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Thermal Dosimetry for Bladder Hyperthermia Treatment: An Overview

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"A recent porcine trial using the COMBAT system measured the temperature on both the internal and external surfaces of the bladder wall, employing thermistors. The results demonstrate that spatial distribution of the temperature on the bladder surface is relatively uniform (<0.4 C)."

Refer to results on P.16 - Heat targeted drug delivery using the COMBAT BRS device for treating bladder cancer.

Abstract

The urinary bladder is a fluid-filled organ. This makes, on the one hand, the internal surface of the bladder wall relatively easy to heat and ensures in most cases a relatively homogeneous temperature distribution; on the other hand, the variable volume, organ motion, and moving fluid cause artefacts for most non-invasive thermometry methods and require additional efforts in planning accurate thermal treatment of bladder cancer. We give an overview of the thermometry methods currently used and investigated for hyperthermia treatments of bladder cancer and discuss their advantages and disadvantages within the context of the specific disease (muscle-invasive or non-muscle-invasive bladder cancer) and the heating technique used. The role of treatment simulation to determine the thermal dose delivered is also discussed. Generally speaking, invasive measurement methods are more accurate than non-invasive methods, but provide more limited spatial information; therefore, a combination of both is desirable, preferably supplemented by simulations. Current efforts at research and clinical centres continue to improve non-invasive thermometry methods and the reliability of treatment planning and control software. Due to the challenges in measuring temperature across the non-stationary bladder wall and surrounding tissues, more research is needed to increase our knowledge about the penetration depth and typical heating pattern of the various hyperthermia devices, in order to further improve treatments. The ability to better determine the delivered thermal dose will enable clinicians to investigate the optimal treatment parameters, and consequentially, to give better controlled, thus even more reliable and effective, thermal treatments.