

Supplementary Materials A

Acquisitions

Diagnostic CT, planning CT and MRI examinations were held on separate days. On average, the diagnostic CT examination was 53 days (range 46–62 days) before the planning CT examination whereas the MRI examination was 19 days (range 15–21 days) before the planning CT examination. The diagnostic CT and MRI examinations were performed before the start of radiochemotherapy, whereas the planning CT examination was on average eight days (range 6–10 days) after the patients received their first administration of gemcitabine.

The diagnostic CT scans were acquired at the referring hospitals. The scans were considered adequate for diagnostic purposes by the dedicated abdominal radiologists from our institution. The diagnostic CT scans were obtained after vascular contrast (iodine) injection and included axial scans in arterial (35 s after injection, all patients), and venous contrast phase (60 s after injection, patients 1, 2 and 4) or portal contrast phase (240 s after injection, patients 1 and 4). In addition, reconstructed coronal views were available for the arterial (patients 1, 2 and 4) and venous (patients 2 and 3) contrast phases.

The planning CT scans were obtained with patients in treatment position: supine on a flat table top with hands above their head. Two planning CT scans were acquired, a 3DCT and 4DCT. The 3DCT scan was acquired during free breathing after contrast injection in the arterial contrast phase and the corresponding 3DCT images represent a snapshot of the respiratory cycle. The 3DCT was reconstructed with a slice thickness of 2.5 mm and an in-plane resolution of $1.3 \times 1.3 \text{ mm}^2$. For the 4DCT scan, the respiratory motion was monitored while data were acquired continuously during free breathing. The respiratory motion was synchronized to the CT acquisition by the respiratory gating system RPM (Real-Time Position Management, Varian Oncology Systems, Palo Alto, CA). The data were sorted according to the respiratory signal and images were reconstructed of the ten respiratory phases. Also, a maximum intensity projection (MIP) and average intensity projection (Ave-IP) were reconstructed from the images from the ten phases. The images reconstructed from the 4DCT scan had a slice thickness of 2.5 mm and an in-plane resolution of $1.0 \times 1.0 \text{ mm}^3$.

MRI scans were obtained with a 16-channel phased-array anterior coil and a 10-channel phased-array posterior coil. Four MRI scans were acquired using various sequences: T1W GE, CE T1W GE, T2W TSE and DWI (Table A.I). The T1W GE scan obtained three echoes and used a Dixon reconstruction to obtain water only images. The T1W GE scan was acquired in a single breath-hold and images had a high isotropic resolution, allowing for a correct representation of the anatomy. However, T1W GE images show poor pancreatic tumor contrast. Therefore, an additional CE T1W GE scan was acquired after gadovist 1.0 (Bayer Healthcare, Leverkusen, Germany) administration (0.1 ml/kg; 5 ml/s, followed by a 15 ml saline flush) in the parenchymal phase (35 seconds after injection), which improves lesion conspicuity. Due to the design of the MIPA study, another gadovist bolus had also been injected approximately 6 minutes before the CE T1W GE scan. On T2W TSE images the tumor is often poorly visible; however, its location can often be derived by finding obstructions of the pancreatic duct, which is clearly visible on these images. Also, these images can show the

presence of peripancreatic inflammation. The apparent diffusion coefficient maps were generated from $b=0$ and $600 \text{ mm}^2/\text{s}$ DWI scans. DWI, and in particular, the apparent diffusion coefficient maps from DWI, give information about the diffusivity of tissue. In general, pancreas carcinomas show increased cellular density, causing decreased diffusivity [14].

Table A.I. MRI sequence settings

	T1W GE	T2W TSE	DWI
Resolution (mm^2)	1.7×1.7	1.3×1.6	3×3
Slice thickness (mm)	1.7	5	3.7
FOV RL $\times$ AP $\times$ FH (mm^3)	$400 \times 353 \times 95$	$400 \times 369 \times 145$	$432 \times 108 \times 67$
TR / TE / dTE (ms)	4.7 / 1.26 / 0.9	779 / 80 / --	>2200 / 45 / --
Parallel imaging	2 (AP) / 1.5 (FH)	2 (AP)	1.3 (AP)
Fat saturation	Dixon	SPAIR	SPIR and gradient reversal
Flip angle ($^\circ$)	9 (25 post contrast)	90 (120 refocussing)	90
Respiratory compensation	1 breath hold	3 breath holds	Respiratory triggering using a navigator

Abbreviations: T2W TSE = T2-weighted turbo spin echo; DWI = diffusion-weighted MRI; FOV = field of view; RL = right–left; AP = anterior–posterior; FH = foot–head; TR = repetition time; TE = echo time; dTE = increase in TE; SPAIR = spectral attenuated inversion recovery; SPIR = spectral presaturation with inversion recovery.

Supplementary Materials B

Lymph nodes, stents/drain, and markers

Table B.I. Number of observers who delineated the lymph nodes.

lymph nodes	3DCT+MRI	3DCT-only*	4DCT+MRI	4DCT-only*
patient 2, portocaval	2	5	4	4
patient 2, along common hepatic duct	2	3	3	2
patient 4	2	2	1	2

* These results are from the CT-only study [12].

Table B.II. Number of observers who delineated the stent or drain.

Patients	3DCT+MRI	3DCT-only*	4DCT+MRI	4DCT-only*
1	2	3	2	5
2	1	2	2	1
3	4	6	5	4
4	8	8	8	7

Number of observers who delineated at least 50% of the stent/drain in at least three slices are reported

* These results are from the CT-only study [12].

Table B.III. Markers located within the delineated volumes.

Patients	3DCT+MRI	3DCT-only*	4DCT+MRI	4DCT-only*
1	24/24 (100 %)	24/24 (100 %)	24/24 (100 %)	23/24 (100 %)
2†	1/24 (4 %)	5/24 (21 %)	5/24 (21 %)	4/24 (17 %)
3	11/24 (46 %)	22/24 (92 %)	14/24 (58 %)	16/24 (67 %)
4	24/24 (100 %)	24/24 (100 %)	24/24 (100 %)	21/24 (88 %)

The number of volumes including the marker over the number of markers multiplied by number of observers (3×8=24). Markers that were included partially in the delineated volume were counted as delineated.

* These results are from the CT-only study [12].

† In patient 2, the markers were mistakenly implanted outside the tumor.

Supplementary Materials C

Local standard deviation

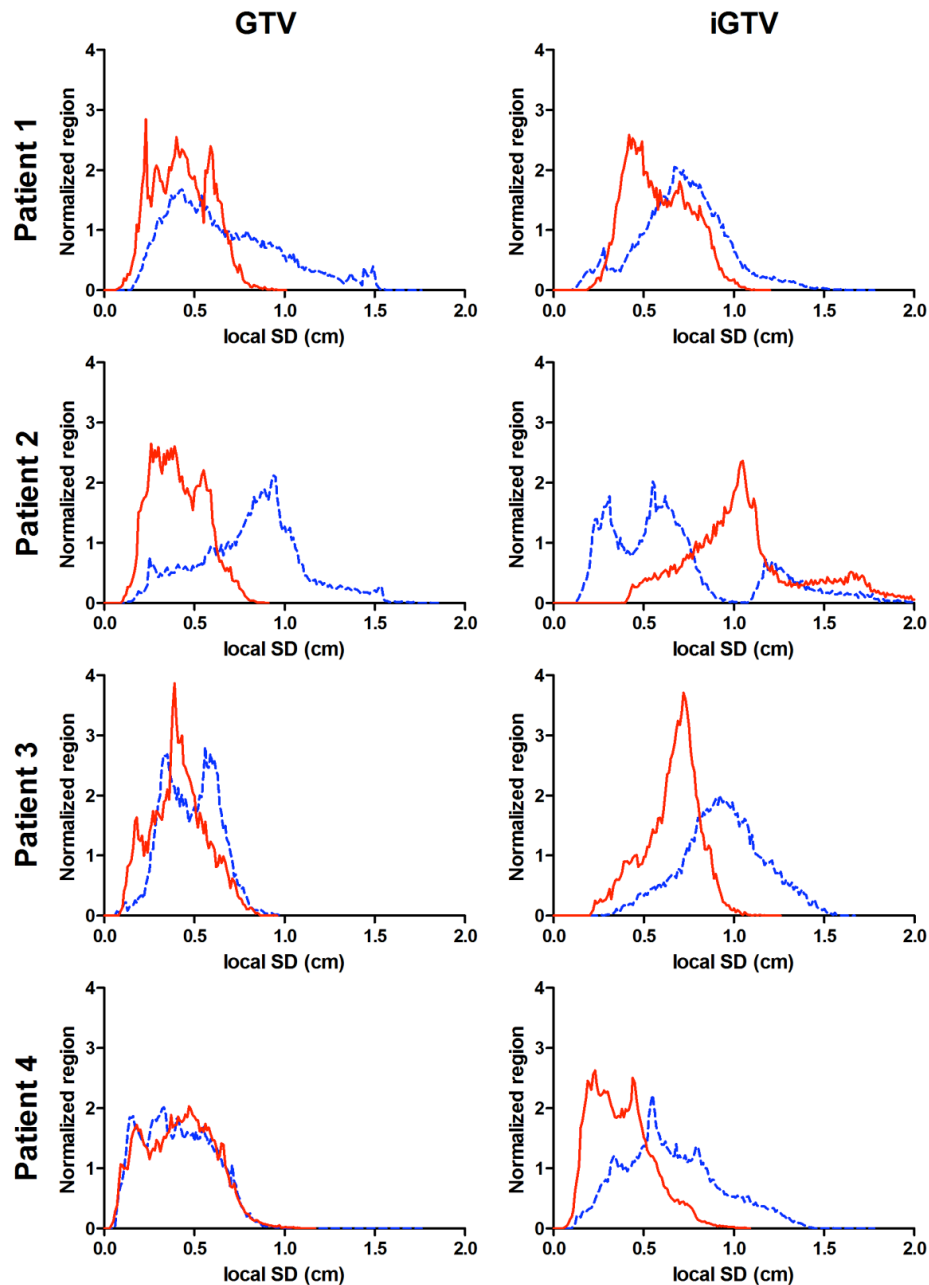


Figure C1. Normalized histogram of the local SD of the CT-only study (dotted blue line) and CT+MRI study (solid red line). Graphs are based on the local SDs from on average 32,324 (range 9,728–66,504) points on the median surface and normalized to the total surface of the median surface.

References:

12. Versteijne E, Gurney-Champion OJ, van der Horst A et al. Considerable interobserver variation in delineation of pancreatic cancer on 3DCT and 4DCT: a multi-institutional study. *Radiat Oncol.* 2017;12:58
14. Barral M, Taouli B, Guiu B et al. Diffusion-weighted MR imaging of the pancreas: Current status and recommendations. *Radiology* 2015;274:45–63.