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4DCT Contouring Variability in Stereotactic Body Radiotherapy of Non-Resectable Biliary Tract Cancer

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Running Title: 4DCT Contouring Variability in Liver SBRT

Dear Editor,

Recent adoption of Stereotactic Body Radiotherapy (SBRT) in a number of treatment sites undoubtedly represents advancement of radiotherapy practice. However, potential for contouring variability to impact treatment quality is increased in SBRT due to tight margins, steep dose gradient and the impact of a fall in dose per fraction on biologically effective dose (BED) in the SBRT fractionation dose range relative to conventional fractionation. Contouring variability is particularly profound in abdominal radiotherapy where structures are difficult to differentiate. Whilst imaging strategies such as exhale breath-hold and IV contrast have been shown to provide the optimal setting for contouring, and thereby reduce variability, where there is tumour motion contouring of internal target volumes on four-dimensional CT (4DCT) provides an additional source of contouring variability/error.

This was seen in the benchmark contouring of the CRUK funded ABC07 clinical trial (addition of SBRT to systemic chemotherapy in locally advanced non-resectable biliary tract cancers; ISRCTN 10639376, sponsor University College London). Contouring was performed on a representative typical case by several investigators from a number of different UK centres on contrast enhanced exhale breath-hold CT and on 4DCT. Contouring showed increased variability on 4DCT relative to that seen on breath-hold CT. The impact of variable 4DCT contouring on target dose coverage, whether defining target volume as single expert contour or algorithm driven consensus contour, in resulting treatment plans was not insignificant; BED to 95% of gold standard target volume drop >20Gy in some cases.

Whilst variability in contouring is well-accepted there has been little work highlighting its increased significance in SBRT and likely impact on rates of local control. We highlight the importance of optimal imaging strategies and motion mitigation in SBRT, not only to reduce the size of treatment volumes but to reduce the scope for contouring variability in the first instance.

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Conflict of Interest

None

Four-dimensional Computed Tomography Contouring Variability in Stereotactic Body Radiotherapy of Non-resectable Biliary Tract Cancer

Madam — Recent adoption of stereotactic body radiotherapy (SBRT) in a number of treatment sites undoubtedly represents advancement of radiotherapy practice. However, potential for contouring variability to affect treatment quality is increased in SBRT due to tight margins, steep dose gradients and the effect of a fall in dose per fraction on biologically effective dose (BED) in the SBRT fractionation dose range relative to conventional fractionation. Contouring variability is particularly profound in abdominal radiotherapy where structures are difficult to differentiate. Although imaging strategies such as exhale breath-hold and intravenous contrast have been shown to provide the optimal setting for contouring and, thereby, reduce variability, where there is tumour motion, contouring of internal target volumes on four-dimensional computed tomography (4DCT) provides an additional source of contouring variability/error.

This was seen in the benchmark contouring of the Cancer Research UK-funded ABC07 clinical trial (addition of SBRT to systemic chemotherapy in locally advanced non-resectable biliary tract cancers; ISRCTN 10639376, sponsor University College London). Contouring was carried out on a representative typical case by several investigators from a number of different UK centres on contrast-enhanced exhale breath-hold computed tomography and on 4DCT. Contouring showed increased variability on 4DCT relative to that seen on breath-hold computed tomography. The impact of variable 4DCT contouring on target dose coverage, whether defining target volume as single expert contour or algorithm driven consensus contour, in resulting treatment plans was not insignificant; BED to 95% of the gold standard target volume drop > 20 Gy in some cases.

Although variability in contouring is well accepted there has been little work highlighting its increased significance in SBRT and probable effect on rates of local control. We highlight the importance of optimal imaging strategies and motion mitigation in SBRT, not only to reduce the size of treatment volumes but to reduce the scope for contouring variability in the first instance.

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