Development of the Galenic Lab-on-a-chip and Therapy-on-a-chip concepts for drug formulation / delivery

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Currently, medicine is faced with many therapeutic challenges that the development of new drug delivery systems is trying to overcome: *How to deliver the drug to the exact right place, in the desired dose and at the required time, while limiting undesirable side effects?*
In the last decades, drug delivery systems (DDS) have developed considerably (in the form of medical devices and micro/nanoparticulate drug carriers) and are now taking a prominent place in human medicine. Particulate DDS are obtained by encapsulating active ingredients that can be released in a controlled and targeted manner within the body. In this sense, nanomedicines are used for targeted therapeutic action and can cross certain barriers in the body such as the blood-brain barrier (BBB) or the intestinal barrier to treat cancers or infections for examples. Continuous production of DDS assisted by microfluidics has drawn a growing interest because of the high reproducibility, low batch-to-batch variation of formulations, narrow and controlled particle size distribution and scale-up facilities induced by this process. Besides, microfluidics offers opportunities **(1)** for high throughput screening parameters and scale-up of process and the implementation of process analytical technologies (PAT) as close to the nanomedicine candidates as possible, and also **(2)** to propose miniaturized medical devices as microneedle-based drug delivery systems.
In this context, the MINT laboratory developed and patented two technological concepts (Figure 1) combining microfluidics and microfabrication/3D printed technologies:

(a) ***GALECHIP*, as an instrumented microfluidic platform such as a Lab-on-a-chip dedicated to the formulation/production under controlled operating conditions of Lipidic Nanocapsules (LNC) as drug nanocarriers (20-100 nm with a polydispersity index < 0,15) and the implementation of PAT such as an X-ray *in operando* characterization technique (Small Angle X-ray Scattering,).**

(b) ***THERACHIP*, as a microfluidic medical device (MMD) with microneedles which is per-operatively implantable (after surgery), biocompatible and compliant with magnetic resonance imaging (MRI) techniques. This MMD is applied to locally deliver drugs to treat brain tumors as glioblastoma (GBM), and to bypass the BBB in the case of operable GBM.**

These proven concepts intended to propose personalized therapeutic strategies for the management of the patient's pathology such as (1) drug administration as close as possible to the target (organ, cells, bacteria, etc.) and (2) the production of nanomedicines as close as possible to the patient.

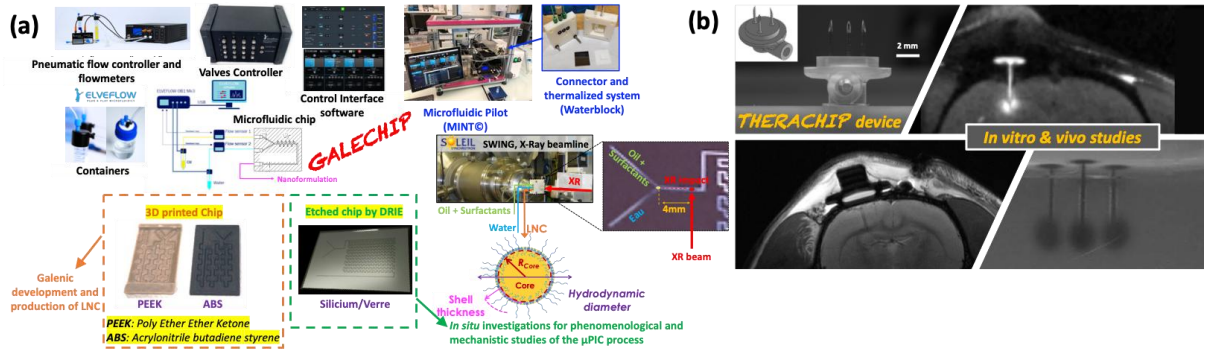

Figure 1: GALECHIP (a) and THERACHIP (b) microfluidic and technological concepts