Demodulation in tissue, the relevant parameters and the implications for limiting exposure.

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In the biomedical literature there are a number of reports that speculate about possible effects in the body due to the demodulation of electromagnetic fields. However, only few interactions in amplitude-modulated or even pulse-modulated electromagnetic waves are fundamentally plausible and have been demonstrated to occur in humans. The following observations fall into this specific category: thermal effects of amplitude- or pulse-modulated microwaves; demodulation of amplitude- or pulse-modulated electromagnetic waves in cell membranes; and demodulation of amplitude- or pulse-modulated electromagnetic fields in the electronics of implants such as cardiac pacemakers or cardioverter defibrillators. The possible consequences of these effects for the organism, their probability of occurrence in everyday life field conditions, and, consequently, the implications for limiting exposure are very different. Microwave hearing is a harmless effect which is perceived by humans only in strong fields with high peak power densities of more than 100 mW cm(-2). In normal residential or occupational environments the peak power density of even the strongest microwave sources is only around 1 mW cm(-2). Demodulation of pulse-modulated electromagnetic fields in the cell membranes decreases the stimulation threshold of nerves and muscles and can introduce numerous adverse effects ranging from perception of pain to dangerous cardiac fibrillations. The stimulation and demodulation effects are restricted to carrier frequencies up to several MHz. In experiments with 900 and 1,800 MHz packets with lengths of up to 100 ms and applied powers of up to 100 W, neither a direct stimulation of superficial nerves and muscles nor the conditioning of an electrical current stimulus could be confirmed. Pulse-modulated electromagnetic waves are demodulated in the electronic circuits of implants and can inhibit cardiac pacemakers and introduce cardiac arrest in this way. The highest sensitivity results from repetition rates of pulses below 100 Hz. The preceding two implications should be considered in the elaboration of new general guidelines limiting the exposure for healthy as well as for sick persons in the future.

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