Comparative Study on the Dielectric Properties of living and Nonliving tissue from Human and Animal

Keywords: Living tissue, dielectric properties, characteristic parameters

Abstract: In this study, dielectric properties of normal liver, kidney and spleen excised from human and rabbit within 30 min and devitalized liver, kidney and spleen excised from human for 24 h were measured, modeled and analyzed over the frequency range from 10 Hz to 100 MHz. Comprehensive comparison of the dielectric differences of the samples was made in order to provide the basis for the establishment of forward matrix model with better precision in EIT image reconstruction.

For dielectric measurement below 300 kHz, a four-electrode measurement system was established using a Solartron 1260 impedance analyzer combined with a Solartron 1294 impedance interface. And a two-electrode method employing an Agilent 4294 impedance analyzer was adopted for measurement above 30 kHz. During measurement the tissue sample was placed in an incubator with constant temperature of 37 ℃ and relative humidity of 90%. The complex resistivity spectrum characteristics of the tissues was estimated according to the Cole formula. The characteristic parameters were estimated and the obtained results were statistically analyzed.

Within the frequency range of observation, the conductivity of animal tissues were all lower than that of human tissues and the difference could be as large as more than 3 times. The conductivity of normal kidneys was higher than that of the devitalized ones in the full frequency range, with difference up to 50%. However, the devitalized liver and spleen had higher conductivity than the normal counterparts within 500 kHz and the results reversed in the frequency range above 5 MHz. Statistical comparison of the characteristic parameters indicated significant differences between the samples.

The dielectric properties of human living tissues are significantly different from those of devitalized ones or those of animal tissues. Therefore the latter two types of tissues can’t be used to approximate dielectric properties of human living tissues in practical applications.

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