ABSTRACT

Nowadays cancer is one of the leading causes of death in Europe. Major challenges in the management of the disease are due to the lack of agents used for early diagnosis and associated with severe and often therapy-limiting side effects. Although chemotherapeutics are able to kill neoplastic cells, they also will induce toxicity in non-neoplastic tissues, thus causing deterioration and weakening of the patients during treatment.

Therefore, new approaches are necessary with the purpose of optimizing anticancer therapy. Among new experimental approaches, the *magnetic particle hyperthermia* has been suggested.

Hyperthermia in itself has been used for many years in cancer treatment. Its introduction as anticancer therapy has been proposed since the 1970s. Despite its acknowledgment in being a promising approach, hyperthermia has still not established in clinical routine owing to the inability in focusing the heat only to the intended region without damaging the surrounding healthy tissue. By contrast, the so-called magnetic particle hyperthermia has the potential to address this shortcoming. It has been used so far as nanoparticles (NPs) that may be made to accumulate exclusively in tumor tissue. Nevertheless, the only use of NPs is not enough for reducing side effects, they could in fact distribute randomly in the body, causing several adverse effect to non-neoplastic tissue. For this reason, thermotherapy using non-directed particles has not achieved widespread support for clinical development.

In order to develop directed particles, the NP have been coated with particles, the NP have been coated with peptides known to deliver the NP to cancer cells selectively.

These magnetic NPs, when exposed to Alternating Magnetic Fields (AMF), can generate heat due to hysteresis loss. This behavior can be exploited for treating cancer, revolutionizing the existing hyperthermia procedures. Magnetic particle hyperthermia presents in addition the following characteristics: is a local therapy; has reduced side effect because of the small area of action; thanks to bio-conjugation, NPs may be targeted to cancer cells.

Since cancer cells exposed to elevated temperatures are more sensible to chemotherapeutics and radiation, hyperthermia can also be associated to chemotherapy and radiotherapy, in order to enhance their effect. It can help in reducing the dose of chemotherapeutics as well as increase the effect of therapeutic radiation two-fold, not only because by increasing the blood flow to the hypoxic tumors allow for radiation to be more efficient, but also because hyperthermia is able to inhabit repair of damages caused after radiations.