

**IAEA Regional Training Course (AFRA) on the Role of Nuclear
Medicine in Endocrine Disease and Infection/Inflammation**

Added Value of SPECT/CT in Neuroendocrine Tumors

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Tumor types	Specific serum tumor markers	Nonspecific serum tumor markers	SS receptors (positive scintigraphy with ¹¹¹ In-octreotide)
Thymus	SS, serotonin	CgA, NSE	50–80%
C-thyroid cells	Calcitonin, CGRP, ACTH, SS, serotonin	CgA, CEA	70–75%
Lung	GRP, CT, SS, POMC, ACTH, ADH, serotonin, β-hCG	CgA, NSE	80%
GI tract	Gastrin, CCK, GIP, VIP, motilin, glucagon, GRP, PP, GHRH, POMC, ACTH, serotonin	CgA, NSE, hCG	80–90%
Pancreatic islet cells	Insulin, gastrin, VIP, glucagon, SS, serotonin	CgA, NSE, hCG	60–95%
Ovary	Serotonin, hCG, PTHrP, POMC, CGRP	CgA, NSE	
Chromaffin cells	Noradrenaline, adrenaline, dopamine, POMC, calcitonin, neuropeptide Y, neurotensin, SS	CgA, NSE	85–95%
Adenocarcinomas with NE differentiation	POMC, CGRP	CgA, NSE	20–35%

Derived from Krenning *et al.* (53); Olsen *et al.* (70); Lamberts *et al.* (6); Nobels *et al.* (40); Oberg (407); Norheim *et al.* (211); and Tomassetti *et al.* (213). POMC, Proopiomelanocortin; GIP, gastric inhibitory peptide.

Endocrine Reviews, June 2004, 25(3):458–511

Gastro-Entero-Pancreatic tumors (GEP)

Insulinoma 70%
 Gastrinoma 20-25%
 VIP-oma 3-5%
 Glucagonoma 1%

Gastric Carcinoid
 Ileal Carcinoid
 Appendix Carcinoid

Expression of SST_{R2} in GEP Tumors and SRS Sensitivity



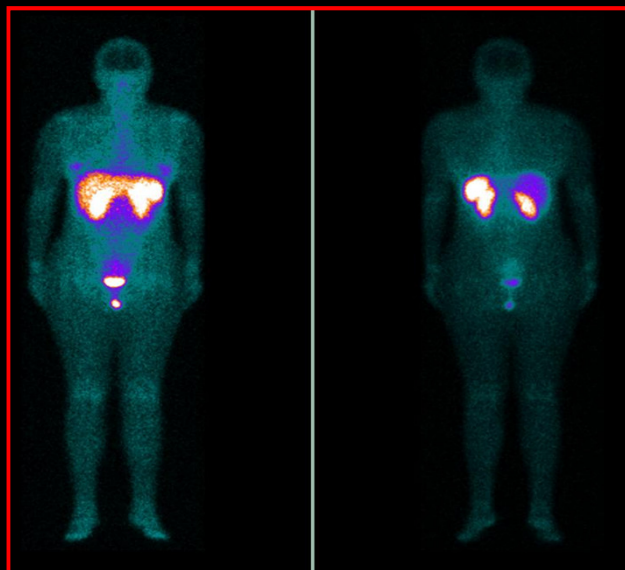
Gastrinoma	90-95%
Carcinoid	85-95%
VIP-oma	80-90%
Non-functioning	75-85%
Glucagonoma	70-80%
Insulinoma	50-60%

SRS (SPECT/CT?) in 253 patients (per-lesion and according to location)

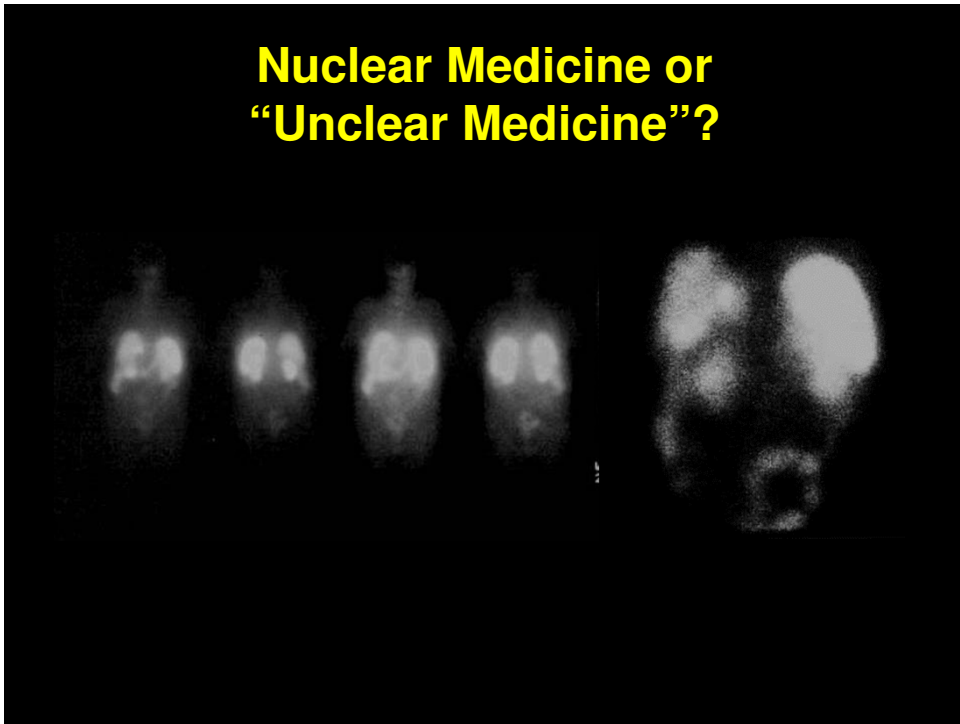
	Sensitivity	Specificity	Accuracy
Primary	59%	99%	82%
Liver	91%	96%	94%
Soft tissue	84%	95%	91%
Bone	86%	99%	98%

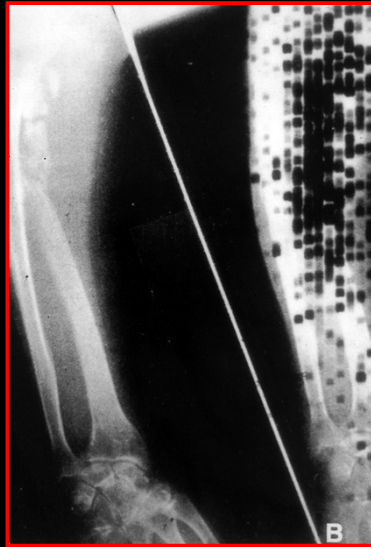
Bombardieri et al. Q J Nucl Med Mol Imaging 2010

^{111}In -Pentetreotide (Octreoscan®)



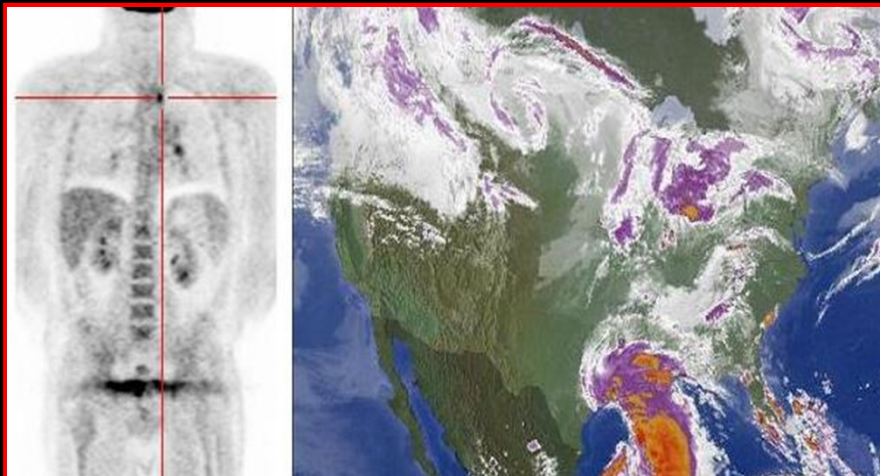
Nuclear Medicine or “Unclear Medicine”?



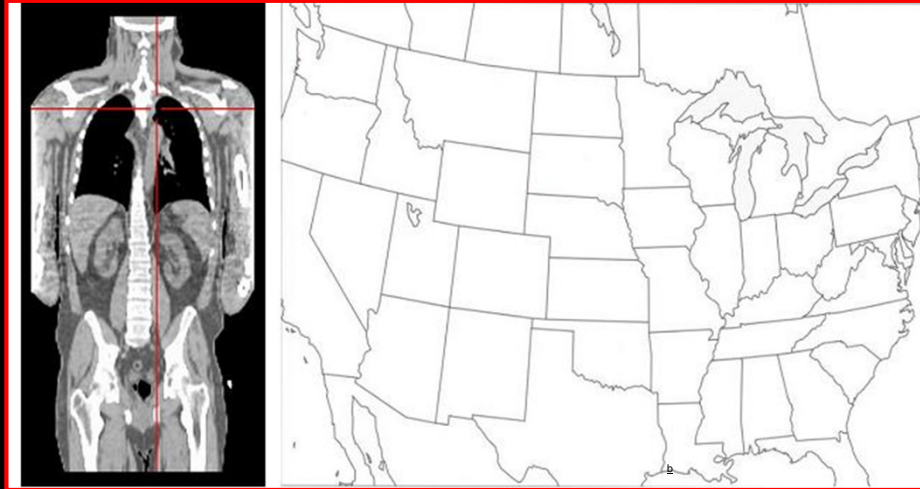


1961
 $^{85}\text{Sr-CI}$

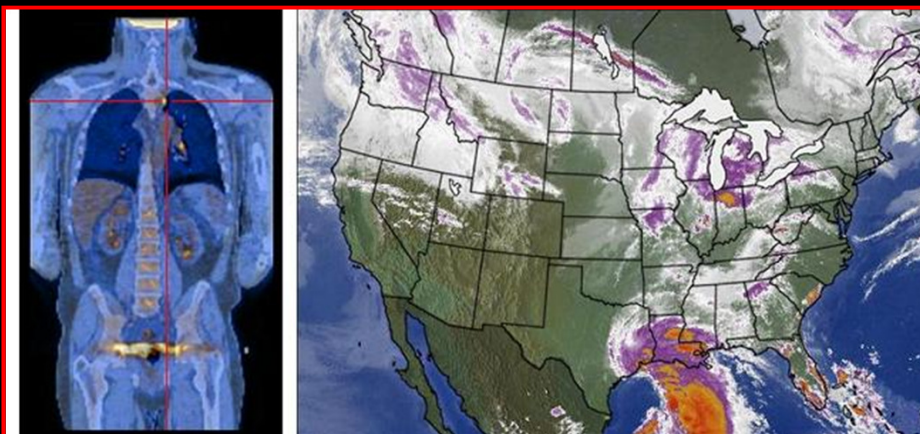
Single modality imaging



Single modality imaging



Hybrid imaging



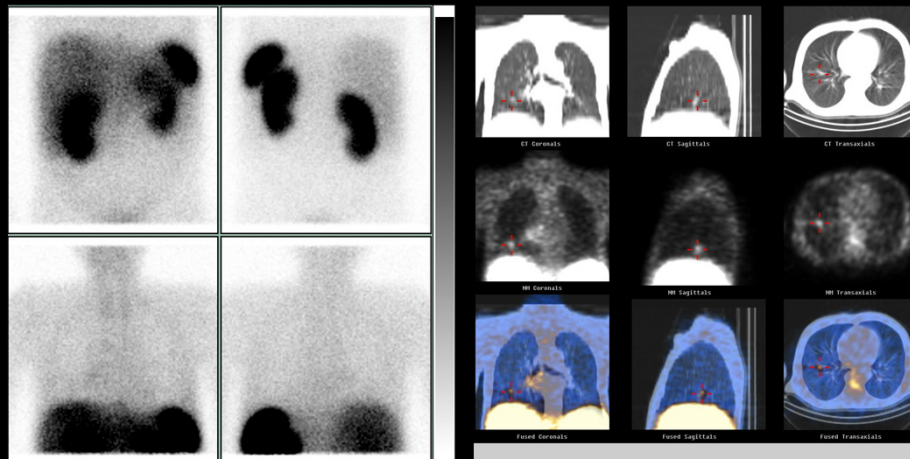
SPECT versus planar

- increased sensitivity and specificity.

SPECT/CT versus SPECT

- increased specificity
- (increased sensitivity with attenuation correction)

SRS with Octreoscan®



**Lung carcinoid missed on planar imaging,
but detected on SPECT/CT**

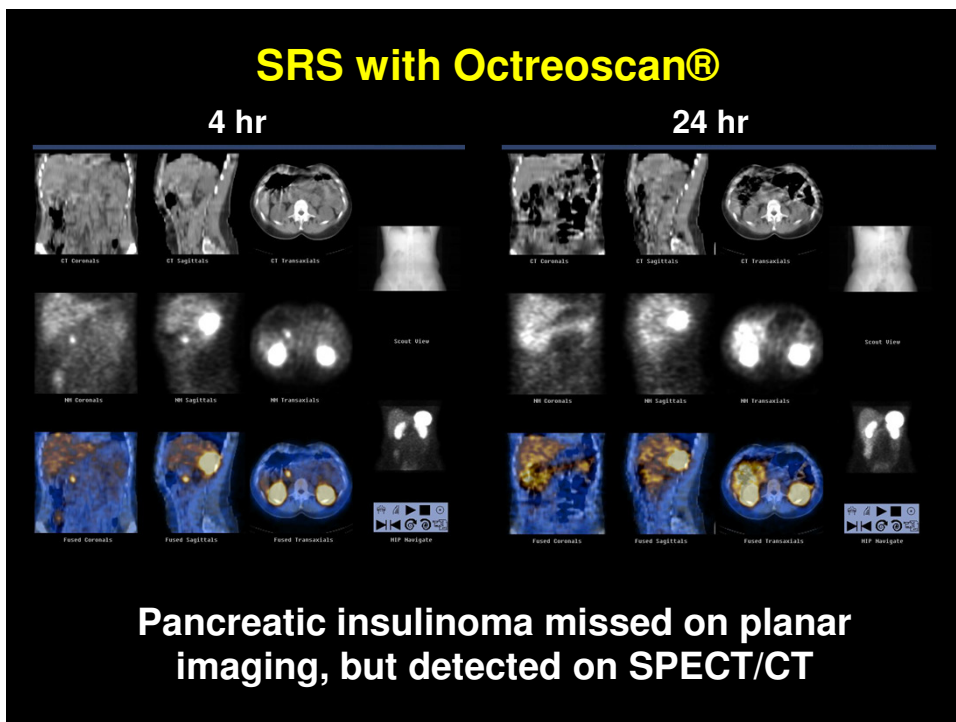
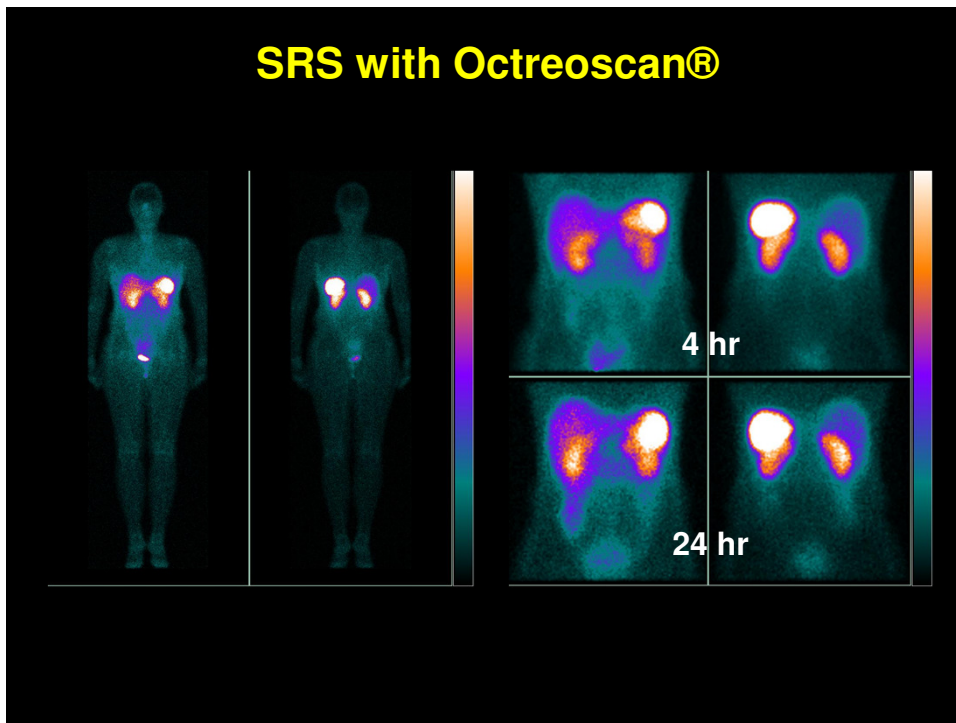


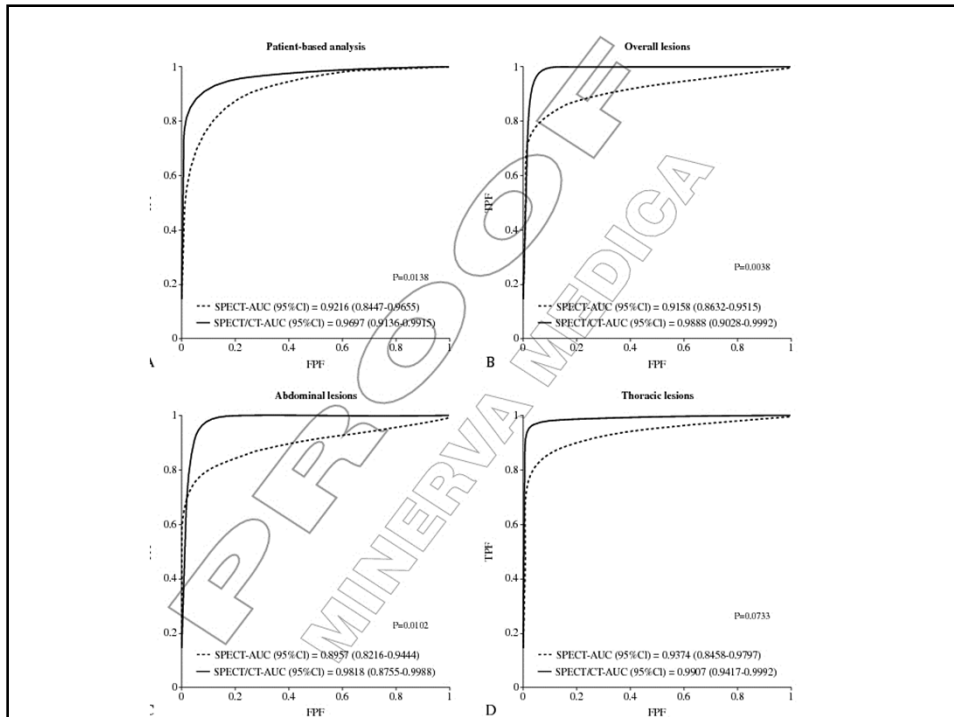
TABLE 1.—NET detection by SPECT and SPECT/CT: Patient-Based Analysis.

	Final diagnosis						AUC	Sens	Spec	PPV	NPV
	NET (n=43)			No NET (n=38)							
	P	N	E	P	N	E					
SPECT	37	2	4	5	27	6	0.9216	95.3 (86.0)	71.0 (86.8)	78.8 (88.1)	93.1 (84.6)
SPECT/CT	40	2	1	2	35	1	0.9697	95.3 (93.0)	92.1 (94.7)	93.2 (95.2)	94.6 (92.3)

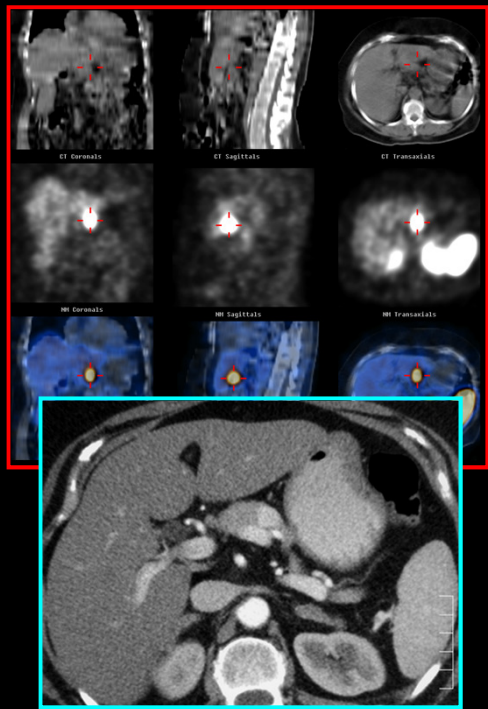
P = Positive; N = Negative; E = Equivocal; AUC = Area Under the Curve; Sens = Sensitivity; Spec = Specificity; PPV = Predictive Positive Value; NPV = Negative Predictive Value. Sensitivity, specificity, and negative and positive predictive values were calculated considering equivocal patients as positive for NET. In parentheses, analysis considering equivocal results as negative for NET.

Perri et al. Q J Nucl Med Mol Imaging 2008:

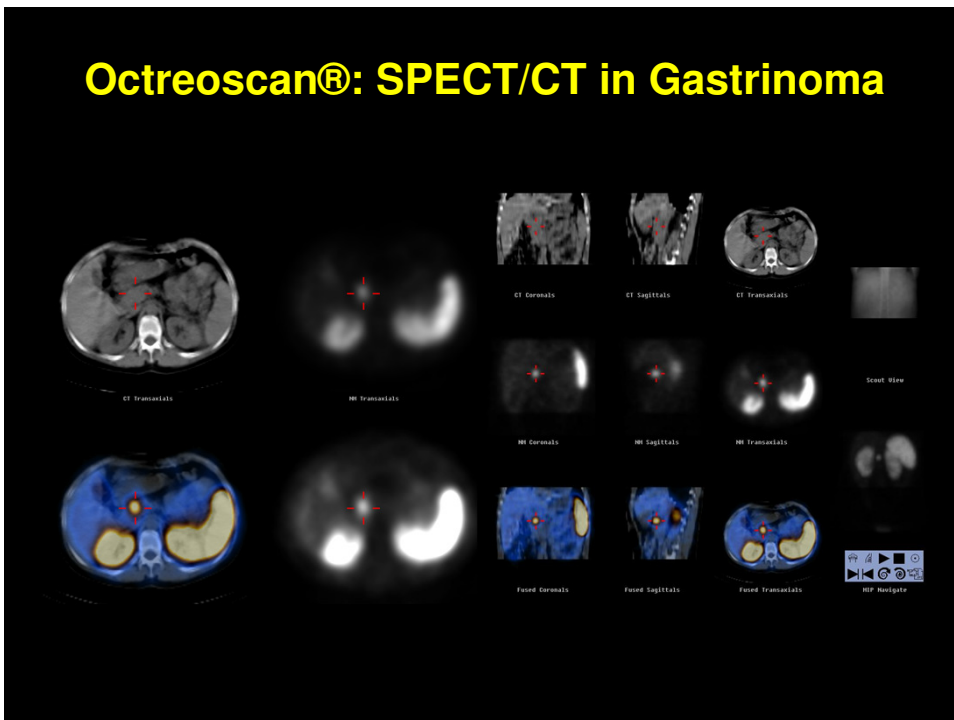
81 patients → 43 NET, 38 non-NET
169 lesions → 138 NET, 31 non-NET



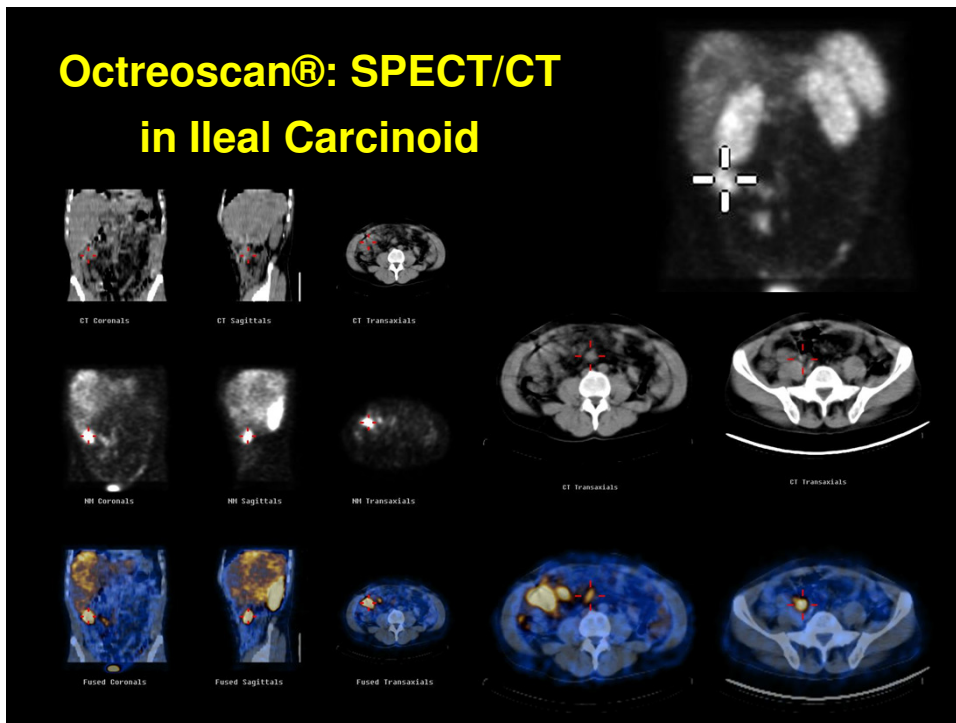
Octreoscan®: SPECT/CT in Gastrinoma



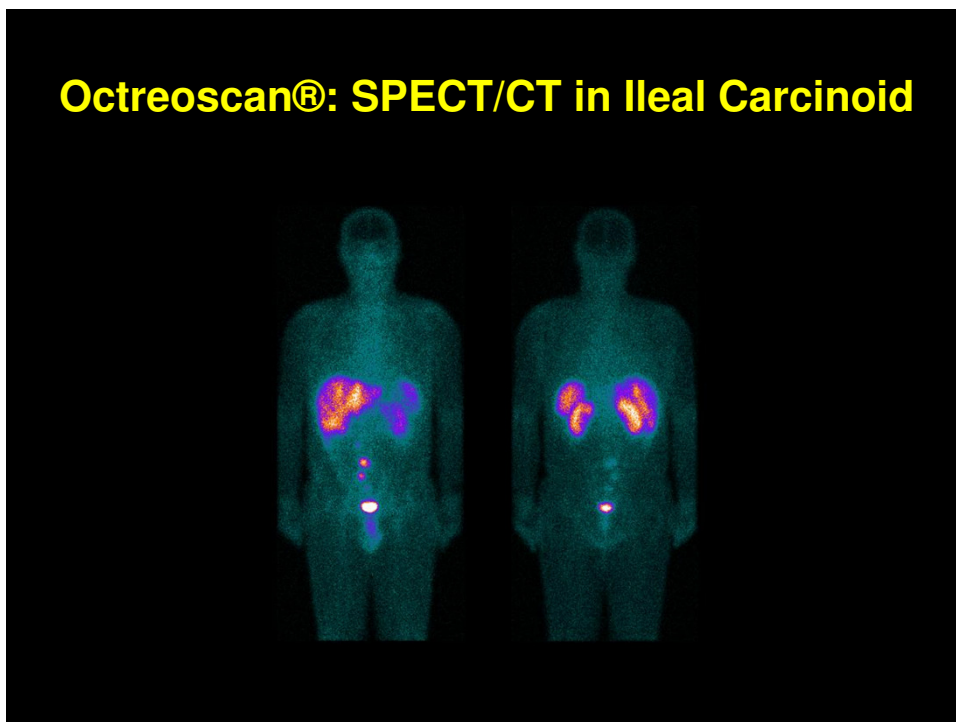
Octreoscan®: SPECT/CT in Gastrinoma



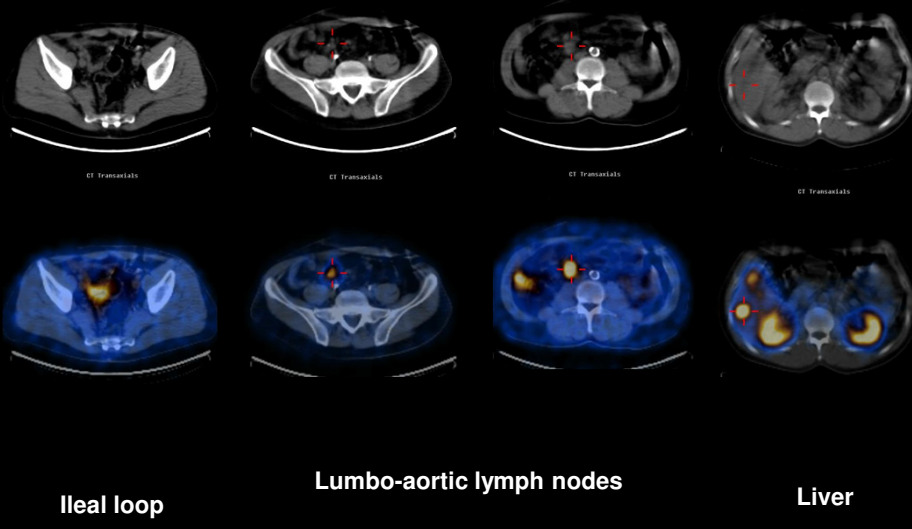
Octreoscan®: SPECT/CT in Ileal Carcinoid



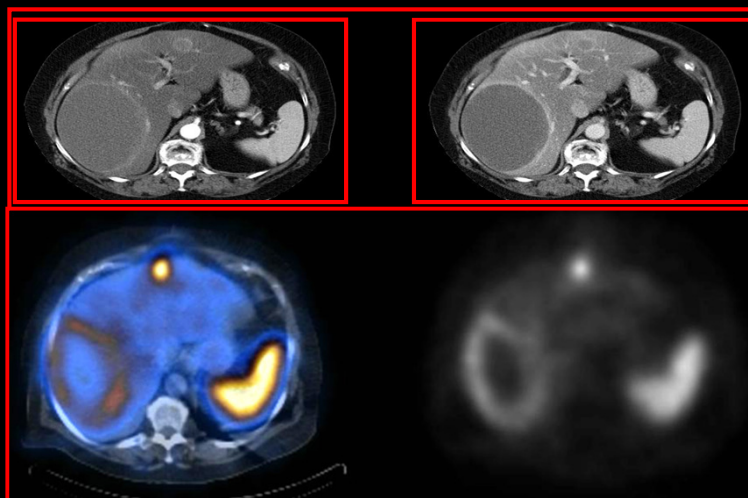
Octreoscan®: SPECT/CT in Ileal Carcinoid



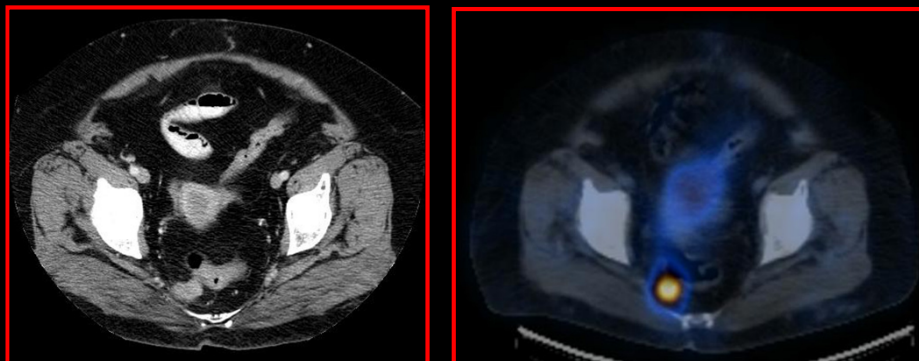
Octreoscan®: SPECT/CT in Ileal Carcinoid



Octreoscan® SPECT/CT: Response to Therapy (radiofrequency on main lesion)



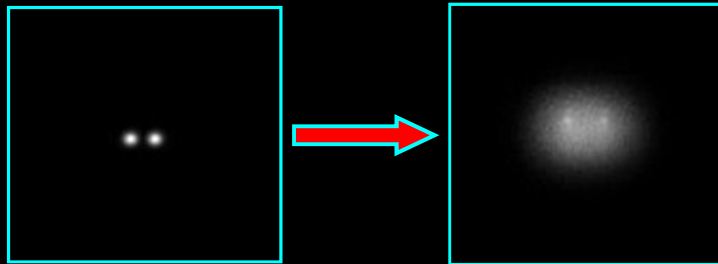
Octreoscan® SPECT/CT: Peritoneal Recurrence Post-surgery for Ileal GEP



Limitations of SRS with Octreoscan®

- Size of lesion(s)
- False positives
- “False” negatives (biological)

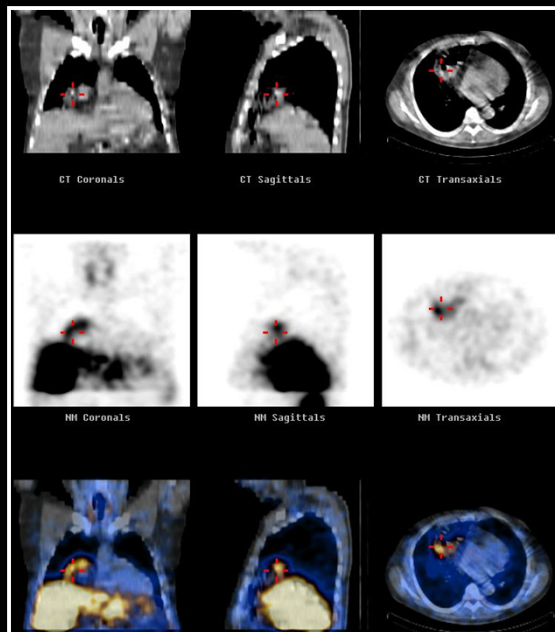
Limited Spatial Resolution or Minimum Detectable Lesion?



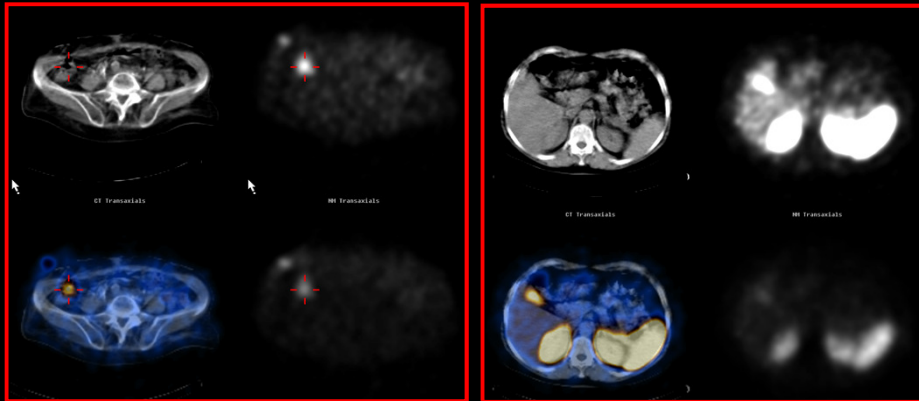
False Positive



Diaphragmatic herniation



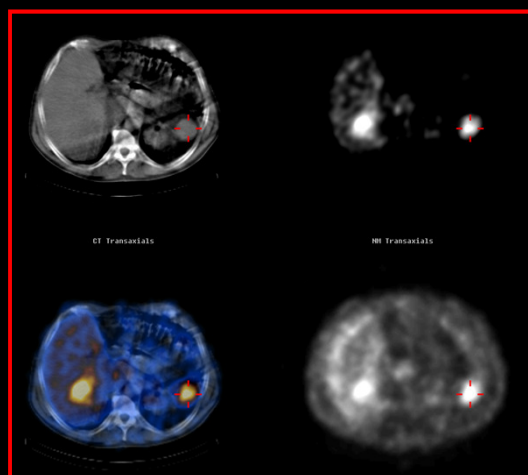
Octreoscan® SPECT/CT: Physiologic Distribution



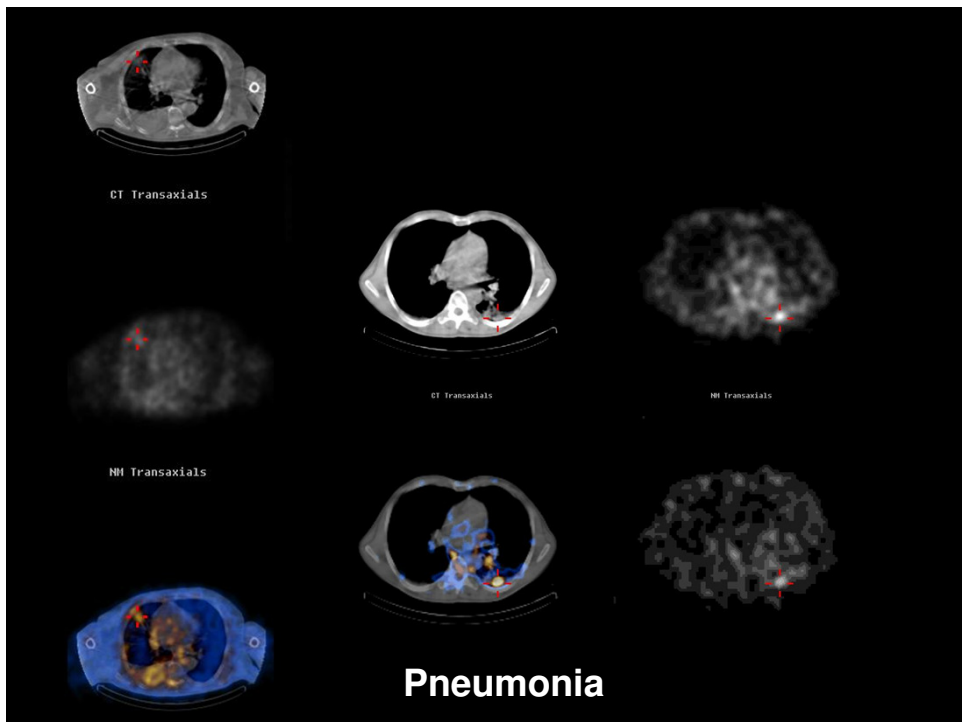
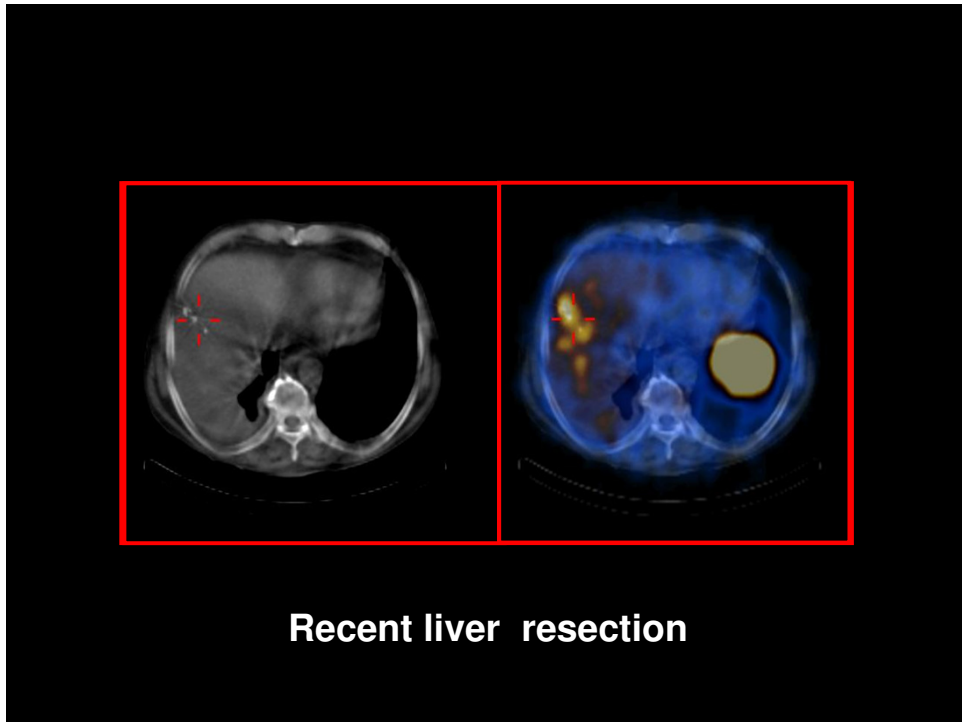
Activity in cecum and skin contamination

Gallbladder

Octreoscan® SPECT/CT: Physiologic Distribution



Accessory spleen



IN CONCLUSION

SPECT *versus* planar

- increased sensitivity and specificity.

SPECT/CT *versus* SPECT

- increased specificity
- (increased sensitivity with attenuation correction)