

Title: Biomaterial-based thermal ablation for ovarian cancer

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Hyperthermia-based thermal ablation has been utilized to treat cancer by eliminating local tumors and subsequently activating an immune response triggered by the tumor cell death. We have previously developed iron oxide-loaded poly(caprolactone) scaffolds designed for cell recruitment and non-invasive hyperthermia. Successful heat generation within these scaffolds has been demonstrated under an alternating magnetic field, highlighting their potential to treat disseminated cancer through non-invasive heating. To deliver heat in a clinically safe manner, the applied field strength needs to be reduced to minimize significant background heating. In this work, scaffold design was optimized by incorporating nanoscale iron oxide particles to enhance heat generation at lower field strengths. These optimized scaffolds achieved sufficient temperatures for thermal ablation, while greatly reducing the required field strength from 30kA/m to 15kA/m. Non-invasive thermal ablation was performed by implanting scaffolds in the abdominal cavity of mice and conducting heating at 15kA/m field strength for 15 minutes. After heating, minimal side effects were observed, and successful cell killing within the scaffolds was achieved. In addition, cancer cell capture in the scaffolds was demonstrated in a metastatic ovarian cancer mouse model through histological analysis. Ovarian cancer cell infiltration was observed within 4 to 5 weeks after scaffold implantation, with cancer cell composition reaching up to 85%. The number of infiltrated cancer cells increased with tumor burden, indicated by bioluminescent tumor cell signal. Collectively, these findings show that the optimized scaffolds enable cancer cell infiltration and non-invasive thermal ablation, demonstrating their promise for treating metastatic ovarian cancer and serving as a platform for subsequent immune activation.