

The influence of the number of needles on the prostate HDR treatment plan quality

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Purpose: One of current approaches for the management of localized prostate cancer is a combination of external beam radiotherapy (EBRT) combined with interstitial high-dose-rate brachytherapy (HDR-BT) boost. The quality of prostate cancer interstitial brachytherapy depends on the operator skills, the anatomy of prostate, its volume and relation to surrounding tissues (pubic arc interference), previous diseases and treatment (e.g. TURP, hormonal therapy). Clinical practice shows that the number of implanted needles is also vital. To date, there is rare data available concerning the minimal number of needles and its influence on dose distribution, side effects and long-term outcome. The study is to determine the minimal number of needles which should be used for prostate HDR brachytherapy to obtain an implant of good quality.

Material and methods: 181 patients (age 51-70, median 64) with localized prostate cancer (T1-3N0M0) were treated with interstitial HDR-BT since April 2007 till December 2008. In all cases HDR-BT was administered as a boost in a single dose of 15 Gy after previous 50 Gy from EBRT. Volumetric and dosimetric data were collected. All treatment plans were divided into two groups. First group (good quality implants) consisted of treatment plans which fulfilled all dose-volume constraints (P-D90 > 90%, P-V200 < 15%, U-D10 < 125%, U-Dmax < 160%, R-D10 < 75%). Second group consisted of suboptimal treatment plans. Both groups were compared taking into account the number of inserted needles. Statistical analysis was prepared with Mann-Whitney U test; significance level $p < 0.05$.

Results: The difference between two groups was found to be statistically significant ($p = 0.013$). Median number of inserted needles in first and second group resulted in 15 (range 9-18) and 13 (range 8-18), respectively. Differences were most eminent in patients with prostate glands of small volume (< 20 cc). Needles number was found to be directly proportional to PTV, P-D90 and P-V100; inversely proportional to P-V200. In the study, either the minimal number of needles nor minimal prostate gland volume were not clearly defined in terms of high probability of achieving a good quality implant.

Conclusions: Relatively higher number of needles is related to a higher probability of achieving a treatment plan with all dose-volume constraints fulfilled. Suggested minimal number of needles that should be used for each implant is > 9, optimally ≥ 13 . Suggested minimal prostate volume qualified to HDR brachytherapy should not be less than 12 cc, optimally ≥ 18 cc. Too small prostate volume and/or low number of implanted needles results in suboptimal treatment plans.