Abstract

Digital Microscopy (DM96/DM8): From Virtual Differentiation to a Virtual Technologist?

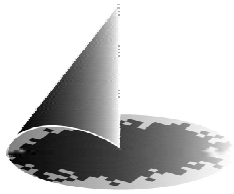
W. van Gelder, R.B. Dinkelaar and H. Ceelie
Geïntegreerd Klinisch Chemisch Laboratorium (GKCL)
Albert Schweitzer Ziekenhuis
Dordrecht, The Netherlands

INTRODUCTION:
Peripheral blood differential counting is an important diagnostic tool. However, this technique requires highly trained staff, is labor intensive and has a limited statistical reliability. A recent development in this field is the introduction of automated peripheral blood differential counting systems. These computerized microscope systems provide an automated examination of peripheral blood films, including a pre-classification of both red and white blood cell results. To investigate whether these systems improve efficiency and quality of peripheral blood examinations, results of two automated microscopy systems, the Cellavision™ Diffmaster Octavia and Cellavision™ DM*96*, were compared with results of manual differentiation.

METHODS:
200 blood samples were randomly selected from the routine workload of the department of Clinical Chemistry of the Albert Schweitzer hospital (1075 beds). Smears were made and in each smear 400 WBC's were subsequently analyzed by two experienced technicians and also with the Octavia and DM*96*. Results from both technicians on RBC and WBC analyses were compared with each other and with pre-classification and post-classification results of both automated systems (accuracy). Within run imprecision and short-term imprecision of each method were also evaluated. Two time efficiency studies were performed to compare both automated systems with each other and with manual analysis.

RESULTS:
Accuracy analysis was performed for the following cell classes: segmented and band neutrophils, eosinophils, basophils, lymphocytes, monocytes and blast cells. Pre-classification correlation ranged from $y=0.926x + 2.662$ ($R^2=0.89$) for lymphocytes to $y=0.713x + 0.147$ ($R^2=0.54$) for basophils. Post-classification results ranged from $y= 0.983x + 1.1524$ ($R^2=0.82$) for lymphocytes to $y=0.889x – 0.104$ ($R^2=0.65$) for basophils. Evaluating the accuracy of red blood cell analysis, 6 categories of morphological changes were compared: polychromasia, hypochromasia, anisocytosis, microcytosis, macrocytosis and poikylocytosis. Results were grouped as "normal + mild" or "moderate + severe" changes and in comparison with manual analysis ranged from 95–100% agreement for normal + mild changes in all categories to 25–80% agreement for moderate to severe changes. Within-run imprecision for both Octavia and DM*96* was less than 3% for all major cell categories.

Abstract



In the time efficiency studies the DM*96* used on average 25.7 min for analysis and reporting of 8 samples (including post-classification), manual analysis took 33.3 min and the Octavia 43.0 min. Average overall “hands-on” time per sample was 3.3 minutes in manual differentiation and 2.0 minutes with the DM*96.*

CONCLUSIONS:
CellavisionTM Diffmaster Octavia and DM96 are automated cell analysis systems capable of morphological classification of red blood cells and leucocytes in peripheral blood smears. Classification accuracy depends on the type of pathological changes in the blood sample and both systems operate most effectively in screening routine blood samples. The possibility to review all cells that were analyzed, both on screen and via email or “remote view” software (DM96), makes these systems valuable diagnostic tools in the modern clinical chemistry laboratory.