Prostatic swelling and shift of intra-prostatic target during HIFU: Implication for targeted focal therapy

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Introduction: Prostatic swelling during high-intensity focused ultrasound (HIFU) during whole gland therapy can be intra-operatively observed, but has not been quantitatively documented. The objective of our study is to quantify (a) intra-operative swelling of the prostate and (b) shift of intra-prostatic targeted points during HIFU.

Methods: Forty patients with clinically localized prostate cancer (without neoadjuvant hormonal therapy or transurethral resection) underwent whole gland HIFU (Sonablate 500®, version 4 or TCM, Focus Surgery, IN, USA). Whole gland HIFU consisted of 3 consecutive treatment sessions to focus initially on the anterior zone, followed by the middle zone, and finally on the posterior zone of the prostate. Three-dimensional (3D) models of the prostate were reconstructed from the routinely acquired 3-mm step-sectional images of the intra-operative transrectal ultrasound (TRUS) before and after each of the treatment sessions. The 3D models were compared to identify changes in prostate volume and any positional change of identical intra-prostatic calcifications.

Results: Mean prostate volume increased from 30 ml to 36 ml (20% increase) during the anterior zone treatment (p<0.001), from 40 ml to 41 ml (2.5% increase) during the middle zone treatment (p=0.027), and from 41 ml to 43 ml (5% increase) during the posterior zone treatment (p<0.001). The volume of the transition zone (TZ) during the anterior zone treatment significantly increased from 16 ml to 20 ml (25% increase) (p<0.001), while the peripheral zone (PZ) did not change during the posterior zone treatment (p=0.5). The mean shift of the identical targeting point measured 3.6 mm in TZ (n=88), and 4.1 mm in PZ (n=102) (p=0.2).

Conclusions: Significant intra-operative swellings of the prostate and definitive shifts of the intra-prostatic points were observed during HIFU. This suggests a need for intra-operative adjustment of the treatment plan during energy-based targeted ablative treatment of the prostate such as focal HIFU therapy.