Magnetic Drug Targeting means the specific delivery of chemotherapeutic agents to their desired targets, e.g. tumors, by using magnetic nanoparticles (ferrofluids) bound to these agents and an external magnetic field which is focused on the tumor. This type of target directed drug injection attempts to concentrate a pharmacologic agent by enhancing its efficacy while simultaneously minimizing deleterious side effects. In previous studies, we have been able to demonstrate the efficacy of this type of localized intraarterial chemotherapy in VX2 squamous cell carcinoma among rabbits [Alexiou, C., Arnold, W., Klein, R.J., Parak, F.G., Hulin, P., Bergemann, C., Erhardt, W., Wagenpfeil, S. and Lübbe, A.S. "Locoregional cancer treatment with Magnetic Drug Targeting", Cancer Res. 60 (2000) 6641-6648]. In the present investigation, we have studied the biodistribution of ferrofluids and chemotherapeutic agent by measuring the amount in the tumor, peritumoral area, various organs and body fluids (e.g. blood and urine), with and without Magnetic Drug Targeting. We compared results to that of administering a chemotherapeutic agent solely. An external magnetic field was directed toward the tumor for 60 min. Biodistribution of ferrofluids in the tumor was investigated using histological cross sections and measured semi-quantitatively using
123I-labeled nanoparticles and quantitatively by the use of radioactive 59Fe-ferrofluids. Mitoxantrone was quantitatively measured using HPLC-analysis. The strength of the external magnetic field was 0.6 Tesla (permanent magnet) in the 123iodine study and 1.7 Tesla (electromagnet) in the 59Fe-study and HPLC-analysis. The concentration of the ferrofluids (FFs) in the tumor region i.e. the tumor tissue and the surrounding area, which was under the influence of an external magnetic field, was found to be much higher than in the absence of one. In contrast to systemic chemotherapy, a much higher concentration of mitoxantrone in the tumor and the peritumoral area (region surrounding the tumor< or = 1 cm), by using only 50% and 20% of the normal dose was seen. Thus, the higher concentration of mitoxantrone could explain the therapeutic efficacy of Magnetic Drug Targeting in treatment of VX2 squamous cell carcinoma in rabbits in our previous studies with the advantage of no adverse clinical side effects.