Cardiac Pacemakers and Industrial Microwave Heating Equipment

Public concern over the use of cardiac pacemakers in the vicinity of microwave ovens has been attributed to a reported incident in the early 1970's ([1]). While the report generated much media attention and public controversy, it was later reported ([2]) that this original article had limitations and required careful interpretation. The article did not establish a clear link between the pacemaker and microwave "radiation" or determine the actual leakage level from that oven. Nevertheless, to help protect themselves from the perceived risk of liability it became common practice for many businesses and institutions to post signs warning people wearing pacemakers of the presence of microwave ovens.

Many electronic devices can be subject to faulty operation if not properly shielded to prevent radio frequency interference (RFI). While some very early pacemakers were designed without RFI shielding, most or all pacemakers manufactured since the mid-1970's include such shielding. A series of studies conducted to determined the maximum threshold of interference for safe operation indicated that newer models could withstand levels well above 1 mW/cm^2 ([3]). As a result, an editorial was published by medical professionals stating that the pacemaker interference issue "does not at this time constitute an important clinical problem." ([4])

Most regulatory agencies (e.g. OSHA, CDRH) have determined the maximum safe level of microwave leakage (without regard to pacemakers) to be 10 mW/cm^2 measured at a distance of 5 cm from any point on the operating equipment. Additionally, the International Electrotechnical Commission (IEC) has established guidelines for equipment operation by limiting leakage to 5 mW/cm^2 (at 5 cm distance) under "normal" operating conditions and 10 mW/cm^2 under "abnormal" operating conditions. Using 1 mW/cm^2 as the threshold for pacemaker interference and knowledge that energy dissipates as the square of the distance from its source, a pacemaker would have to be less than 16 cm (6.3 inches) from the source of leakage under worst case operating conditions before any interference could occur. Under normal operating conditions (as defined by IEC) the possibility for interference exists only if the pacemaker is within 11.2 cm (4.4 inches) from the source of leakage.

Although the above analysis suggests that the risks of microwave interference to pacemaker wearers are minimal, the following procedures should be implemented to ensure safe operation of industrial microwave heating equipment:

- Establish a regular maintenance program that includes periodic measurement of microwave leakage levels and standardized calibration of the measurement equipment.
- Discontinue operation and perform all necessary repairs or maintenance whenever microwave leakage exceeds 5 mW/cm^2 at 5 cm distance under normal operating conditions or 10 mW/cm^2 at 5 cm under abnormal operating conditions.
- Clearly identify all areas and locations on the microwave heating equipment where the potential for microwave leakage hazard exists.
- Pacemaker wearers should maintain sufficient distance from microwave heating equipment such that the actual pacemaker remains at least 16 cm (6.3 inches) from any location of potential microwave leakage.

References

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