

Spectral analysis of the fetal phonocardiogram

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Up to today the application of prenatal phonocardiography (PCG) is quite limited but certainly, with suited techniques, the PCG will enable the assessment of important physiological parameters. Important applications are the recording of the FHR, the determination of systolic and diastolic time intervals, the detection of heart diseases, and there is evidence that even the fetal stage of maturity can be monitored. Some of the mentioned parameters may be recorded from the time domain representation of the PCG, whereas others require its spectral analysis.

The normal way to obtain the PCG spectrum is to perform a Fourier transform after the suppression of artefacts such as maternal sounds and noise. Extensive analysis of the spectra showed that there is a strong correlation between the spectrum of the PCG and the stage of maturity of the fetus. According to the development of dimensions and contractile strength of the heart, both first and second heart sounds show characteristic shifts of the corresponding spectra during the course of pregnancy. Experimental results show that analysis of the spectrum may be a real alternative to ultrasonic imaging in the determination of fetal maturity. As conventional phonotransducers hide this facility due to their unsuitable transfer characteristics, special microphones have to be used.

Fourier transform analysis of the PCG shows the drawback that the spectrum represents a spectral summary of the whole cardiac cycle. Information about the time course of the contraction and the action of single parts of the heart is lost. In order to avoid this disadvantage, a continuous spectral analysis during heart action is necessary. A convenient tool for this purpose is the momentary frequency of the PCG that is determined by its Hilbert transform. In this way an improved control of the heart action and thus the detection of diseases becomes possible.