In this issue: LAB-ON-A-CHIP TECHNOLOGY

The Journal of the International Federation of Clinical Chemistry and Laboratory Medicine

eJIFCC

Introduction on the special edition "Lab-on-Chip technology for clinical diagnostics"

Guest editors
L.I. Segerink, I. Vermes and A. van den Berg
BIOS, Lab on a Chip group, MESA+ Institute for Nanotechnology
University of Twente
PO Box 217, 7500 AE Enschede, The Netherlands

In the past decade, chip technology has shown its great value for chemical analysis in so called Lab-on-a-Chip systems (Reyes D 2002; Aroux P 2002; van den Berg 1998). The current interest in microfabrication has extended to the clinical arena, with many reviews about the expanding field of microfluidics in clinical chemistry and diagnostics (Kricka LJ 2001; Verpoorte E 2002; Schulte TH 2002; D'Orazio P 2003; Li SFY 2006). Moreover, research focuses more and more on nanotechnology conquering the world of bioresearch (Eijkel JCT 2005; Fortina P 2005; Jain KK 2005; Azzazy HME 2006; Cheng MM 2006). Clinical diagnostics is one of the promising applications for microfluidic Lab-on-a-Chip systems. Clinical diagnostics refers to the measurements of clinical analytes in physiological fluids for either the prevention or treatment of disease. There is a growing interest to use these Lab-on-a-Chip systems for point-of-care (POC) purposes (Floris, 2010). POC testing defines laboratory testing at or near the site of patient-care (Price 2001). POC applications are preferred at sites where fast diagnostic monitoring can improve medical decisions, such as intensive care units, emergency - and operating rooms. Though, near-patient testing is also established in the doctors' office and even for patients at home, where frequent measurements are necessary (e.g. glucose monitoring). Moreover, POC devices are highly preferable in the developing world, where the resources to perform clinical test are limited (Yager 2006). POC devices have to have specific requirements in that they have to obtain and process small volumes of complex fluids with efficiency and speed, and the device should be simple to use by non-laboratory staff. Furthermore, the device has to be low-cost or cost-effective, easily interpreted, and stable with long-shelf lives, especially under extreme conditions, important prerequisites at low-resource settings. The advantages listed above meet the requirements for developing miniaturized devices (Tudos 2001). Therefore, Lab-on-Chip devices suit well for being implicated in POC devices. Nowadays, many diagnostic companies have expanded their products list with point-of-care assays. The i-STAT analyzer of Abott Laboratories is one of the best known and widely used to perform a number of critical care assays, including blood gases, electrolytes, chemistries, coagulation, hematology and cardiac markers. Roche has commercialized point-of-care assays for blood analysis, cardiac markers and metabolites for the doctor's office and emergency rooms. Though, many other companies have commercialized point-of-care assays for detection of various cardiac markers, traces of alcohol and drug-abuse and various bacteria and viruses. This issue will focus on the latest developed microfluidic Lab-on-a-Chip devices for the main clinical applications and possible future developments all suitable and implemental in a point-of-care setting.

References

1. Reyes D, Iossifidis D, Auroux P, Manz A. Mirco total analysis systems. 1. Introduction, theory, and technology. Anal Chem 2002;74:2623-2636.
2. Aroux P, Iossifidis D, Reyes D, Manz A. Micro total analysis systems. 2. Analytical standard operations and applications. Anal Chem 2002;74:2637-2652.
3. van den Berg A, Lammerink T. Micro total analysis systems: Microfluidic aspects, integration concept and applications. Top Curr Chem 1998;194:21-49.
4. Kricka LJ. Microchips, microarrays, biochips and nanochips: personal laboratories for the 21st century. Clin Chim Acta 2001;307:219-223.
5. Verpoorte E. Microfluidic chips for clinical and forensic analysis. Electrophoresis 2002;23:677-712.
6. Schulte TH, Bardell RL, Weigl BH. Microfluidic technolgies in clinical diagnostics. Clin Chim Acta 2002;321:1-10.
7. D'Orazio P. Biosensors in clinical chemistry. Clin Chim Acta 2003;334:41-69.
8. Li SFY, Kricka LJ. Clinical analysis by microchip capillary electrophoresis. Clin Chem 2006;52:37-45.

9. Eijkel JCT, van den Berg A. Nanofluidics: what is it and what can we expect from it? Microfluid Nanofluid 2005;1:249-267.
10. Fortina P, Kricka LJ, Surrey S, Grodzinski P. Nanobiotechnology: the promise and reality of new approaches to molecular recognition. Trends Biotechnol 2005;23:168-173.
11. Jain KK. Nanotechnology in clinical laboratory diagnostics. Clin Chim Acta 2005;358:37-54.
12. Azzazy HME, Mansour MMH, Kazmierczak SC. Nanodiagnostics: A new frontier for clinical Laboratory Medicine. Clin Chem 2006;52:1238-1246.
13. Cheng MM, Cuda G, Bunimovich YL, Gaspari M, Heath JR, Hill HD, et al. Nanotechnologies for biomolecular detection and medical diagnostics. Curr Opin Chem Biol 2006;10:11-19.
14. Floris, J. and Staal, S.S. and Lenk, S.O. and Staijen, E. and Kohlheyer, D. and Eijkel, J.C.T. and van den Berg, A. (2010) A prefilled, ready-to-use electrophoresis based lab-on-a-chip device for monitoring lithium in blood. Lab on a chip, 2010; 10:1799-1806.
15. Price CP. Point of care testing. Brit Med J 2001;322:1285-1288.
Yager P, Edwards T, Fu E, Helton K, Nelson K, Tam MR, et al. Microfluidic diagnostic technologies for global public health. Nature 2006;442:412-418.
Tudos AJ, Besselink GAJ, Schasfoort RBM. Trends in miniaturized total analysis systems for point-of-care testing in clinical chemistry. Lab Chip 2001;1:83-95.