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## Advances in Automated Urinalysis Systems, Flow Cytometry and Digitized Microscopy

Screening of urine samples is the third most frequently performed test in clinical laboratories [1]. Urinalysis generally includes two kinds of methods: strip tests and microscopic examinations [1]. Urine microscopy, urine sediment analysis using microscope, has been used to detect various urologic diseases affecting from kidney to urinary tract [1, 2]. However, manual microscopic examination is time consuming and needs experts for interpretation [3].

The effort of examining the particles in samples has long been a big issue in the hematologic field [2]. Wallace Coulter developed a counting method for particles in electrolyte solutions [2]. It made accurate cell counts in blood and became main equipment in laboratory hematologic analysis [2]. However, Coulter method could not be easily adapted in urinalysis until the late 1990s, because urine contains the broad spectrum of particles such as crystals, and cells that do not exist in blood [2]. Fifty years after Coulter method was introduced, laboratory instrument for identifying and enumeration urine particle was finally developed [2]. In the field of automated microscopy, the process of continuous technical development and adaptation has been achieved [3]. Consequently, flow cytometry and digitized microscopy have been introduced and established for enumerating urine particles in modern laboratories.

Urinary tract infection (UTI) is the most common infections in both hospitalized and community-acquired patients [4]. Many investigators have evaluated the ability of flow cytometry to detect bacteria and WBCs in urine samples [3]. Because of the high percentage of negative urine culture results, efficient screen-

ing method with a high negative predictive value (NPV) has been required for a long time [5]. Researchers have extensively investigated to show whether laser-based flow cytometry can be useful screening tests for pyuria or bacteriuria [2]. Rosa *et al.* [4] reported that the new Sysmex urine analyzer, UF-5000 (Sysmex cooperation, Kobe, Japan) based on laser flow cytometry, presented high NPV up to 99.7% with conventional urine culture. If flow cytometric methods reduce the number of unnecessary urine culture tests, it can also save labor, time, and cost in laboratories [3].

On the other hand, the software image analysis of the digital microscope forms another one of the two main axes of automated urine sediment examinations. Because flow cytometric methods make a scattergram not an image, laboratorian cannot discard manual microscope to verify and differentiate problematic particles in urine [2]. In contrast, automated digital microscopy based on pattern recognition produces real images that can be reviewed by experts [2, 3]. Compared with manual microscopy, it shows good performance and agreement to detect RBCs, WBCs, bacteria and squamous epithelial cells [2]. However, it is less reliable in detecting non-squamous epithelial cells, non-hyaline casts, unusual crystals and lipids [6, 7].

In this issue of Ann Lab Med, Oyaert and Delanghe [3] introduced detailed reviews on recent advances in automated urinalysis systems, including application of these two practical developments. Although their performance requires further evaluation, adaptation and integration of these new technologies in urinalysis can lead to make more accurate patients results and

more effectively used laboratory resources.

## Authors' Disclosures of Potential Conflicts of Interest

No potential conflicts of interest relevant to this article were reported.

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