

Inflammation

Subarachnoid haemorrhage

Clinical information and laboratory results

A male patient in his 70s has undergone surgery for subarachnoid haemorrhage (SAH), which is a bleeding within the subarachnoid space that is most often caused by a traumatic injury to the brain or by a spontaneous ruptured aneurysm [1]. One week after the removal of the drainage tube, a cerebrospinal fluid (CSF)

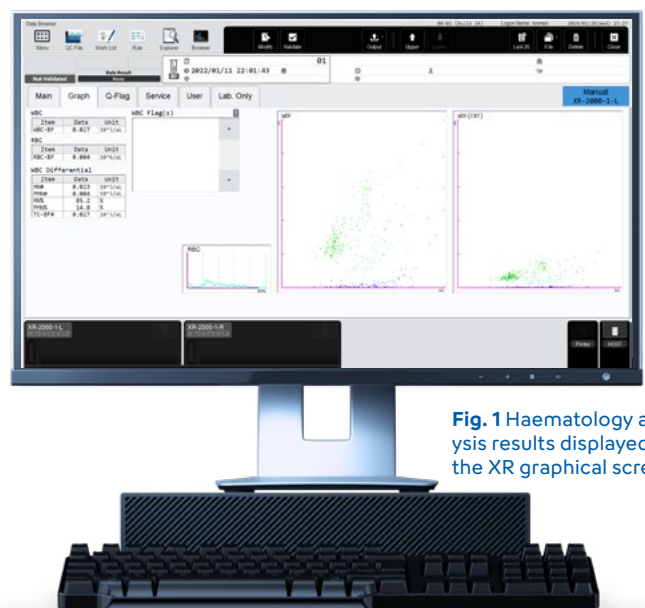


Fig. 1 Haematology analysis results displayed by the XR graphical screen.

sample was collected for analysis. Macroscopically, the CSF sample exhibited a pale orange colour. This is also known as 'xanthochromia' and is an indicator for the presence of bilirubin, the haemoglobin degradation product, which occurs after bleeding in the subarachnoid space. In the Body Fluid (BF) mode of the XR analyser, an elevated number of white blood cells (WBC: $0.027 \times 10^3/\mu\text{L}$) with a predominance of mononucleated cells (MN: 85.2%) were found along with an elevated number of red blood cells (RBC: $0.004 \times 10^6/\mu\text{L}$) (Fig. 1).

In the cytospin preparation (Fig. 2), stained with May-Grünwald-Giemsa, numerous RBC and siderophages containing basophilic haemosiderin granules and brownish haematoidin crystals, were observed.

Result interpretation

CSF is a clear and colourless fluid that surrounds the brain and spinal cord of all vertebrates [2]. A thorough morphologic analysis of CSF is indicated in every case of elevated CSF cell count to obtain valuable diagnostic information and evaluate therapeutic responses [1, 3]. As a rule of thumb, the finding of more than five white blood cells (WBC) per μL and any red blood cell (RBC) are considered pathological in adults [3, 4]. However, in case of SAH an elevated RBC count can be observed, which is accompanied by an inflammatory response, which leads to an increased WBC count [2].

A first sign of bleeding is the detection of erythrophages. After three to four days, these cells exhibit the iron-storage complex haemosiderin in their cytoplasm and are then called siderophages [1]. After around eight days, another product of the haemoglobin degradation process, haematoidin, may be observed. Haematoidin presents itself as yellowish to brown crystals that are either found intra- or extracellularly. Therefore, the presence of siderophages with haemosiderin or haematoidin crystals are indicative for the presence of a SAH and may support in the assignment of time at which the bleeding occurred [2]. In the BF WDF scattergram of the XR analyser the predominance of MN is visible as green dots (Fig. 3). The rightward extension of

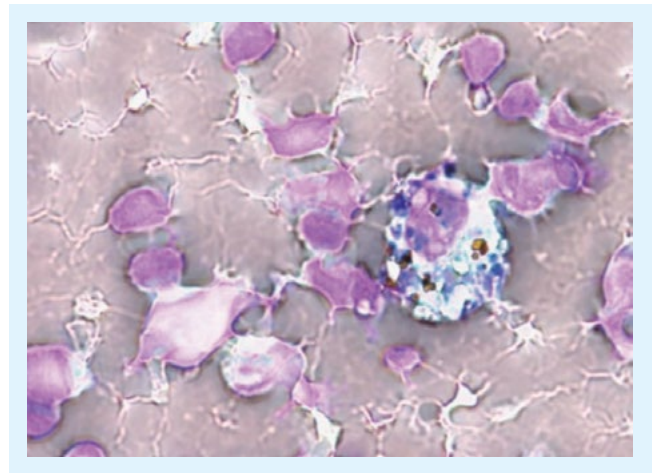


Fig. 2 The May-Grünwald-Giemsa staining of the cytospin revealed numerous RBC and brown haematoidin crystals inside the macrophages.

the MN cluster towards the high SSC area indicates the presence of macrophages with engulfed haematoidin crystals and haemosiderin granules, which were also observed on the cytospin.

Since the patients' drainage tube was removed one week prior to measurement, the presence of haematoidin crystals is in accordance with the patients' medical history.

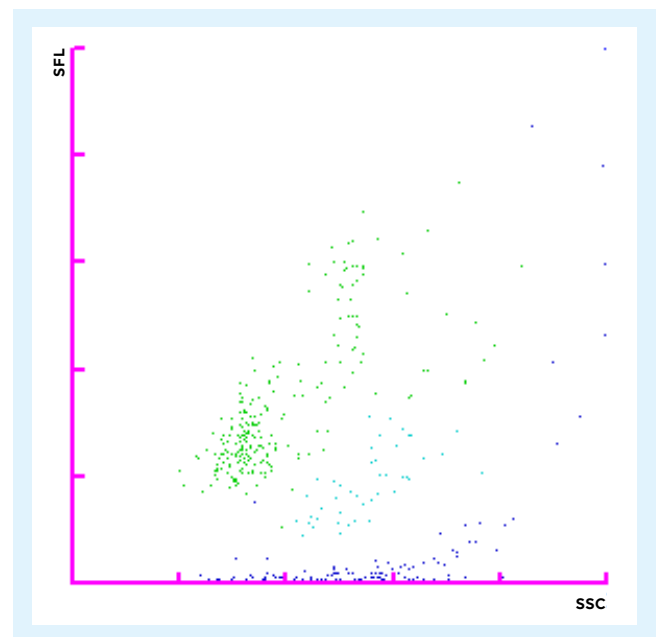


Fig. 3 The BF scattergram of the WDF channel presents mononucleated cells (MN) in the high SSC and SFL area.

References

- [1] **Hrishi A et al. (2019):** Cerebrospinal Fluid (CSF) Analysis and Interpretation in Neurocritical Care for Acute Neurological Conditions. Indian J Crit Care Med; 23(2): S115-S119.
- [2] **Torzewski M et al. (2016):** Cerebrospinal fluid cytology: a highly diagnostic method for the detection of diseases of the central nervous system. LaboratoriumsMedizin; 40(s1).
- [3] **Fleming C et al. (2015):** Clinical relevance and contemporary methods for counting blood cells in body fluids suspected of inflammatory disease. Clin Chem Lab Med; 53(11):1689.
- [4] **Jurado R et al. (1990):** Cerebrospinal fluid. Clinical methods: the history, physical, and laboratory examinations; 3rd ed. Boston: Butterworths.