Microcapsule loaded with an active substance / application in oncology

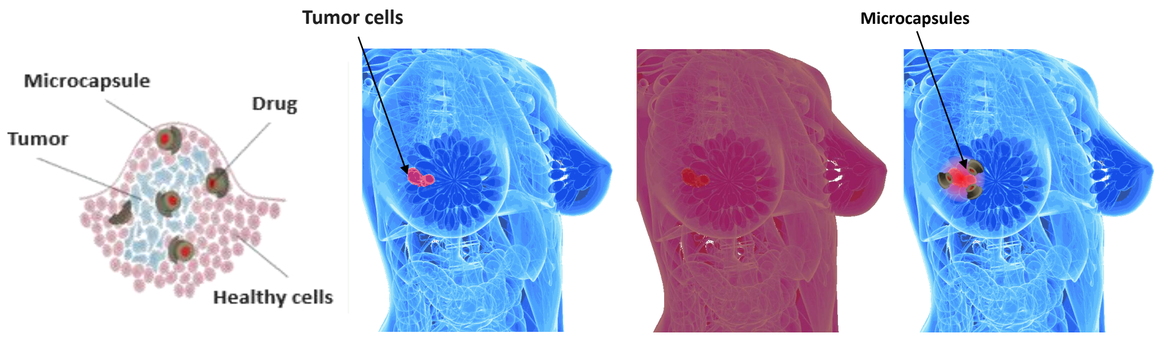
IJL : (H. JABAL, S. MC MURTRY, O. EL MAZRIA), IGR : (E. GAUTREAU, F. ANDRE, L. MIR)

ABSTRACT :

- Local chemotherapy aims to improve tumor destruction while reducing systemic side effects.
- This approach requires the development of efficient and easy-to-use drug delivery systems.
- Microcapsules allow targeted delivery of pure chemotherapeutic agents directly to tumors.
- They help spare healthy tissues surrounding the tumor area.
- Their sustained release and tumor-specific targeting overcome traditional chemotherapy limits.
- These systems ensure controlled and sustained drug delivery for better efficacy and lower toxicity.

Micro-encapsulation

The development of bioresorbable polymer-based microcapsules capable of **delivering drugs directly to cancer cells** at a sustained and controlled rate offers improved efficacy and reduced toxicity for cancer treatment.

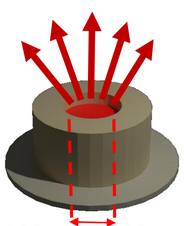


The microcapsules are implanted near or into the tumor

Intravenous chemotherapy

Injection of capsules and local diffusion of drugs

- The microcapsules are manufactured only with a physical process and at room temperature
- Allows the encapsulation of all types of molecules.
- Microcapsules of approximately **800µmx800µm** (adjustable) with a capacity of **0.1 – 0.6 mg** of encapsulated active ingredient (**Doxorubicin, Bleomycin, Herceptin, mCTLA-4**…).
- Bio-assimilable polymer including a micrometric perforation allowing slow diffusion.



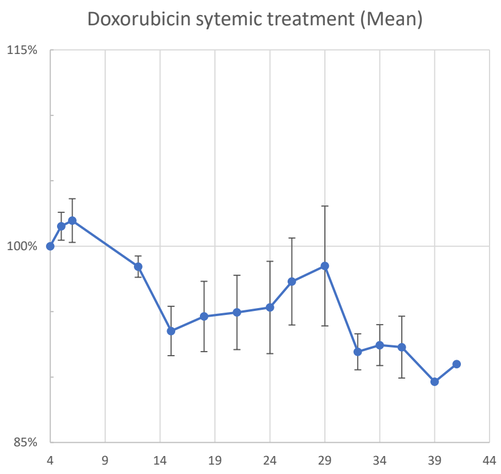
100µm à 500µm

Microcapsule

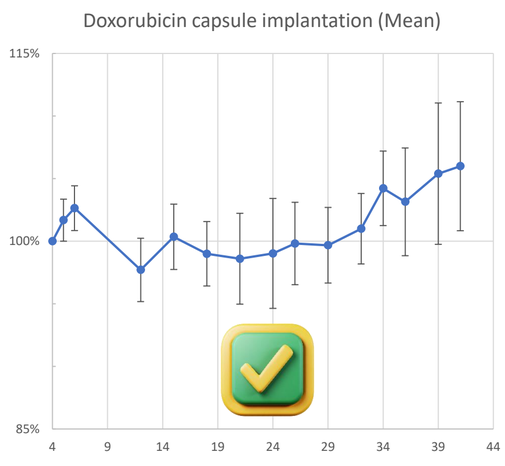
Coaxial needle

Toxicity

Comparison of intravenous injection and capsule implantation of doxorubicin



3 intravenous injections at 6 mg/kg : lower efficiency high toxicity



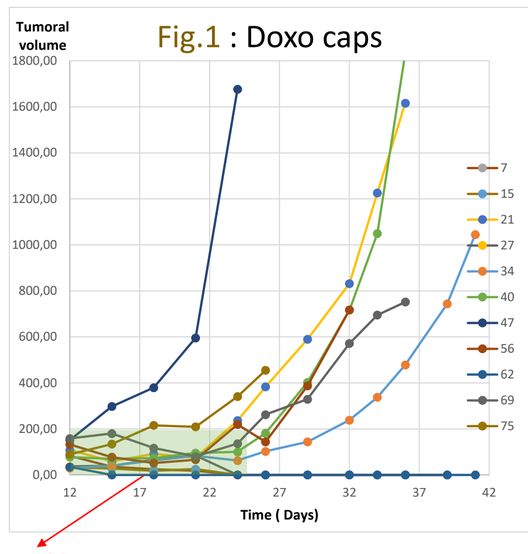
3 capsules in one shot : better efficiency and no toxicity

Preclinical results

The contribution of micro-encapsulation :

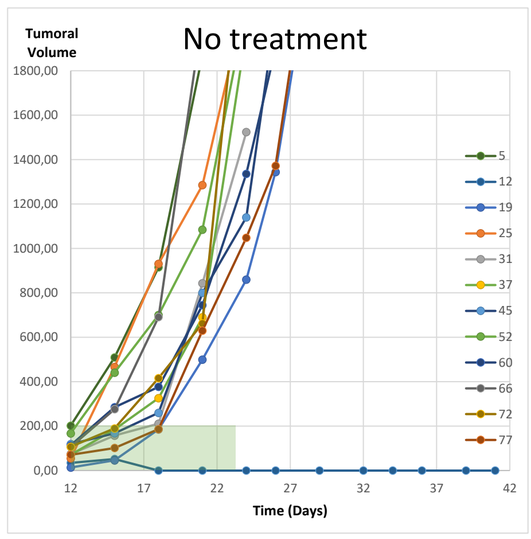
The use of microcapsules allows **slow**, **controlled** and **concentrated** diffusion on/in tumor cells

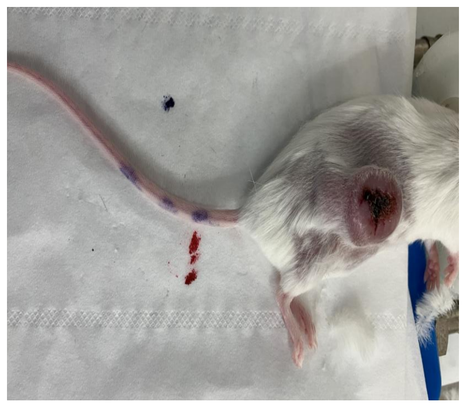
CT26 colon cancer tumors are implanted subcutaneously in the right flank of BALB/c mice. Microcapsules containing doxorubicin (Fig 1) and doxorubicin or mCTLA-4 antibody (Fig 2) were implanted near the tumor (at day 4 for doxorubicin, day 10 for antibody).

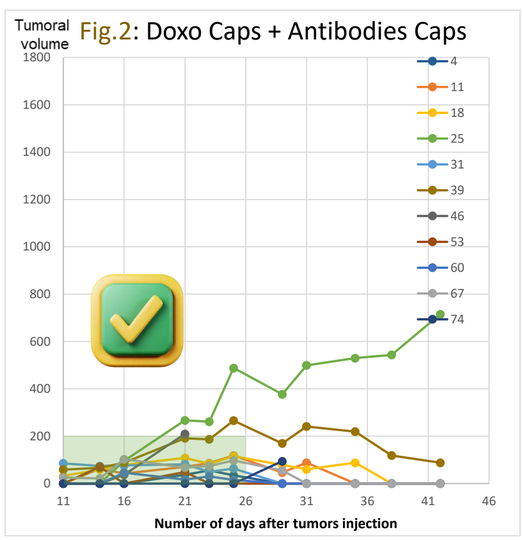


Effective on 26 Days

- **Local Injection**
- **No systemic effects**
- **High local concentration**
- **Slow diffusion (26 days)**
- **Bioabsorbability of the capsule**
- **Lower cost**
- **Bioavailability of fragile molecules (ADCs …)**







Complete disappearance of the tumor with no visible toxicity

CONCLUSION:

The use of resorbable polymeric microcapsules for the treatment of cancer represents a promising advance in oncology. These microcapsules allow controlled and targeted release of drugs directly to cancer cells. This approach offers several significant advantages, including increased effectiveness in eliminating tumor cells while minimizing unwanted side effects often seen with conventional treatments. Thus, this technology could transform current therapeutic strategies by improving patient tolerance and increasing the success rate of anticancer treatments.

PATENTS:

(1) Method for obtaining a nano-capsule structure Inventors: Stefan Mc Murtry, Omar El Mazria
https://patents.google.com/patent/WO2013186292A2/en?oq=WO2013186292A2
(2) Biofunctional electrode for storing and releasing compounds by slow diffusion Inventors: Stefan Mc Murtry, Omar El Mazria, Serge Cosnier, Hanna Riahi, Yannig Nedellec
https://patents.google.com/patent/US20240105979A1/en?oq=US20240105979A1
(3) Microcapsule loaded with an active substance and comprising a micrometric opening Inventors: Stefan Mc Murtry, Omar El Mazria, Luis Mir, Franck Andre
https://patents.google.com/patent/WO2023242280A1/en?oq=WO2023242280A1