

Biomagnetism and Gynaecology

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In the latest years superconducting quantum interference device (SQUID) biomagnetometry has been demonstrated as a useful tool in investigating the hemodynamic of certain vessels by measuring the exceedingly weak magnetic fields emitted by circulating blood cells (10^{-8} of the earth's magnetic field). The high concentration of blood cells in the examined region gives high biomagnetic activity (BA). This method has been effectively used in our lab for the investigation of breast, ovary and uterine myomas [1-9].

In our lab, BA was recorded by a single channel second order gradiometer DC-SQUID (MODEL 601; Biomagnetic Technologies Inc., San Diego, USA) [1-9] in a magnetically shielded room of low magnetic noise. Ultrasound scanner Doppler examination assessed previous to the process the correct position of the examined area (breast, ovary, uterine myomas) in order to ensure that the BA from near vessels was not included. Throughout the recordings the patients were relaxed lying supine on a wooden bed with no metallic object so as to reduce the environmental noise. The BA was recorded after positioning the SQUID sensor 3 mm above the exact recorded position assessed by the Doppler examination in order to permit the highest magnetic flux to pass throughout the coil with little deviation from the vertical direction. Five points were selected for examination according to the examined areas' topography. Point 5 was located at the center of the target area, whereas points 1-4 were located at the periphery. For each point 32 second recordings were taken and digitized by a 12 bit precision analogue-to-digital converter with a sampling frequency of 256 Hz. The duration of the above recordings is justified since the chosen time interval is sufficient to withdraw, on the average, all random events and to permit the persistent ones to remain. The BA was band-pass filtered, with cut-off-frequencies of 0.1-100 Hz. The obstetricians were ignorant of the BA. Informed consents for the studies was obtained from all the participants prior to the procedures.

Our Results were as Follows

The BA of breast in young women with regular cycling endometrium showed biphasic magnetic curves whereas young women with irregular menstrual cycles showed a monophasic ones [3]. The BA of breast was low at puberty and the menopause but was high during the reproductive years [4]. High amplitudes characterized the waveform of a malignant breast lesion while in benign ones the corresponding amplitudes were low. Using the application of non-linear analysis there was a clear saturation value for the dimension of malignant breast lesions and no saturation for benign ones [5]. The ovarian lesion waveforms and the corresponding spectral densities were of high amplitude in the majority of them, and of low amplitude in most benign ovarian diseases [6]. Using the application of non-linear analysis in the ovarian lesions together with the use of dimensional calculations we observed a clear saturation value for the dimension of malignant ovarian lesions and no saturation for benign ones [7]. High BA was also obtained in the majority of large uterine myomas and low BA in most small ones [8]. Applying nonlinear analysis to the BA of the uterine myomas, we observed a clear saturation value for the group of large ones and no saturation for small ones [9].

Our research work, justified a new approach to biomagnetism and propose that this imaging modality could be potentially exploited in gynaecology. It is a non-invasive procedure, consistent, quick, simple to interpret, completely safe and well tolerated by the women. An additional modification of the equipment so as to be more sensitive and without difficulty moved to the women's bedside could be most cooperative in clinical practice. Nevertheless, more research is needed in order to investigate its possible role as an adjunct process to the established investigative techniques.

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