Pushing limits in routine laboratory haematology with the XT-4000i

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Fig. 1 *The XT-4000i haematology system*

Fig. 2 *Measuring body fluids using the XT-4000i with its integrated body fluid mode*

With the launch of the XE-5000, Sysmex set new standards in haematology. Advanced clinical parameters that have been tested for effectiveness in clinical studies, embedded in a concept that combines laboratory data with clinical knowledge, offer both the laboratory physician and the clinician valuable support with different patient cases and in therapy monitoring. On top of this, the analyser features a special mode, which measures body fluids to convincing specifications.

While the XE-5000 is designed mainly for the top end market segment, the XT-4000i provides a worthy alternative for a variety of laboratories that have set high standards for haematological diagnostics. The concept of the XT-4000i surpasses expectations for routine laboratory use – besides the differential blood count in proven X-Class quality, the XT-4000i also offers further analytical possibilities in terms of both the sample material and the analytical parameters. The XT-4000i can be intelligently linked to the established *Extended* IPU (*Extended* information-processing unit) and expanded with components for digital morphology. This makes it part of an efficient solution that combines the users' and Sysmex's expert knowledge to standardise very effectively the analytics of the complete work area.

New standards in the automated analysis of body fluids

Measuring certain body fluids is playing an increasing role for a large number of laboratories. An example for this is the analysis of cerebrospinal fluid (CSF), which is important for diagnosing diseases of the central nervous system, e.g. multiple

sclerosis, benign and malignant tumours, hereditary diseases, or meningitis. An exact determination of the cell count, and frequently a morphological differentiation as well, is necessary in order to diagnose various diseases. The analytical challenge lies, of course, in the physiologically low cell concentration in the CSF sample. In addition to this, laboratories are faced with great difficulties due to the short lifespan of the samples with regard to the time of day or night when these are taken.

The XT-4000i is well equipped to meet exactly these challenges. Based on the established technology of fluorescence flow cytometry the XT-4000i has a special body fluid mode, which, besides providing complete count values for white blood cells (WBC-BF) and red blood cells (RBC-BF), also allows the differentiation of white cells into mononuclear (MN, i.e. lymphocytes and monocytes) and polymorphonuclear cells (PMN, i.e. granulocytes). Substances, which may adversely affect the count, e.g. micro air bubbles or other non-nucleated cellular particles, are not labelled by the fluorescence marker used in the DIFF channel, and so do not interfere with this measurement. The same is true for any red blood cells that may be present; lacking cellular nucleic acids they are not labelled either, and therefore cannot impair the white cell count. In this way, an exact measurement is possible even when the cell concentration is low. Apart from CSF analysis, the XT-4000i also offers the possibility to measure other body fluids such as serous fluids and synovial fluid.

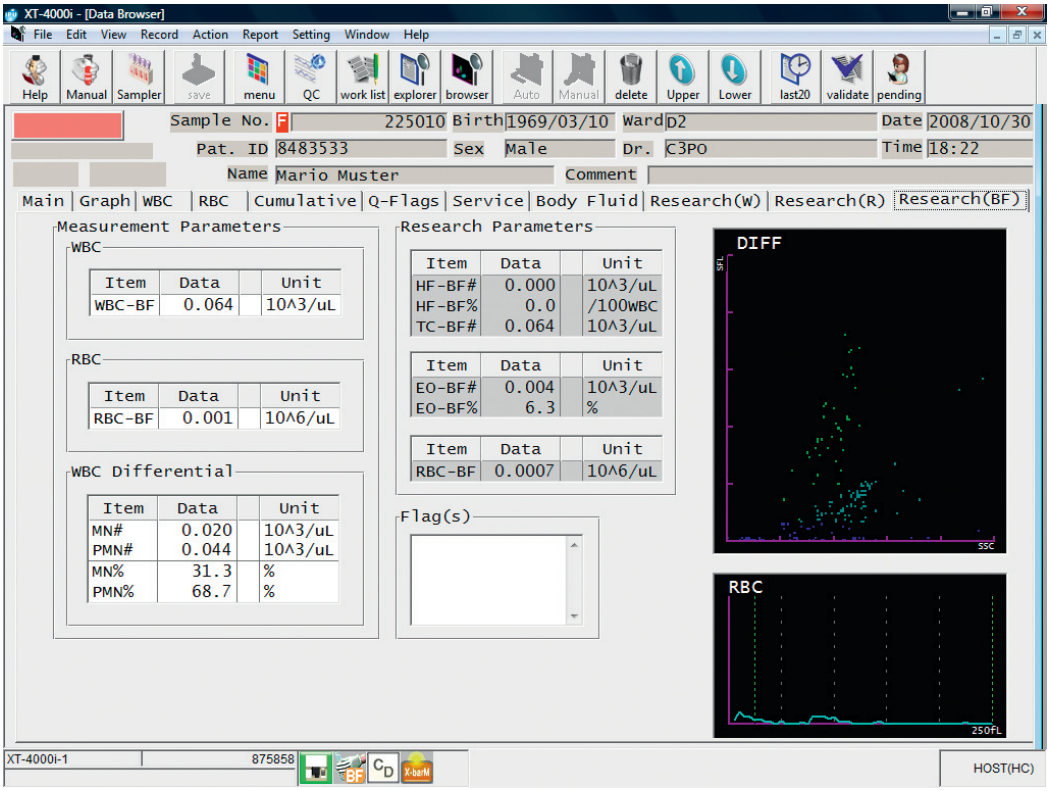

Fig. 3 *Result display after the analysis of a sample in body fluid mode*

However, what matters for a laboratory's efficiency is not just the quality of the analysis technology and its results, but also the optimisation of the corresponding processes. A high level of standardisation sets the preconditions for fast and reliable results at any time of the day. By embedding automation processes in an intelligent validation system, Sysmex has shown how laboratories with very different sample throughputs and requirement profiles can clearly increase their efficiency. The platform for this is provided by the *Extended* IPU, a system with a rule engine built on vast experience designed for the technical validation of results. Hundreds of Sysmex users have integrated the *Extended* IPU into their haematology workflow, hence having optimised it. With such experience coming from the market the system has been constantly tested in daily use, and this has helped develop it further. The *Extended* IPU generates and displays information to the user; this comprises commentaries, additional or repeat measurements, and requests that the morphology in the smear should be examined. The laboratory concept is rounded off by the possibility to utilise digital morphology through CellaVision® DM1200.

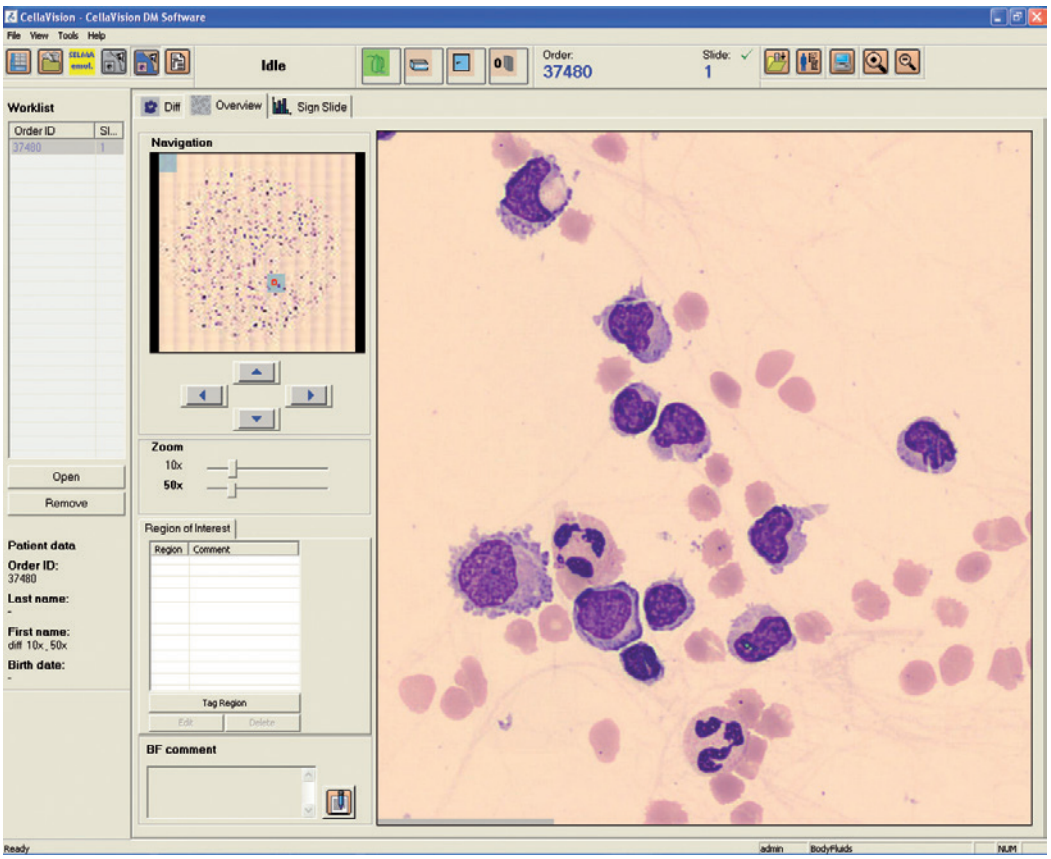

Fig. 4 *Automated image analysis of body fluids by CellaVision® DM1200*

This approach has now been carried forward to the analysis of body fluids. Special new rules for measuring body fluids in the *Extended* IPU can standardise the workflow to a great extent, and can supply valuable information directing attention to conspicuous results. In the comprehensive laboratory solution, the automated image analysis of body fluids by CellaVision® DM1200 sets high standards for the laboratory routine.

Advanced clinical parameters make a valuable contribution to diagnostics

'Adding value to health': this is the global message associated with XT-4000i. It refers to the value of good analysis in establishing the diagnosis, because the diagnosis is not merely based on the routine parameters but may utilise additional analytical information to support it. The advanced clinical parameters have proved their clinical benefits in both studies and through routine use. They make a valuable contribution to the diagnosis and therefore to a patient's health. Two examples shall be highlighted in the following paragraphs. They deal with diagnostic parameters that the XT-4000i reports with every analysis at no additional expense.

Measuring the haemoglobin content of reticulocytes (RET-H_e) has in recent years proved its clinical relevance in diagnosing functional iron deficiency and in monitoring the therapy. There are now instances where RET-H_e is used as part of a pre- and post-operative monitoring programme for orthopaedic patients. The objective is to ensure a speedy recovery of patients after hip and knee replacements, and to avoid potential blood transfusions (for more information, please see [1]).

The counting of immature granulocytes (IG) is a further example of a beneficial diagnostic parameter beyond the usual 5-part differentiation. The parameter is based on the principle of fluorescence flow cytometry and enables laboratories to quickly deliver IG count results to the physicians, not just around the clock, but also with improved reproducibility in comparison with manual counts. Determining the IG count is beneficial in recognising inflammations and infections and helps simplify the monitoring of their therapies. Besides the advantages of automatic counting and its potential for reducing the number of smears to be examined, many publications have also substantiated the positive clinical use of the IG parameter, for example in the early detection of bacterial infections in infants and adult intensive care patients [2, 3]. Patients in intensive care can be shown to have an increased number of immature granulocytes in their peripheral blood.

This provides important information for the patient-specific prognosis. XT-4000i offers the IG count in a fully automated way and determines the sum of myelocytes, promyelocytes and metamyelocytes with low imprecision, which is particularly important with the absolute count value. Compared to routine 100-cell differentiation, up to 8,000 white blood cells are analysed from normal patient samples; in the case of intensive care patients, usually with higher WBC concentrations, this number reaches well over 10,000 white cells. The low imprecision is what makes it possible to implement this parameter for clinical diagnosis or the monitoring of therapy for critical patients in the intensive care unit.

Proven reliability in routine laboratory use

XT-4000i has a lot to offer the laboratory routine besides the applications just described. Describing the system's complete range would of course not be possible here. During its development, major emphasis was placed on improving quality and speed, just like in other X-Class systems. The quality of the reticulocyte analysis has raised the standard of anti-doping tests during many sporting events, e.g. the Olympic Games. As well as that, the possibility of fluorescence-optical determination of platelet values has often proved very beneficial, in particular when the time-consuming count in the chamber could be avoided. The cost-saving aspects of the reagent system have also been consistently paid attention to. Defined analysis profiles can be selected for different order requests, e.g. from the laboratory information system. The XT-4000i's maximal throughput rate of 100 samples/hour provides for a smooth workflow and even remains on a comfortably high level with extended analysis profiles under routine conditions.

Fig. 5 *XT-4000i's user-friendly menu navigation*

If you would like to know more about the specifications of the XT-4000i, and how you could perhaps integrate it into your laboratory routine, please contact your local Sysmex representative.

References

[1] ***Muusze R et al.*** *(2009): Protocol for transfusion-free major orthopedic operations using RET-H_e. SJI Vol 19 No 1.*

[2] ***Cimenti C et al.*** *(2012): The predictive value of immature granulocyte count and immature myeloid information in the diagnosis of neonatal sepsis. Clin Chem Lab Med 50: 1429 – 1432. http://www.degruyter.com/view/j/cclm.2012.50.issue-8/cclm-2011-0656/cclm-2011-0656.xml*

[3] ***Nierhaus A et al.*** *(2013): Revisiting the white blood cell count: immature granulocytes count as a diagnostic marker to discriminate between SIRS and sepsis – a prospective, observational study. BMC Immunology 14:8. Free online: http://www.biomedcentral.com/content/pdf/1471-2172-14-8.pdf*

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