Impact of miniaturized concepts for the rapid and generic detection of bacterial contamination

C. Fournier-Wirth [1*], S. El Ichi 1, [2], F. Leon [1], L. Vossier [1], H. Marchandin [3], J. Coste [1,] A. Errachid [2], N. Jaffrezic-Renault [2]

1 R&D-Agents Transmissibles par Transfusion, Etablissement Français du Sang Pyrénées - Méditerranée, Montpellier. France.
2 Laboratoire des Sciences Analytiques, CNRS UMR 5180, Université Claude Bernard Lyon, Villeurbanne,France.
3 Laboratoire de bactériologie CHRU / UMR 5119 Université Montpellier, Montpellier. France.

* contact : chantal.fournier@efs.sante.fr

Introduction :
Blood safety is a major concern for the health surveillance. Preventive measures implemented to reduce the viral risk allowed unprecedented levels of blood safety to be reached. The risk of transmission of the main viruses (HIV, HTLV, HCV and HBV) is currently very low in the developed countries. The bacterial risk then became the most frequent infectious risk in transfusion despite of the current preventive strategies. A better control of the bacterial risk will enhance the safety of the cellular products. The technological approaches developed up to now, which are mainly based on the detection of bacteria after culture or on their metabolism, are long and present many limits. Alternative strategies were proposed. Pathogen reduction technologies are in strong development and are evaluated in several countries. These techniques are performed during the process of product preparation. They cannot be applied to products derived from cellular engineering. The rapid control of a labile blood product or of a product derived from cellular engineering, carried out just before its delivery could represent another safety strategy. This control requires a simple, sensitive, and fast system for bacterial detection. Second generation biosensors coupling micro- and nano-technologies allow to meet these requirements and consequently to further develop miniaturized tests at a lower cost for the diagnosis.

Aim : To develop microsystems integrating ultrasensitive electrochemical biosensors to test the presence of bacteria in a cellular product or any other biological fluid. These systems are expected to be very sensitive, easy to use by a non specialised personnel and of low cost at the end of development.

Methods / Results: The first development is based on immunosensors: addressable nanoparticles under magnetic field and coupled with anti-LTA and anti-LPS antibodies, directed against Gram (+) and Gram (-) respectively, are used for the generic capture. Preliminary conductivity measurements performed on *E. coli* cultures showed specific, label-free and real-time detection from 1 to 10^5 CFU / ml. The immunosensors will then be integrated in a microfluidic "lab on chip" system. The second development is to design a peptide biosensor: human natural defensins HNP1-3 patented in the laboratory will be used for the recognition of bacteria. Antimicrobial peptides offer new strategic opportunities already identified in highly innovative areas related to the diagnosis.

Conclusions : The development of miniaturized technologies is expected to improve the detection of bacterial contamination in a biological product.

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