-	3	—
45-	2	—
55-	4	—
65-	1	—
75-	1	—
85-	—	—
95-	1	—
105-	—	—
115-	—	1

TABLE VI

SUMMARY OF RELATIONSHIP OF HEADACHE TO FALL IN PRESSURE ON REMOVING 10 ML. OF CEREBROSPINAL FLUID AT FIRST LUMBAR PUNCTURE

Headache	Fall in Pressure on Withdrawal of 10 ml. Cerebrospinal Fluid		
	Less than 35 mm.	35 mm. and more	Total
Present ..	4	1	5
Absent ..	19	12	31
Total ..	23	13	36

—215 mm., when severe headache was present. Tilting the patient to 15° from the horizontal eliminated the headache. Further cerebrospinal fluid was removed, and the headache returned though the vertex pressure was only —113 mm., a figure which was higher than the original resting pressure when no headache was present. In another case headache was produced at —230 mm.; the patient was then tilted to 40° and more fluid was removed, but at —248 mm. the headache had not returned. There is, therefore, a clear lack of direct dependence of the headache on the cerebrospinal fluid pressure.

Pickering (1948) suggested that normal cerebrospinal fluid pressure in patients with headache might be a result of meningeal irritation, but in the observations made here the cell counts in the fluid showed no evidence of a meningeal reaction. Further, in the patient in whom a meningeal reaction was present the headache was unlike that of a post-puncture type.

A possible factor in the failure of some patients to develop headache with a low cerebrospinal fluid

pressure was suggested by one observation. The patient who had a zero pressure and no headache was given 0.1 mg. of histamine acid phosphate intravenously and, though she developed a marked facial flush and metallic taste, she had no headache. The ease with which histamine headaches can be produced in different subjects varies considerably (Pickering, 1933). It may well be that this is associated with a variable sensitivity of the intracranial perivascular tissues to pain. Such a variable sensitivity might also be a factor in determining the presence or absence of post-puncture headache.

In conclusion, therefore, it may be said that though post-puncture headache has probably a mechanical basis it cannot always be correlated with a lowered cerebrospinal fluid pressure, and other factors must play a part.

#### Summary

The cerebrospinal fluid pressure in 43 patients was ascertained 24 hours after an initial lumbar puncture.

Five patients had a post-puncture headache, three with a low cerebrospinal fluid pressure, two with a normal pressure.

Thirty-seven patients had no headache, seven having a low cerebrospinal fluid pressure and thirty a normal pressure.

Though there is a tendency for post-puncture headache to be associated with a low cerebrospinal fluid pressure, the association is not invariable, nor is a low cerebrospinal fluid pressure always accompanied by a headache.

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