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Smarttransfuser: A lab-on-chip system for enhancing transfusion security

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Background:

Before each transfusion of red blood cell concentrate, a final ABO compatibility test is carried out at the patient's bedside on a piece of card and interpreted visually. Despite this ultimate test, transfusion accidents still occur due to group incompatibility, which can be lethal. In order to improve this test, we have developed a specific device based on microarrays for the validation of a smart and safe transfuser in the context of critical transfusional situations.

Methods/Results

This miniaturized device incorporates a biochip to analyze ABO compatibility in order to replace the hemagglutination reaction of red blood cells by IgM in solution with their specific capture and concentration on microarrays.

Successful immobilization of IgM on a solid base requires control of several critical factors. We showed that variation in pH could dramatically influence IgM grafts capabilities whereas variations of IgM concentration are not so important in spotting mode.

The establishment of on-chip cell capture was monitored on a macro-scale with resonance surface plasmon imaging (SPRi) and at the cell scale with atomic force microscopy prior to its integration in a portable device. High density of RBCs was obtained on arrays with high integrity in their shape (Fig 1 & 2).

We then investigated the response of the sensor to red blood cells in globular concentrate or in crude blood. Results indicate that a specific immunocapture is obtained with globular concentrates and with different total blood groups which cover major cases of transfusion.

Finally the sensor will be presented in the main device called "smarttransfuseur" developed for clinical studies (1).

Conclusion:

Smarttransfuser is a smart device developed in collaboration with the French Blood Transfusion Center for the optimization at the patient's bedside of an ultimate test prior transfusion.

(1) Confidential : pending patent

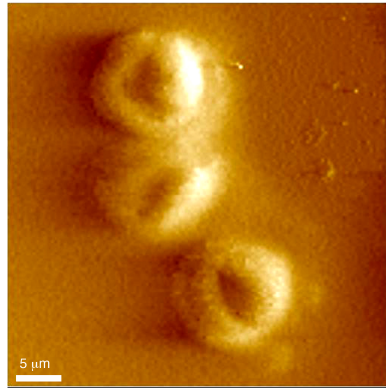


Fig. 1: On-array AFM characterization of immunochip after RBCs capture

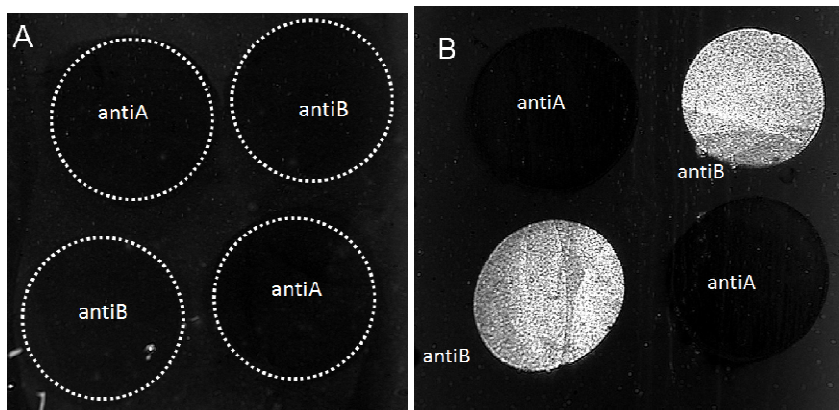


Fig. 2: SPRi response of RBCs capture in various blood types: A) in total blood O type no diluted, 200μl, B) in total blood B type, no diluted, 200μl.

Keywords: Immunochip, Red blood cells, biodevice, transfusion