431q High Gradient Magnetic Implants: a More Effective Approach to Magnetic Drug Targeting

Armin D. Ebner and James A. Ritter

One of the key problems associated with drug administration is the difficulty to target specific areas or sites in the body, like cancerous tumors or arterial blockage. Typically in these cases, exceedingly large doses of a drug are needed to ensure that some of the drug reaches a specific site, a fact which unavoidably imposes substantial toxic side effects at non-targeted organs. One way to achieve drug targeting in the body is to incorporate magnetic particles into drug carriers and then to retain them at the site using an externally applied magnetic field. This process is referred to as magnetic drug targeting (MDT). However, the main limitation of MDT is that under a given set of conditions an externally applied magnetic field alone may not be able to retain a sufficient number of magnetic drug carrier particles (MDCPs) to justify its use. Such a limitation may not exist if high gradient magnetic implants (HGMIs) are used to assist MDT.

HGMIs are based on the same principles as high gradient magnetic separation (HGMS). When a ferromagnetic element (e.g., an implant) is placed in a magnetic field, it becomes magnetically energized creating a very strong but localized magnetic field that is far more capable of concentrating magnetic particles at the site of the implant compared to the magnetic field alone. Invasive magnetic implants can be made of needles, wires, stents, catheter tips, and even very magnetic (non-drug carrying) particles. Wires can also be placed just outside the body near the target zone to improve the collection efficiency of the MDCPs. Finally, magnetic implants can be placed in the body at the target site by transdermal injection through the skin using a specially designed syringe, or through the use of catheters.

This presentation will provide an overview of the different approaches where HGMIs can be used to enhance the collection of MDCPs at targeted sites. The interesting notion is that the collection may have to take place in blood vessels ranging from large arteries where exceedingly high velocities exist to capillary networks where exceedingly low velocities exist. In this light, this presentation will also discuss the current challenges being faced by implant assisted MDT that are slowly being overcome based on recent experimental and theoretical research.