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[Poster Presentation] SAR calculations around an implanted cardiac pacemaker due to a mobile radio terminal for business in VHF band

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Abstract — Recently, various types of radio communication devices such as cellular phones have become common. Therefore, influence with the electromagnetic wave emitted from these equipments is widely concerned. In particular, electromagnetic interference of an implanted pacemaker induced by these equipments has been investigated. However, there are few studies of specific absorption rate (SAR) around the pacemaker by the mobile radio terminal. In this study, SAR due to a mobile radio terminal for business in very high frequency (VHF) band, which are used in police officers, airport employees etc., is investigated. As a result of calculations, possibilities of increasing the SAR around a pacemaker housing were observed.

Keywords SAR, implanted cardiac pacemaker, VHF

1. Introduction

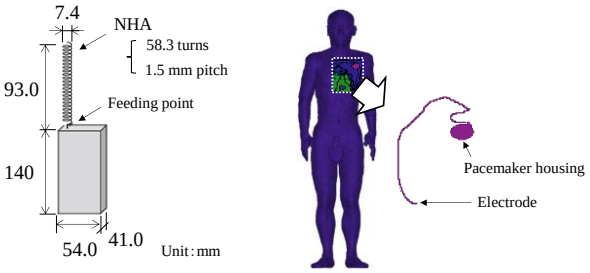
The implanted cardiac pacemaker is one of the medical devices for cardiac diseases such as irregular heartbeat and is implanted in the chest of patient. Meanwhile, various types of radio communication equipment such as cellular phones have become common. Recently, electromagnetic interference of an implanted pacemaker with these equipments has been investigated. However, there are few studies of SAR around the pacemaker induced by mobile radio terminal. In this study, SAR due to a mobile radio terminal for business in very high frequency band was investigated, which should be considered that the electromagnetic energy penetrates deep region of the operator body because of longer wave length.

2. Analytical model

Figure 1 shows wireless radio terminal model and the pacemaker model for the investigations. Wireless radio terminal model is a normal mode helical antenna (NHA) with metallic case (operating frequency: 150 MHz, output power: 5 W). NHA is constructed by $0.1 \times 0.1 \times 0.1$ mm^3 voxels. The pacemaker housing is implanted in subcutaneous fat of human model "TARO" [1]. Figure 2 shows analytical model. Feeding point of wireless radio terminal is arranged in front of the pacemaker housing. In order to calculate the SAR values, finite-difference time-domain (FDTD) calculation is employed.

3. Calculated result

Figure 3 shows the SAR distribution around pacemaker model. In this figure, high SAR value is observed at the muscle ($\varepsilon_r = 62.2$, $\sigma = 0.73$ S/m) near the pacemaker model. It is considered that the result is caused by high conductivity of the muscle tissue.



(a) Wireless radio terminal (b) Pacemaker implanted in human

Fig. 1 Numerical models.

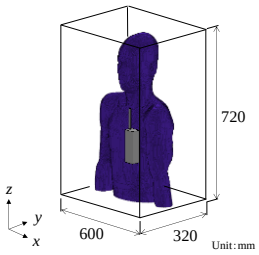


Fig. 2 Analytical model.

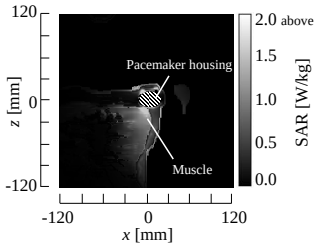


Fig. 3 SAR distribution.

4. Conclusion

In this study, the SAR distributions around the pacemaker model embedded into the human model by the VHF wireless radio terminal model. From the result of calculations, increase of SAR value due to the existence of muscle which has high conductivity was observed.

Acknowledgments

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Reference

[1] T. Nagaoka *et al.*, Transactions of the Japanese Society for Medical and Biological Engineering, vol. 40, no. 4, pp.45-52, Dec. 2002.