

Detection of magnetic nanoparticles in deep position by using pulsed magnetic field V

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Breast cancer is known as cancer with recurrence or metastasis. It is important to know the presence or absence of the metastasis. Currently, the sentinel lymph node (SLN) biopsy, which is used to check for the presence or absence of the metastasis, is mainly performed by the method using a radioisotope. In recent years, a method using a magnetic tracer and a magnetic probe has been garnering attention. The magnetic particles are injected directly into the breast tissue, and the magnetic nanoparticles flow into the SLN. The position of the SLN is specified by specifying the position of the magnetic nanoparticles. In previous study, there is a method using a permanent magnet and a magnetic force meter by Sekino *et al.* [1] However, the accuracy is low for patients with high BMI. Since the pulsed magnetic field can generate a larger magnetic field than the permanent magnet, it is considered to be effective for patients with high BMI. In this study, we aimed to establish a method using a pulsed magnetic field, which has not been reported in SLN biopsy. We used Resovist® (Fuji Film Co.) as the magnetic tracer and a search coil as the magnetic probe.

The EMF was measured by a pair of search coils fixed on the surface of the exciting coil which has the inner diameter of 15 mm and 200 turns. The Resovist was placed at a position h away from the surface of the search coil on one side. Fig. 1 showed an example of EMF signals with and without the Resovist. The former and latter signals corresponded to red and black curves, respectively. The peak of EMF was enlarged when the Resovist was placed as shown in the inset of Fig. 1. When these waveforms are compared and statistically significant difference is found, it is judged that Resovist can be detected. The maximum distance that Resovist can be detected was defined as the distance of detection limit. We sought for the search coil with the largest distance of detection limit. We evaluated different types of search coils by changing the inner diameter and the number of turns and succeeded in detection at a distance $h = 15.0$ mm with the search coil, which has the inner diameter of 13 mm and 200 turns.

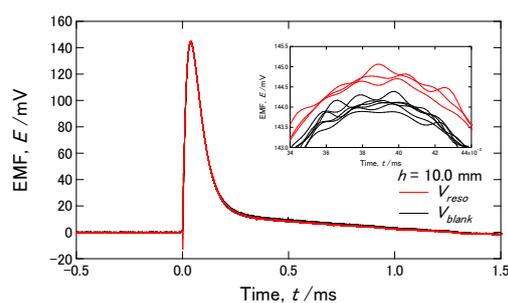


Fig. 1. EMFs of search coil without and with Resovist at $h = 10.0$ mm.

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References: [1] Masaki Sekino *et al.*, Scientific Reports 8 (2018) 1195. [2] Ryota Motoki *et al.*, JSAP Autumn meeting 19a-E201-2, Abs. DVD 09-115 (2019).