

Microwave Heating for Thermal Therapy of Bile Duct Carcinoma using Indwelling Metallic Stent

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In recent years, various types of medical applications of microwaves have widely been investigated and reported. Among them, microwave thermal therapy is one of the useful applications and is modality for cancer treatment. In this treatment, there are several schemes of microwave heating. The authors have been studying microwave antenna for intracavitary heating aiming at the treatment of bile duct carcinoma. In this treatment, an endoscope is first inserted into the duodenum and a long and flexible antenna is then inserted into the forceps channel of the endoscope, which is used to insert the tool for surgical treatment. Finally, the antenna is guided to the bile duct through the papilla of Vater, which is located in the duodenum, and is inserted in the bile duct.

Meanwhile in many cases, a metallic stent is employed for the treatment of bile duct carcinoma. The metallic stent improves stricture by expanding physically. However, in many cases recurrent stenosis will be incurred by explosive growth of the cancer cells. In this case, the thermal treatment by the microwave energy may be effective. Here, according to our previous study, the microwave antenna inserted into the metallic stent cannot radiate the microwave energy to outside of the stent, where the cancer cells are existing. This is because the electromagnetic wave is shielded by the metallic stent. So, the authors have been studying structure of the metallic stent, which can leak the electromagnetic wave to outside.

In this study, heating performances around the thin microwave antenna which is inserted into the bile duct is evaluated by specific absorption rate (SAR [W/kg]) distributions. Here, the SARs are measured by use of biological tissue-equivalent phantom and are calculated using finite-difference time-domain (FDTD) method. As a result of some investigations, possibilities of thermal treatment of bile duct carcinoma with developed metallic stent were found.