Rapid sepsis diagnostics by cell separation in a microfluidic sorting system

Every year, 49 million people worldwide contract sepsis, 11 million of whom die during the course of the disease. In Germany, sepsis is the third most common cause of death after cardiovascular disease and cancer, with 85,000 deaths per year. It is caused by an infection of the bloodstream with primarily bacterial pathogens. While broad-spectrum antibiotics for sensitive pathogens kill effectively, they are ineffective against pathogens that have become resistant to antibiotics. In this case, a resistance profile of the pathogen must first be determined, and then highly specific narrow-spectrum antibiotics must be administered. Such resistance determination requires separation and cultivation of the pathogen. This takes more than 24 hours, so unfortunately effective therapy often comes too late for those affected.

Saving time thanks to a new sorting system

Scientists at Fraunhofer ILT have, therefore, developed a microfluidic sorting system to significantly speed up the isolation of pathogens from a patient's sample. The system makes use of the cross-flow called Dean flow, which occurs in spiral-shaped curved microchannels. With appropriate parameter selection, this flow causes bacteria to separate out from blood cells in a patient sample based on their size. This high-throughput separation process was investigated and conducted on a fused silica chip.

Rapid resistance test for efficient and rapid isolation of pathogens

The process for separating the larger erythrocytes and leukocytes from the 1 µm to 3 µm sized bacterial cells was demonstrated using the Dean flow sorting chip in fused silica. The efficient and rapid isolation of the pathogens forms the basis for a rapid resistance test in the microsystem. This technology, developed at Fraunhofer ILT, allows the separation of typically several 100 to several 1000 bacteria from a 10 ml blood sample within 2 hours.

Fields of application in medicine

In addition to the addressed rapid resistance tests, the technology can be applied in microbiological assays based on cell cultures as well as in biomedical research. The R&D project underlying this report was carried out on behalf of the German Federal Ministry of Education and Research under the funding program "Innovative medical technology solutions for the prevention and care of nosocomial infections" under the grant number 13GW0431C.

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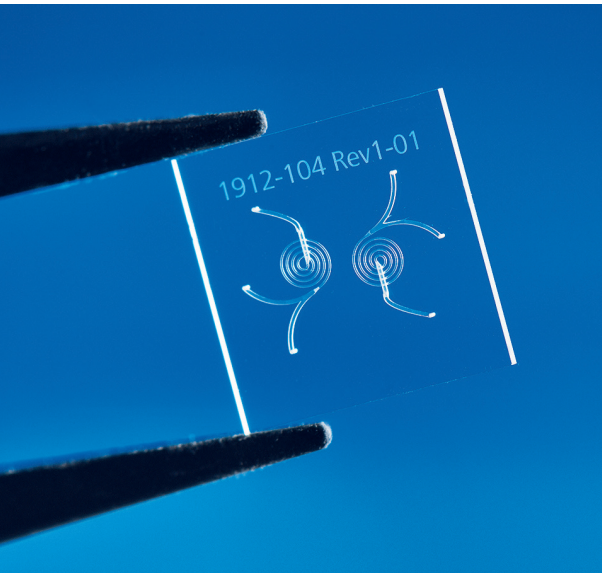

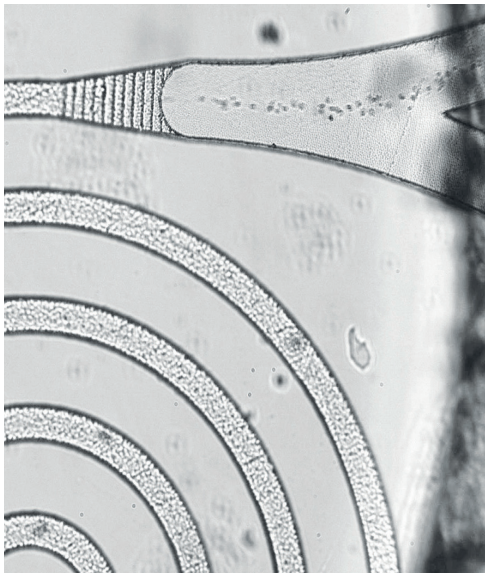

1 Fused silica chip with two Dean flow sorting structures. 2 Separated blood cell flow at a branch in the sorting chip.