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Tracking of the pharmaceutical dissolution process with magnetoresistive sensors

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Introduction

The introduction of new oral pharmaceuticals requires the investigation of the dissolution process of the pharmaceutical in the gastrointestinal tract. Currently, SQUID based magnetic measurement systems are used for non-invasive observation of this dissolution process. Recently we introduced a new magnetic marker concept, which allows room temperature measurements using e.g. magnetoresistive sensors. Here we aim to evaluate the new marker in a phantom study.

Methods

The magnetic marker consists of a permanent magnet and a compartment of iron powder mechanically pressed into a tablet. During the dissolution the iron powder rearranges around the magnet, which yields a decrease in the measured magnetic field. The phantom consists of a set of glass tubes connected by silicone rings and a Cyamopsis tetragonoloba flour solution circulating in the tubing system. The marked tablet circulated in the tubing system and the magnetic field was measured with a set of 27 anisotropic magnetoresistive sensors at a distance of approximately 7 cm. The marker position was continuously estimated with a magnetic dipole model and a Levenberg-Marquardt localization algorithm.

Results

We were successfully able to continuously track the marked tablets moving in the phantom and, at the same time, measure the decay of the field (respectively magnetic dipole) amplitude until the tablet dissolved. During a run of the marker of 3.2 m the maximal localization error was 1.5 cm. The dissolution of the tablet resulted in a 20% reduction of the dipole amplitude.

Conclusion

We measured for the first time the dissolution of a magnetically marked tablet in a physical phantom with a magnetoresistive sensor array. This technique might replace the more expensive and less flexible SQUID based measurements of the pharmaceutical dissolutions in the gastrointestinal tract.