Purpose or Objective: In pancreatic cancer, the delineation of target volumes on a CT scan can be difficult due to poor contrast between tumour and surrounding tissues. This study quantifies, for pancreatic cancer in the Netherlands, the interobserver variation of delineated gross tumour volume (GTV) and the internal GTV (iGTV: the volume encompassing GTV in all ten phases of the respiratory cycle) on three-dimensional CT (3DCT) and four-dimensional-CT (4DCT), respectively.

Material and Methods: Seven radiation oncologists from six institutions, with an average of 5 irradiated pancreatic patients per year (range: 3-10), delineated pancreatic tumours in four patients with (borderline) resectable pancreatic cancer. First, the GTV was delineated on a contrast-enhanced 3DCT under guidance of an arterial and venous contrast-enhanced diagnostic scan. This contrast-enhanced 3DCT scan was obtained during free breathing, using a GE LightSpeed RT16 scanner. The GTV was expanded with a fixed margin of 5 mm to create the CTV. In the same session, a 4DCT scan, without contrast enhancement, was obtained, during which the respiratory motion of the patient was monitored to reconstruct 10 respiratory phase scans. Second, the iGTV was delineated on the 4DCT, under guidance of the diagnostic CT and expanded with a fixed margin of 5 mm to create an iCTV. In addition, a questionnaire concerning experience of the participating radiation oncologists was filled out. We calculated median volumes, encompassing volumes and common volumes of the GTV, iGTV, CTV and iCTV. Also, a questionnaire concerning experience of the participating radiation oncologists was filled out. We calculated median volumes, encompassing volumes and common volumes of the GTV, iGTV, CTV and iCTV. In addition, the generalized conformity index (Clgen) and overall observer variation were calculated (value of 1 representing full agreement; 0 no agreement). Interobserver variation of 3DCT and 4DCT delineations were analysed and compared.

Results: For all delineated and created volumes, the results of the mean median volumes, encompassing volumes, common volumes and Clgen over all four patients are presented in Table 1. The mean overall standard deviation (SD) (averaged over 4 patients) was 0.54 cm and 0.58 cm on 3DCT and 4DCT, respectively. The Clgen was smaller for 4DCT, indicating larger variations in delineation on 4DCT. Typical differences in delineations between the seven observers are presented in Fig. 1. The radiation oncologists experienced the GTV and iGTV delineations in this study as difficult.

Table 1: The volumes and generalized conformity index Clgen averaged over all 4 patients.

<table>
<thead>
<tr>
<th>Volume Type</th>
<th>3DCT GTV</th>
<th>3DCT CTV</th>
<th>4DCT GTV</th>
<th>4DCT CTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median (m³)</td>
<td>20.8</td>
<td>52.2</td>
<td>19.6</td>
<td>48.7</td>
</tr>
<tr>
<td>Mean SD (cm)</td>
<td>0.48</td>
<td>0.58</td>
<td>0.42</td>
<td>0.54</td>
</tr>
<tr>
<td>Encompassing volume (m³)</td>
<td>65.5</td>
<td>129.7</td>
<td>93.9</td>
<td>178.7</td>
</tr>
<tr>
<td>Common volume (m³)</td>
<td>7.3</td>
<td>22.0</td>
<td>6.1</td>
<td>19.6</td>
</tr>
<tr>
<td>Clgen</td>
<td>0.36</td>
<td>0.46</td>
<td>0.27</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Conclusion: A considerable interobserver variation in delineation of pancreatic tumours was found, with a mean Clgen of 0.46 for 3DCT (GTV) and 0.35 for 4DCT (iGTV). This indicates a large variation in interpretation of diagnostic CT images and 4DCT images. The limited experience of the observers with delineation as well as the poor contrast between pancreatic cancer and surrounding tissues on CT imaging may have contributed to these results. This should be improved, perhaps by using additional imaging.

PO-0711
Relating CT image heterogeneity to patient outcome in the SCOPE 1 oesophageal cancer trial
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Purpose or Objective: Heterogeneity is a well recognised feature of malignancy that has been associated with adverse tumour biology (1). There is also initial evidence that it may be a potential prognostic biomarker for oesophageal cancer (2). Using texture analysis, the purpose of this study is to investigate the relationship between CT image heterogeneity and patient outcome in the SCOPE 1 UK wide multi-centre clinical trial on oesophageal cancer.

Material and Methods: The planning CT images of 215 patients from the SCOPE 1 clinical trial were uploaded to the TexRAD texture analysis software package. The original GTV outlines from the trial were imported on to the relevant DICOM CT images for each patient. Outcome data from the trial (Overall survival (OS) and progression free survival (PFS)) was included for analysis. Texture analysis of the area within

Figure 1: Typical delineations of all seven observers of the GTV and iGTV in two patients projected on the average scan

Conclusion: A considerable interobserver variation in delineation of pancreatic tumours was found, with a mean Clgen of 0.46 for 3DCT (GTV) and 0.35 for 4DCT (iGTV). This indicates a large variation in interpretation of diagnostic CT images and 4DCT images. The limited experience of the observers with delineation as well as the poor contrast between pancreatic cancer and surrounding tissues on CT imaging may have contributed to these results. This should be improved, perhaps by using additional imaging.

References
the GTV was undertaken on the images to quantify entropy, uniformity, mean grey-level intensity, kurtosis, standard deviation of histogram and skewness for fine to coarse textures (filters: 0.0-6.0).

Results: To date, 23 patients from 21 centres entered in the trial have been analysed. Mean Grey Level <399.745, Skewness >2.215, Kurtosis >0.6 were associated with improved PFS (p=0.0227, p=0.0218, p=0.0460 respectively) for medium filter 3.0. For filter 4.0, improved PFS was associated with Mean Grey Level <454.055 (p=0.0227) and Skewness >0.840 (p=0.0371). Mean Grey Levels of <565.535 (p=0.0251) and <542.5 (p=0.0251) were associated with improved PFS for filters 5.0 and 6.0 respectively. For OS, mean grey levels of <34.845 (p=0.0182), <399.745 (p=0.0381) and <454.055 (p=0.0381) were associated with improved survival for filters 0.0, 3.0 and 4.0 respectively. An entropy level <5.6 was also found to be significant (p=0.0428) for improved overall survival using filter 2.0.

Conclusion: Normal 0 false false false EN-GB JA X-NONE
We have shown using a 10% sample of the overall database available that CT image heterogeneity factors are associated with PFS and OS for patients from multiple centres. Preliminary results therefore suggest that in the future it may be possible to make clinical treatment decisions based on the CT image heterogeneity of a tumour volume. This will be confirmed by completing analysis on the whole SCOPE 1 database.

PO-0712
Stereotactic body radiotherapy in the treatment of inoperable hepatocellular carcinoma
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Purpose or Objective: To evaluate the feasibility and clinical results of stereotactic body radiation therapy (SBRT) in the treatment of hepatocellular carcinoma (HCC) in patients unsuitable or failing to standard loco-regional therapies.

Material and Methods: Patients with < 3 inoperable HCC lesions with < 6 cm diameter were treated with SBRT. Prescription dose was adapted according to tumor size and global liver function and comprised 48-36 Gy in 3 fractions or 40 Gy in 5 fractions (prescribed on 80 % isodose). Primary endpoint included in-field (LC) local control and toxicity. Secondary endpoints were overall (OS), cancer-specific (CSS) and progression-free survival (PFS).

Results: 82 patients with 120 HCC lesions were treated. Median age was 70 (range 44-90). Most of the patients had Child-Pugh A5-A6 cirrhosis (80.4%), Barcelona Clinic Liver Cancer classification 0-A-B (93%). Median lesion size was 22 mm (range 7-120 mm). Most lesion were in the left lobe (65%). In most patients SBRT was the first local treatment (82%). Up to 7% of patients had portal vein thrombosis. Median observation time was 14 months. Actuarial 1-year LC, PFS, CSS and OS were 76.7% (95%CI:40-92.5%), 13.5% (95%CI:4-26-4), 92.1% (95%CI:81.8-96.7%) and 78% (95%CI:66.4-86%), respectively. Up to 18 patients (22%) experienced G3-G4 acute toxicity and 1 case of G5 toxicity was reported. Four cases of classical Radiation-induced liver disease (RILD) were reported, while 21 patients experienced a modification of Child-Pugh classification (25%), mostly of 2-3 points. On multivariate analysis, no factors were predictive for LC while initial Child-Pugh class and > 2 points Child-Pugh classification modification predicted for OS and CSS.

Conclusion: SBRT is a safe and effective treatment option for inoperable HCC, with acceptable LC rate and toxicity profile. Limiting toxic events may have prognostic significance.

PO-0713
Conformity analysis of target-volume definition for margin-directed boost in pancreatic cancer SBRT
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Conclusion: SBRT is a safe and effective treatment option for inoperable HCC, with acceptable LC rate and toxicity profile. Limiting toxic events may have prognostic significance.