Purpose: The purpose of this study is to estimate the effect of edema, developed during implant procedure, on tumor cell surviving fraction (SF) and tumor control probability (TCP) in the patients of prostate cancer who underwent 131Cs permanent seed implants.

Methods: The impact of edema on SF and TCP, was calculated using LQ equation extended to account for exponential nature of edema decay, dose delivered to edematous prostate and inhomogeneous dose distribution.

\[
S(D) = \left(1/V\right) \sum_{i} n_i \left[V_i \{1 + M_0 \exp(-\alpha \cdot \lambda E_t)\} S_i(D)\right]
\]

(1)

Where

\[
S_i(D) = \exp[\alpha \cdot \lambda E_t \cdot Ri(0) \int_0^t \{\exp(-\alpha \cdot \lambda E_t)\} \cdot \frac{1}{1 + M_0 \exp(-\alpha \cdot \lambda E_t)} \cdot \frac{1}{3}] dt
\]

and

\[
TCP = \exp[\alpha \cdot \lambda E_t \cdot VpS(D)]
\]

(2)

Following parameters, \( \lambda E_t = 0.15 \text{Gy}^{-1} \), \( \lambda E = 0.05 \text{Gy}^{-1} \), \( \lambda E/\alpha = 3.0 \text{Gy} \), \( Tp = 42 \text{days} \), \( \alpha = 61.6 \text{d}^{-1} \), and \( \alpha = 10^{-2} \) are used to calculate SF and TCP for 31 patients of 131Cs permanent seed implants for edema half lives (EHL) ranging from 4 days to 34 days and for edemas of magnitudes (M0) varying from 5% to 60% of the actual prostate volume.

Results: The dose reductions in 131Cs implants varied from 1.1% (for EHL=4 days and M0=5%) to 32.3% (for EHL=34 days and M0=60%). These are higher than the dose reduction in 125I implants, which vary from 0.3% (for EHL=4 days and M0=5%) to 17.5% (for EHL=34 days and M0=60%). As edema half life increased from 4 days to 34 days and edema magnitude increased from 5% to 60% the SF increased by 4.57 log, and the TCP decreased by 0.80.

Conclusions: Compensation of edema induced increase in the SF and decrease in the TCP in 131Cs seed implants should be carefully done by redefining seed positions with the guidance of post needle plans. The presented model in this study can be used to estimate the SF or the TCP for pre plan or real time permanent prostate implants using day 0 post implant CT images.