Effect on the white cell count of contaminating cerebrospinal fluid with blood

JOHN P OSBORNE AND B PIZER

Bristol Royal Hospital for Sick Children, Bristol

SUMMARY Retrospective analysis of heavily blood-stained cerebrospinal fluid shows that there are fewer white cells found in this fluid than would be expected by calculations using the peripheral blood red to white cell ratio. This phenomenon may disguise a true leucocytosis.

Cerebrospinal fluid (CSF) is occasionally heavily contaminated with blood during collection. When lumbar punctures are performed to confirm or refute the diagnosis of meningitis, accurate interpretation of the cell count is required. Many clinicians believe that the number of white cells found in blood-stained CSF can be calculated by determining the ratio of red to white cells in peripheral blood and expecting the same ratio to be found in the CSF. An excessive number of white cells would then indicate a leucocytosis in the CSF. We investigated this hypothesis.

Methods and results

A retrospective analysis of all CSF samples contaminated by more than $10{\cdot}0 \times 10^9$/l red cells (10 000 cells per mm^3) detected only 28 cases in a 5-year period in patients in whom a peripheral white cell and red cell count had been obtained simultaneously. All lumbar punctures were performed to exclude meningitis. An expected white cell count was calculated using the ratio of red to white cells as described above, and this was compared with the observed white cell count. Fourteen of the specimens were obtained from neonates and are considered separately because of their rapidly changing red and white cell counts.

There were 9 neonates and 10 older children (age range 8 weeks to 10 years) in whom meningitis was subsequently thought extremely unlikely clinically and in whom CSF culture was sterile. Their observed and expected white cell counts are shown in the Table. The mean observed CSF white cell count was 25% of expected for the neonates and 14% for the older children.

There were 4 neonates in whom meningitis was thought possible because of disproportionately high white cell counts (129, 219, 231, and 518% of expected). In one neonate encephalitis was suspected on the computerised tomography scan and echo II virus was found in the stool but not in the CSF (WBC 17% of expected).

There were 4 older children (age range 5 weeks to 13 months) in whom meningitis was thought possible. In 2 cases there was a disproportionately high white cell count (WBC 177 and 184% of expected). In one case an earlier lumbar puncture had proved meningitis (WBC 73% of expected), and in one case meningitis was proved on culturing *Haemophilus influenzae* from the blood-stained CSF (WBC 238% of expected).

Table *Observed and expected CSF white cell counts of 19 children without meningitis are compared. The expected count is that calculated if the CSF red cell count and the peripheral blood red to white cell ratio are known*

Age	*Observed CSF white cell count* ($\times 10^9$/l)	*Expected CSF white cell count* ($\times 10^9$/l)	*Observed white cell count as a percentage of expected*
Children (months)			
8	80	1496	5
22	0	63	0
84	0	48	0
19	176	841	21
3	25	238	11
9	2	40	5
14	40	122	33
2	10	105	10
10	8	57	14
12	15	37	41
Neonates (days)			
3	189	415	46
21	35	34	103
1	50	509	10
3	1	40	3
1	5	195	3
1	200	468	43
3	9	616	1
1	20	335	6
2	5	41	12

Discussion

Contamination with less than $10{\cdot}0 \times 10^9$/l red cells was not studied, since it did not result in an altered

white cell count. There were 13 further cases where a peripheral white but not red cell count was available but the haemoglobin was normal. Their results, assuming a normal age-related red cell count, give a mean CSF white cell count 26% of expected. We are not aware of any previous studies on this subject, although Sarff *et al.*[1] found no association between CSF red and white cell counts in a group of high-risk infants without meningitis. The peripheral cell counts were not mentioned.

This study shows that the expected number of white cells are often not found in CSF contaminated with more than $10{\cdot}0 \times 10^9$/l red cells. Inaccurate counts would not consistently produce the discrepancy found, and some white cells are lost either at the site of bleeding, in the CSF, or during collection and transport. Even with the CSF white cell count less than expected the possibility exists that some of the white cells observed were present in the CSF before contamination occurred and the blood staining has concealed a true meningitis. Therefore all blood-stained CSF samples should be cultured regardless of the white cell count. Repeat lumbar punctures are advisable if it is necessary to prove the diagnosis of meningitis on the cell count, for instance with partially treated bacterial meningitis. Culture should prove the diagnosis in previously untreated bacterial meningitis. In one of our cases with a disproportionately high white cell count *H. influenzae* was grown: we presume that the other 6 patients had viral meningitis.

Reference

[1] Sarff L D, Platt L H, McCracken G H, Jr. Cerebrospinal fluid evaluation in neonates: comparison of high-risk infants with and without meningitis. *J Pediatr* 1976; **88:** 473–7.

Correspondence to Dr J Osborne, Bristol Royal Hospital for Sick Children, St Michael's Hill, Bristol BS2 8BJ.

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Precordial catch syndrome

DOUGLAS PICKERING

Department of Paediatrics, John Radcliffe Hospital, Oxford

SUMMARY Seventeen cases of precordial 'catch' are reported. The children varied in age from 8 to 16 years. The characteristics of this painful condition are discussed; in particular, the diagnostic indication of the site of the pain over an intercostal space, with the finger tip, is stressed. Anxiety in the child, or the parents, in relation to the complaint is discussed. Several methods of treatment are recommended.

Richard Asher, in his description of 'a pain without a name', asked at a medical meeting, 'Have any of you ever had, a very brief, sharp, needle-like pain, near the apex of the heart, acutely localised to one point seemingly inside the chest wall, but feeling as if something was adherent to it? Breathing sharpens it, so there is often a disinclination to take a deep breath while it lasts. It comes on out of the blue, it passes off in a few minutes, and although acute it is not at all distressing.'[1]

Children often complain of a similar pain due to anxiety from having had the searchlight of attention pointed towards the heart.

The pain is mainly precordial, along the left sternal border or beneath the left breast. It does not radiate. The pain is described as stabbing, shooting, needle-like, or knife-like. It may be at any grade of severity. The pain may occur at rest while watching television in a slouched posture, or during mild to moderate exercise. It causes patients to hold their breath, or breathe in a shallow fashion while they have the pain; the patient of Miller and Texidor was afraid to breathe 'as if something were catching' when she attempted an inspiration.[2] The technique of forced deep inspiration when the pain is present, may actually relieve the pain. Change of posture—for example, stretching upright from the slouched position, lying down, massaging the chest, or alternating the respirations between deep and shallow—may also bring relief. The pain is brief, it is generally transient, and it rarely lasts more than a minute. When it does go, it may in some instances be followed by a dull ache. The frequency varies from 3 times in an evening to once in 8 months. It is not related to hyperventilation.

Results

Seventeen children attending either the Radcliffe Infirmary, the John Radcliffe Hospital, Oxford, or