curac2004
3. Jahrestagung der Deutschen Gesellschaft für Computer- und Roboterassistierte Chirurgie e.V.

Virtuelle Dosimetrie: ein neues Verfahren zur rechnergestützten Planung intrakoronarer Brachytherapie

Virtual dosimetry: A new tool for computer-aided planning of intracoronary brachytherapy

Carsten Joachim Beller[1], Krempien, Robert[2], Hensley, Frank[2], Harms, Wolfgang[2], Szabo, Gabor[1], Hagl, Siegfried[1]

[1]Abteilung Herzchirurgie,Chirurgische Klinik, Universität Heidelberg
[2]Abteilung für Klinische Radiologie, Universität Heidelberg
[3]Institut für Rechnerentwurf und Fehlertoleranz, Universität Karlsruhe

Objective:

Intracoronary brachtherapy is an established treatment option for in-stent-restenosis after interventional procedures in cardiology. Long-term outcome can be compromised by technical failures ("geographical miss") and undesired side-effects such as edge-stenosis due to inaccurate and inhomogenous dose administration. Therefore a method for exact planning and simulation of intracoronary brachytherapy applications should be developed.

Material und Methods

Multidetector CT-Scans of coronary arteries from patients with coronary artery disease were used to simulate the dose distribution in the surrounding myocardium close to target lesions. With the use of the previously developed software framework MEDIFRAME a real-time three-dimensional trimming and clipping of the heart enabled optimal views of target coronary lesions. After identifying the vessel segment, the corresponding CT scans were selected to simulate the dosage distribution in the myocardium close to the localized gamma-irradiation (Ir192) via an virtually inserted irradiation catheter (PLATO, Nucleotron, Veenendahl, Netherlands).

Results

Homogenous distribution for doses of 10 Gray and 20 Gray in 1mm tissue depth of the applied High-Dose-Rate (HDR) brachytherapy gamma-irradiation could be modeled in the selected vessel segment.

In the adjacent myocardium a step dose gradient with dose reduction of 95% and 99% in 0,5cm and 1 cm ,respectively, from the vessel wall was ensured with this simulation of intracoronary irradiation.

Discussion

Simulation of localized irradiation of coronary artery segments using multidetector CT-scans and the PLATO-software is feasible and dose accumulation can be prevented. This technique of virtual dosimetry, so far mainly used for dose distribution in tumors and surrounding organs at risk, may be therefore a new tool for computer-aided planning and optimising of intracoronary brachytherapy applications.