AbdomenAtlas 3.0:
From Segmentation to Radiology Reports

Pedro R. A. S. Bassi

Johns Hopkins University

University of Bologna

Italian Institute of Technology

E: psalvad2@jh.edu

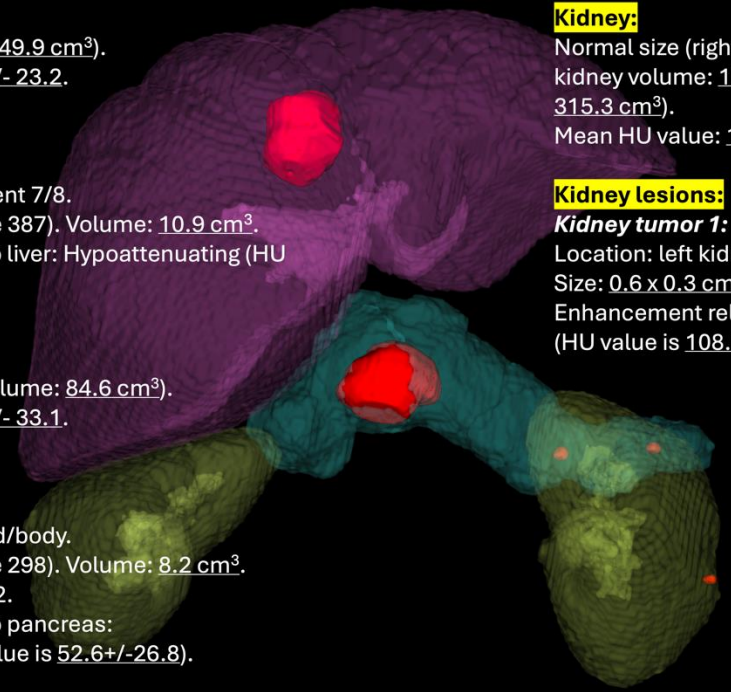
AbdomenAtlas 3.0

Liver:
Normal size (volume: 1249.9 cm^3).
Mean HU value: 131.4 +/- 23.2.

Liver lesions:
Liver tumor 1:
Location: hepatic segment 7/8.
Size: 3.1 x 2.7 cm (image 387). Volume: 10.9 cm^3.
Enhancement relative to liver: Hypoattenuating (HU value is 58.7+/-29.7).

Pancreas:
Pancreas is enlarged (volume: 84.6 cm^3).
Mean HU value: 105.7 +/- 33.1.

Pancreas lesions:
Pancreas tumor 1:
Location: pancreas head/body.
Size: 2.9 x 2.2 cm (image 298). Volume: 8.2 cm^3.
Tumor Stage (T stage): T2.
Enhancement relative to pancreas:
Hypoattenuating (HU value is 52.6+/-26.8).



Kidney:
Normal size (right kidney volume: 148.6 cm^3; left kidney volume: 166.6 cm^3; total kidney volume: 315.3 cm^3).
Mean HU value: 172.9 +/- 57.4.

Kidney lesions:
Kidney tumor 1:
Location: left kidney.
Size: 0.6 x 0.3 cm (image 321). Volume: 0.1 cm^3.
Enhancement relative to kidney: Hypoattenuating (HU value is 108.5+/-49.1).

Kidney tumor 2:
Location: left kidney.
Size: 0.5 x 0.4 cm (image 321). Volume: 0.1 cm^3.
Enhancement relative to kidney: Hypoattenuating (HU value is 97.8+/-54.5).

Kidney tumor 3:
Location: left kidney.
Size: 0.6 x 0.4 cm (image 283). Volume: 0.1 cm^3.
Enhancement relative to kidney: Hypoattenuating (HU value is 49.5+/-48.4).

AbdomenReport

- **9,262 CT-Report pairs**
- **1.2 million tokens**
- **7,960 tumor instances**
- **5,262 small tumors (<20mm)**
- **3 pancreatic sub-segments**
- **8 hepatic sub-segments**
- **4 pancreatic tumor stages**

AbdomenAtlas 3.0

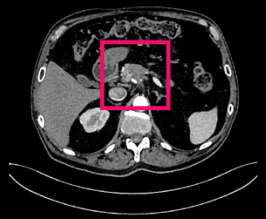
NARRATIVE:
The patient has a hypoattenuating liver mass located in hepatic segments 7 and 8, measuring 3.1 x 2.7 centimeters (image 387) with a volume of 10.9 cm^3. The liver itself is of normal size, with a volume of 1249.9 cm^3 and a mean HU value of 131.4 +/- 23.2.

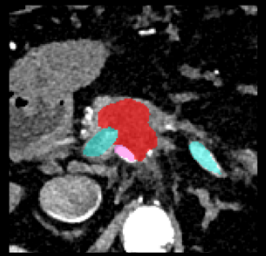
The pancreas is enlarged, with a volume of 84.6 cm^3 and a mean HU value of 105.7 +/- 33.1. A hypoattenuating mass is present in the head and body of the pancreas, measuring 2.9 x 2.2 centimeters (image 298) with a volume of 8.2 cm^3. This mass is classified as T2.

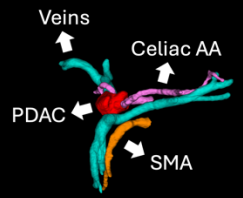
The kidneys are of normal size, with the right kidney having a volume of 148.6 cm^3 and the left kidney having a volume of 166.6 cm^3. The total kidney volume is 315.3 cm^3, with a mean HU value of 172.9 +/- 57.4. Two small hypoattenuating masses are present in the left kidney, measuring 0.6 x 0.3 centimeters (image 321) and 0.5 x 0.4 centimeters, respectively. The total volume of these kidney lesions is 0.1 cm^3.

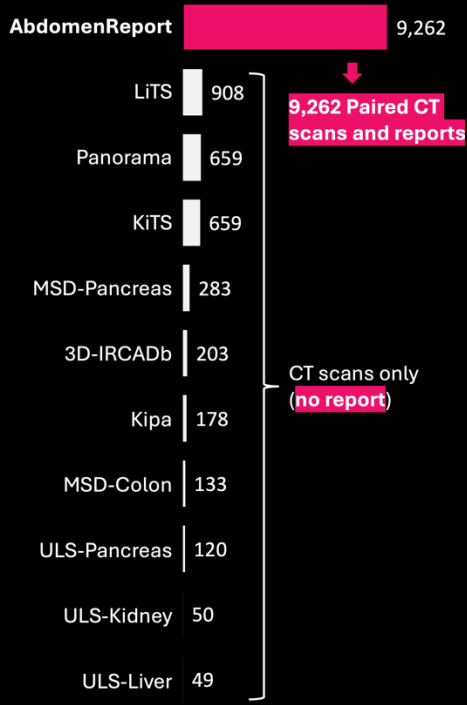
The spleen is of normal size, with a volume of 133.2 cm^3 and a mean HU value of 131.3 +/- 31.5.

IMPRESSION:
1. A hypoattenuating liver mass located in hepatic segments 7 and 8, measuring 3.1 x 2.7 centimeters.
2. A hypoattenuating pancreas mass located in the head and body, measuring 2.9 x 2.2 centimeters, classified as T2.
3. Multiple small hypoattenuating kidney masses, with the largest one measuring 0.6 x 0.3 centimeters.









AbdomenAtlas 3.0

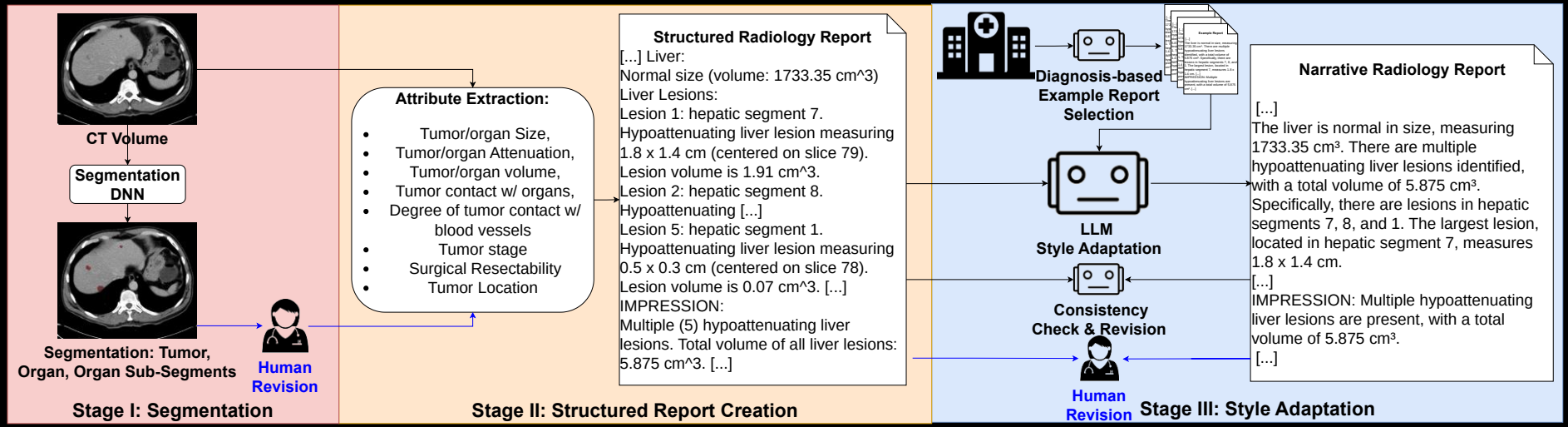
- **3.12x** more tumor annotation
- Uniqueness: pancreas **sub-segments**, PDAC **staging**, **reports**

dataset	CTs	institutions	countries	annotated liver lesions	annotated pancreatic tumors	annotated kidney tumors
FLARE'23 [2022] [link]	4,100	35	1	0 → 376	0 → 34	0 → 763
KiTS'23 [2020] [link]	489	1	1	0 → 1	0	452
LiTS [2019] [link]	131	7	5	50	0	0
TCIA-Pancreas-CT [2015] [link]	42	1	1	0	0	0
CT-ORG [2020] [link]	140	8	6	0 → 41	0	0 → 17
Trauma Det. [2023] [link]	4,714	23	13	0 → 46	0 → 15	0 → 38
BTCV [2015] [link]	47	1	1	0	0	0
CHAOS [2018] [link]	20	1	1	0	0 → 1	0
AbdomenCT-1K [2021] [link]	1,050	12	7	0 → 82	0 → 100	0 → 113
MSD CT Tasks (6) [2021] [link]	945	1	1	251	191	0 → 224
WORD [2021] [link]	120	1	1	0 → 28	0	0 → 26
AMOS [2022] [link]	200	2	1	0 → 54	0 → 3	0 → 41
AtlasReport (ours)	**9,262**	**88**	**19**	**301 → 929**	**191 → 344**	**452 → 1,674**

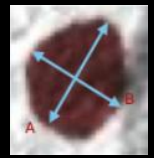
dataset	liver sub-segments	pancreas sub-segments	peripancreatic blood vessels†	tumor stage	radiology reports	text tokens
FLARE'23 [2022] [link]	X	X	X	X	0	0
KiTS'23 [2020] [link]	X	X	X	X	0	0
LiTS [2019] [link]	✓	X	X	X	0	0
TCIA-Pancreas-CT [2015] [link]	X	X	X	X	0	0
CT-ORG [2020] [link]	X	X	X	X	0	0
Trauma Det. [2023] [link]	X	X	X	X	0	0
BTCV [2015] [link]	X	X	X	X	0	0
CHAOS [2018] [link]	X	X	X	X	0	0
AbdomenCT-1K [2021] [link]	X	X	X	X	0	0
MSD CT Tasks (6) [2021] [link]	X	X	X	X	0	0
WORD [2021] [link]	X	X	X	X	0	0
AMOS [2022] [link]	X	X	X	X	0	0
AtlasReport (ours)	✓	✓	✓	✓	**18,524**	**1,843,262**

†Celiac axis (CA), superior mesenteric artery (SMA), superior mesenteric vein (SMV), common hepatic artery (CHA), and portal vein. AbdomenReport is the first database with per-voxel annotations for these vessels, which are critical for pancreatic tumor staging.
→ represents the number of CTs with tumor annotations in the original dataset, followed (→) by our updated number of CTs with tumor annotations, including the additional annotations AbdomenReport provided with radiologist support

RadGPT: AI-assisted Report Generation

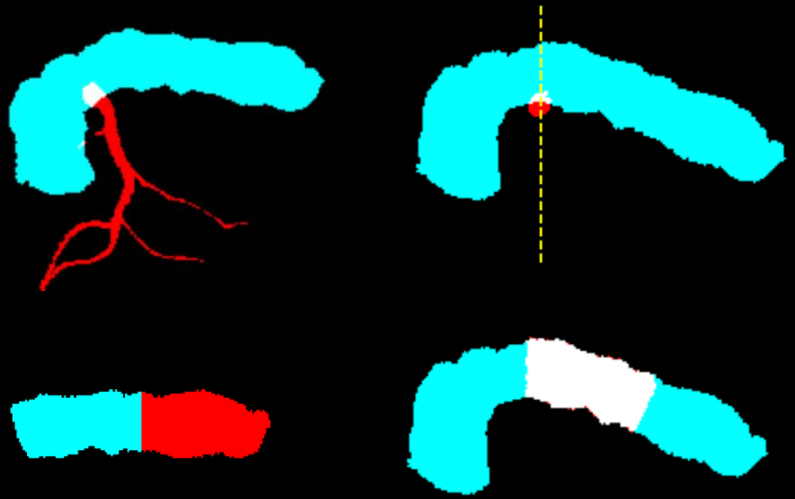


- Ground-truth Per-voxel Annotations + RadGPT + Human Revision = **AbdomenAtlas 3.0**
- Tumor Segmentation + RadGPT = Fully-automatic Report Generation
- Deterministic algorithms translate the accuracy of segmentation into text
- WHO Measurement



RadGPT: Pancreas Sub-Segments

- Pancreas Sub-segmentation: SMA-based



RadGPT Radiology Report

CT Arterial Phase

FINDINGS:

Liver:

Normal size (volume: 976.0 cm^3).

Mean HU value: 64.3 +/- 25.2.

Pancreas:

Pancreas is enlarged (volume: 89.3 cm^3).

Mean HU value: 109.3 +/- 64.8.

Pancreas lesions:

Pancreas tumor 1: appearance consistent with cyst.

Location: pancreas head.

Size: 3.8 x 2.5 cm (image 232). Volume: 17.4 cm^3.

Enhancement relative to pancreas: Hypoattenuating (HU value is 15.0+/-19.6).

Kidney:

Normal size (right kidney volume: 125.7 cm^3; left kidney volume: 156.2 cm^3; total kidney volume: 281.9 cm^3).

Mean HU value: 135.0 +/- 93.9.

Spleen:

Normal size (volume: 115.2 cm^3).

Mean HU value: 128.8 +/- 43.7.

IMPRESSION:

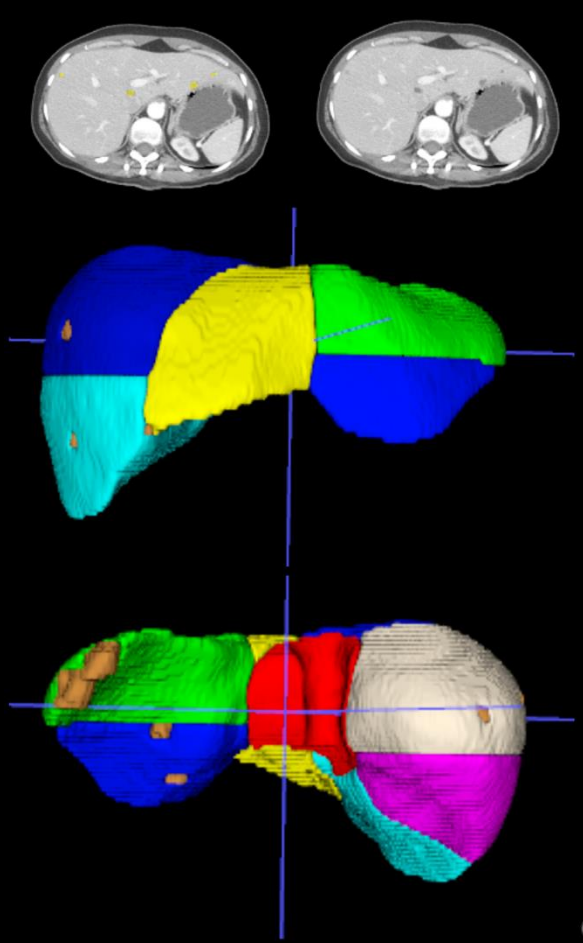
A single hypoattenuating pancreas (head) mass of cystic appearance (3.8 x 2.5 cm).

RadGPT: PDAC T Staging

RadGPT Radiology Report

CT Arterial Phase
FINDINGS:
Liver:
Normal size (volume: 1860.0 cm^3).
Mean HU value: 8.6 +/- 28.3.
Pancreas:
Pancreas is enlarged (volume: 94.6 cm^3).
Mean HU value: 64.3 +/- 64.0.
Pancreas lesions:
Pancreas tumor 1: appearance consistent with PDAC.
Location: pancreas head/body.
Size: 5.1 x 3.2 cm (image 348). Volume: 29.0 cm^3.
Enhancement relative to pancreas: Hypoattenuating (HU value is 56.1+/-46.4).
Contact with adjacent organs: duodenum.
Vascular Involvement:
SMA: tumor encasement (360 degree contact with the tumor).
Aorta: tumor contact but not encasement (98 degree contact with the tumor).
Portal vein and SMV: tumor encasement (255 degree contact with the tumor).
IVC: tumor contact but not encasement (56 degree contact with the tumor).
Tumor does not contact: CA, CHA, SA.
Tumor Stage (T stage): T4.
Surgical resectability: unresectable (SMA encasement).
Kidney:
Normal size (right kidney volume: 143.3 cm^3; left kidney volume: 156.8 cm^3; total kidney volume: 300.1 cm^3).
Mean HU value: 139.7 +/- 70.1.
Spleen:
Spleen is enlarged (volume: 327.1 cm^3).
Mean HU value: 118.4 +/- 44.5.
IMPRESSION:
A single large hypoattenuating pancreas (head/body) mass (5.1 x 3.2, cm).
Clinical stage: T4NxMx.
Surgical resectability: unresectable (SMA encasement).

RadGPT : Liver Sub-Segments



RadGPT Radiology Report

CT Arterial Phase

FINDINGS:
Liver:
Normal size (volume: 1293.7 cm^3).
Mean HU value: 111.3 +/- 17.4.

Liver lesions:
Liver tumor 1:
Location: hepatic segment 2.
Size: 3.2 x 1.7 cm (image 174). Volume: 8.1 cm^3.
Enhancement relative to liver: Hypoattenuating (HU value is 9.6+/-19.8).

Liver tumor 2:
Location: hepatic segment 8.
Size: 2.5 x 2.0 cm (image 178). Volume: 4.9 cm^3.
Enhancement relative to liver: Hypoattenuating (HU value is 36.3+/-31.3).

Liver tumor 3:
Location: hepatic segment 8.
Size: 1.4 x 0.9 cm (image 170). Volume: 0.7 cm^3.
Enhancement relative to liver: Hypoattenuating (HU value is 58.5+/-28.6).

[...]

Liver tumor 23:
Location: hepatic segment 4.
Size: 0.5 x 0.4 cm (image 159). Volume: 0.1 cm^3.
Enhancement relative to liver: Hypoattenuating (HU value is 96.4+/-11.8).

Liver tumor 24:
Location: hepatic segment 5.
Size: 0.5 x 0.4 cm (image 156). Volume: 0.1 cm^3.
Enhancement relative to liver: Hypoattenuating (HU value is 97.2+/-16.9).

[...]

IMPRESSION:
Multiple (24) hypoattenuating liver masses. Largest one (hepatic segment 2) measures 3.2 x 1.7 cm.
Total volume of all liver lesions: 19.4 cm^3.

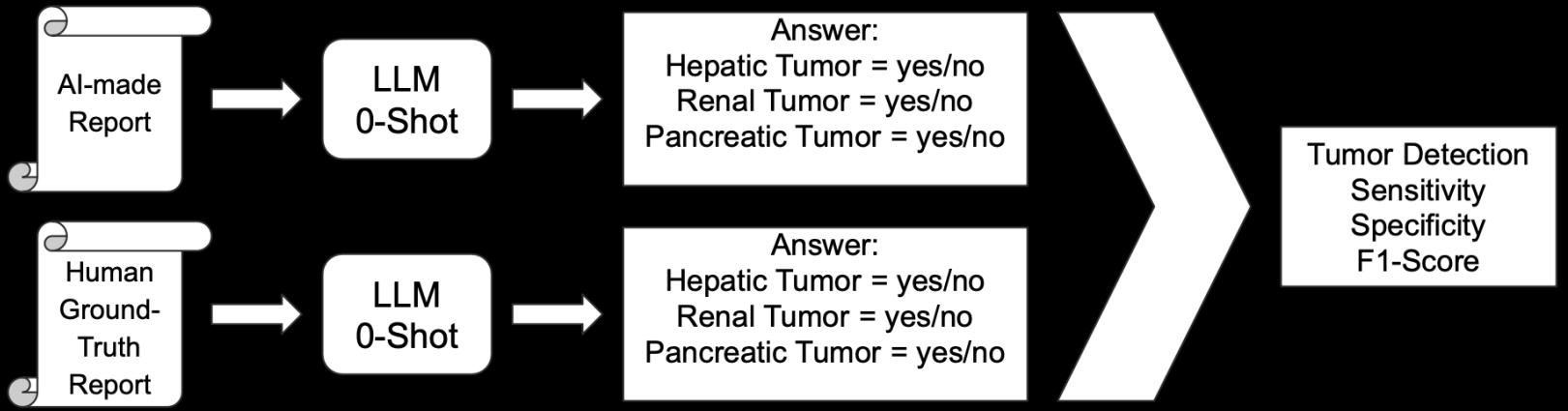
RadGPT : Evaluation Strategy

-Usual evaluation of Report Generation: LLM text similarity metrics

Model	BLEU	METEOR	ROUGE-1	ROUGE-2	ROUGE-L	BERT-Score
M3D	0.0000	0.0252	0.0694	0.0100	0.0453	0.4416
CT2Rep	0.0003	0.0443	0.0772	0.0068	0.0525	0.5128
RadGPT-DiffTumor Structured Reports	**0.0098**	0.1099	0.1476	0.0181	0.0888	**0.5489**
RadGPT-DiffTumor Narrative Reports	0.0069	**0.1120**	**0.2467**	**0.0276**	**0.1243**	0.5344

-Proposal:

-LLM Accuracy (0-Shot): 96%, 182 TP, 18 FP, 247 TN, 0 FN



RadGPT: OOD Evaluation

Model	Liver Tumor-HCC			Kidney Tumor-RCC			Pancreas Tumor-PDAC			Liver Tumor-CRC Metastases		
	Sen	Spe	F1	Sen	Spe	F1	Sen	Spe	F1	Sen	Spe	F1
Large Tumors > 2cm												
M3D	0.0 (0/142)	88.8 (199/224)	0.0	0.0 (0/219)	95.1 (232/244)	0.0	1.3 (5/385)	90.2 (220/244)	2.4	1.72 (1/58)	1.9 (3/158)	3.38
CT2Rep	0.0 (0/301)	100.0 (244/244)	0.0	10.0 (22/219)	98.0 (239/244)	17.9	3.8 (4/105)	96.7 (236/244)	6.8	9.4 (2/21)	1.9 (3/158)	3.16
RadGPT-nnU-Net	-	-	-	-	-	-	87.6 (92/105)	45.5 (111/244)	55.8	-	-	-
RadGPT-DiffTumor	92.7 (279/301)	63.1 (154/244)	**83.3**	0.977 (214/219)	62.3 (152/244)	**81.5**	0.857 (90/105)	0.947 (231/244)	**86.5**	1.000 (58/58)	67.1 (106/158)	**69.0**
Small Tumors ≤ 2cm												
M3D	0.0 (0/301)	88.8 (199/224)	0.0	0.0 (0/50)	95.1 (232/244)	0.0	1.6 (6/105)	90.2 (220/244)	2.9	4.7 (1/21)	1.9 (3/158)	2.71
CT2Rep	0.0 (0/142)	100.0 (244/244)	0.0	4.0 (2/50)	98.0 (239/244)	7.0	2.1 (8/385)	96.7 (236/244)	4.0	3.44 (2/58)	1.9 (3/158)	6.65
RadGPT-nnU-Net	-	-	-	-	-	-	70.9 (273/385)	45.5 (111/244)	69.0	-	-	-
RadGPT-DiffTumor	87.3 (124/142)	63.1 (154/244)	**69.7**	96.0 (48/50)	62.3 (152/244)	**50.5**	59.5 (229/385)	94.7 (231/244)	**73.0**	100 (21/21)	67.1 (106/158)	**44.7**

Models and Dataset:
https://github.com/MrGiovanni/RadGPT

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Technical Exhibits: Dec. 1–4

Thank You!

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https://github.com/MrGiovanni/RadGPT