Neuroendokriinsed tuumorid

When you hear hoofbeats, think horses, not zebras

…

When you hear hoofbeats, sometimes it's a ZEBRA.

Alina Kornejeva

V

Difuusne neuroendokriinrakude süsteem

- Tsentraalne grupp

Hüpotaalamus

Hüpofüüs

Epifüüs

- Perifeerne grupp

Kõrvalkilpnääre

Kilpnäärme C-rakud (medullaarne vähk)

Sümpaatiline närvisüsteem (paraganglioom)

Neerupealiste säsi (feokromotsütoom)

Pankrease Langerhansi saarekeste rakud

NE rakud

- Gastrointestinaal traktis (+ pankreas 70% NEN-dest)
- Bronhopulmonaalses süsteemis (25% NEN-dest)
- Urogenitaaltraktis
- Tüümuses
- Merckel rakud nahas

November 10

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CENTERS OF EXCELLENCE

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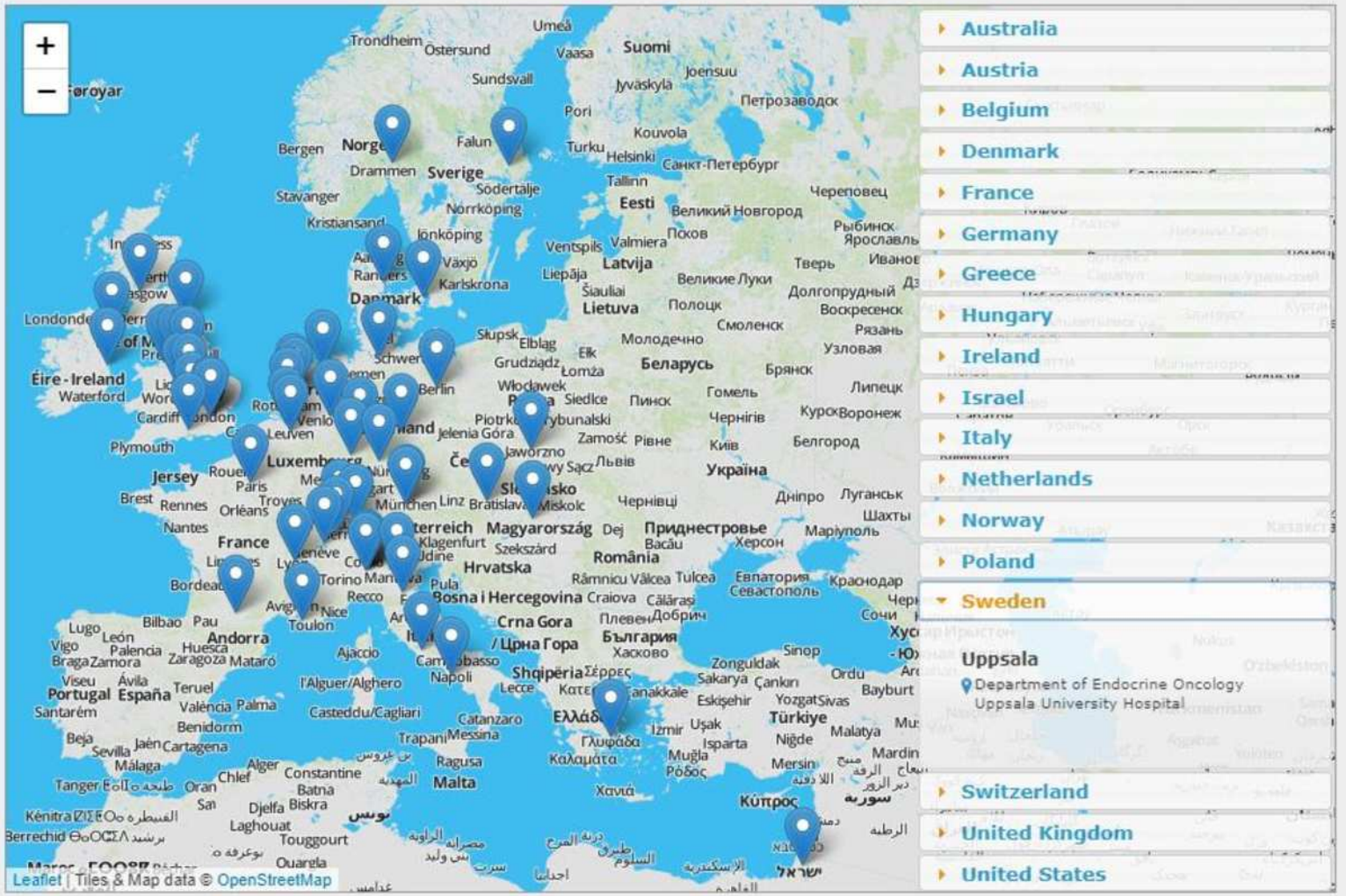
ENETS Centers of Excellence — ENETS CoE — Assuring Quality since 2009

Centers of Excellence (CoE) Interactive Map



- Australia
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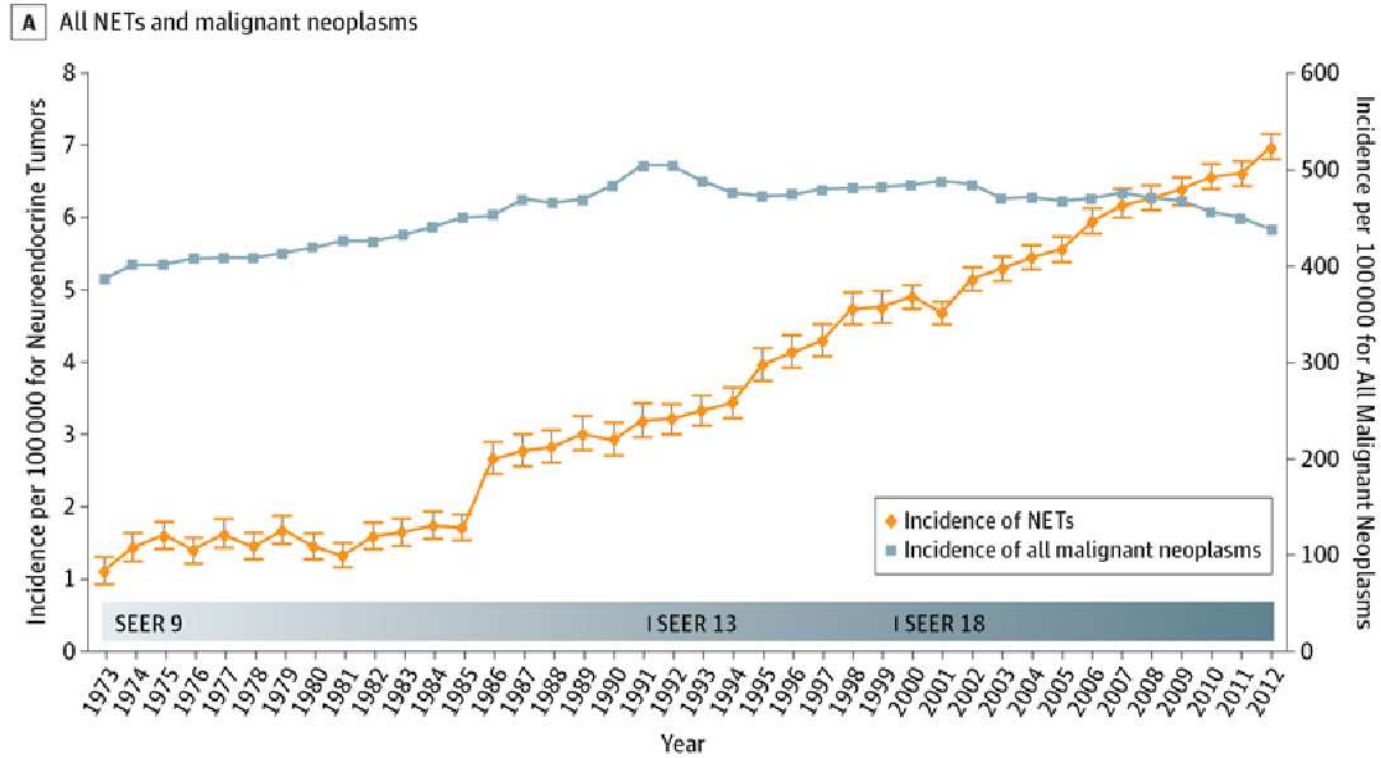
European ENETS Neuroendocrine Tumor Society

https://www.enets.org/

Epidemioloogia

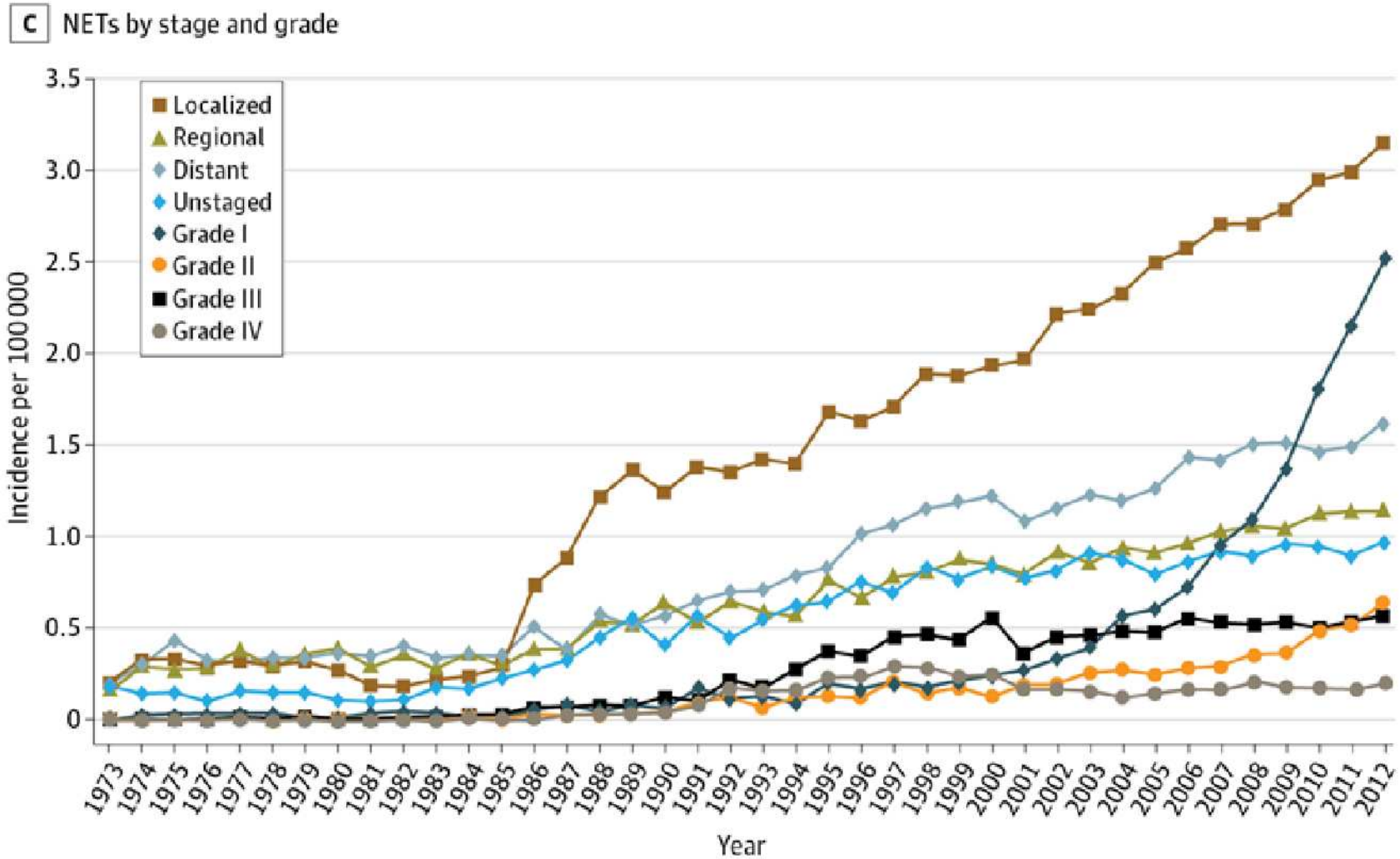
Taani andmed:

- autopsiate järgi 8,4/100 000 aastas
- Kopenhaageni riklik haigla:
  - Haigestumus > 10 /100 000 aastas
  - Levimus > 50/100 000 aastas



Dasari, JAMA Oncology 2017, USA

Trends in the Incidence, Prevalence, and Survival Outcomes in Patients With Neuroendocrine Tumors in the United States



Dasari, JAMA Oncology 2017, USA

Elulemus

- 5 aasta elulemus NET keskus Kopenhaagen RH:
  - 76% peensoole NET puhul
  - 75% pankrease NET puhul (9% adenoCa puhul)

Radioloogia

- I/v kontrastainega KT, hilisarteriaalne - ja portovenoosne faas
  - Klassika - arteriaalses faasis intensiivselt kontrasteeruv lesioon

- Peensoole NET ? - > CT enteroclysis - *fluoroscopic intubation-infusioon (via nasojejunal tube) small bowel examinations with abdominal CT*
- Pankreas/ duodenum - > endoskoopiline UH
- Maksa metastaasidele - > MRT

Mõisted

- NEN – neuroendokriine neoplaasia:
  - NET- neuroendokriine tuumor
  - NEC- neuroendokriine kartsinoom

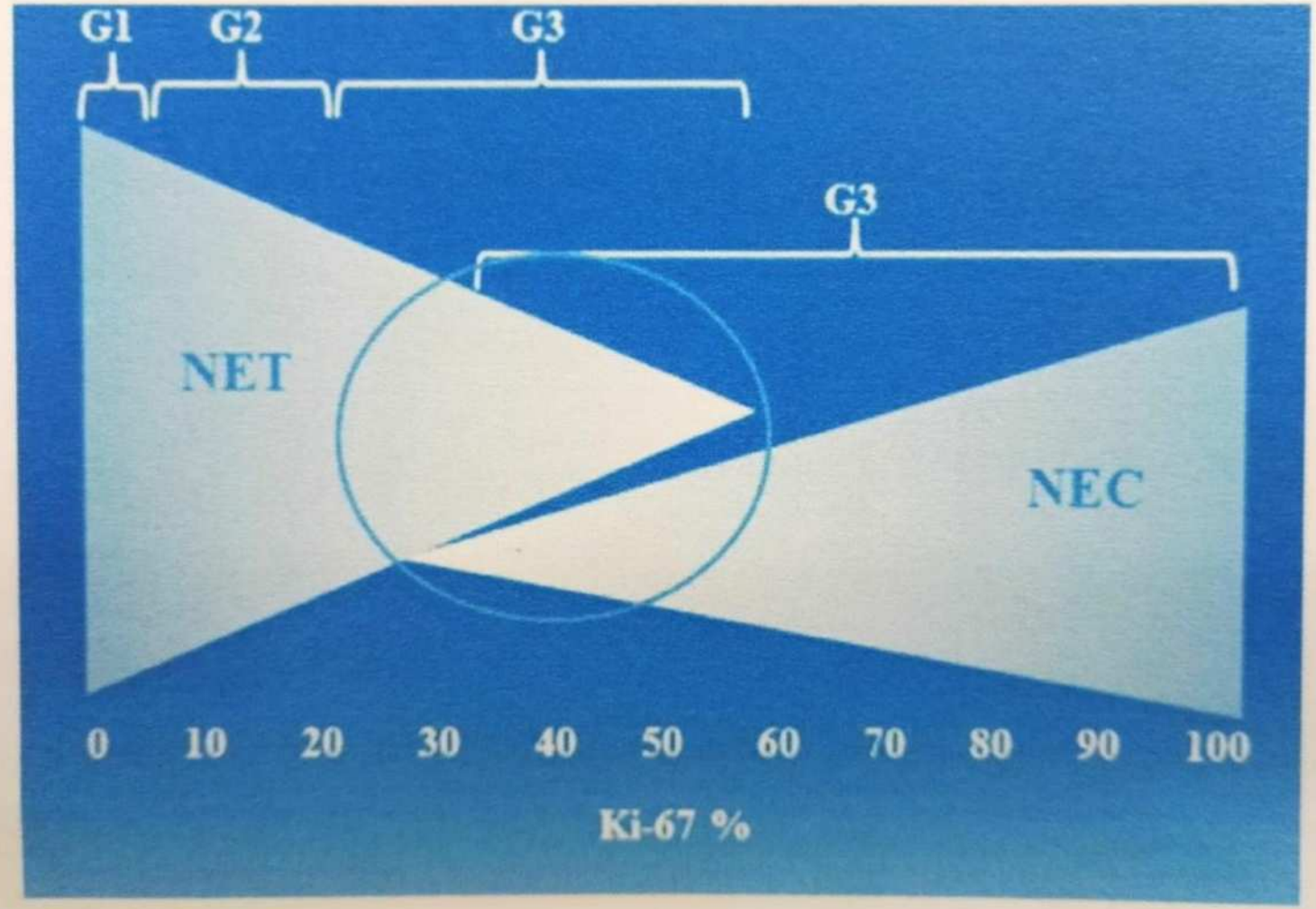
WHO 2019 klassifikatsioon, GI ja pankrease NEN

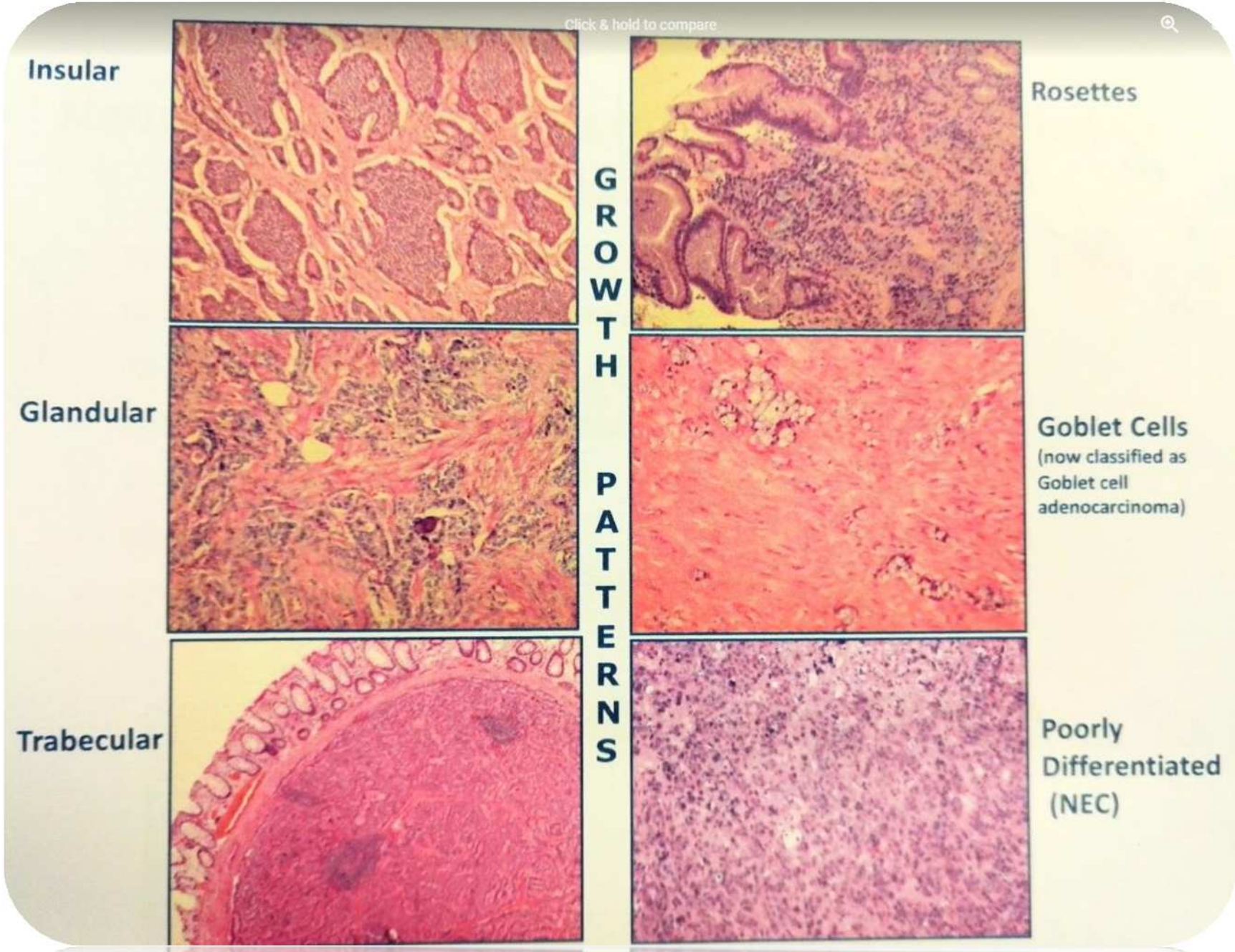
- G1: NET Ki-67* <3%
- G2: NET Ki-67 < 20%
- G3:
  - G3 NET Ki-67 > 20%
  - G3 NEC Ki-67 > 20%
    - *Large cell*
    - *Small cell*
- MiNEN – mixed neuroendocrine-non-neuroendocrine neoplasm(1/3 igat komponenti)

** The Ki-67 protein (also known as MKI67) is a cellular marker for proliferation, is encoded by the MKI67 gene. The name is derived from the city of origin (Kiel, Germany)*

https://www.uptodate.com/contents/pathology-classification-and-grading-of-neuroendocrine-neoplasms-arising-in-the-digestive-system#H13525387

NEC and NET G3




Click & hold to compare
Insular
Glandular
Trabecular
GROWTH PATTERNS
Rosettes
Goblet Cells
(now classified as Goblet cell adenocarcinoma)
Poorly Differentiated (NEC)

NET - NET IVH

→ NEC - adeno Ca IVH

For G3 tumours

P53

Rb1

ATRX/DAXX

PCR-NGS HS

50 most common mutations

PCR-MGMT

Methylguanine DNA methyl transferase

For treatment with Temozolomide

Teadamata algkolle, histoloogilised markerid

- TTF – kops?
- Somatostatiin – duodeenum, pankreas?
- Serotoniin – *midgut ?*

Kartsinoid

Kartsionoid tuumor – NET alaliik, *APUD* enterokromafiinsetest rakkudest GI ja bronhopulmonaalses süsteemis.

Kartsionoid sündroom – üleliigsest serotoniini produktsioonist kõige sagedamini GI kartsinoidist

- 8% patsientidest
- Sümptomid:
  - Kõhulahtisus (80%)
  - Vasomotoorsed sümptomid – näo ja rindkere punetus
  - Südame parema poole puudulikkus (<15% firboos-stenoos)
  - Bronhospasm (<10%)

Neuroendocrine neoplasms of the small intestine

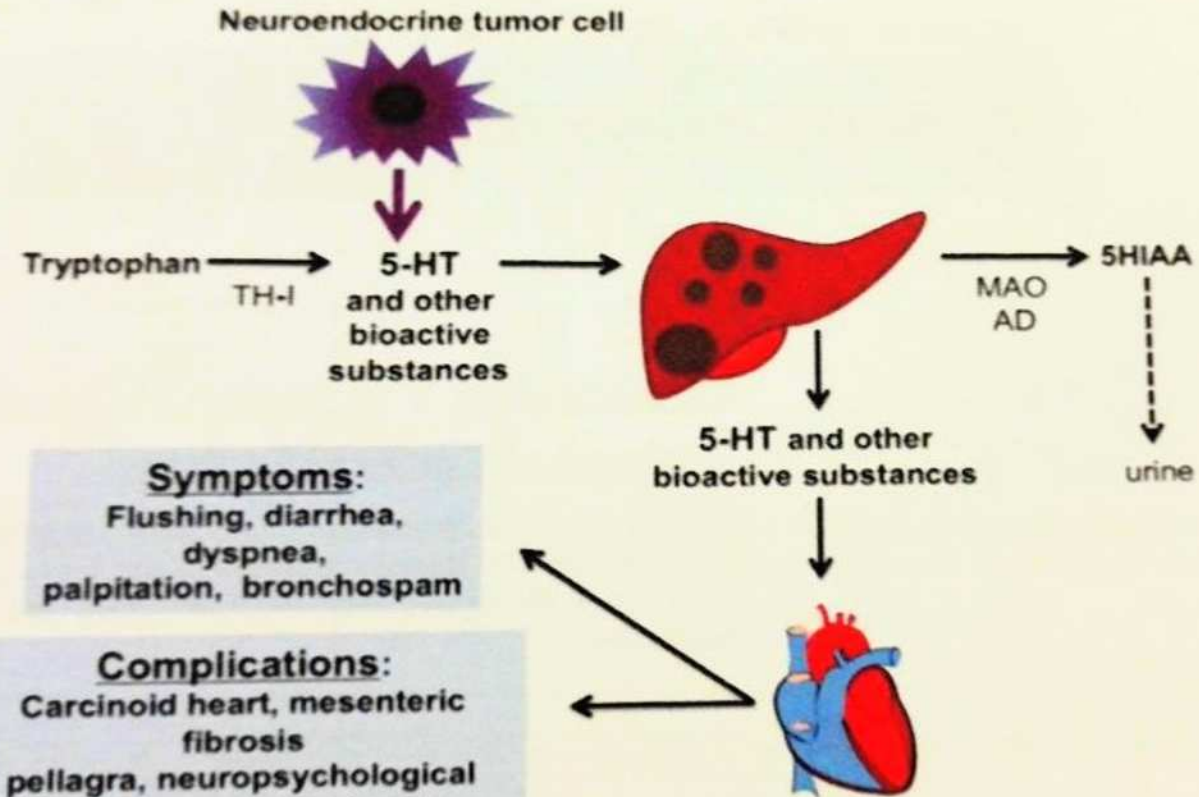
Clinical manifestations

Related to metastatic and advanced disease

Carcinoid syndrome

- Incidence: 0.40 - 0.65 / 100.000 / year
- Caused by serotonin and peptides released from liver metastases to the major circulation
- Hormones released from the primary tumor to the portal venous circulation are metabolized by the liver and rarely cause carcinoid syndrome

Serotonin and carcinoid syndrome



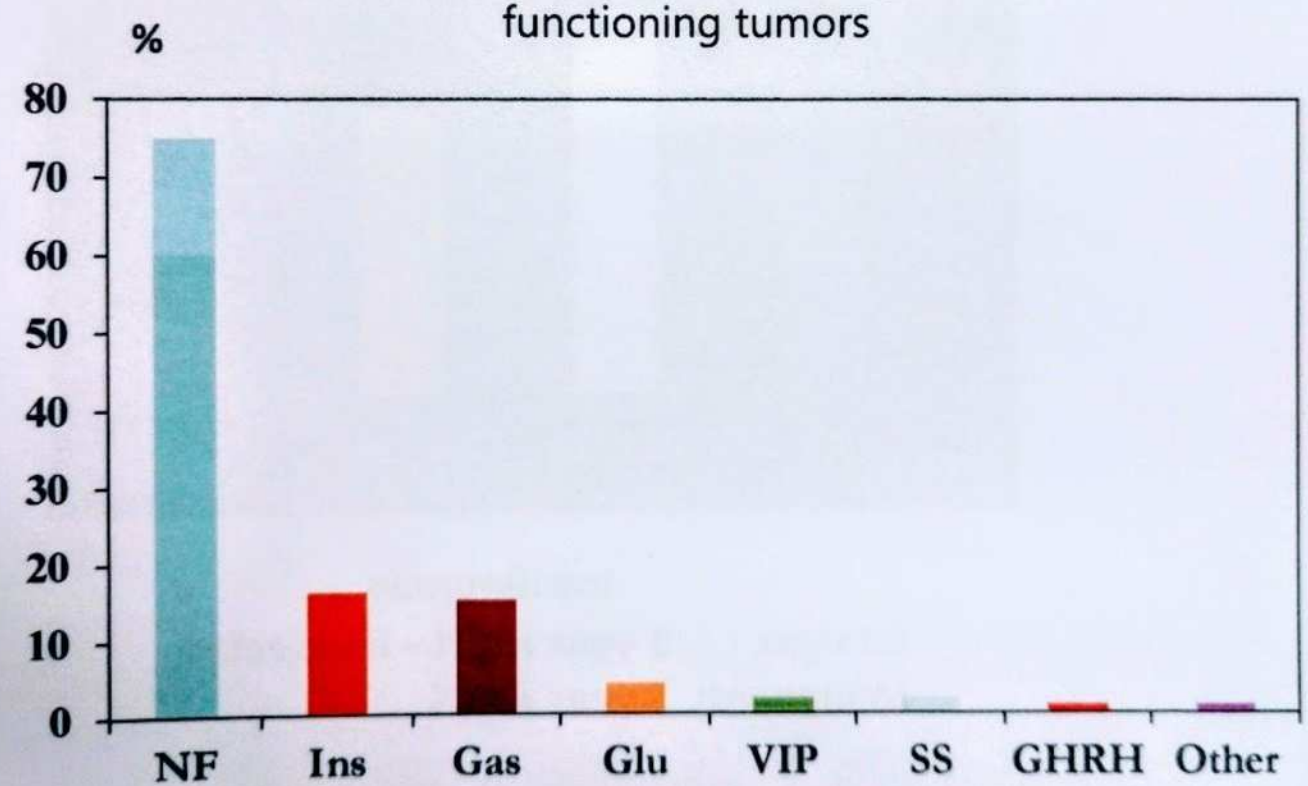
Abbreviations: 5-HT: serotonin; TH-I: tryptophan hydroxilase I; MAO: monoamine oxidase; AD: aldehyde dehydrogenase

Pancreatic NET

Incidence: 1/ 100.000 / year

Approximately 2 -10 % of pancreatic cancers

Distribution of non-functioning (NF) and functioning tumors



Pancreatic Endocrine Tumors: Radiologic-Clinicopathologic Correlation

Rachel B. Lewis ✉, Grant E. Lattin, Jr, Maj, Edina Paal

Axial contrast-enhanced CT image shows a well-defined mass in the pancreatic tail that demonstrates heterogeneous hyperenhancement.

State-Of-The-Art Imaging of Pancreatic Neuroendocrine Tumors

Eric P Tamm, M.D., Priya Bhosale, M.D., Jeffrey H. Lee, M.D., and Eric Rohren, M.D., Ph.D.

PNET liver metastases (white arrowheads) on multiphasic CT are classically hyperdense to background on early arterial phases

Pancreatic neuroendocrine tumours: hypoenhancement on arterial phase computed tomography predicts biological aggressiveness

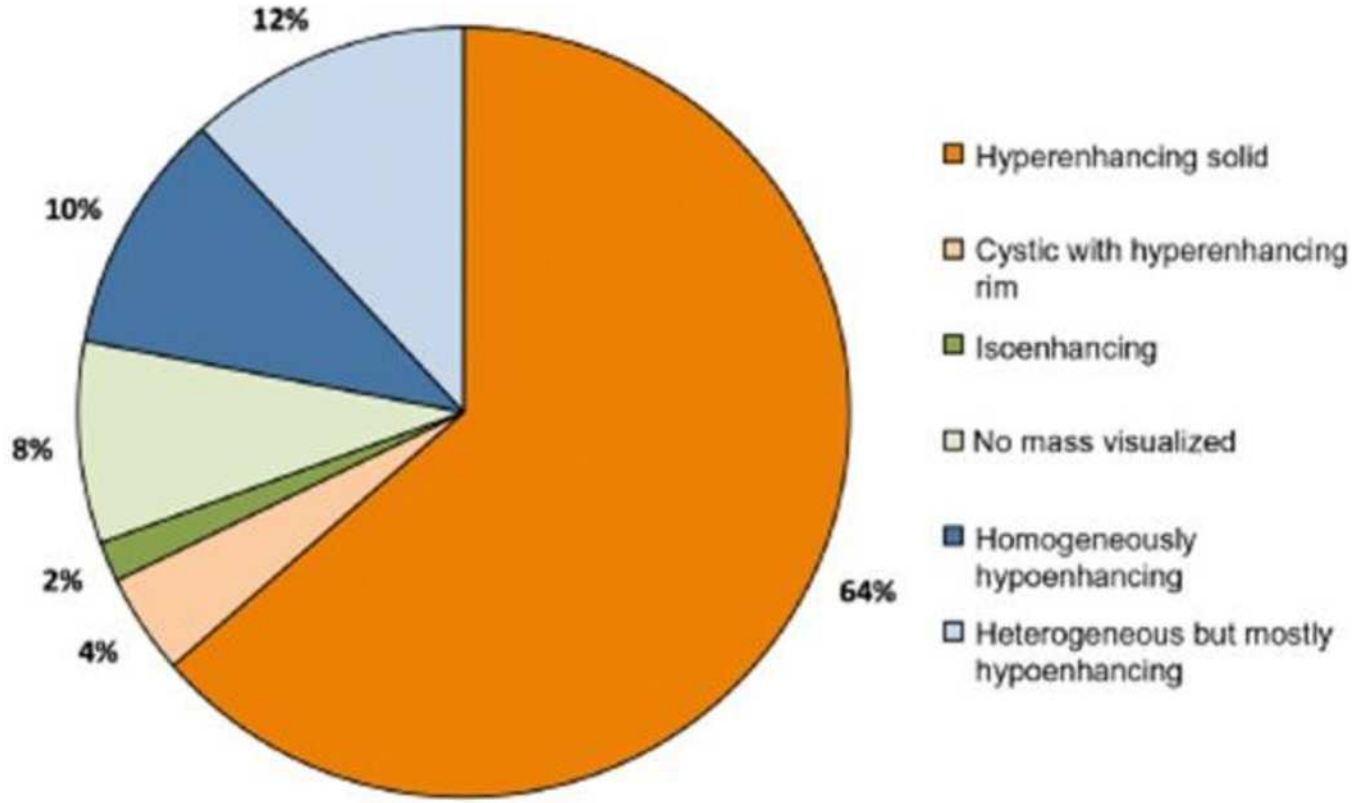
David J Worhunsky,[1] Geoffrey W Krampitz,[1] Peter D Poullos,[2] Brendan C Visser,[1] Pamela L Kunz,[3] George A Fisher,[3] Jeffrey A Norton,[1] and George A Poultsides[1]

118 operated patients

22% of hypoenhanced tumors:

- larger diameter
- G2-3: 76% vs. 30% for hyperenhanced tumors
- more frequent N+ et M+ (p<.001)

Worst pronostic with 5 y survival: 54% vs 93%



Hüpovaskulaarne pankrease NET

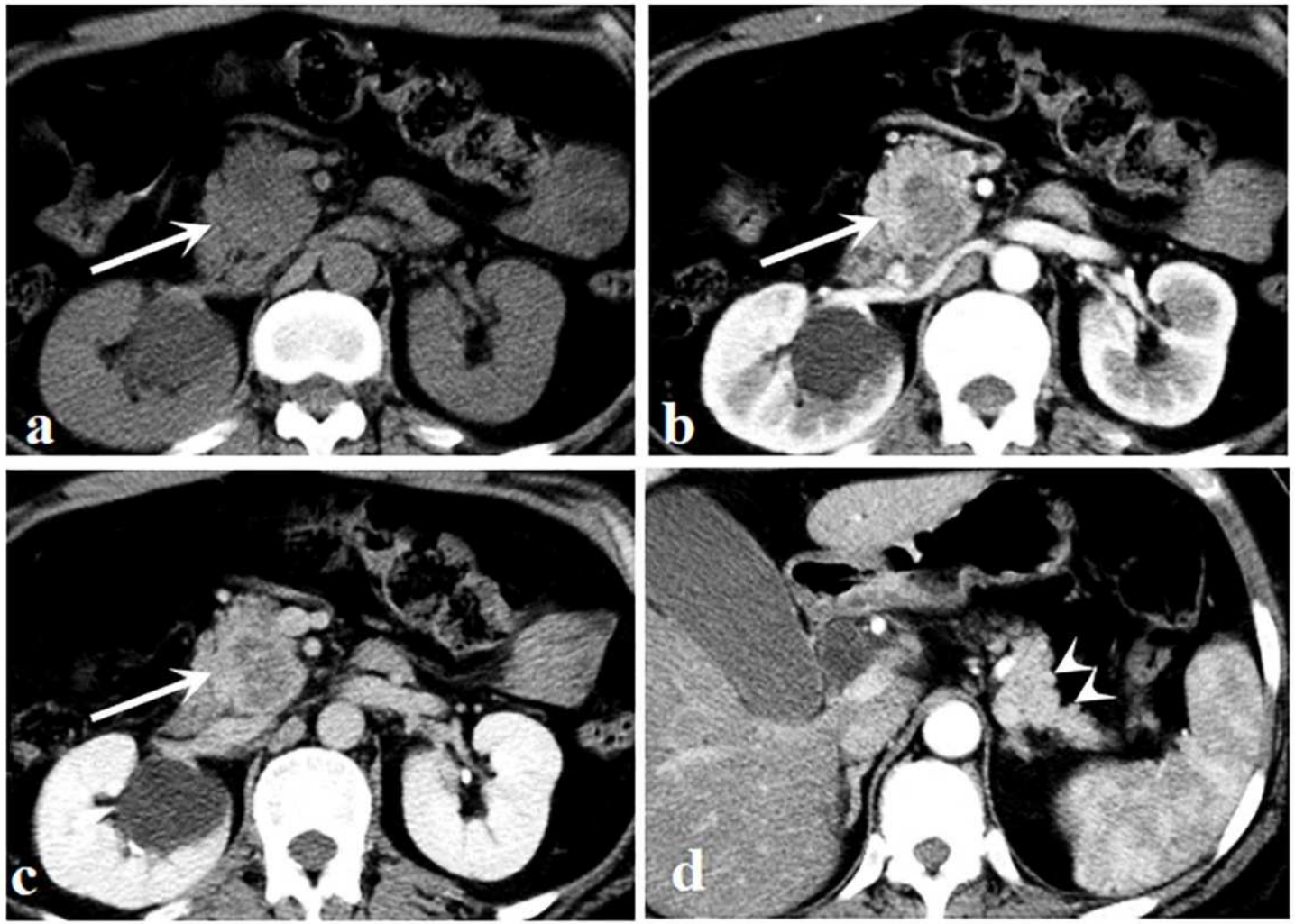


Fig 2. A 51-year-old woman with pancreatic neuroendocrine carcinoma.*(a) Unenhanced image shows an isodense mass (arrow) located in the head of the pancreas. (b, c) Arterial (b) and portal venous (c) phase images show a well circumscribed mass (arrows) with a hypovascular enhancement pattern. (d) There was neither upstream pancreatic parenchymal atrophy nor pancreatic duct dilatation (arrowheads).*

Differentiation of hypovascular pancreatic neuroendocrine tumors from pancreatic ductal adenocarcinoma using contrast-enhanced computed tomography

Shuai Ren, Xiao Chen, Zhonglan Wang, Rui Zhao, Jianhua Wang, Wenjing Cui, Zhongqiu Wang

Published: February 1, 2019 • https://doi.org/10.1371/journal.pone.0211566

CT findings	hypo-PNETs (n = 18)	PDAC (n = 39)	*P* value	Correlation coefficient
Location			0.278[b]	0.141
Head	9 (50)	22 (56.4)		
Body	3 (16.7)	11 (28.2)		
Tail	6 (33.3)	6 (15.4)		
Margin			0.016[b]	0.320
Well-defined	10 (55.6)	9 (23.1)		
Ill-defined	8 (44.4)	30 (76.9)		
Calcification	1 (5.6)	3 (7.7)	1.0[b]	0.039
Pancreatic duct dilatation	2(11.1)	23 (59)	0.002[b]	0.448
Bile duct dilatation	2 (11.1)	14 (35.9)	0.106[b]	0.256
Pancreatic Atrophy	4 (22.2)	20 (51.3)	0.076[b]	0.274
Local invasion or Metastases	7 (38.9)	31 (79.5)	0.003[b]	0.400
Size (cm)	4.3±1.6	3.8±1.3	0.20[a]	0.242
Tumor contrast enhancement (HU)				
Arterial phase	59.8±8.7	44.2±9.2	<0.001[a]	0.630
Portal venous phase	69.0±8.9	60.0±10.4	0.003[a]	0.393
Delayed phase	66.6±10.6	60.6±10.5	0.083[a]	0.261
Tumor-to-pancreas enhancement ratio				
Arterial phase	0.66±0.14	0.51±0.10	<0.001[a]	0.536
Portal venous phase	0.71±0.15	0.61±0.12	0.010[a]	0.338
Delayed phase	0.79±0.11	0.73±0.14	0.174[a]	0.206

[a] Calculated with a t-test

[b] Calculated with a Fisher's exact test or an χ^2 test

https://doi.org/10.1371/journal.pone.0211566.t002

CT findings	AUC	Sensitivity (%)	Specificity (%)	Odds ratio	Confidence interval (95%)
Tumor margin	0.607	44.4	76.9	0.375	0.114–1.234
Pancreatic duct dilatation	0.739	59	88.9	11.5	2.316–57.101
Local invasion or Metastases	0.703	79.5	61.1	6.089	1.788–20.741
Tumor contrast enhancement (arterial)	0.888	88.9	77	0.839	0.765–0.921
Tumor contrast enhancement (portal)	0.748	94.4	54.3	0.917	0.863–0.975
Tumor-to-pancreas enhancement ratio (arterial)	0.812	83.3	61.6	0.034	0–4.444
Tumor-to-pancreas enhancement ratio (portal)	0.693	83.3	53.9	0.003	0–0.357

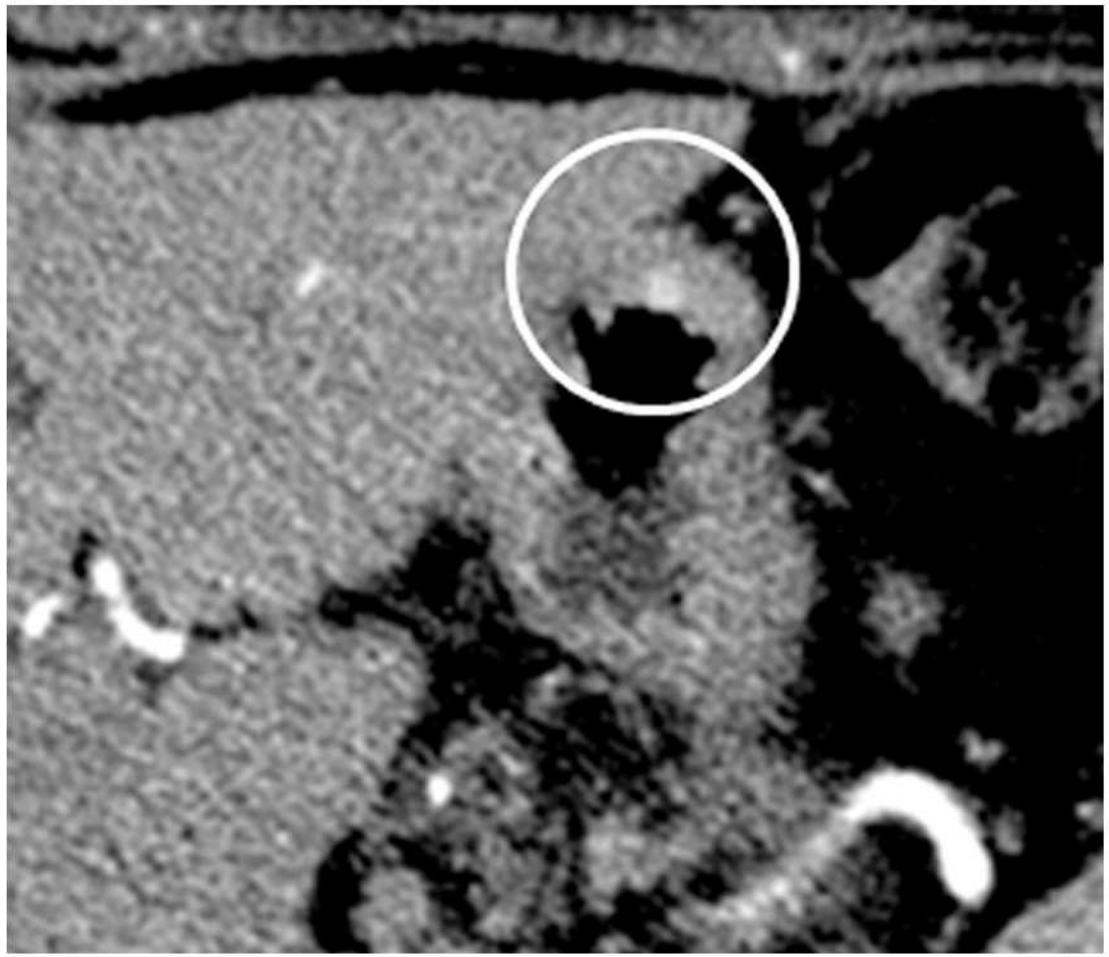
https://doi.org/10.1371/journal.pone.0211566.t003

Table 3. The receiver operating characteristic analysis of CT findings in differentiating hypovascular pancreatic neuroendocrine tumors (hypo-PNETs) from pancreatic ductal adenocarcinoma (PDAC).

Multimodality Imaging Findings in Carcinoid Tumors: A Head-to-Toe Spectrum

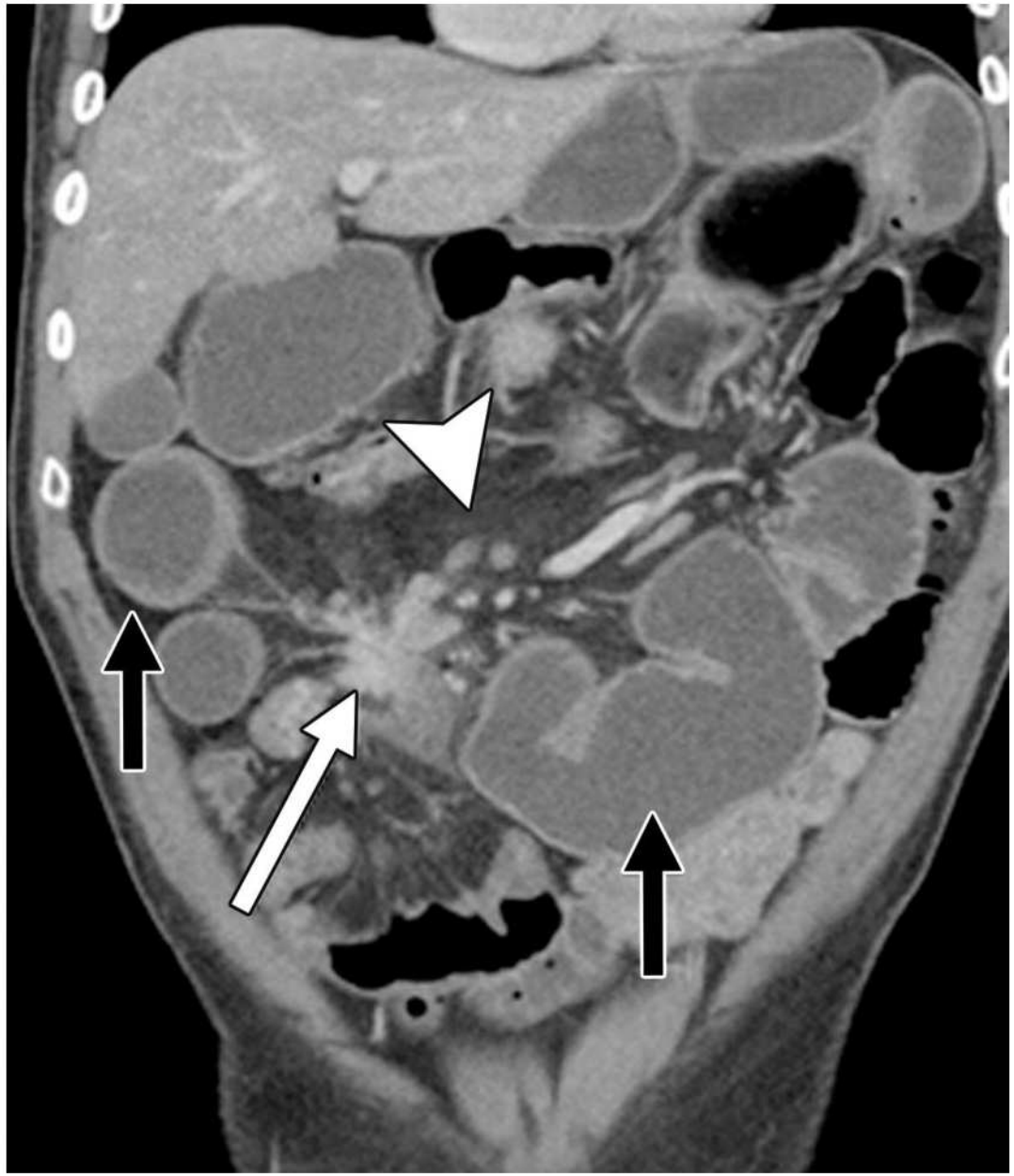
RadioGraphics

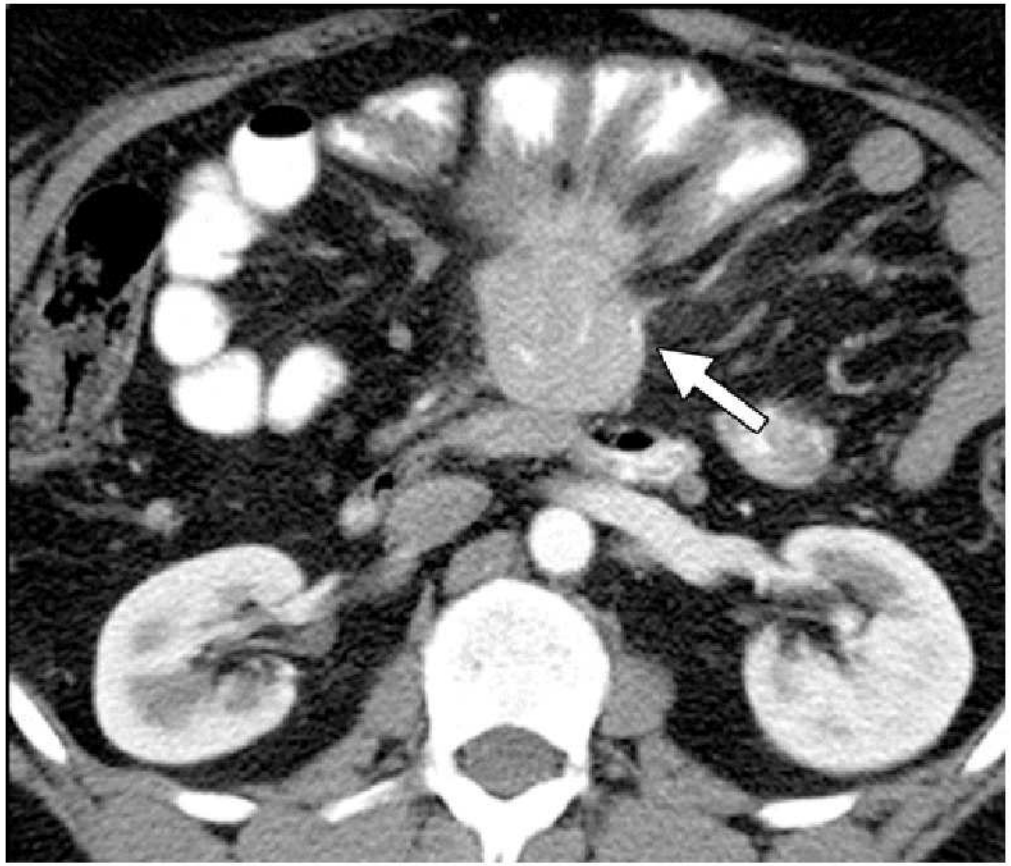
Ameya Jagdish Baxi ✉, Kedar Chintapalli, Amol Katkar, Carlos S. Restrepo, Sonia L. Betancourt, Abhijit Sunnapwar



Axial contrast-enhanced multidetector CT image of the abdomen demonstrates a small enhancing nodule (circle) in the gastric wall

Gastrointestinal (74)
Appendix (18.9)
Ileum (15.4)
Rectum (11.4)
Cecum (4.2)
Stomach (3.2)
Duodenum (2.0)
Jejunum (1.9)
Rectosigmoid (1.2)
Ascending colon (1.0)
Other sites* (<1)
Respiratory (25)
Trachea
Bronchi
Lung
Reproductive (0.56)
Ovary
Cervix
Uterine corpus
Testes
Unspecified (0.6)
Thymus
Head and neck
Breast





(b) *Axial multidetector CT image of the abdomen demonstrates a partially calcified soft-tissue mass (arrow) in the mesentery with adjacent desmoplastic reaction and spoke-wheel or sunburst arrangement of mesenteric vessels.*

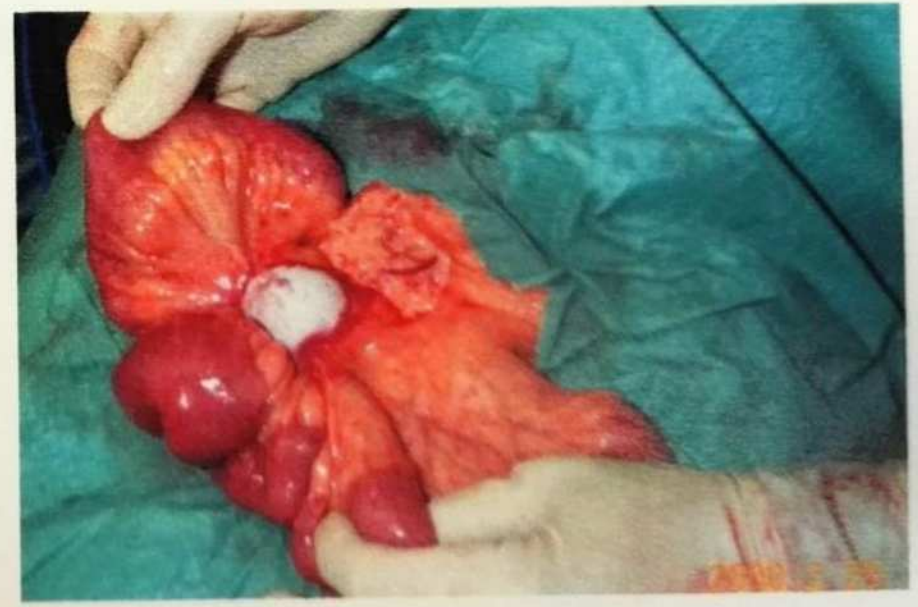
85% peensoole NET-dest distaalses iileiumis

Neuroendocrine neoplasms of the small intestine

Clinical manifestations

Related to primary tumor

- None
- Abdominal discomfort (for years)
- Diarrhoea
  due to partiel bowel obstruction or ischemia
- Small bowel obstruction
- Vascular encasement
  Intestinal ischemia or infarction
- Malnutrition
- Gastrointestinal bleeding (rarely)
- Intussusception
- Mesenteric fibrosis
- Abdominal mass

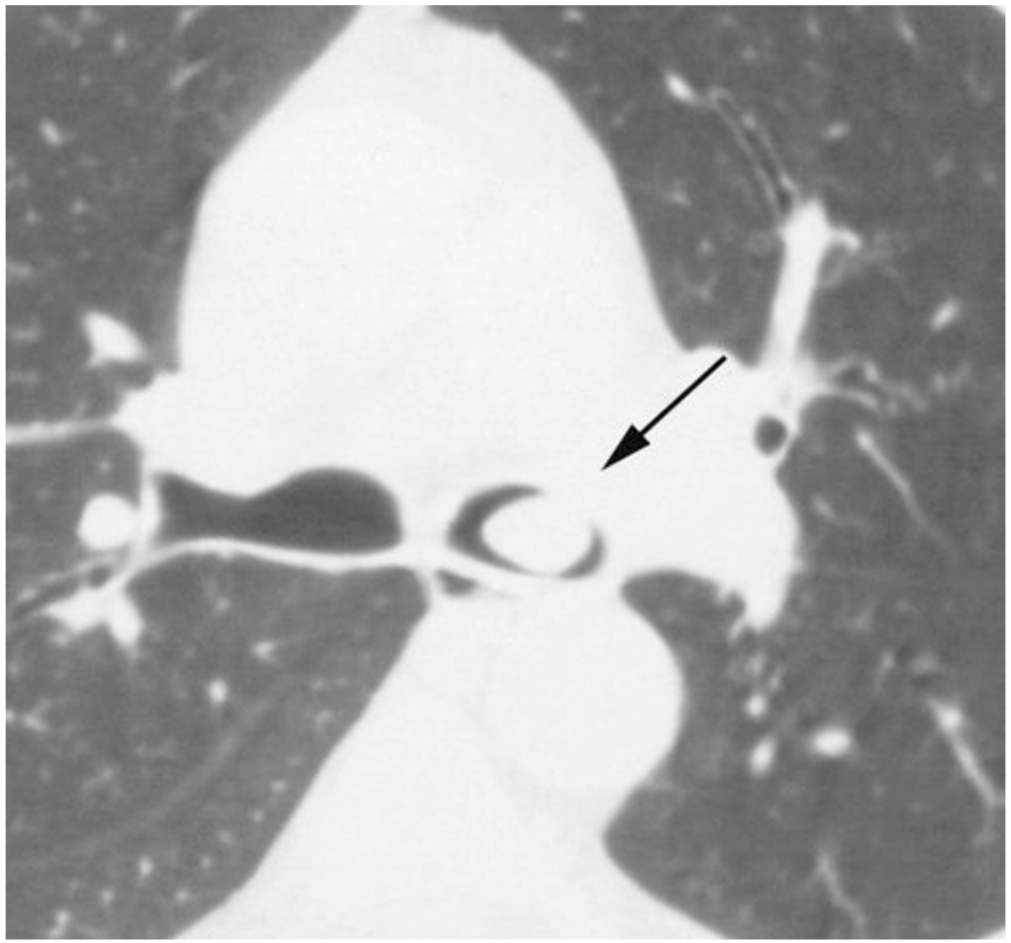


Bronchial Carcinoid Tumors of the Thorax: Spectrum of Radiologic Findings

RadioGraphics

Mi-Young Jeung, Bernard Gasser, Afshin Gangi, Dominique Charneau, Xavier Ducroq, Romain Kessler, Elisabeth Quoix, Catherine Roy

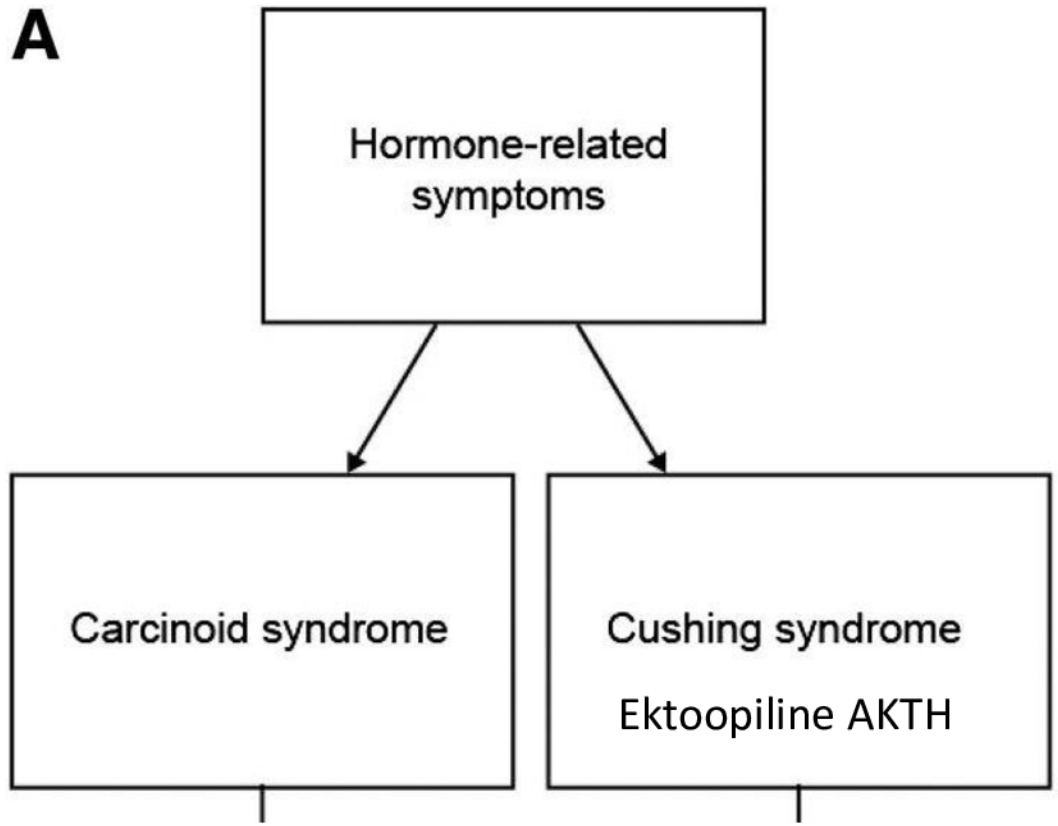
- Tsentraalsed ja perifeersed
- Endobronhiaalne tuumor - obstruktsioon



b) *CT scan (lung windowing) shows a well-circumscribed, ovoid, completely endoluminal nodule (arrow).*

Bronhopulmonaarsed NET-id

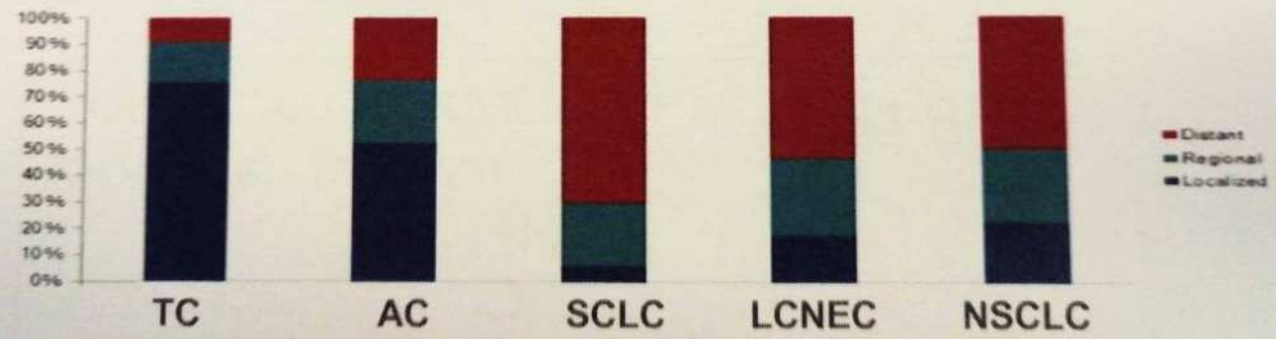
- Tüüpiline kartsionid, *TC*
- Atüüpiline kartsinoid, *AC*
- Suur-rakk neuroendokriinne kasvaja, *LCNEC*
- Väike-rakk kopsuvähk, *SCLC*



Stage, histology, and prognosis

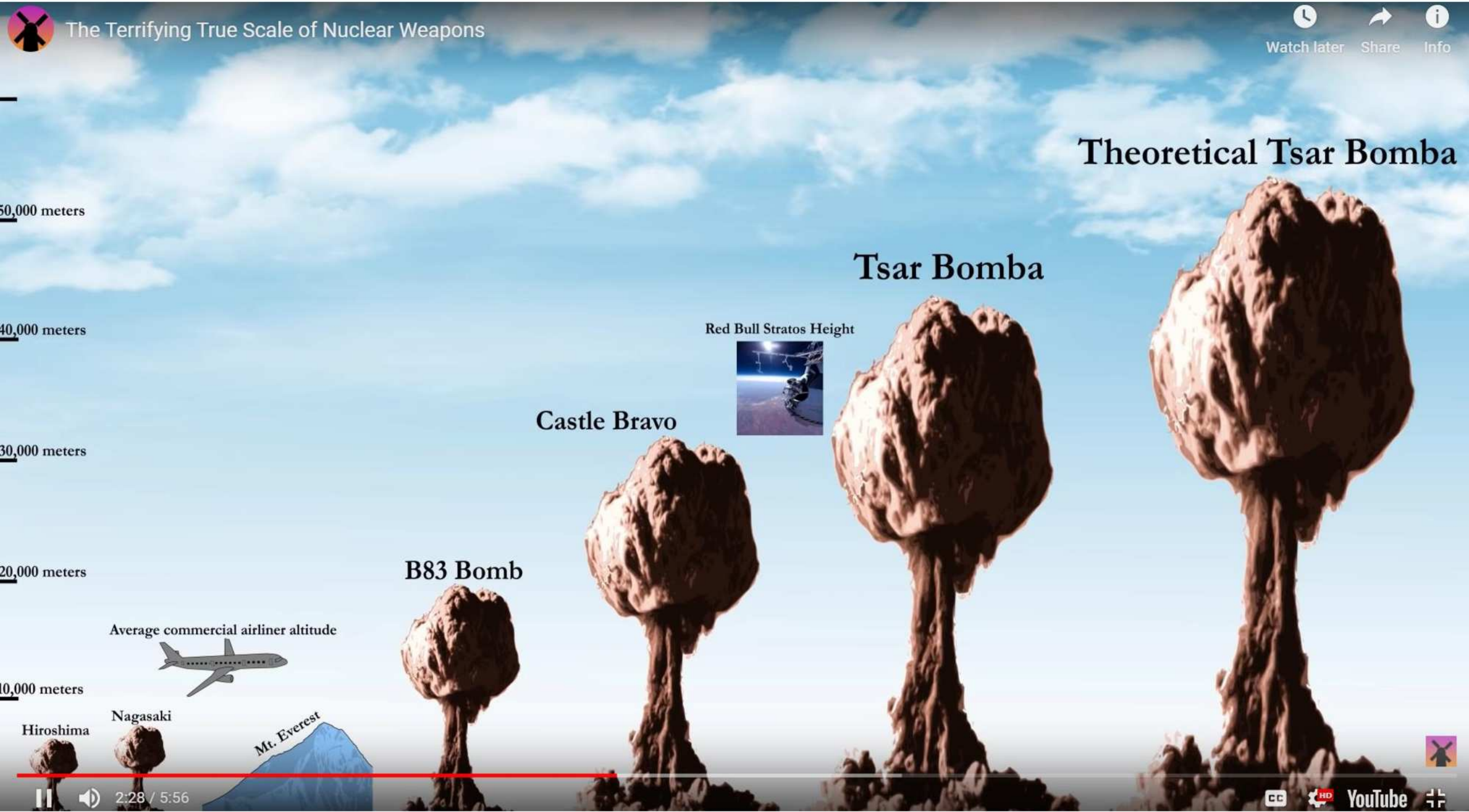
SEER 2000-2010

Survival (months)	Localized	Regional	Distant
TC	>120	>120	42
AC	>120	70	12
LCNEC	30	13	3
SCLC	16	12	5



For TC, surgical resection provides excellent outcomes, with 5- and 10-year survival rates of ~90% and ~80%, respectively, and very low recurrence rates (3%–5%).

ACs are notably more aggressive than TCs, with a higher frequency of regional lymph node involvement (50%–60% vs. 10%–15%) and distant metastasis (~20% vs. 2%–5%) and worse survival outcomes at 5 years (56%–79% vs. 87%–96%) and 10 years (35%–56% vs. 82%–87%)


The Terrifying True Scale of Nuclear Weapons
Watch later
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Info
Theoretical Tsar Bomba
50,000 meters
Tsar Bomba
40,000 meters
Red Bull Stratos Height
Castle Bravo
30,000 meters
B83 Bomb
20,000 meters
Average commercial airliner altitude
10,000 meters
Nagasaki
Hiroshima
Mt. Everest
2:28 / 5:56
YouTube

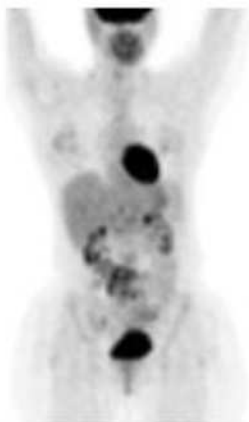
NM to image NEN: tracers targeting

PET/CT

METABOLISM

18F-DOPA

18F-FDG



SOMATOSTATIN RECEPTORS

*AGONISTS (**SA**)*

68Ga-DOTA-TATE

68Ga-DOTA-NOC

68Ga-DOTA-TOC

64Cu-DOTA-TATE

THERANOSTIC

^{177}Lu-DOTA-TATE

SOMATOSTATIN RECEPTORS SCINTIGRAPHY SPECT/CT

^{111}In-OCT

^{99m}Tc-TOC

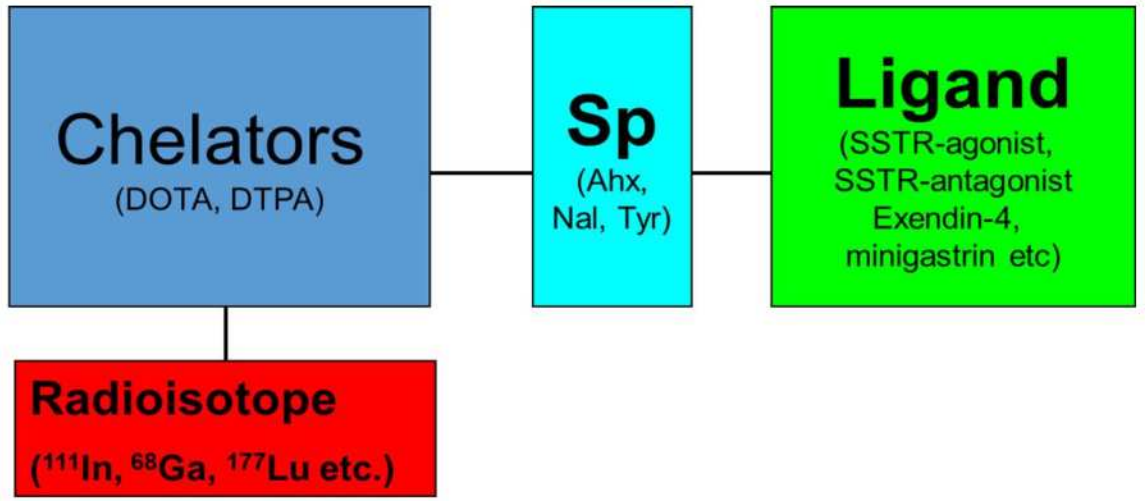
Molecular imaging for neuroendocrine tumours

DOI: https://doi.org/10.4414/smw.2019.20017
Publication Date: 10.03.2019
Swiss Med Wkly. 2019;149:w20017
Swiss Medical Weekly

- 5 somastatiin retseptorie alatüübi
- SSR 2 –tihedalt ja homogeenselt ekspresseeritud NET tuumorite rakkude pinnal 80-90% juhtudest.
- Erandid: insulinoomid ja kilpnäärme medullaarne vähk

- muud retseptorud GLP-1 ja CCK-2

- SSR enam G1 ja G2 tuumoritel, Ki67 1-20%



	G1 NET	G2 NET	G3 NET	G3 NEC
Differenciation	.....	well differentiated	.....	**Poorly diffrentiated**
Evolution	slow	→		fast/bad pronostic

Nuclear Imaging

Fonctional Imaging MDCT/MRI

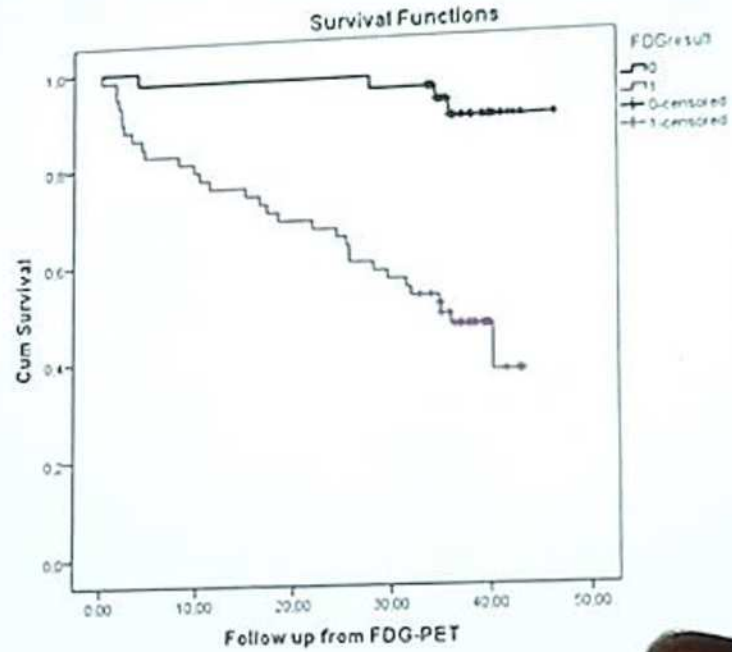
UNIVERSITY OF COPENHAGEN

FDG-PET in neuroendocrine tumors

Clinical Cancer Research

Imaging, Diagnosis, Prognosis

^{18}F-Fluorodeoxyglucose Positron Emission Tomography Predicts Survival of Patients with Neuroendocrine Tumors



RH

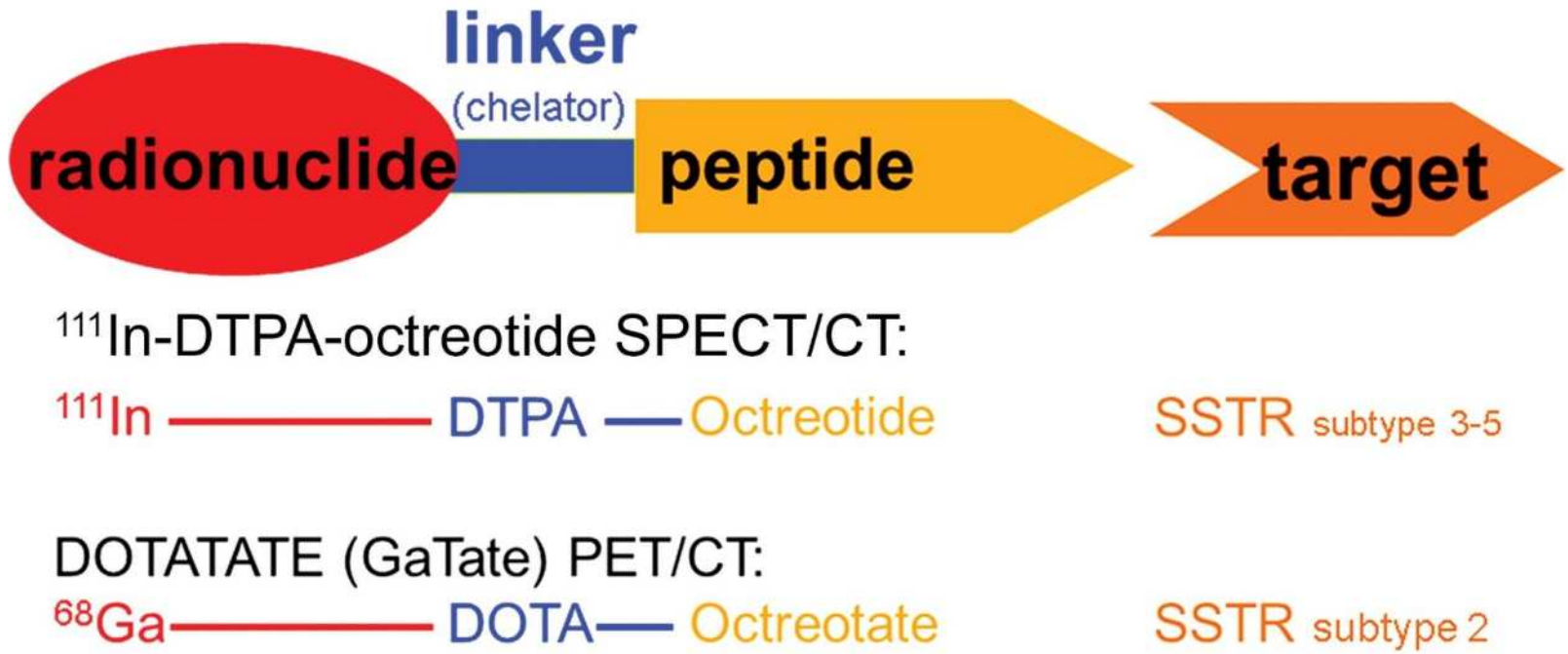
Clin Cancer Res / Nat Rev Clin One

Nuclear Medicine

Free Access

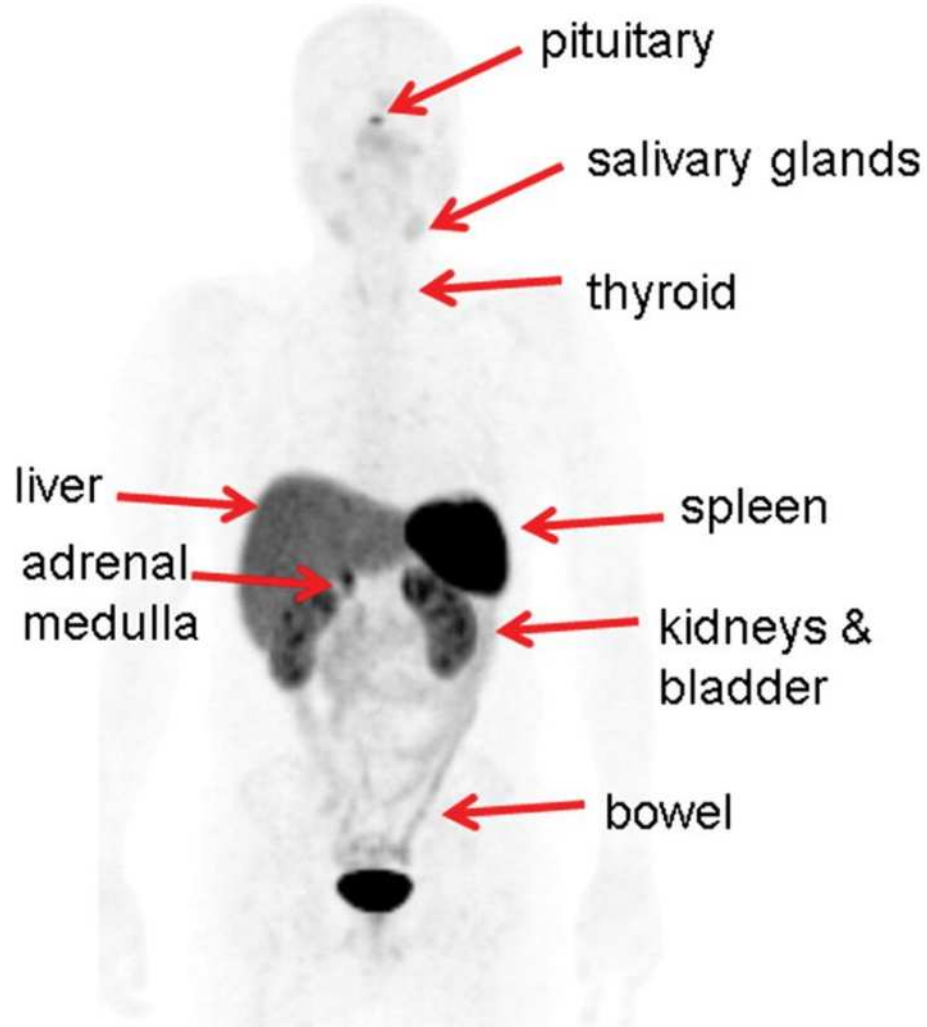
RadioGraphics

Somatostatin Receptor Imaging with ^{68}Ga DOTATATE PET/CT: Clinical Utility, Normal Patterns, Pearls, and Pitfalls in Interpretation

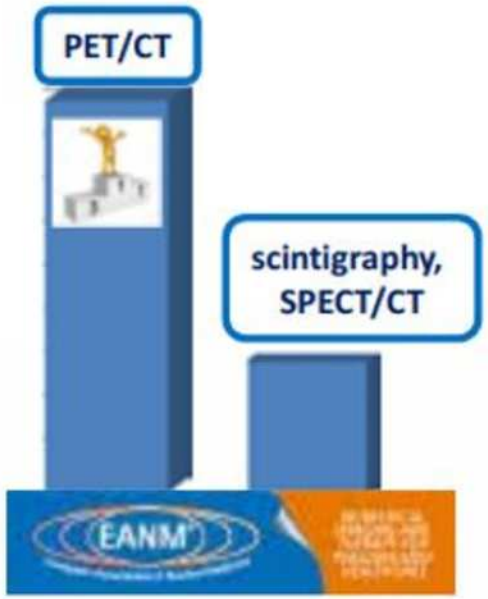


Somatostatiin retseptorite e. SSR kuvamine

- Teadmata algkolde otsimine
- Staadiumi määramine
- ^{177}Lu-peptiid ravi planeerimine



NM to image NEN: procedures..



Guideline for PET/CT imaging of neuroendocrine neoplasms with ^{68}Ga-DOTA-conjugated somatostatin receptor targeting peptides and ^{18}F–DOPA

Murat Fani Bozkurt[1] · Irene Virgolini[2] · Sona Balogova[3,4] · Mohsen Beheshti[5,6] · Domenico Rubello[7] · Clemens Decristoforo[2] · Valentina Ambrosini[8] · Andreas Kjaer[9] · Roberto Delgado-Bolton[10] · Jolanta Kunikowska[11] · Wim J. G. Oyen[12] · Arturo Chiti[13] · Francesco Giammarile[14] · Stefano Fanti[8]

^{68}Ga-DOTATATE PET/CT, ^{99m}Tc-HYNIC-Octreotide SPECT/CT, and Whole-Body MR Imaging in Detection of Neuroendocrine Tumors: A Prospective Trial

PET/CT whenever possible

Neuro-endocrinology

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At the Cutting Edge

The Status of Neuroendocrine Tumor Imaging: From Darkness to Light?

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EANM

The Status of Neuroendocrine Tumor Imaging: From Darkness to Light?

Bodei L.[a] · Sundin A.[b] · Kidd M.[c] · Prasad V.[d] · Modlin I.M.[c]

Fig. 2

Methods for the identification of primary and metastatic gastroenteropancreatic NETs. Data are pooled from 52 studies and are mean (95% confidence interval). Data for specificity and sensitivity are not comparable across studies. S = Calculated sensitivity.

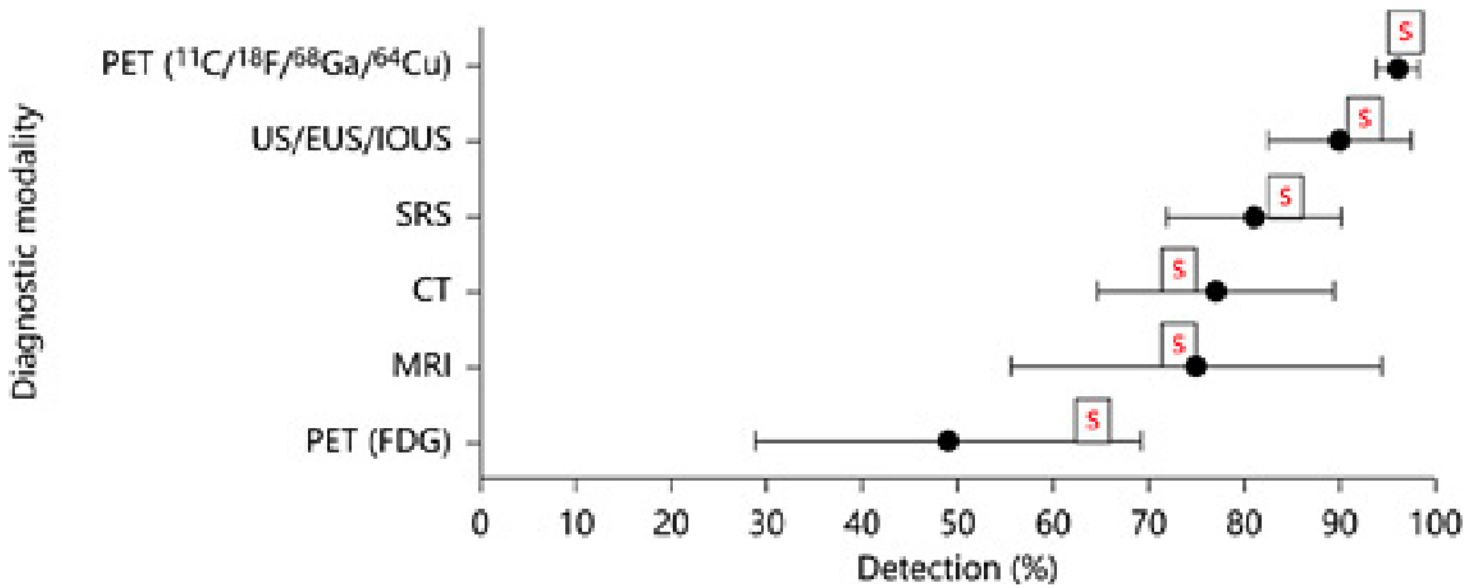


Table 3 Proposed diagnostic strategy based on the NEN type

Type of NEN	Place in diagnostic strategy (I-II-III)*		
	^{68}Ga-somatostatin analogue	*^{18}F–DOPA*	*^{18}F–FDG*
Medullary thyroid cancer	III mainly when treatment with SST analogues is an option	In patients with high serum calcitonin levels: I In patients with high serum CEA levels II	In patients with high serum calcitonin levels II In patients with high serum CEA levels I
Foregut NET	I	Not indicated	I
Midgut NET	I	I	II
Hindgut-NET	II	II	I
Pheochromocytoma	II/III	With SDHD mutation I With SDHB mutation II-	With SDHD mutation II With SDHB mutation I
Paraganglioma	Head and neck I Abdomen/pelvis II	Head and neck II Abdomen/pelvis I	Head and neck III Abdomen/pelvis III
CUP NET	If suspected primary foregut I	İf suspected primary midgut I	To localise the primary tumour and eventual non-NET malignancy I
Neuroblastoma		I	Older age, advanced stages or MYCN amplification I
Hyperinsulinism in infants and in children		I	

CUP: carcinoma of unknown primary

*I: The first choice proposed

II: The second choice proposed

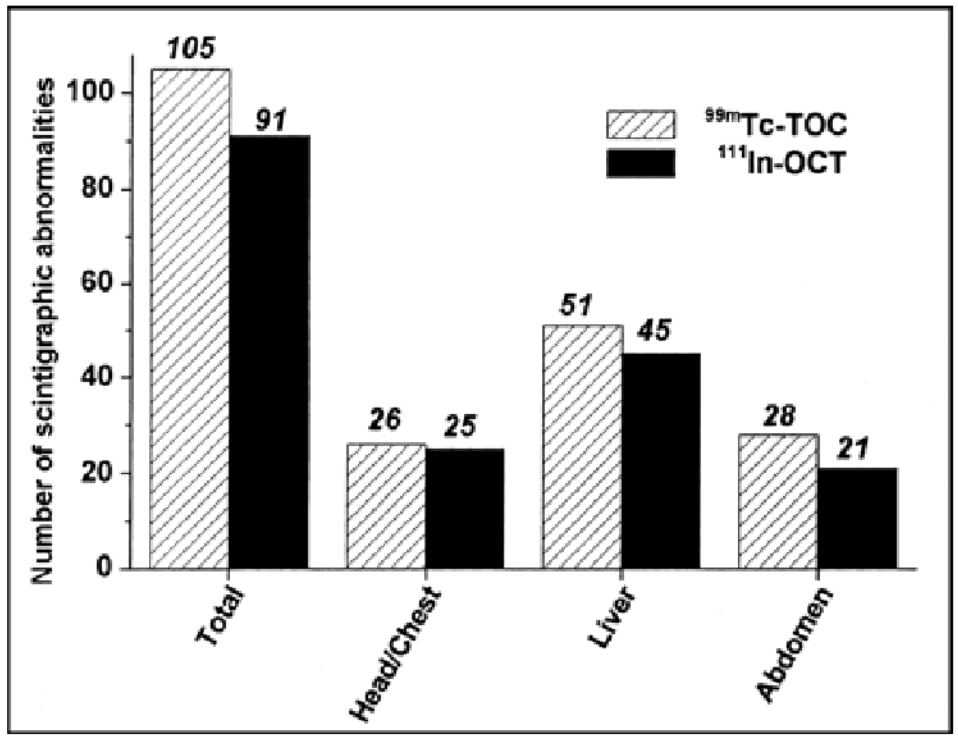
III: The third choice proposed

Somatostatiin retseptorite stsintigraafia ja SPET/KT

- ^{111}In-OCT – OctreoScan (Mallinckrodt Medical)
- ^{99m}Tc-TOC - Tektrotyd (Polatom)

An Intrapatient Comparison of ^{99m}Tc-EDDA/HYNIC-TOC with ^{111}In-DTPA-Octreotide for Diagnosis of Somatostatin Receptor-Expressing Tumors

Michael Gabriel, MD[1], Clemens Decristoforo, PhD[1], Eveline Donnemiller, MD[1],



SSR agonistid
PET/KT DOTA-peptiidid

- Diagnostikum:

^{68}Ga-DOTATATE, -DOTATOC, -DOTANOC

^{64}Cu- DOTATATE

- Terapeutikum:

^{177}Lu-DOTATATE - TERANOSTIKA

High management impact of Ga-68 DOTATATE (GaTate) PET/CT for imaging neuroendocrine and other somatostatin expressing tumours

Journal of Medical Imaging and Radiation Oncology

2012

Michael S Hofman, Grace Kong, Oliver C Neels, Peter Eu, Emily Hong, Rodney J Hicks

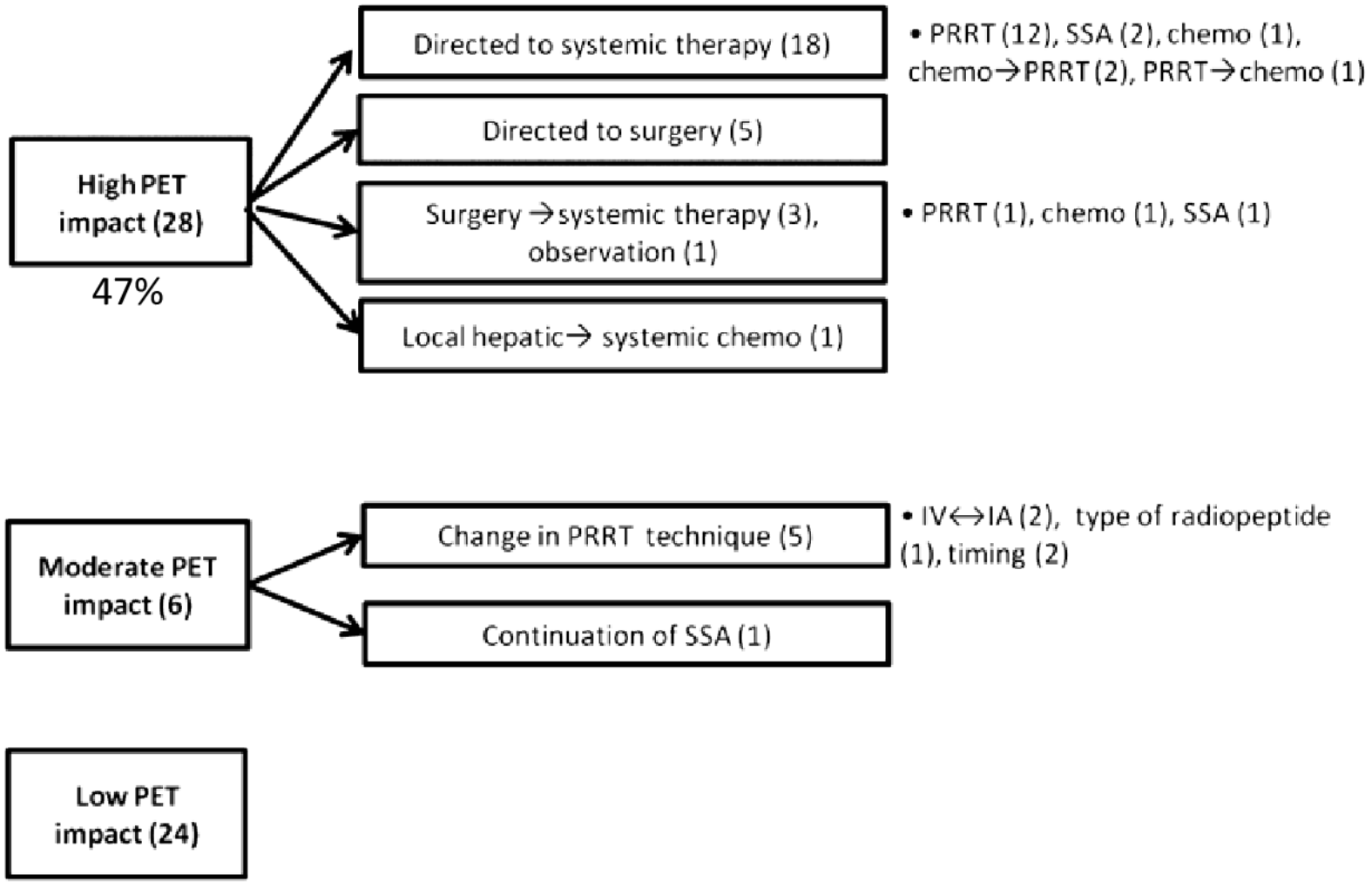


Fig. 3. Management impact. High impact denotes an inter-modality change and moderate impact denotes an intra-modality change. Chemo, chemotherapy; IA, intra-arterial; IV, intravenous; PET, positron emission tomography; PRRT, peptide receptor radionuclide therapy; SSA, long-acting somatostatin analogue.

In patients who underwent 111In-octreotide imaging in the preceding 3, 3–6 or >6 months, there was a high management impact in 71, 40 and 50%; the greater impact in patients imaged within a shorter time window suggests that results have not been confounded by disease progression between scans.

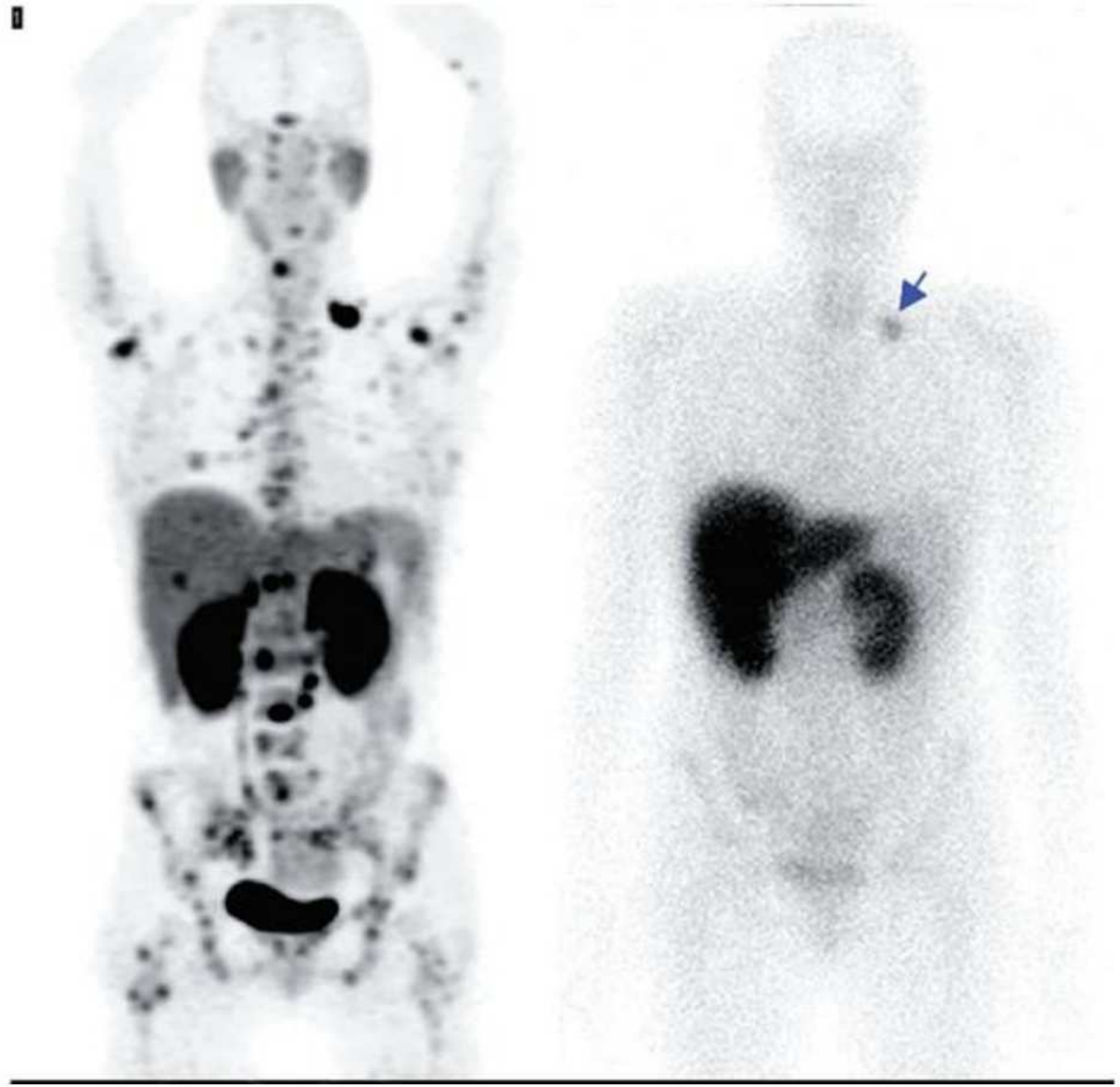


Fig. 4. Middle age woman with long-standing history of 'chronic pancreatitis'. At second operation found to have sub-centimetre hepatic metastasis with histology demonstrating well-differentiated neuroendocrine tumour. Triple phase CT scan demonstrated no abnormality apart from multiple sclerotic bone lesions considered to be benign bony islands (osteopoikylosis) with prior 'negative' bone biopsy. ^{111}In-octreotide scan (top right) anterior planar and single photon emission tomography/CT (not shown) demonstrated a solitary left supraclavicular nodal abnormality (blue arrow). GaTate positron emission tomography (PET)/CT scan (top left: anterior maximum image projection, bottom: selected axial PET/CT fusion slices) performed 1 week later demonstrated a pancreatic primary and sub-centimetre liver metastasis (red arrows), and widespread nodal and osseous metastases. The patient subsequently underwent radionuclide therapy with ^{177}lutetium-octreotate.

^{68}Ga-DOTATATE PET/CT, ^{99m}Tc-HYNIC-Octreotide SPECT/CT, and Whole-Body MR Imaging in Detection of Neuroendocrine Tumors: A Prospective Trial

Elba Cristina Sá de Camargo Etchebehere[1], Allan de Oliveira Santos[1], Brenda Gumz[2], Andreia Vicente[1], Paulo G Gustavo Corradi[3], Wilson André Ichiki[1], José Geraldo de Almeida Filho[1], Saulo Cantoni[3], Edwaldo Eduardo Cz and Frederico Perego Costa[2]

Results: *McNemar testing was applied to evaluate the detectability of lesions using $_{68}$Ga-DOTATATE PET/CT in comparison to SSRS SPECT/CT and WB DWI: a significant difference in detectability was noted for* ***pancreas, gastrointestinal, and bones.***

Two ***unknown primary*** *lesions were identified solely by $_{68}$Ga-DOTATATE PET/CT. $_{68}$Ga-DOTATATE PET/CT, SSRS SPECT/CT, and WB DWI demonstrated, respectively, sensitivities of 0.96, 0.60, and 0.72; specificities of 0.97, 0.99, and 1.00;*

TABLE 1
Lesion Detection Capability of SSRS SPECT/CT, ^{68}Ga PET/CT, and WB DWI

Variable	N/P	*P* value	
		^{68}Ga-DOTATATE PET/CT vs. SSRS SPECT/CT	^{68}Ga-DOTATATE PET/CT vs. WB DWI
All solid organs	N	0.0253	0.0833
	P		
Lungs and pleura	N	1.0000	0.1573
	P		
Liver	N	0.1573	0.3173
	P		
Pancreas	N	0.0455	0.0455
	P		
Gastrointestinal tract	N	0.0455	0.0455
	P		
All LNs	N	0.5637	1.0000
	P		
Cervical LNs	N	1.0000	1.0000
	P		
Thoracic LNs	N	0.5637	0.0833
	P		
Abdomen and pelvic LNs	N	0.3137	0.3173
	P		
All skeletal system	N	0.0082	0.0082
	P		
Bones of spine and pelvis	N	0.0143	0.0455
	P		
Thoracic bones	N	0.0143	0.0143
	P		
Bones of limbs	N	0.0253	
	P		0.0455
Skull and skull base	N	0.0455	
	P		0.0455

LNs = lymph nodes; N = negative; P = positive.

Comparison of diagnostic accuracy of ^{111}In-pentetreotide SPECT and ^{68}Ga-DOTATOC PET/CT: A lesion-by-lesion analysis in patients with metastatic neuroendocrine tumours

S. Van Binnebeek[1] · B. Vanbilloen[1] · K. Baete[1] · C. Terwinghe[1] · M. Koole[1] · F. M. Mottaghy[2,3] · P. M. Clement[4] · L. Mortelmans[1] · K. Bogaerts[5] · K. Haustermans[6] · K. Nackaerts[7] · E. Van Cutsem[8] · C. Verslype[8] · A. Verbruggen[9] · C. M. Deroose[1,10]

Table 3 Lesion–based organ–by–organ comparison of ^{68}Ga–DOTATOC $PET_{FOVSPECT}$ and ^{111}In–pentetreotide single–photon emission computed tomography (SPECT) for the liver, the lymph nodes (LN), the bone and other regions (not bone, lymph nodes or liver). The total number of lesions as well as the incremental lesions (ILs) are given; we also added the number of patients in whom ILs were seen

Organ	No. of lesions $PET_{FOVSPECT}$	No. of lesions $SPECT_{total}$	P–value	IL^*_{PET}	IL^*_{SPECT}	No. of patients with IL_{PET} (n=53)	No. of patients with IL_{SPECT} (n=53)
Liver	593	395	$9.7*10^{-5}$	199	1	35 (66 %)	1 (2 %)
LN	183	129	$2.9*10^{-5}$	54	0	14 (26 %)	0
Bone	249	86	$5.5*10^{-2}$	163	0	14 (26 %)	0
Other	73	50	$2.1*10^{-2}$	23	0	9 (17 %)	0
Total	1,098	660	$1.7*10^{-5}$	439	0	42 (79 %)	1 (2 %)

DOI: https://doi.org/10.4414/smw.2019.20017
Publication Date: 10.03.2019
Swiss Med Wkly. 2019;149:w20017

Swiss Medical Weekly

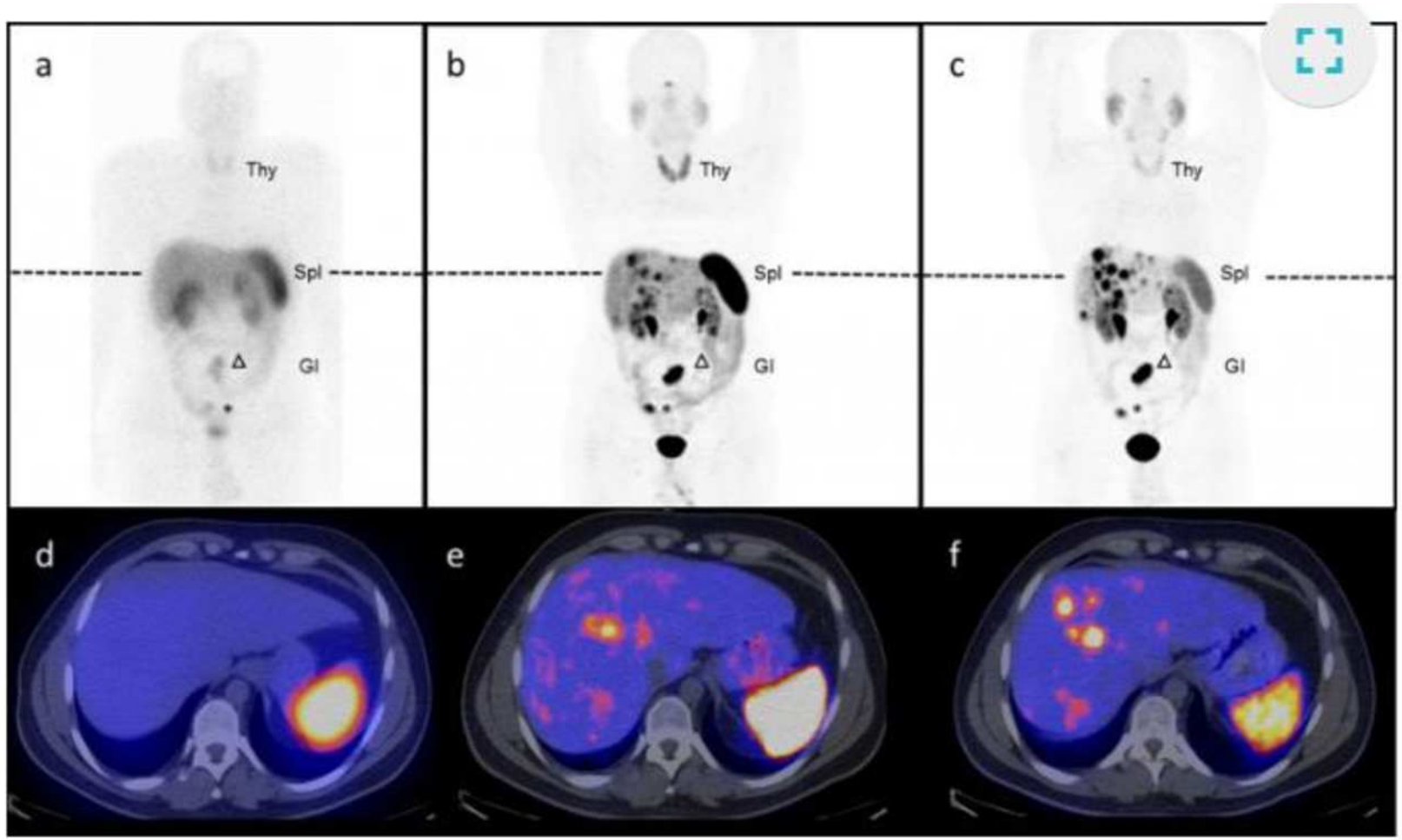
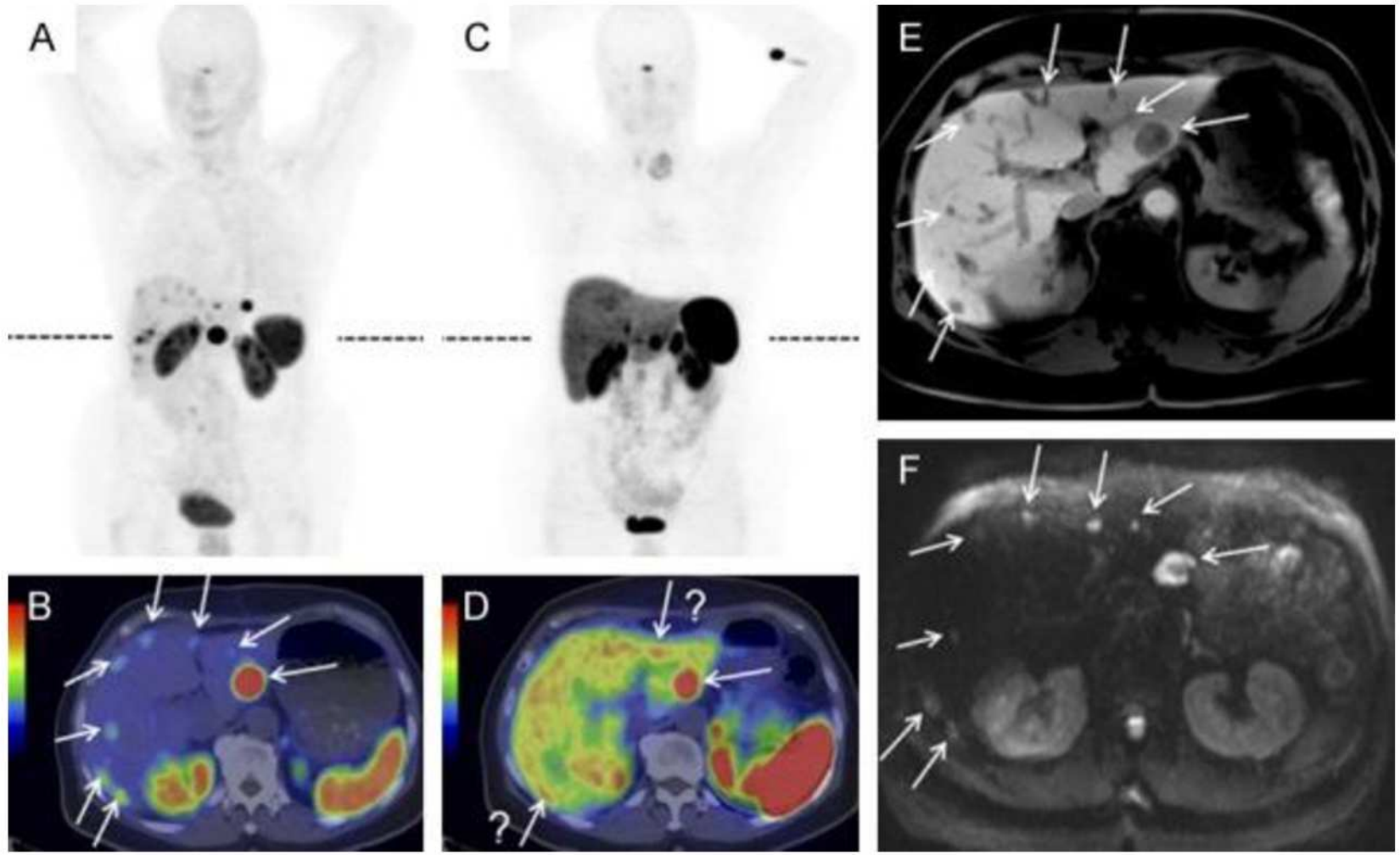


Figure 3

Somatostatin-receptor targeting using ^{111}In-DTPA-octreotide, ^{68}Ga-DOTA-octerotide and ^{68}Ga-DOTA-SSTR-antagonist. Head-to-head comparison of ^{111}In-DTPA-octreotide scintigraphy and SPECT/CT

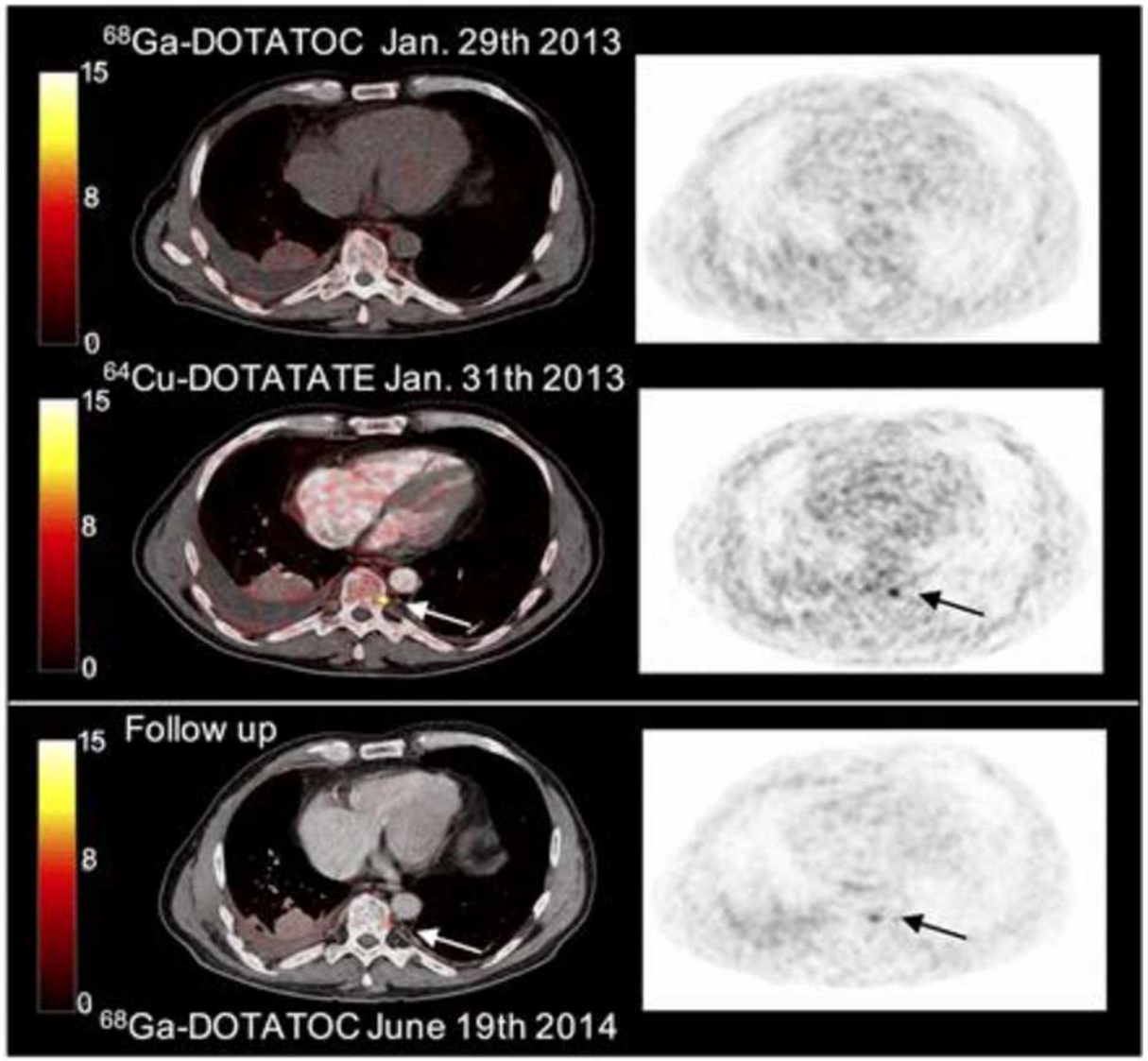
SSR antagonistid….



Maximal-intensity projections (A and C) and PET/CT (B and D) scans with ^{68}Ga-NODAGA-JR11 (A and B) and ^{68}Ga-DOTATOC of a patient with ileal NET and bilobar liver metastases.

Head-to-Head Comparison of ^{64}Cu-DOTATATE and ^{68}Ga-DOTATOC PET/CT: A Prospective Study of 59 Patients with Neuroendocrine Tumors

Camilla B. Johnbeck[1,2], Ulrich Knigge[2,3], Annika Loft[1,2], Anne K. Berthelsen[1,2],



Editorial | Published: 07 August 2019

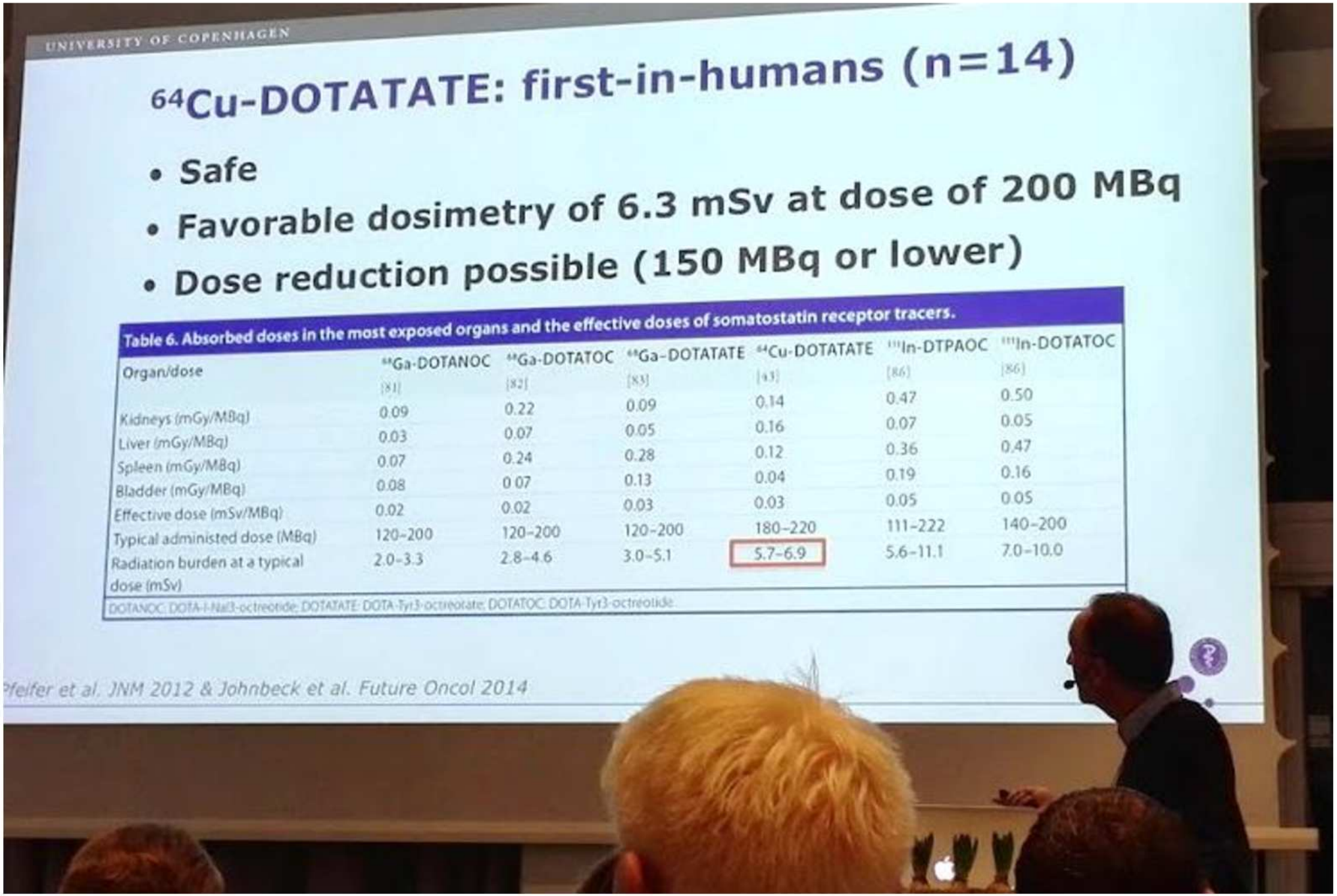
Al^{18}F-NOTA-octreotide and ^{18}F-SiFA*lin*-TATE: two 'new kids on the block' in somatostatin receptor imaging

J Nucl Med. 2015 Jul;56(7):1100-5. doi: 10.2967/jnumed.114.149583. Epub 2015 May 14.

In Vivo Evaluation of ^{18}F-SiFAlin-Modified TATE: A Potential Challenge for ^{68}Ga-DOTATATE, the Clinical Gold Standard for Somatostatin Receptor Imaging with PET.

Niedermoser S[1], Chin J[2], Wängler C[3], Kostikov A[2], Bernard-Gauthier V[4], Vogler N[5], Soucy JP[6], McEwan AJ[7], Schirrmacher R[4], Wängler B[1].

...

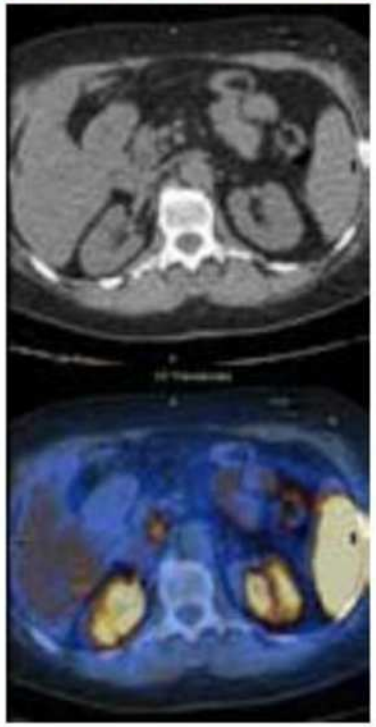


99mTc – Tektrotyd
370 - 740 MBq
1,7- 4,5 mSv

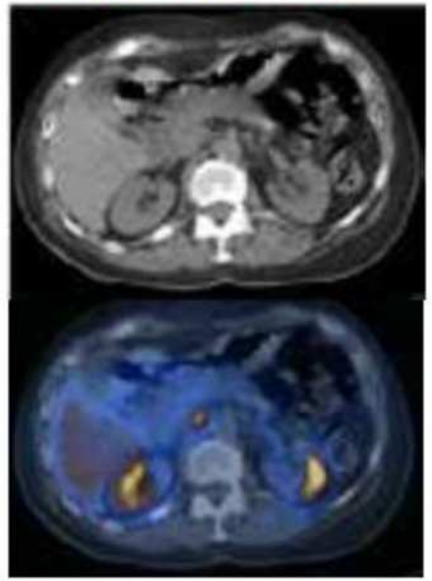
FP: PANCREAS, UNCINATE PROCESS/HEAD

Kuni 1/3 patsientidest

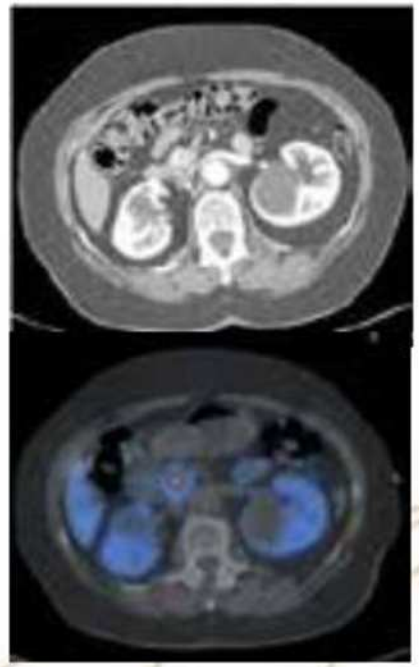
- **DIFFUSE,**
  CT NEGATIVE



- **FOCAL,**
  CT NEGATIVE

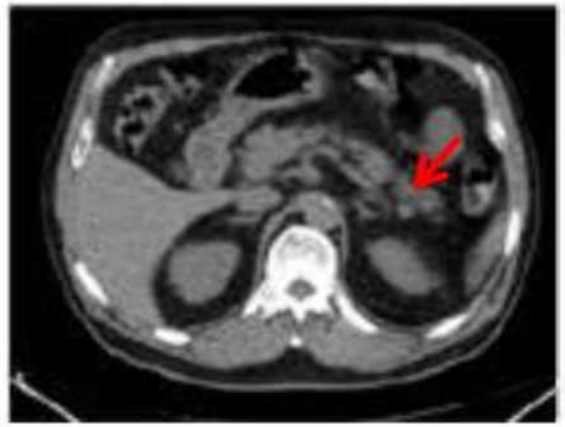


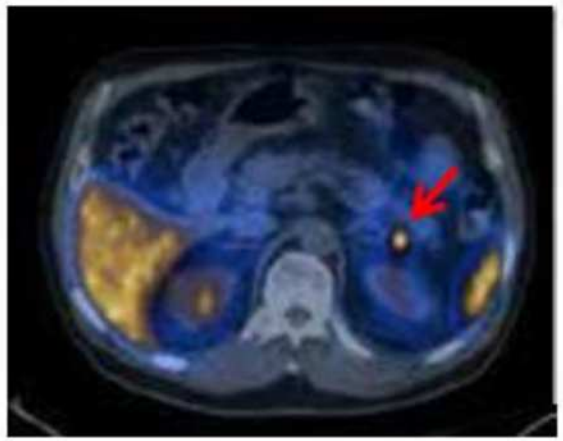
- **FOCAL,**
  CT POSITIVE (TP)



Gabriel M et al. J Nucl Med. 2007
Castellucci P et al. J Nucl Med. 2011.

FP: ACCESSORY SPLEENS (AS)





POSTMORTEM STUDIES: approx. 10% (311/3000pts) show AS
(higher prevalence-60%- after splenectomy or trauma)
Ludtke FE et al. Acta Chir Scand 1989;155:533–9

Intrapancreatic accessory spleen: **approx 20%** of single AS @ autopsy (54/272 solitary AS→pancreatic tail)

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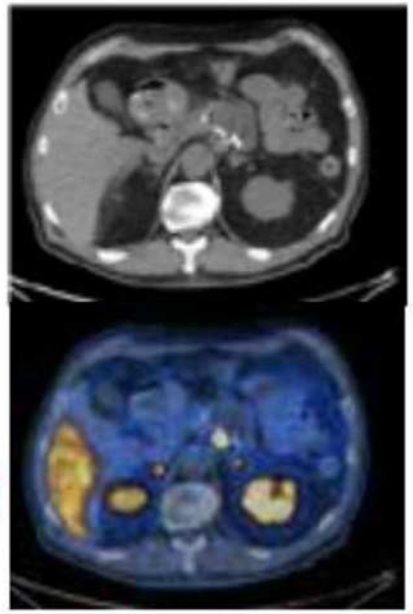
FP: INFLAMMATION/INFECTION

CHRONIC PANCREATITIS

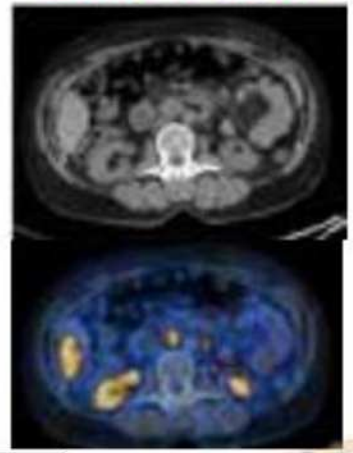


positive surgical margins (ABSCESS)

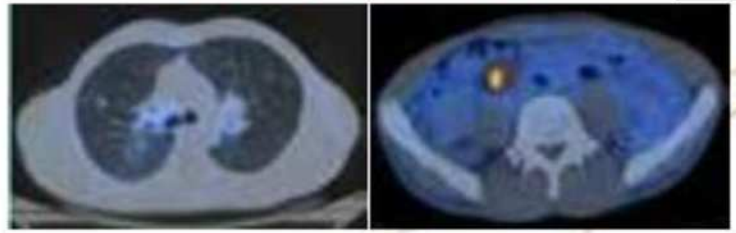
CHRONIC GASTRITIS

SARCOIDOSIS

LYMPHOMA



TUBERCULOSIS



- Osteoblastiline aktiivsus (k.a. vertebraalne hemangioom
- Meningioomid

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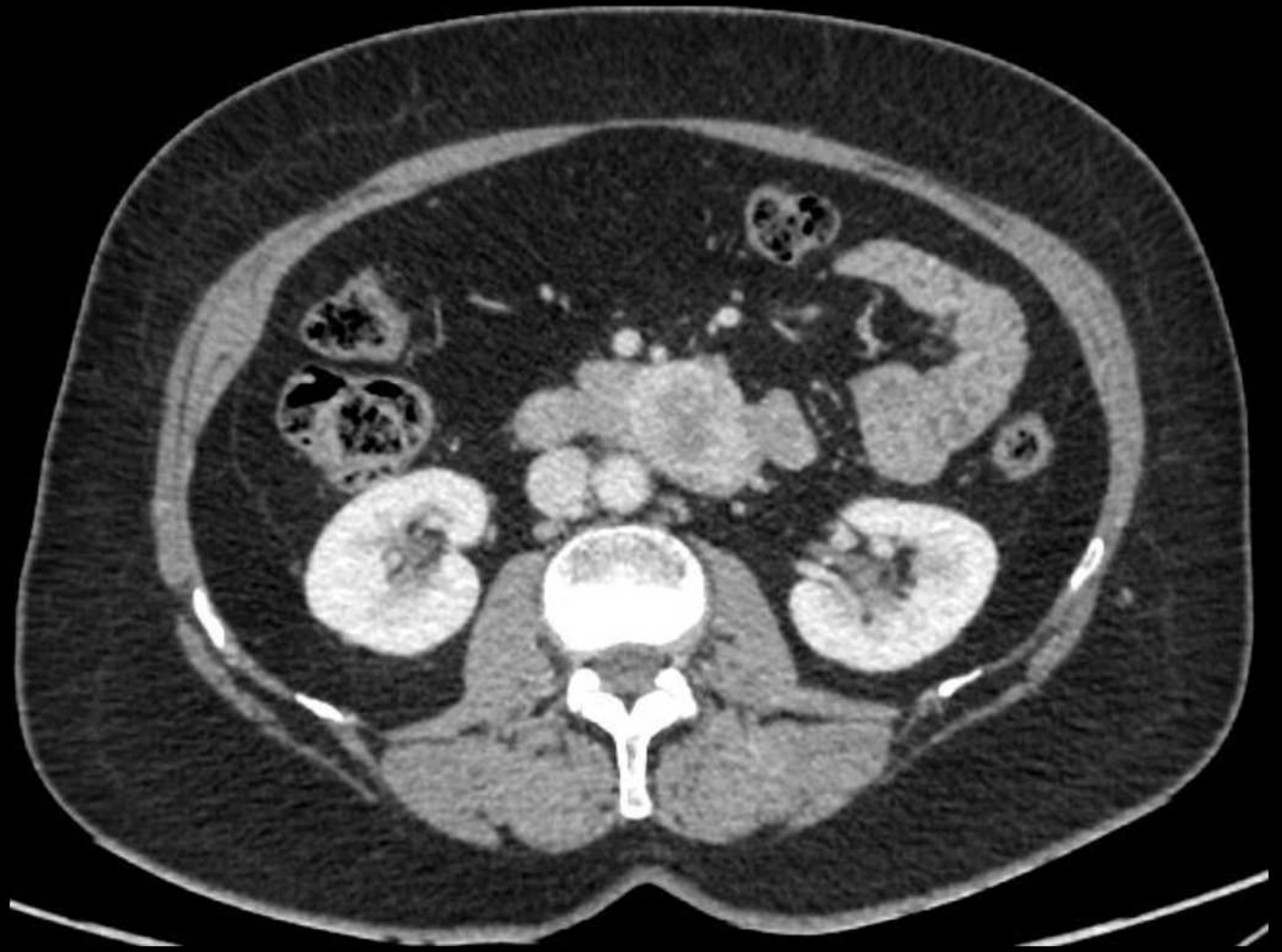
EANM

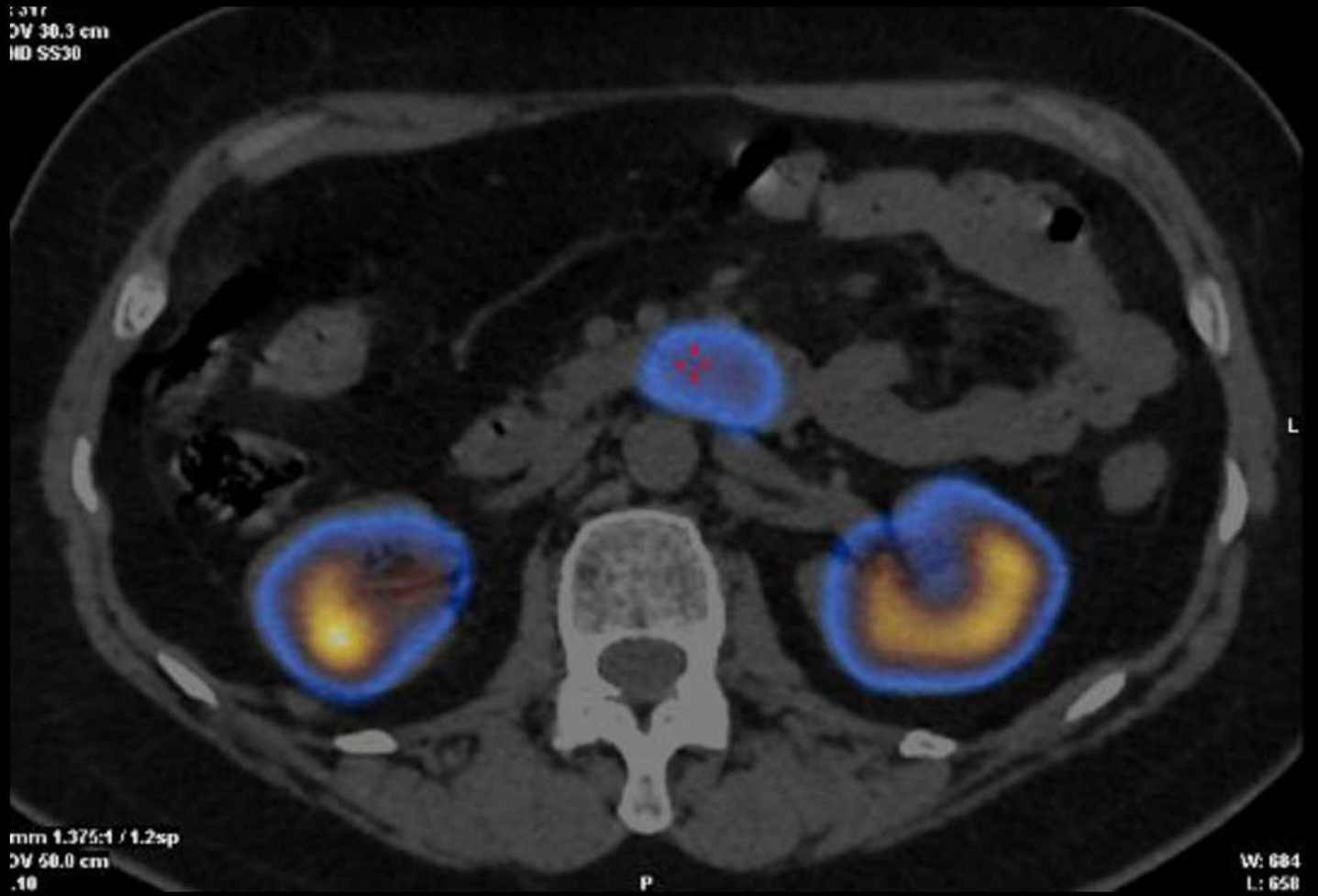
HJ1, N, 1961 a.

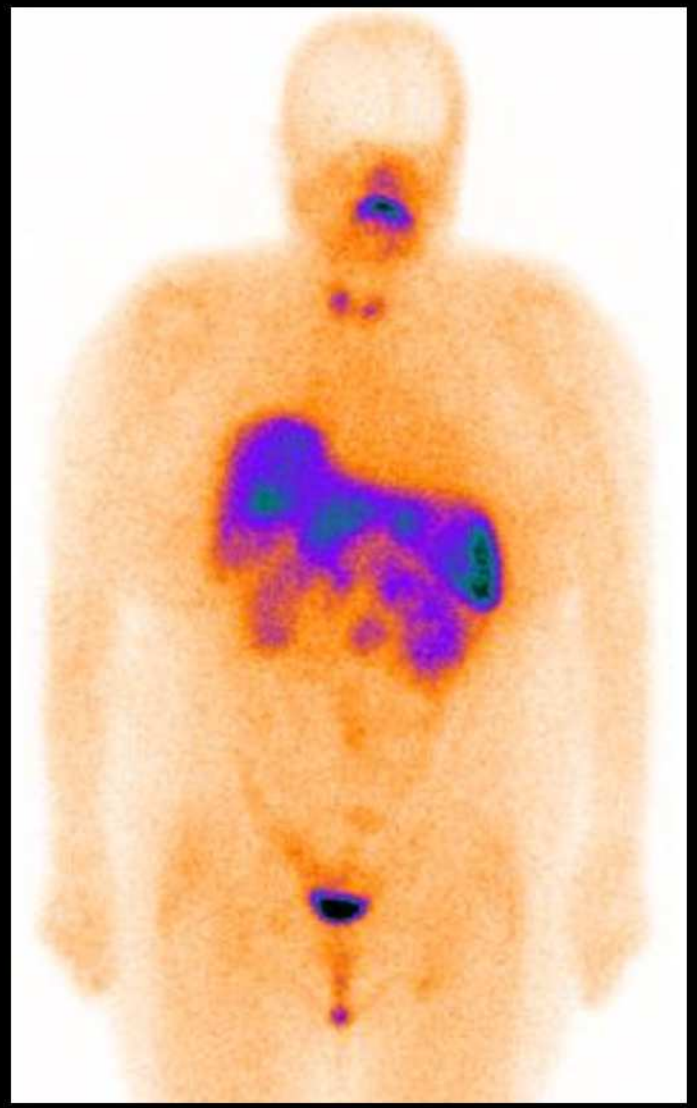
Kõhuõõne sonograafial ebselge lisamass paraaortaalsel



15.09.2019 KT

HJ1 (2) Histo: GIST Ø 3,8 cm : pT2, Ki67 1,15%

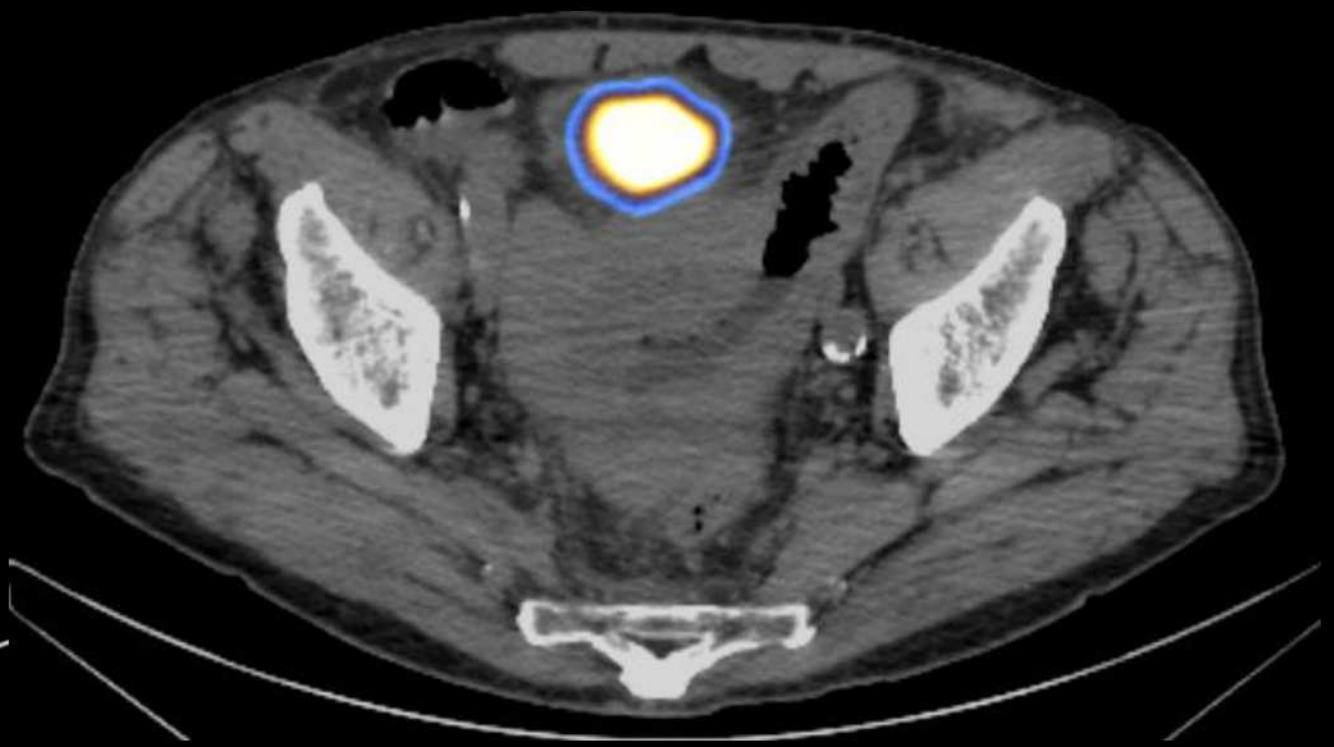




10.10.2019 ^{99m}Tc-Tektrotyd SPET/KT

HJ2, M, 1936 a.
Histo: T-rakkuline lümfoom

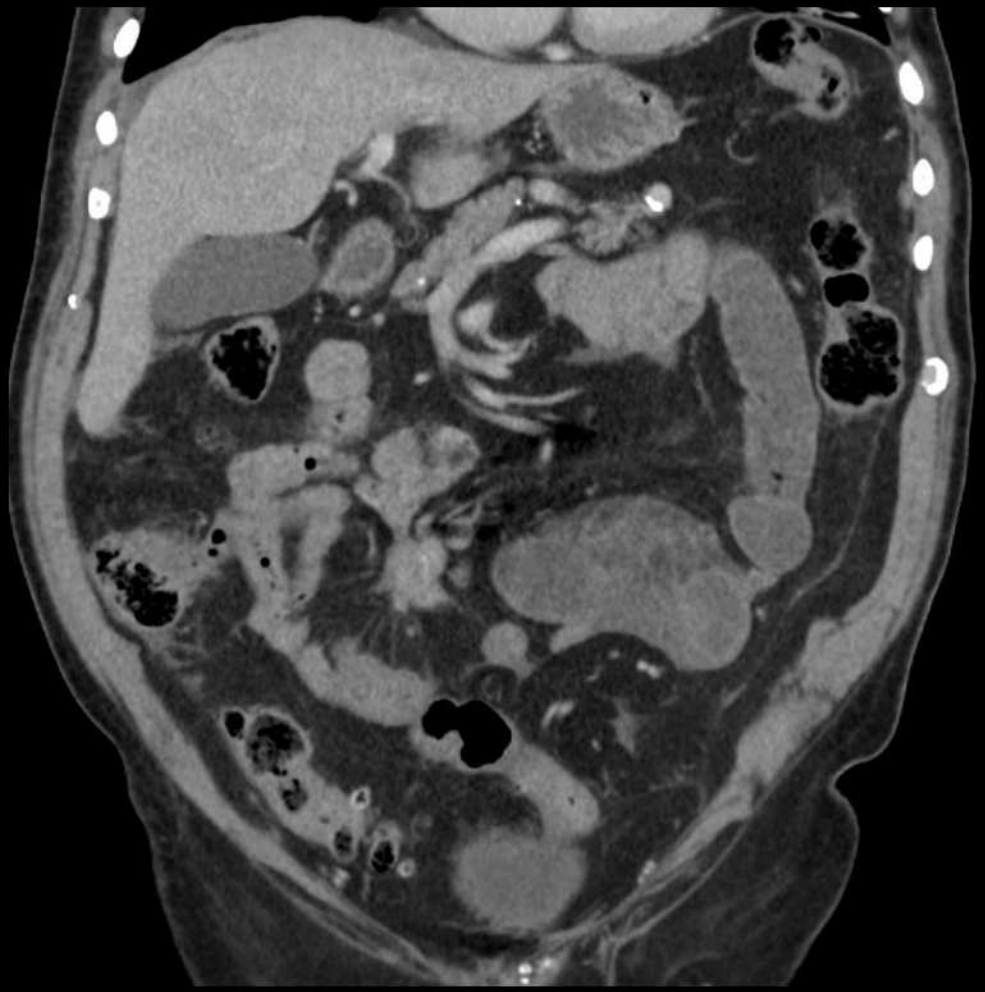
16.09.2019 KT



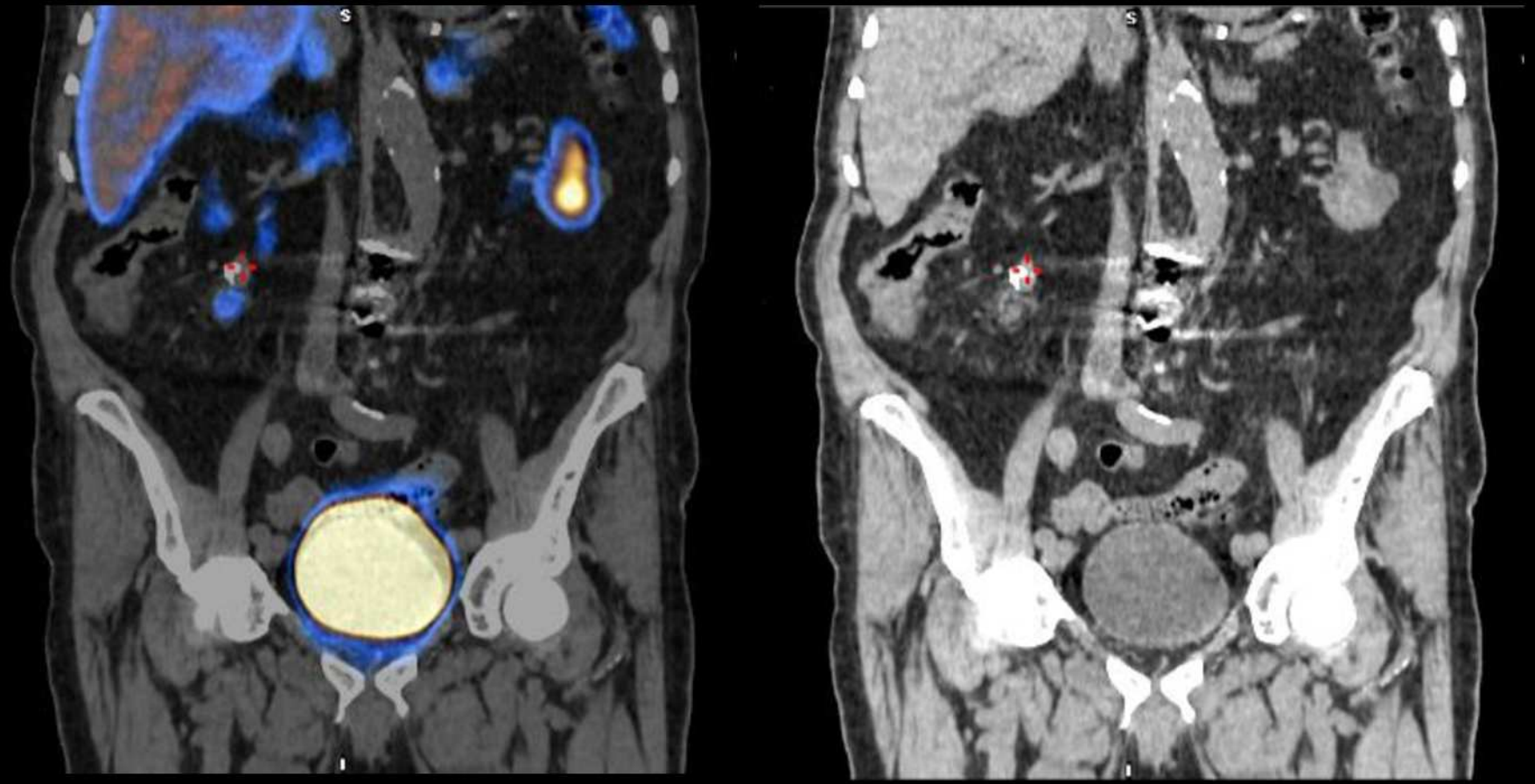
04.11.2019 ^{99m}Tc-Tektrotyd SPET/KT

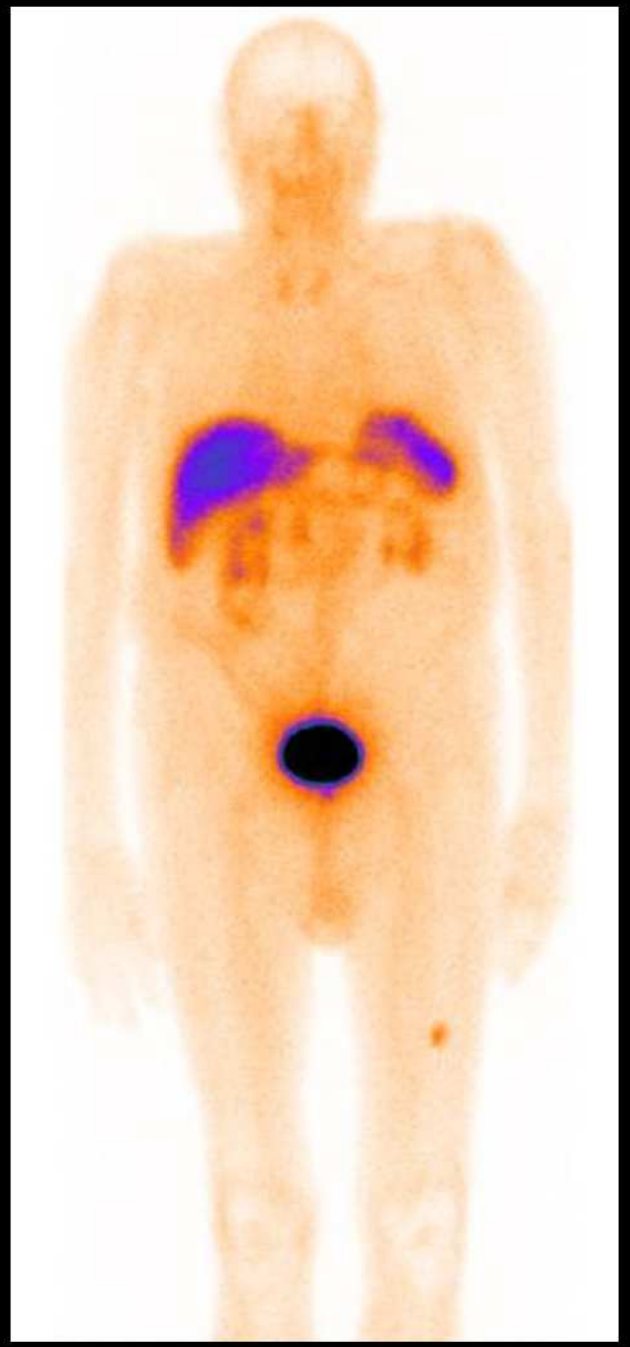
HJ3, M, 1933 a.
Tugev ülakõhuvalu.
Histo: NET, Grade 2 pT2 N2 PN LVI R0. Ki67 kuni 5%

11.10.2019 KT



HJ3 (2)





13.11.2019 ^{99m}Tc-Tektrotyd SPET/KT

HJ3 (3)

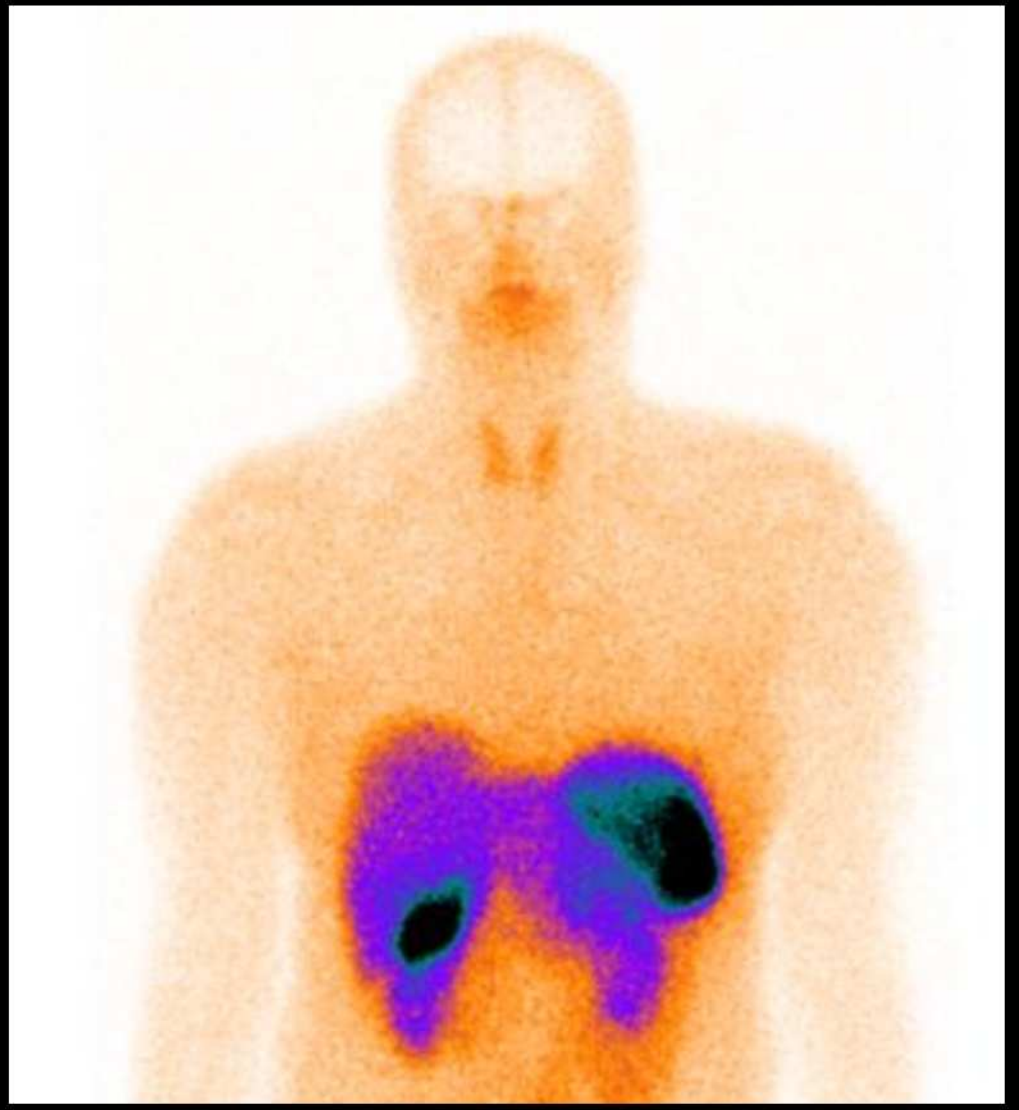
13.11.2019 ^{99m}Tc-Tektrotyd SPET/KT

HJ4, N, 1995 a.

- 13.07.2017 : Kliiniliselt ning analüüside alusel kahtlus Cushingi tõvele, tõusnud nii AKTH kui ka kortisool - viitab hüpofüüsile adenoomile.
- 18.07 tehtud ka sinus petrosuste kateteriseerimine ja CRH test, mille tulemus viitab AKTH-d sekreteerivale ektoopilisele koldele.
- 08.2017. a. opereeritud vasaku kopsu lingulas paiknevat tüüpilist kartsinoidi G1, millega kaasnes ektoopiline Cushingi sündroom. Selle järgselt hüperkortisolism järk-järgult lahenes.
- 2019 aasta suve lõpust märkas patsient muutusi enesetundes ja välimuses. Tekkis kuunägu, jämenes kael, tekkis ka aknelaadne lööve üle keha, põlvevalud, ärevus, uinumisraskused.

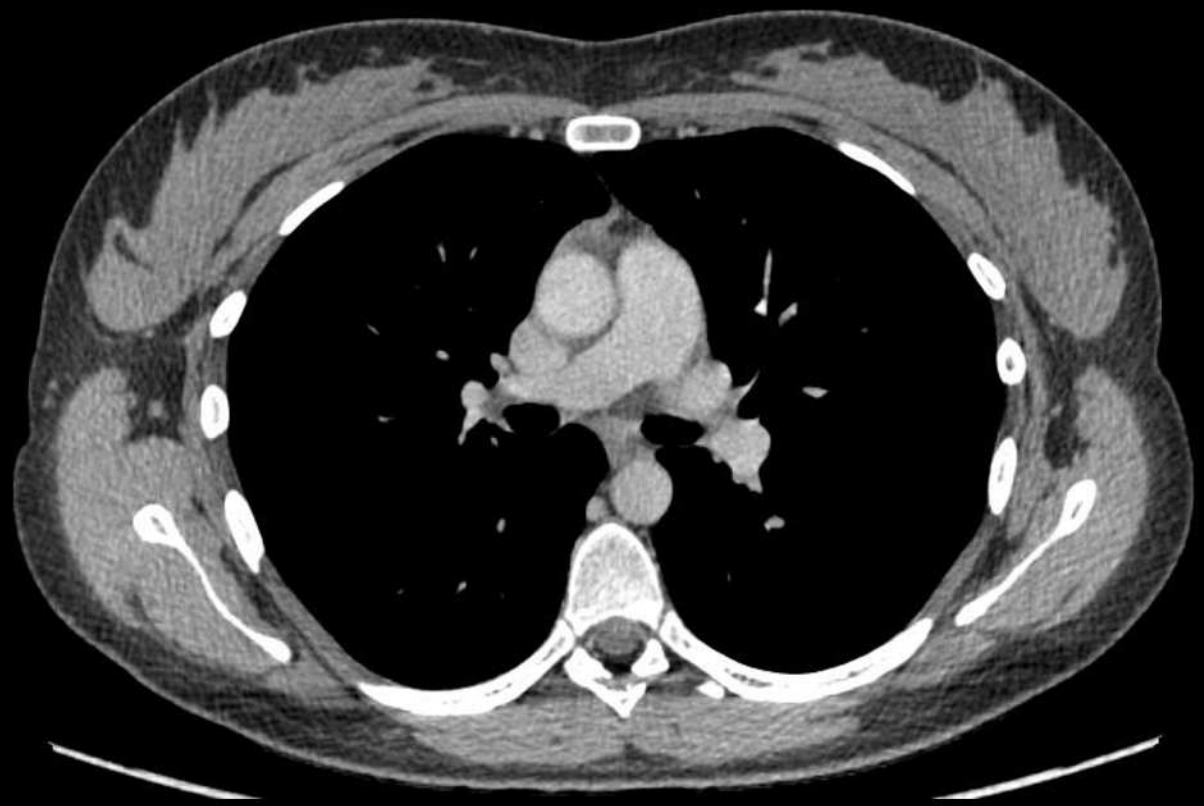
HJ4 (2)
Histo: tüüpiline kartsinoid, G1, pT1b R0. Ki67 1,7 %
AKTH värvingul tugev difuussne positiivne reaktsioon

HJ4(3)
13.03.2019 ja 06.11.2019 KT uuringud leiuta 06.2019 a. tekkinud uuesti kaebused- nägu muutunud ümaramaks, akne sarnane lööve näol,kehal kehakaal suurenenud 3kg, liigesvalud (põlved).
21.10.2019 Kortisool uriinis 5410,7 nmol/d (N 8,3-118,7)

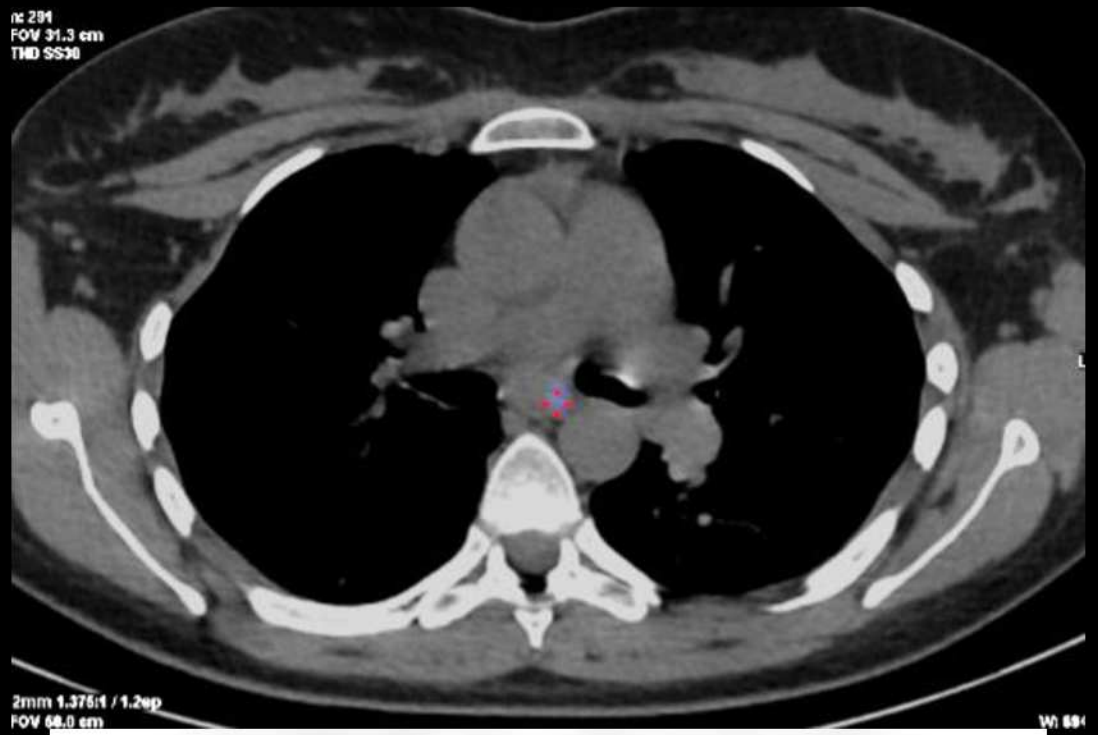


13.11.2019 ^{99m}Tc-Tektrotyd SPET/KT

HJ4 (4)

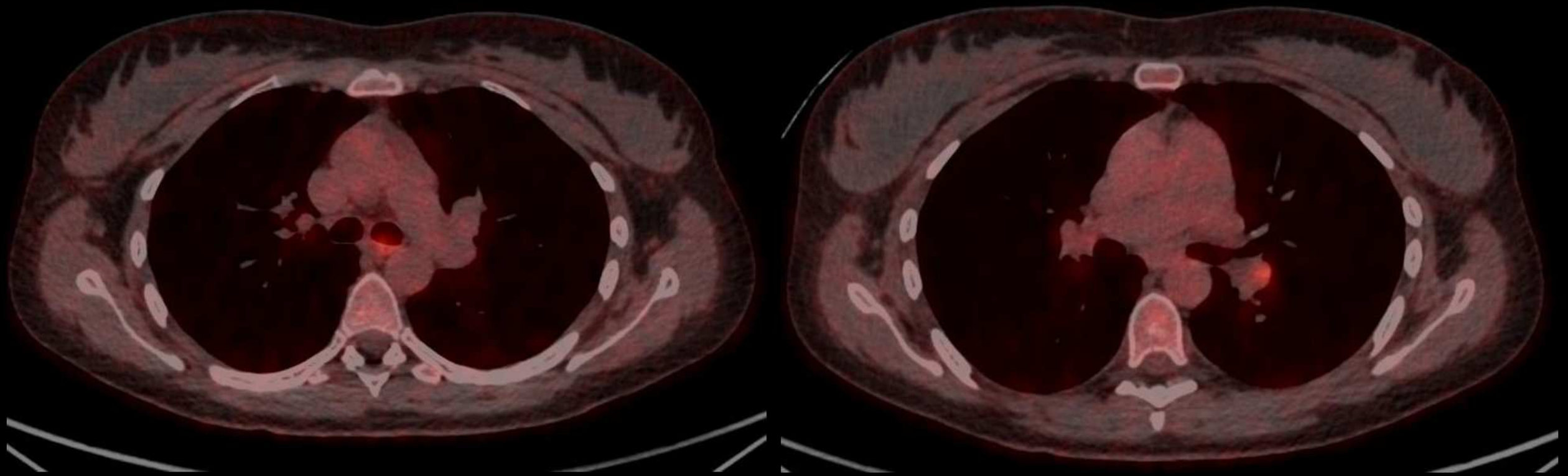


06.11.2019 KT



13.11.2019 ^{99m}Tc-Tektrotyd SPET/KT

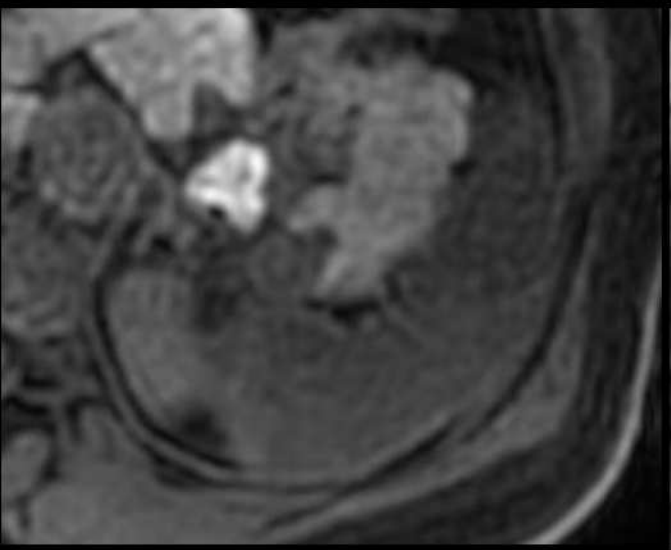
HJ4 (5)

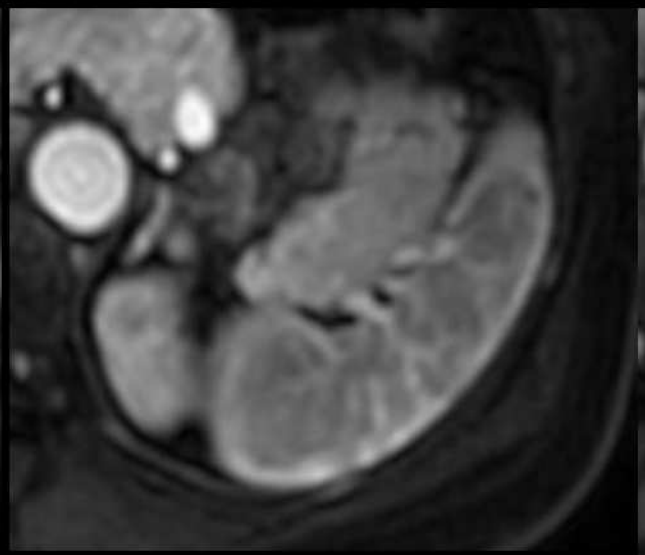


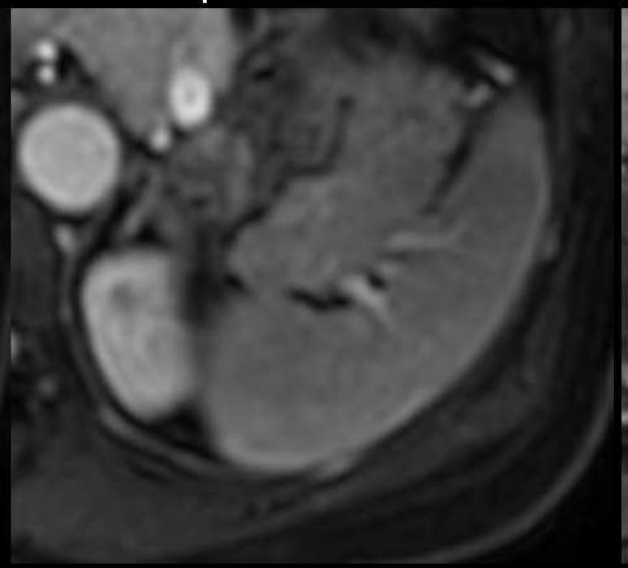
29.11.2019 ^{18}F-FDG PET/KT

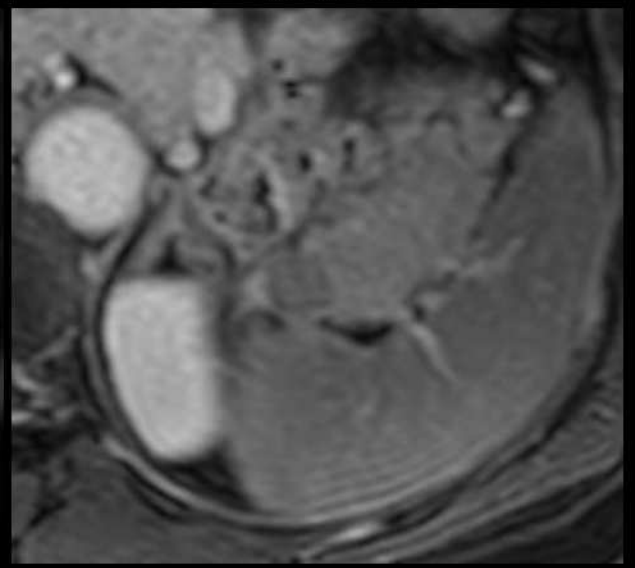
HJ4 (6)

- 27.11.19 hospitaliseeritud, K 2,2 mmol/L
  09.12.19 bronhoskoopial: Trahhea bif. aluses regioonis vasaku peabronhi mediaalse seinaga on kontaktis kuni 15mm inhomogeensed l/s-d Keskseinandi lümfisõlmes 7L immuunohistokeemiliselt: CK AE1/AE3, sünaptofüsiin ja kromograniin A positiivne; TTF-1 negatiivne; Ki 67 0,5%. Leid vastab tüüpilise kartsinoidi metastaasile keskseinandi lümfisõlmes.
- 19.12.2019 Lobektoomia sin sup. Lümfadenektoomia regioonidest nr. 4L,5,6,7,8,10R.
- “Pre- ja postoperatiivselt AKTH sündroom, mis suhteliselt stabiilse seisundi foonil kiiresti läinud üle hulgiorganpuudulikkuseks. Põhjustena tulevad arvesse intraparenhümatoosne verejooks või fulminantne sepsis”.
- Surmlõpe 25.12.2019 kell 12.49. Pata.anat. Lahang.

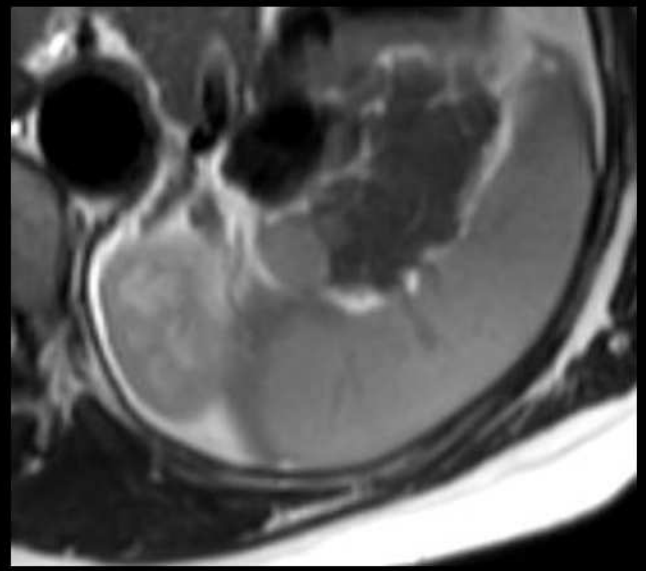


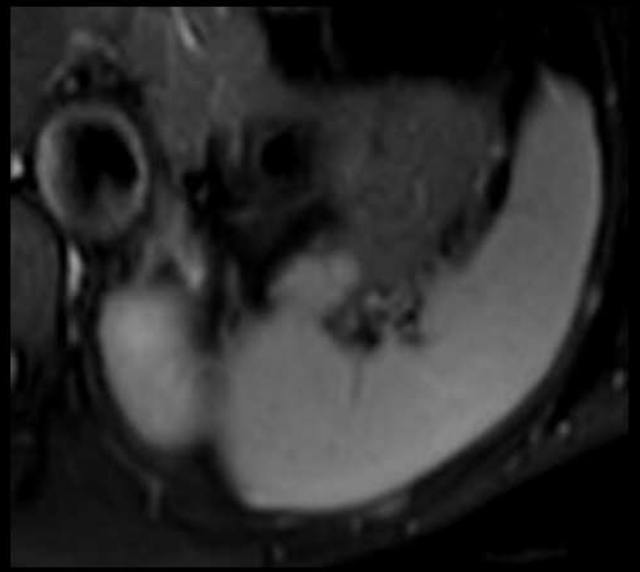


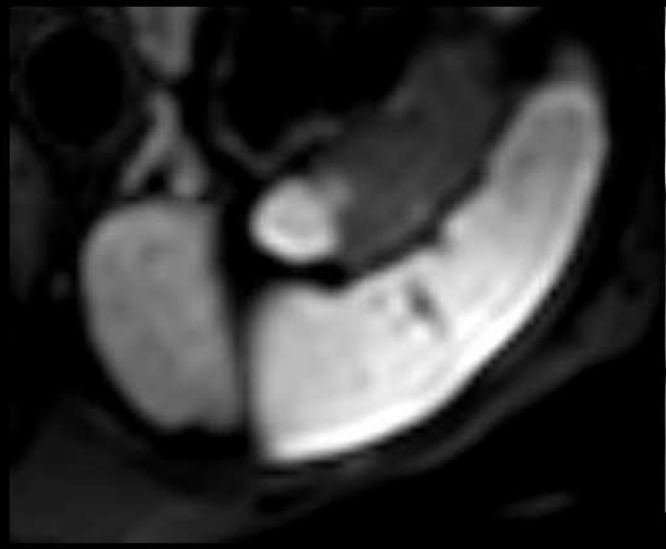


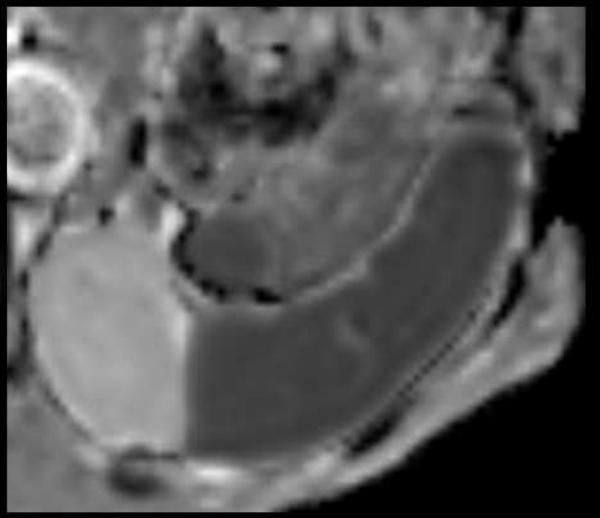


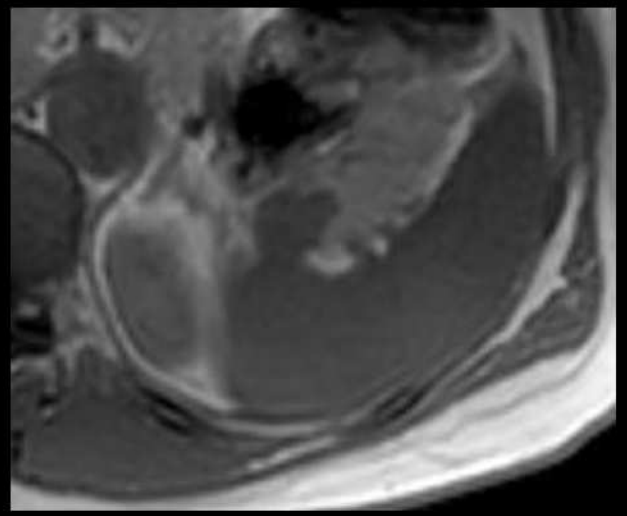
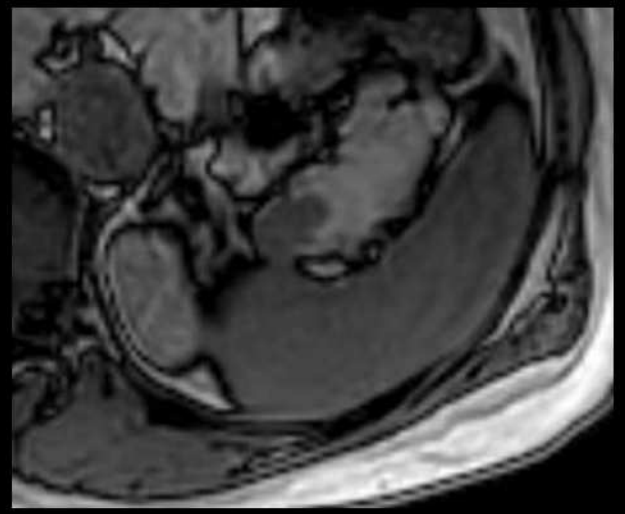
HJ 5, 26.11.2019 ja 29.11.2019 MRT



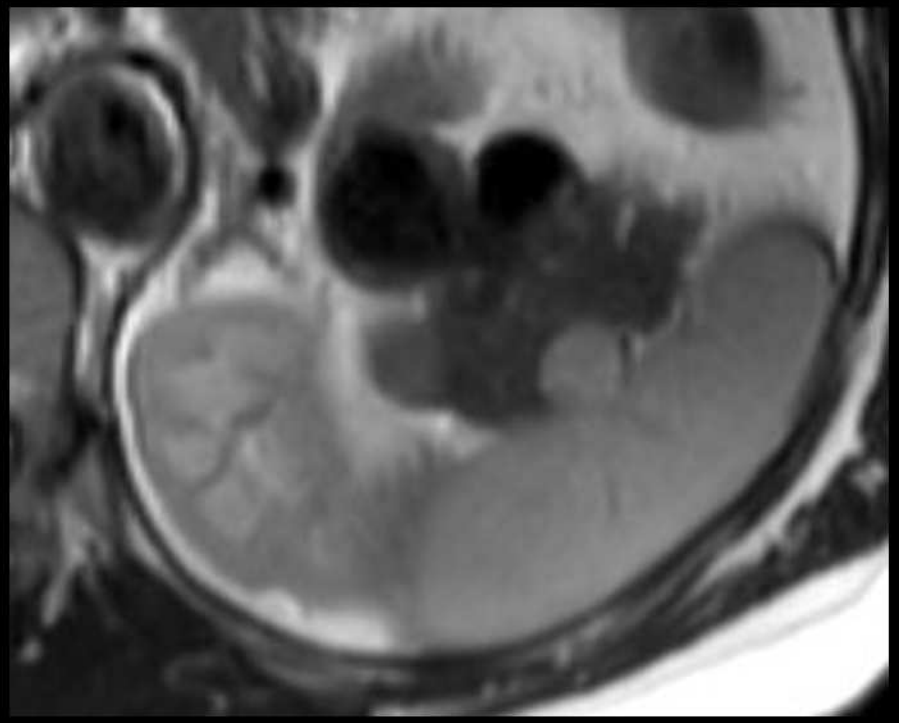
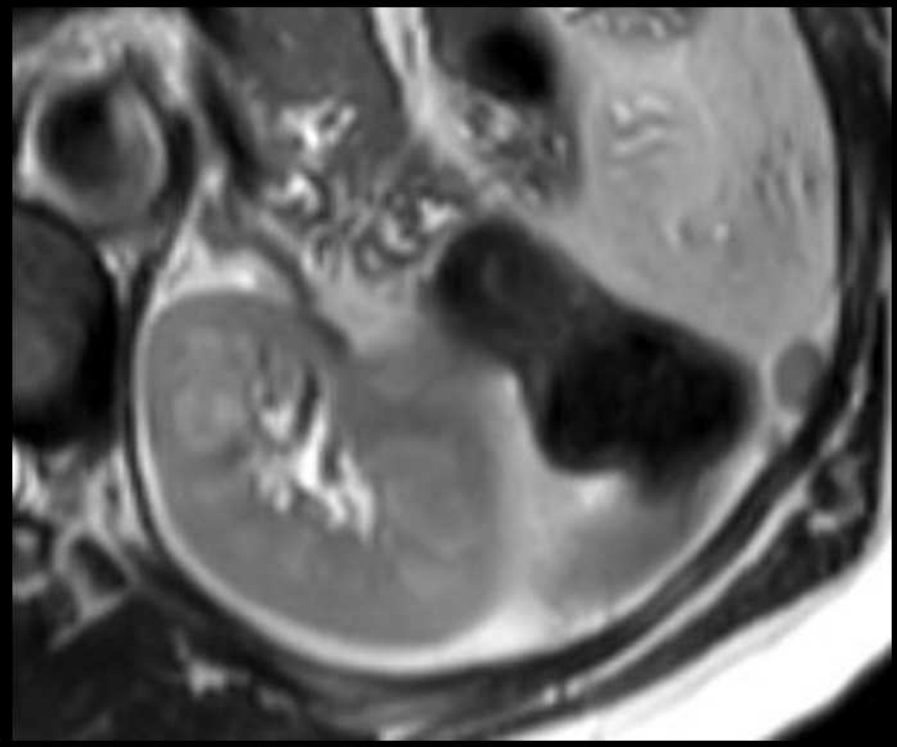




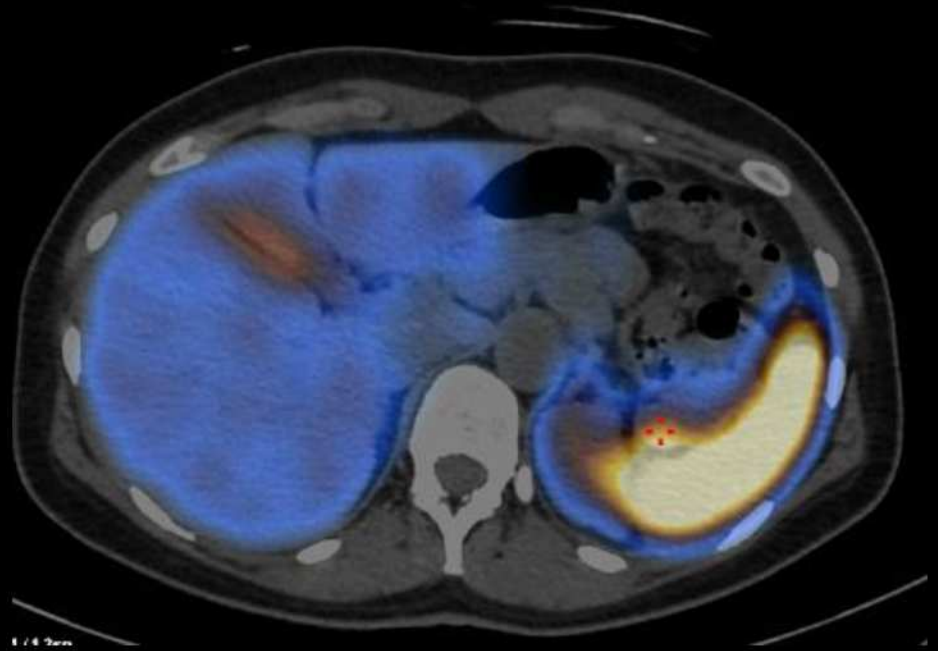


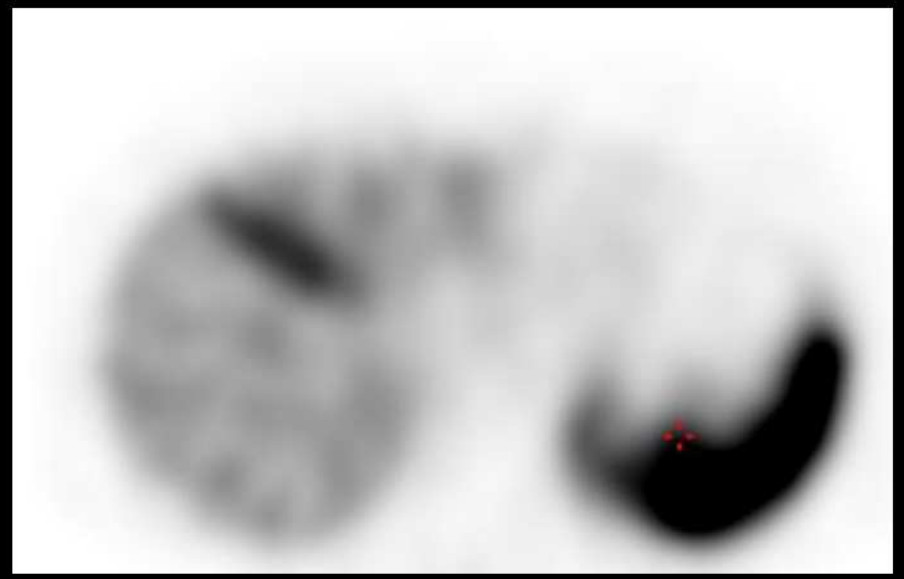



In-phase and out-of-phase

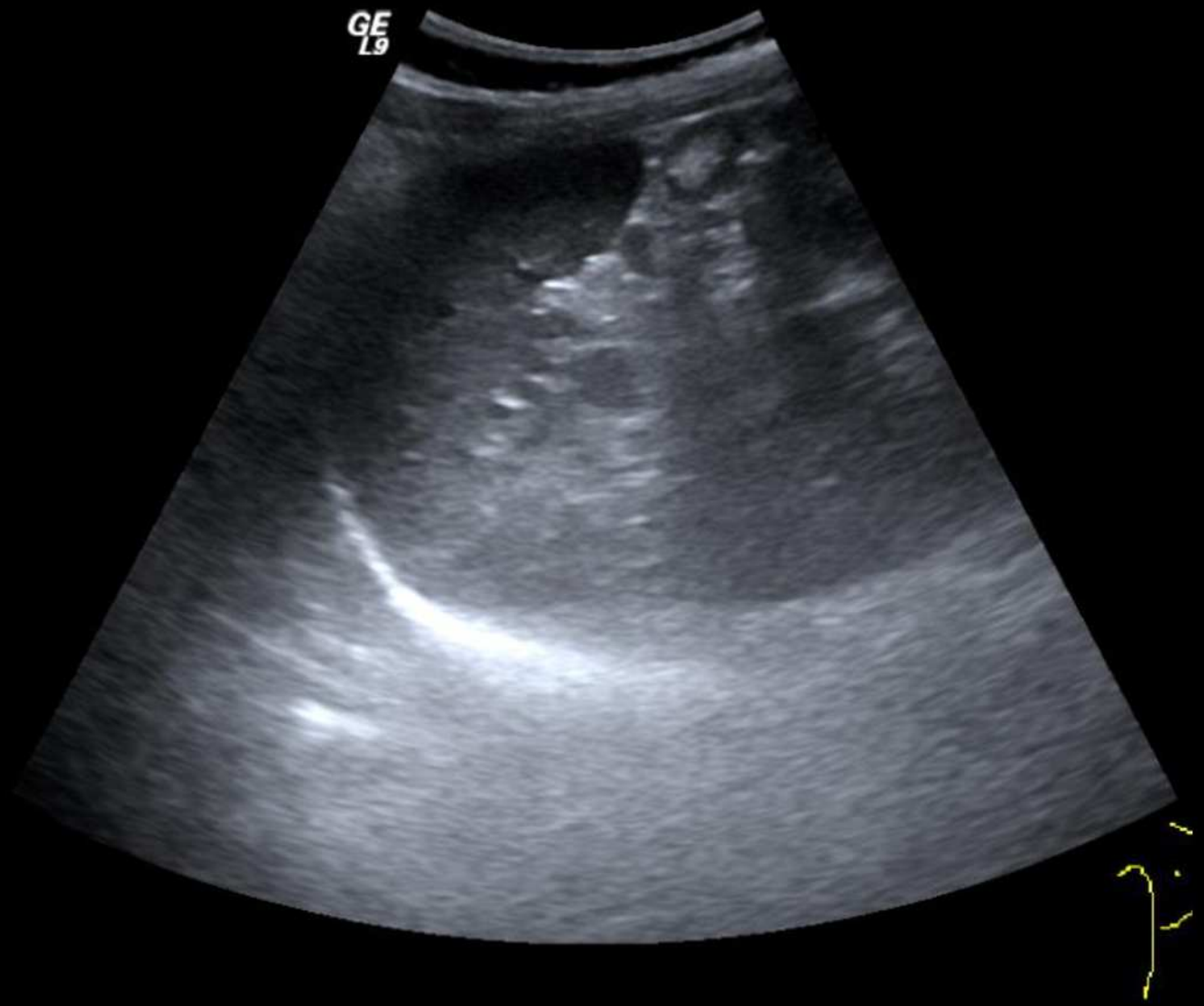



T2





17.12.2019 99mTc- Tektortyd SPET/KT



16.10.2014 UH

HJ6, N, 1942 a.

- 2015: Haiguse anamnees: Sattus Pärnu Haiglasse kõhuvalude tõttu.

Korralikult uuritud, leitud maksas kolded, punkteeritud NET G2 vastusega, algkollet ei leia – peensool?

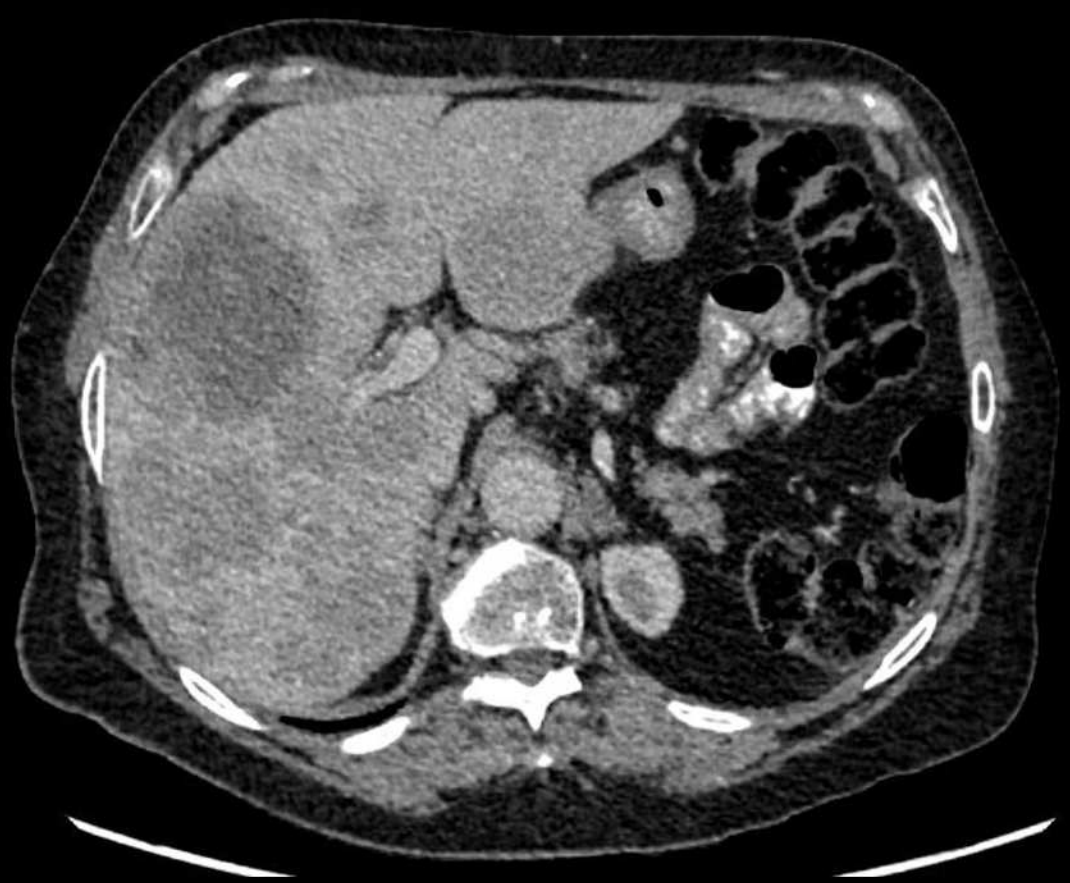
2015 op - Leid sobib peensoole NET-le, G2, pT3, Ki67 15%.

Ravi: peensoole resektsioon, SSA

2.11.16 - 22.11.17: saanud 5 177Lu-DOTATE ravikuuri, maksa mts-d stabiilsed

01.08.2015 KT

HJ6 (2)



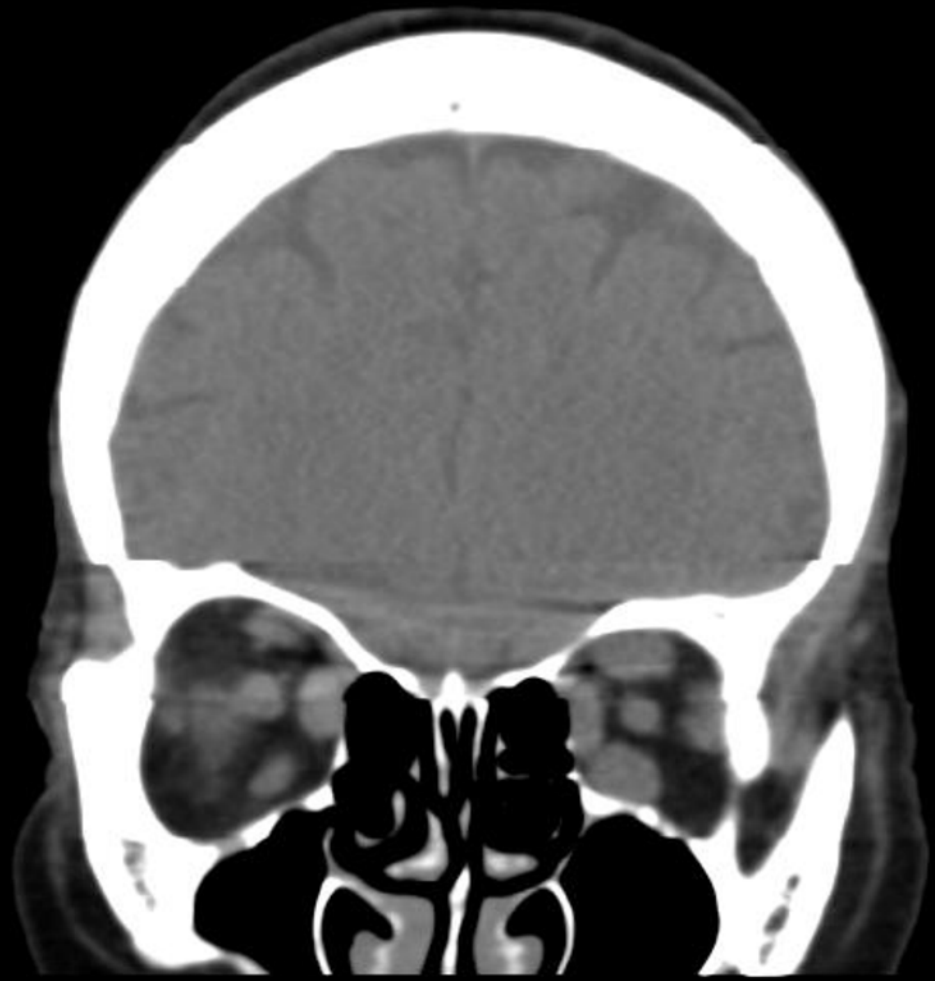
01.09.2016 KT

06.03.2018 KT

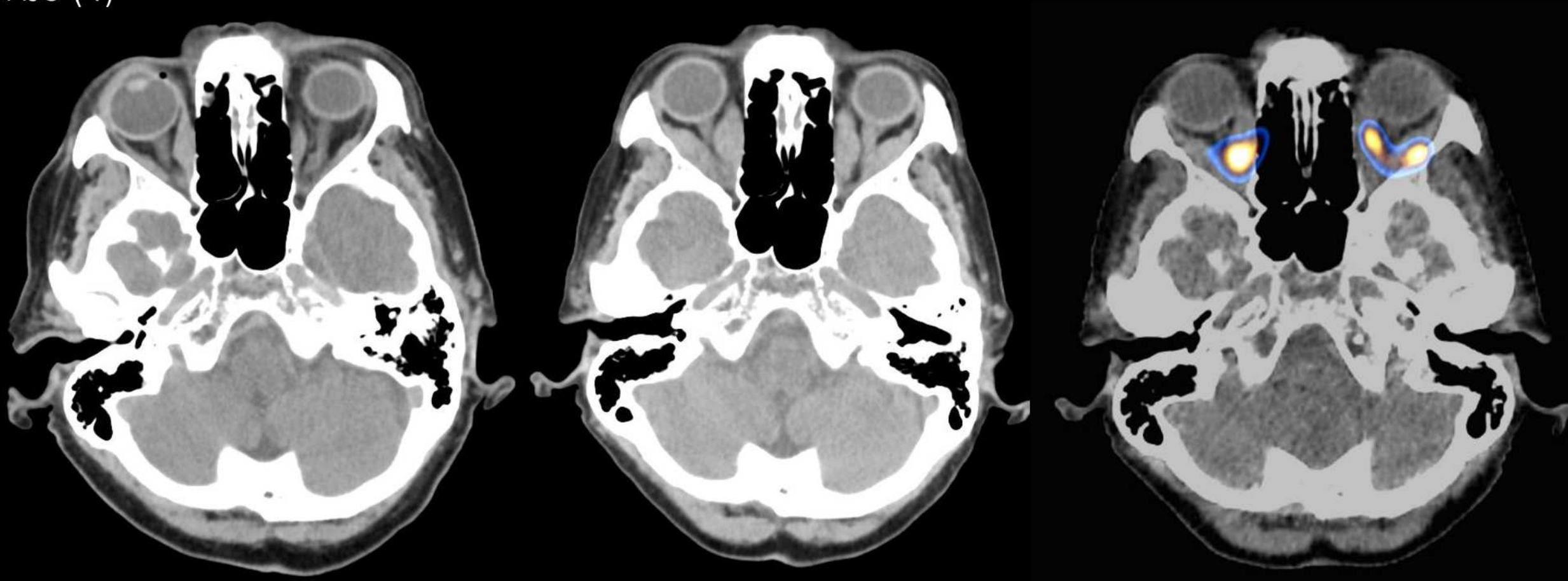
HJ6 (3)

04.04.2019 KT: Maksa kolded dünaamikas veidi tihedamad, kuid see võib olla kontrasteerumisfaasist tingitud muutus. Tekkinud vähene astsiit.

Paremas rinnas väike sõlm dünaamikas suurenenud - vajadusel täpsustamiseks mammogrammid. Vasaku orbita m. rectus sup. on paremaga võrreldes paksenenud - ebaselge tähendusega leid.



HJ6 (4)



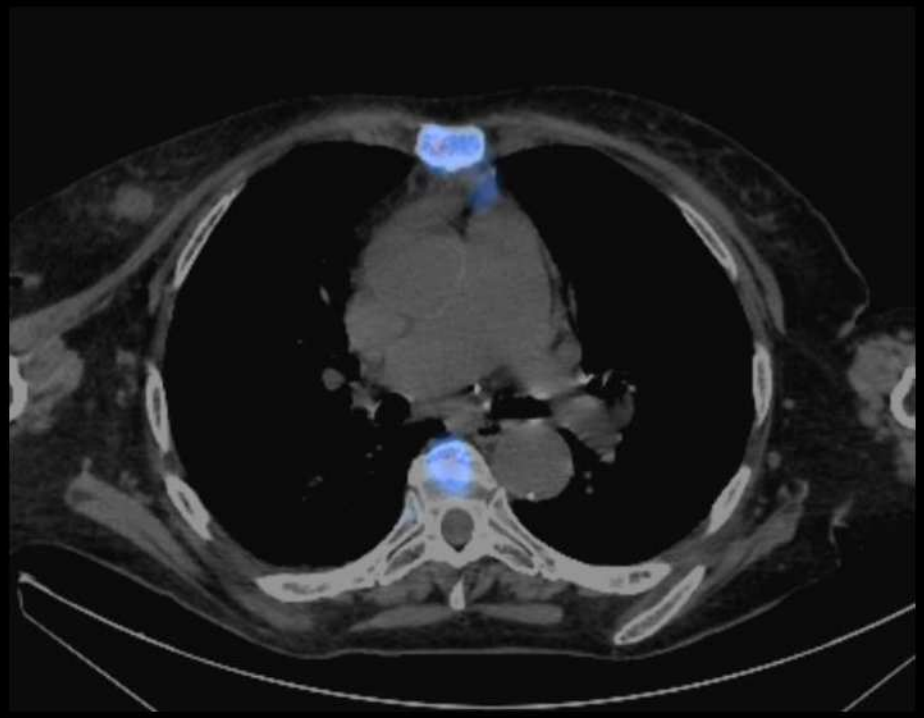
04.04.2019 KT

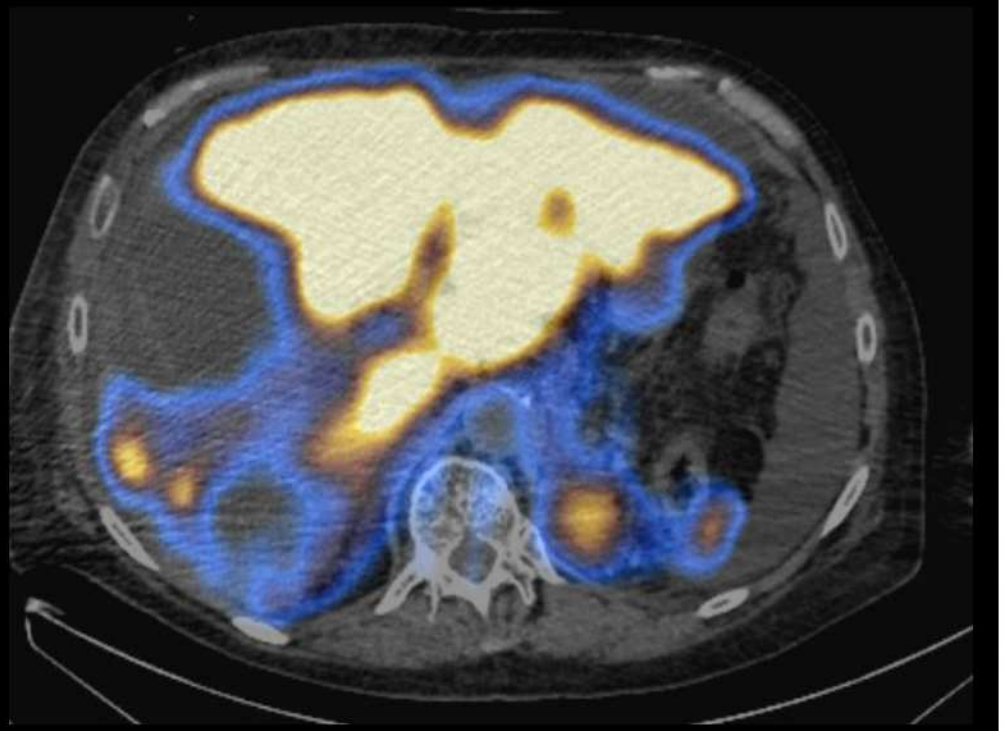
13.09.2019 KT

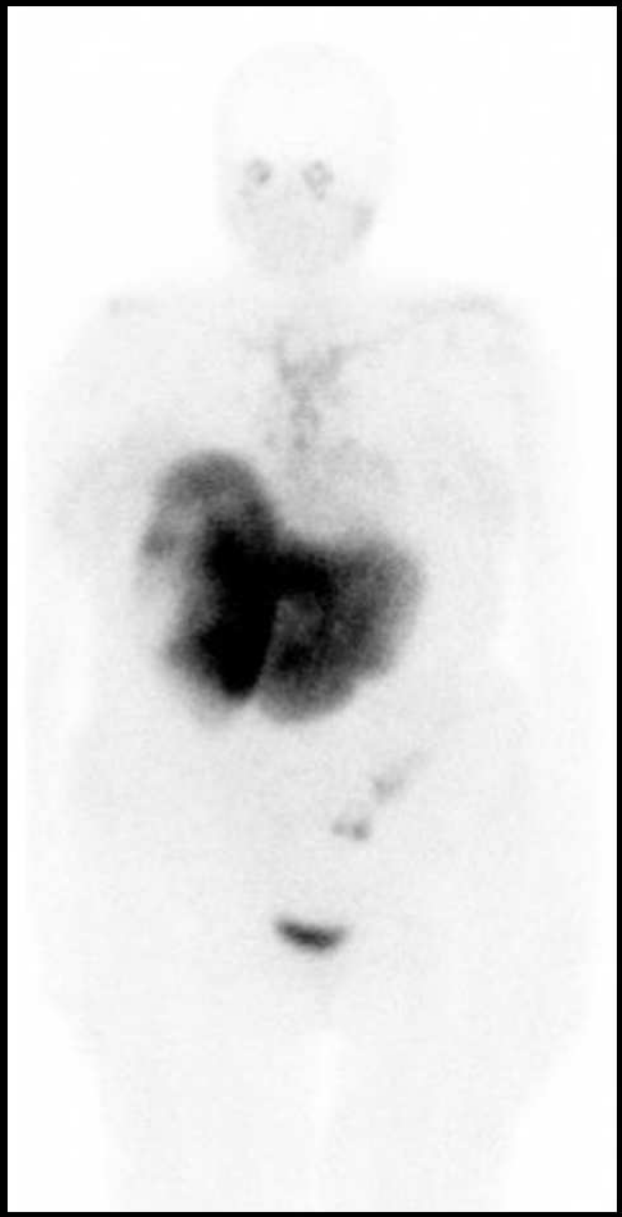
23.09.2019
^{99m}Tc-Tektrotyd SPET/KT

Viimasel ajal lisandunud ka pearinglus, tasakaaluhäire ja kahelinägemine. Maksa rebiopsia Ki67 3%, paremast rinnast algkoldele sobivam 15%; seega G2.

HJ6 (5)







23.09.2019 ^{99m}Tc-Tektrotyd SPET/KT

Kokkuvõte

NET – suhteliselt hea prognoosiga, kuid eluiga lühendav haiguste grupp

PET/KT – „*whenever possible*“

- Parem pildi kvaliteet
- Lühem uuringu aeg (salvestus 60 min post inj.)
- SUVmax kasutamine
- Võimalik madalam kiirgusdoos

Vale positiivsus

- Pankrease pea/proc. uncinatus’es kogunemine

– korrelatsioon KT/MRT-ga

According to The National Geographic Society, the zebra has the most unique coat of all animals. And each individual zebra has its own striped pattern, as unique to it as fingerprints are to humans. In fact, no two are exactly alike. Just like NET patients. No two NET Cancer patients are the same.

CURRENT TRENDS IN NEUROENDOCRINE TUMORS

Have a safe travel back home

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