Dermatotoxicological and other Safety Testing Methods without Animals - State November 2013

Session 3: New challenges for toxicological safety testing

Human-on-a-Chip

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Current in vitro and animal tests for drug development are failing to emulate the systemic organ complexity of the human body and, therefore, to accurately predict drug safety and efficacy. Microfluidic culture devices combining micro-tissues of the ten (at least) most important human organs in a human-like arrangement at homeostatic steady state are supposed to become a translational solution for that testing dilemma. The presentation highlights the most recent developments in that so called “Human-on-a-chip” development arena. In particular, it focusses on a universal microfluidic chip platform the area of a microscopic slide, consisting of an on-chip micro-pump and, in a first design, capable of interconnecting two different organ equivalents. The micro-pump ensures stable long-term circulation media through the tissue culture compartments at variable flow rates, adjustable to the physiological mechanical stresses of the respective tissues. The tissue culture compartments and the connecting channels are optically accessible, thus supporting live tissue imaging. Co-cultures of human liver and skin equivalents, on the one hand, and liver equivalents and neuronal tissues, on the other hand, have proven the ability to culture these tissues over weeks at steady state. Furthermore, the connecting channels could be covered with human endothelia mimicking blood transport vessels. The system layout and chip design support repeated substance exposure for safety or efficacy test assay development. Toxicity assays have been performed using the co-cultures mentioned above. Finally, rapid prototyping tools allow for the addition of up to ten further tissue culture spaces to the MOC platform. Platform performance will be analysed against the existing chip-based co-culture systems. Opportunities and challenges are discussed against the background of other developments in the field.