千伏级锥形束CT影像进行放疗剂量计算的可行性研究

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Title: **Feasibility analysis of kilovoltage cone-beam CT imaging for dose calculation in radiotherapy**

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关键词: 千伏级锥形束CT; 扇形束CT; 放疗计划; HU-RED; 剂量计算

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摘要: 目的：研究千伏级锥形束CT（kilovoltage cone-beam CT，KVCBCT）影像进行放疗剂量计算的可行性及精确性。方法：用Elekta Synergy医用直线加速器及多层螺旋CT（德国Siomonos AG，SOMATOM Definition AS 40层）分别扫描CIRS-062电子密度模体，获取KVCBCT及扇形束CT（fan beam CT，FBCT）特定区域亨氏单位值（hounsfield unit，HU），重新刻度亨氏单位值-相对电子密（HU-RED）表。选取我院行调强放疗的肿瘤患者80例（鼻咽癌、肺癌、胃癌及宫颈癌各20例），将在FBCT影像上进行的三维适形调强放疗（intensity modulated radiation therapy，IMRT）计划在相对应的CBCT影像上以相同的条件再次进行剂量的计算，并将两种影像条件下的计算结果行配对t检验，比较其剂量分布有无明显差异。结果：在KVCBCT及FBCT两种影像条件下的放疗计划的比较中，鼻咽癌、胃癌、宫颈癌的95%PTV无明显差异，而在肺癌的计划中有着明显差异，在脊髓最大剂量(Dmax)、脑干Dmax、腮腺V30、眼球Dmax、肺 V20、肺 V5、心脏 V30、肝脏平均剂量（Dmean）、直肠 V40、膀胱 V50、小肠Dmax的比较中无明显差异。结论：经过修订HU-RED表后，CBCT影像用于放疗计划的计算是可行的，但在胸部肿瘤即肺癌患者的放疗中还需要进一步研究找到更合适的方法去减少伪影的干扰。CBCT影像能较准确的反应出患者在治疗中的组织结构变化，并能根据变化实时的制定放疗计划，最终为实现自适应放疗（ART）提供准确的影像及剂量保证。

Abstract: Objective：To study the feasibility and accuracy of kilovoltage cone-beam CT(KVCBCT) in dose calculation of radiotherapy.Methods：CIRS-062 electron density phantom was scanned with Elekta Synergy medical linear accelerator and multi-slice spiral CT(Siomonos AG，Germany，SOMATOM Definition AS 40 layer)，obtaining the hounsfield unit（HU) of the specific region of the KVCBCT and FBCT image.Rescale hounsfield unit-relative electron density(HU-RED) table.80 cases of tumor patients（20 cases each of nasopharyngeal carcinoma，lung cancer，stomach cancer and cervical cancer) were selected.Intensity modulated radiation therapy（IMRT) on FBCT images was planned to recalculate doses on corresponding CBCT images under the same conditions.The calculation results of two images were tested by t test，and the difference of dose distribution was compared.Results：In the comparison of radiotherapy plans under KVCBCT and FBCT two imaging conditions，95%PTV of nasopharyngeal carcinoma，lung cancer，stomach cancer and cervical cancer had no significant difference，but there were significant differences in radiotherapy plan for lung cancer.In spinal Dmax，brainstem Dmax，parotid V30，eye Dmax，lung V20，lung V5，heart V30，liver Dmean，rectal V40，bladder V50，and small intestine Dmax ，there was no significant difference.Conclusion：After revising the HU-RED table，it is feasible to use CBCT images in the calculation of radiotherapy plans，but further research is needed to find more appropriate methods to reduce artifacts in the radiotherapy of patients with chest tumors

or lung cancer.CBCT images can accurately reflect the changes of the patient's tissue structure during the treatment and can make a real-time radiotherapy plan according to the changes，and ultimately provide accurate images and dose assurance for the realization of ART.

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