

Stadiazione del carcinoma mammario localmente avanzato: è raccomandabile la FDG PET/TC?

Pro Daniela Grigolato
Contro Gaia Griguolo

VII SESSIONE

Controversie cliniche



Progetto **CANOA**

CARCINOMA MAMMARIO: QUALI NOVITA' PER IL 2024?

"Saper leggere" uno studio clinico per migliorare la pratica clinica

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Verona, 22-23 Marzo 2024
Hotel Leon d'Oro



Seminars in Nuclear Medicine

Volume 54, Issue 2, March 2024, Pages 247-255

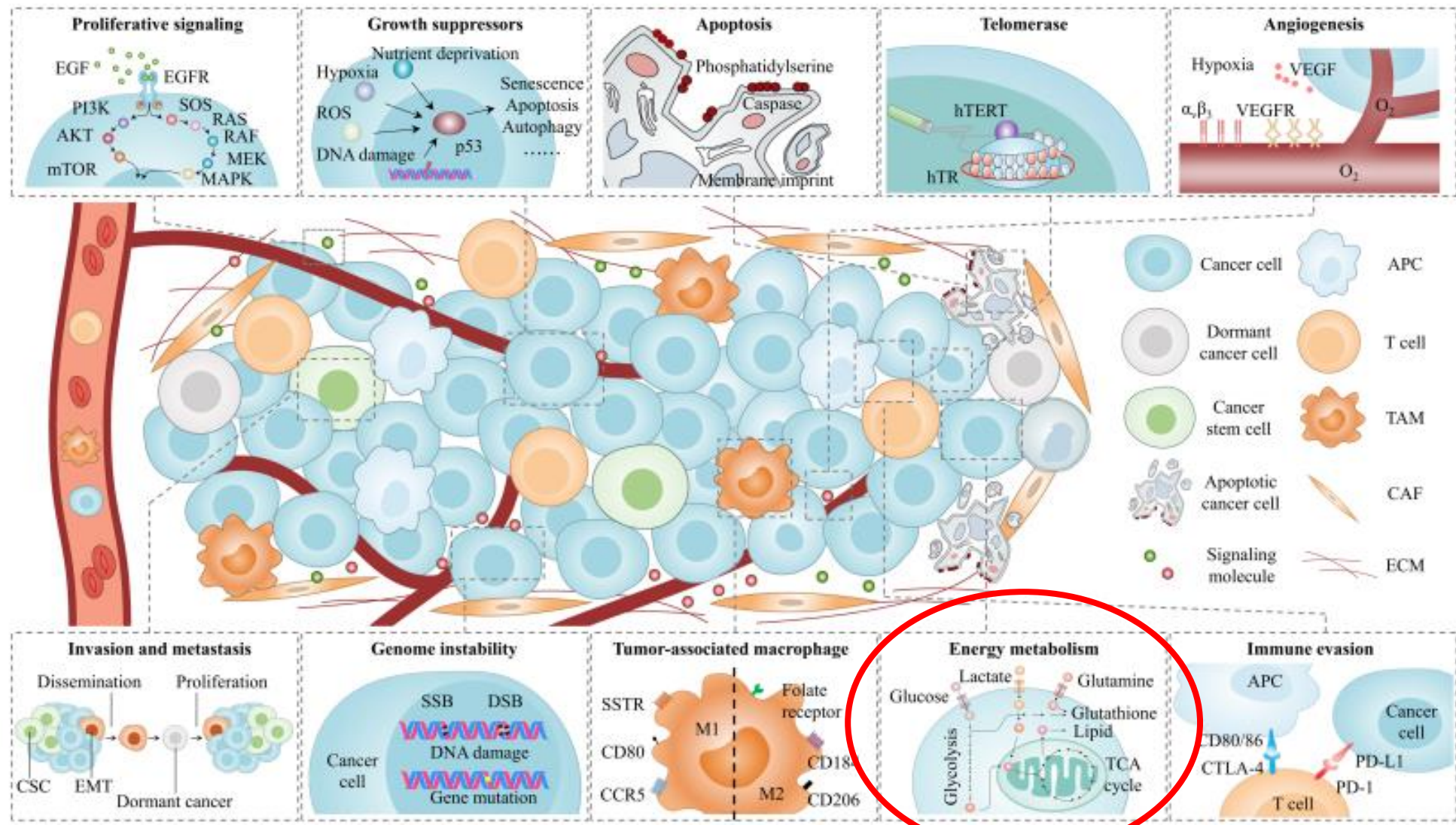


Women's Health Update: Growing Role of PET for Patients with Breast Cancer

Gary A. Ulaner MD * †  , Sofia Carrilho Vaz MD ‡ §

Prospective evidence for the use of 18F-FDG PET

- systemic staging of newly diagnosed locally advanced breast cancer (stages IIB-IIIC)
- monitoring breast cancer treatment response
- detecting breast cancer recurrence



Positron emission tomography molecular imaging-based cancer phenotyping. *Cancer* 2022;128:2704-2716

Differential diagnosis of breast lesions

Non-neoplastic diseases

- Lactation
- Abscess
- Fat necrosis
- Seroma

Benign neoplasms

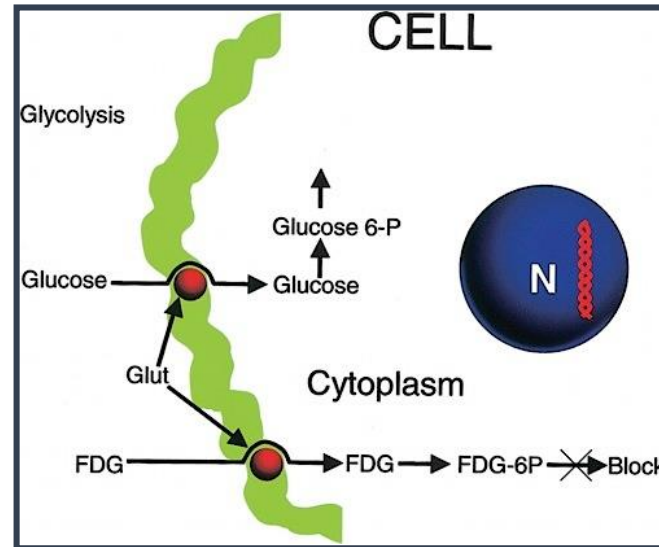
- Fibroadenoma
- Intraductal papilloma

Malignant lesions

- Ductal carcinoma in situ
- Mucinous carcinoma
- Invasive lobular carcinoma

Parameters Affecting FDG-PET/CT Imaging in Breast Cancer Patients

- Tumour grade
- Histological subtype
- Proliferation index
- p53 status
- Hormone receptor status
- Tumour phenotype



FDG

Malignant lesions

- Invasive ductal carcinoma
- Medullary carcinoma
- Malignant phyllodes tumour
- Lymphoma
- Metastases to breast

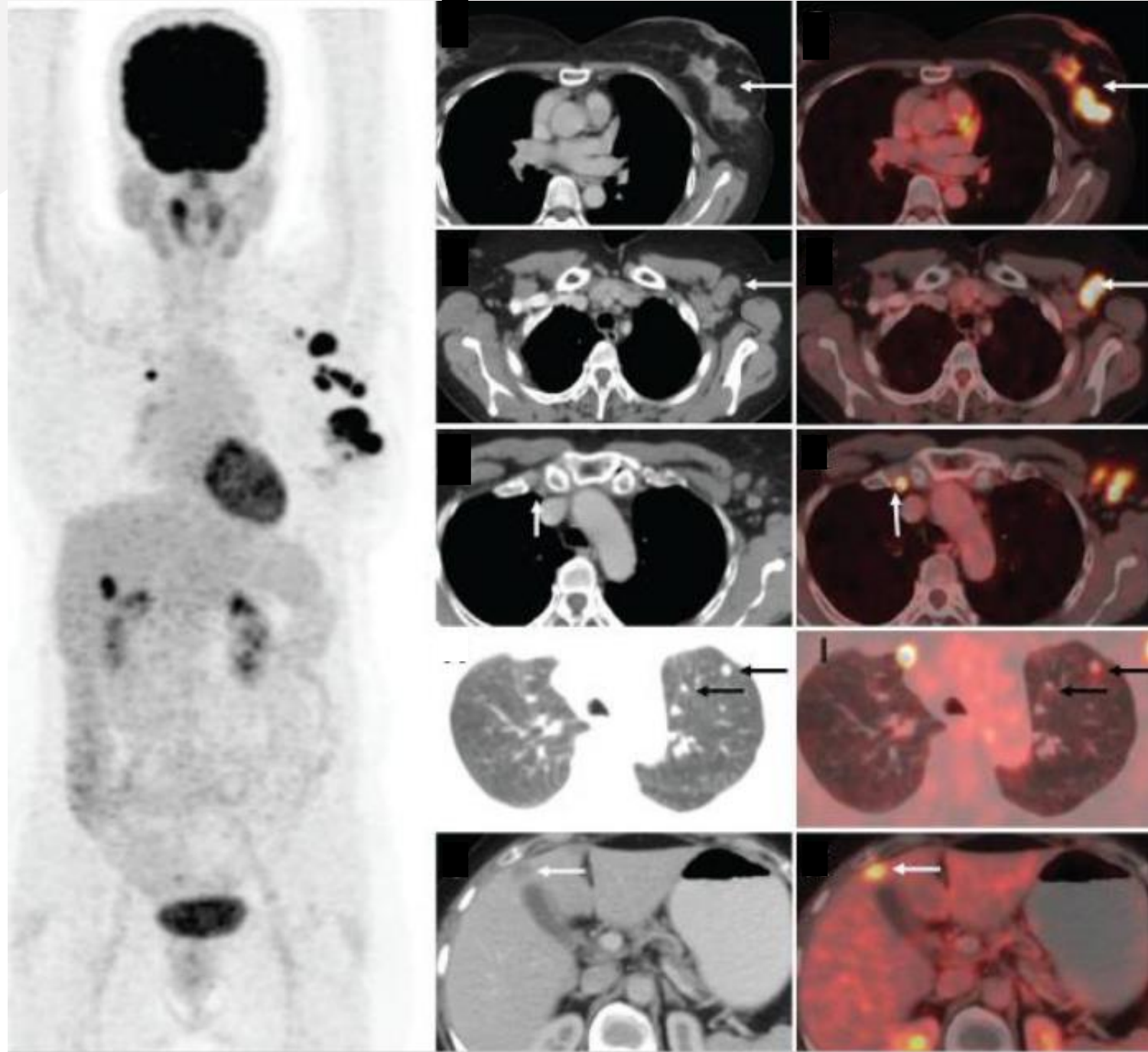
PRO

IMAGING
WHOLE BODY

cT₂ cN₁ M_x

Post
PET/CT

T₃ N₃ M₁





Linee guida

CARCINOMA MAMMARIO AVANZATO

Edizione 2023

TC del torace e dell'addome



scintigrafia ossea SPECT/TC

Rispetto alla TC con mezzo di contrasto e alla scintigrafia ossea, la tomografia ad emissione di positroni (**PET**) con 2-fluoro-2- deossi-D-glucosio (**18F-FDG**) è la metodica che mostra la maggiore accuratezza diagnostica nella ricerca delle metastasi a distanza a livello scheletrico e viscerale (ad eccezione dell'encefalo), configurandosi come un **mezzo di approfondimento utile qualora le metodiche convenzionali non siano conclusive**

REVIEW ARTICLE

The current role of nuclear medicine in breast cancer

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Table 2. Dates of FDA and EMA approval of PET radiopharmaceuticals used in breast cancer with the respective clinical indication and type of recommendation/document

PET radio pharmaceutical	FDA approval	EMA approval	Clinical indications	Type of recommendation (date of last update)
[¹⁸ F]NaF	1972	2015 EMA/212874/2015	Bone metastases identification and treatment response assessment	<ul style="list-style-type: none"> EANM/SNMMI guideline (2015)³⁸ NCCN guidelines (2023)¹⁰
2-[¹⁸ F]FDG	2000 (for oncology)	2018 EMA/496103/2018	<u>Whole-body</u> <ul style="list-style-type: none"> Systemic staging of patients with clinical Stage IIB – IV Lesion detection when there is suspicion of recurrence Assessing response to treatment <u>Breast-dedicated imaging</u> MRI contraindication	<u>Whole-body</u> ESMO guidelines (2019) ⁶ ESTRO guidelines (2020) ³⁹ ESMO guidelines (2021) ⁴⁰ NCCN guidelines (2023) ¹⁰ EANM/SNMMI guideline being revised* <u>Breast-dedicated imaging</u> EANM/SNMMI guideline being planned*
[¹⁸ F]FES (Cerianna™)	2020	Not approved	<ul style="list-style-type: none"> Detection of ER-positive lesions in patients with recurrent or metastatic BC Patients selection for hormonal therapies 	<ul style="list-style-type: none"> NCCN guidelines (2023)¹⁰ EANM/SNMMI guideline being revised*

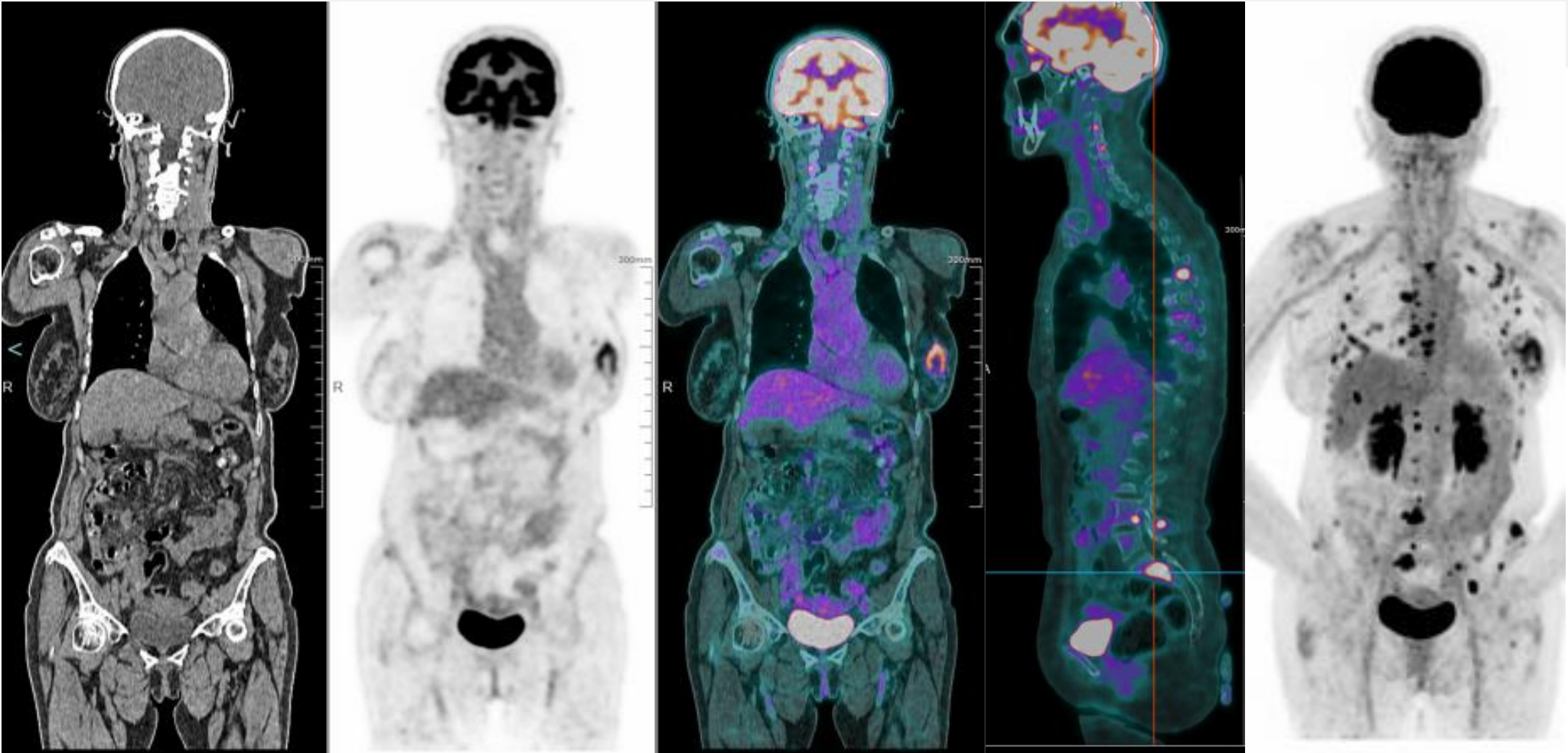
In which patient groups FDG-PET/CT staging would be beneficial and should be offered

29 studies (4276 patients) involving FDG-PET, PET/CT or PET/MRI, the pooled proportions of **changes** in stage and management were **25%** (95% CI, 21%- 30%) and **18%** (95% CI, 14%- 23%), respectively

breast cancer

	T1	N1	M0	
	T2	N0	M0	
Stage IIB	T2	N1	M0	
	T3	N0	M0	
Stage IIIA	T3	N1	M0	
	T0	N2	M0	Locally advanced breast cancer
	T1	N2	M0	
	T2	N2	M0	
	T3	N2	M0	
Stage IIIB	T4	N0	M0	
	T4	N1	M0	
	T4	N2	M0	
Stage IIIC	any T	N3	M0	
Stage IV	any T	any N	M1	Metastatic disease

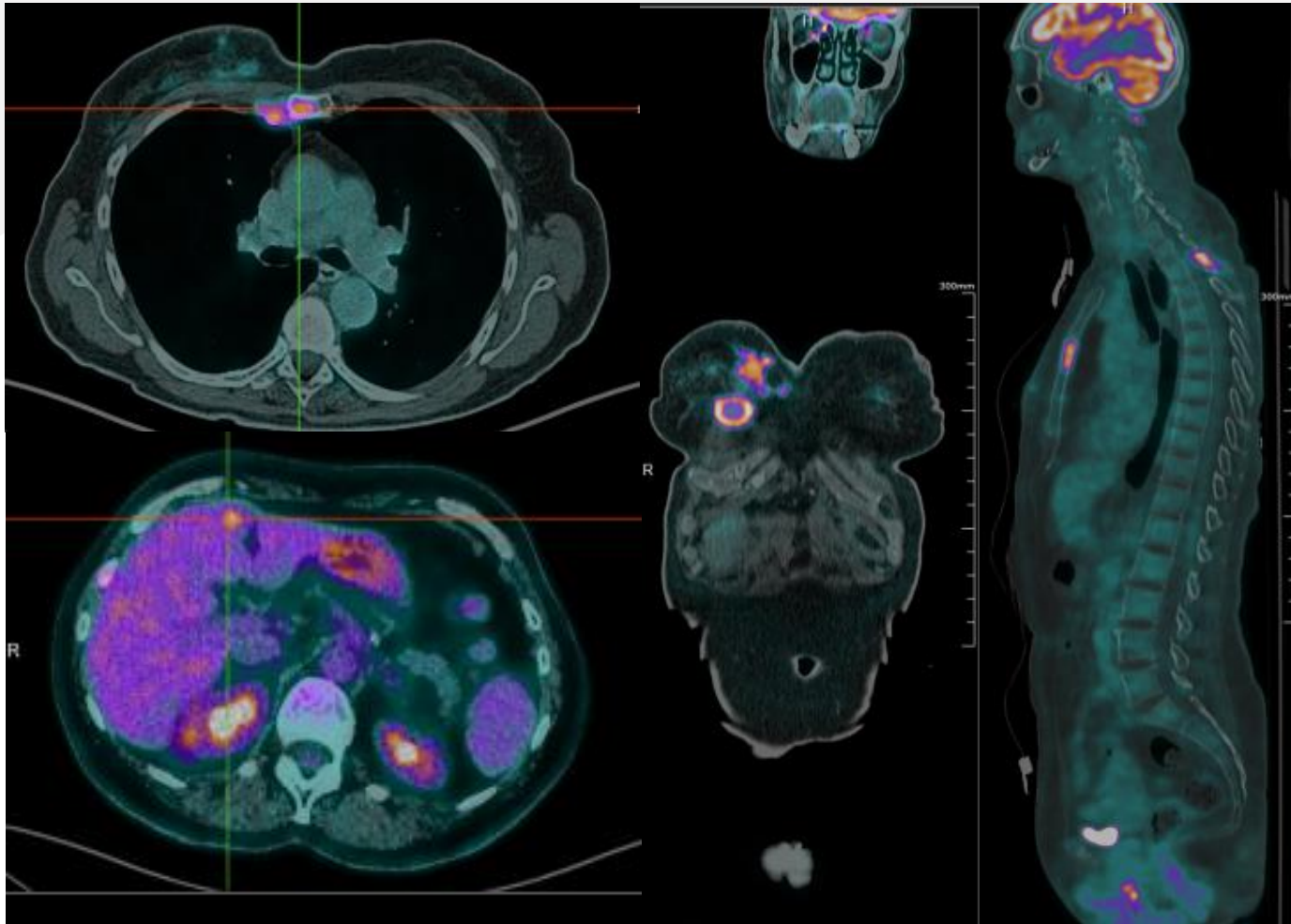
- Breast Cancer Systemic Staging (Comparison of Computed Tomography, Bone Scan, and 18F-Fluorodeoxyglucose PET/Computed Tomography). *Pet Clin* 2023
- FDG-PET/CT for primary staging and detection of recurrence of breast cancer. *Sem Nucl Med* 2022
- Impact of FDG PET/CT and PET/MR on staging and management as an initial staging modality in breast cancer. A systematic review and meta-analysis. *Clin Nucl Med* 2021
- FDG-PET/CT for primary staging and detection or recurrence of breast cancer. *Seminar Nucl Med*, 2022
- Breast cancer: Initial workup and staging with FDG-PET/CT. *Clin Transl Imaging*, 2021
- Good clinical practice recommendations for the use of PET/CT in oncology. *Eur J Nucl Med Mol Imaging*, 2020
- Update of the recommendations of good clinical practice for the use of PET in oncology. *Bull Cancer*, 2019
- FDG-PET/CT in breast cancer: evidence-based



ILC

cT3 cN1 Mx stage IIIA vs T3 N1 M1 stage IV

ER 90%, PgR 20%, HER2 NEG, Ki67 15%, G2 SUVmax 6



cT2 cN1 Mx stage IIIA vs T2 N3 M1 stage IV

ILC

MF, MC, ER 80%, PgR 10%, HER2 NEG, Ki67 30%, G3

Among 196 breast cancer patients, the overall **upstaging rate to stage IV** based on findings of unsuspected distant metastases was 14% (27/196)

0% for stage IIA
 13% for stage IIB (10/79)
 22% for stage IIIA (9/41)
 17% for stage IIIB (5/30)
 37% for stage IIIC (3/8).

PET/CT had **comparable costs** than conventional imaging, consisting in ceCT plus bone scan, and had **lower radiation dose** exposure. **14 vs 21 mSv**

Ko H. Clinical utility of 18F-FDG PET/CT in staging localized breast cancer before initiating preoperative systemic therapy.

JNCCN 2020

Impact of ¹⁸F-Labeled Fluorodeoxyglucose Positron Emission Tomography-Computed Tomography Versus Conventional Staging in Patients With Locally Advanced Breast Cancer

For **inclusion**, patients had histological evidence of **invasive ductal** carcinoma of the breast and TNM **stage III or IIB (T3N0, but not T2N1)**. Consenting patients from **six** regional cancer centers in Ontario were **randomly assigned** to ¹⁸F-labeled fluorodeoxyglucose PET-CT or conventional staging (bone scan, CT of the chest/abdomen and pelvis). The **primary end point** was **upstaging to stage IV**. A key **secondary outcome** was **receiving curative intent combined modality therapy** (neoadjuvant chemotherapy, surgery, and regional radiation). ClinicalTrials.gov identifier: [NCT02751710](https://clinicaltrials.gov/ct2/show/study/NCT02751710).

	pts	Upstage	Treatment change	Combined treatment modality
FDG PET/CT	184	43 (23%)	35 (81.%)	149 (81%)
Conventional imaging	185	21 (11%)	20 (95%)	165 (89%)

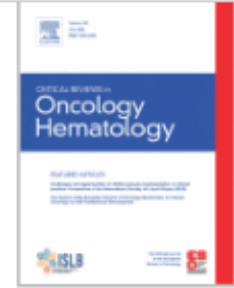
Use of ^{18}F -FDG PET/CT as an Initial Staging Procedure for Stage II–III Breast Cancer: A Multicenter Value Analysis

Colby J. Hyland, AB¹; Flora Varghese, MD, MBA¹; Christina Yau, PhD¹; Heather Beckwith, MD²; Katia Khoury, MD³; William Varnado, MD⁴; Gillian L. Hirst, PhD¹; Robert R. Flavell, MD, PhD⁵; A. Jo Chien, MD¹; Douglas Yee, MD²; Claudine J. Isaacs, MD³; Andres Forero-Torres, MD⁴; Laura J. Esserman, MD, MBA¹; and Michelle E. Melisko, MD¹

J. Natl. Compr. Cancer Netw. 2020;18:1510–1517.

564 patients with stage II-III breast cancer data were reviewed to compare **the cost implications of staging procedures** and concluded that **FDG PET-CT reduced false-positive risk by half** (22.1% vs. 11.1%) and **decreased the workup of incidental findings**, allowing for an earlier treatment start, and also found that PET-CT was cost-effective and may be cost-saving in some settings.

FPs were more commonly noted in patients aged 45 years. Whereas rates of FPs were higher with SoC than PET/CT in all biologic subsets, the ratios of FPs were highest in triple-negative and HER2 pos disease.



[¹⁸F]FDG PET/CT in the staging of inflammatory breast cancer: A systematic review

D.J.P. van Uden et al

This [systematic review](#) showed that ¹⁸F]FDG PET/CT detects additional locoregional [lymph node metastases](#) and [distant metastases](#) in **10.3 %** of patients, that were not detected with standard staging imaging. Compared with conventional imaging procedures, [¹⁸F]FDG PET/CT had better [diagnostic performance](#) for detection of locoregional and distant metastases and should standardly be used in the diagnostic work-up of IBC patients.

ORIGINAL RESEARCH

Open Access



^{18}F -FDG PET/CT-based deep learning radiomics predicts 5-years disease-free survival after failure to achieve pathologic complete response to neoadjuvant chemotherapy in breast cancer

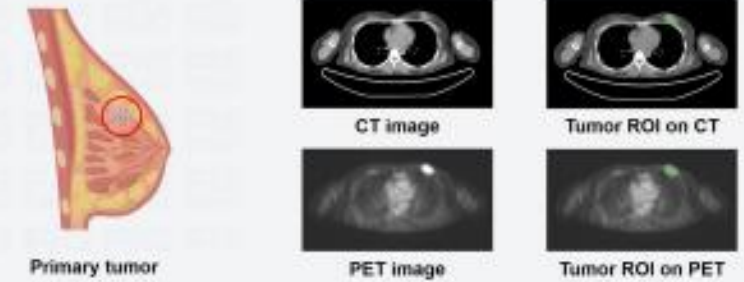
This study aimed to assess whether a combined model incorporating radiomic and depth features extracted from PET/CT can predict disease-free survival (DFS) in patients who failed to achieve pathologic complete response (pCR) after neoadjuvant chemotherapy.

105 non-pCR pts and 71 months follow-up (T2-4 N0-3 M0 or T1c N1-3 M0).

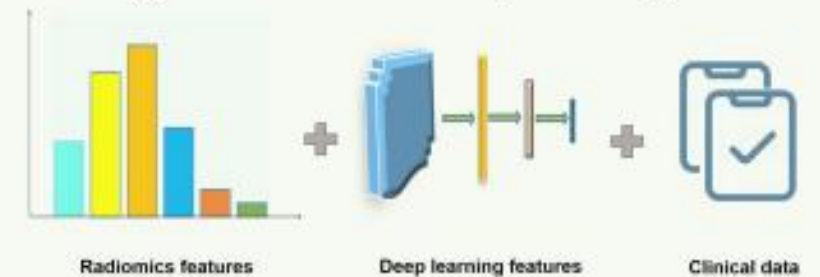
The integrated model incorporating RCB, cT, and radiomic and depth features extracted from PET/CT images exhibited the highest accuracy for predicting 5-year DFS in the training (AUC 0.943) and the validation cohort (AUC 0.938).

Conclusion The integrated model combining radiomic and depth features extracted from PET/CT images can accurately predict 5-year DFS in non-pCR patients. It can help identify patients with a high risk of recurrence and strengthen adjuvant therapy to improve survival.

(A) Image acquisition and tumor segmentation



(B) Feature extraction and processing

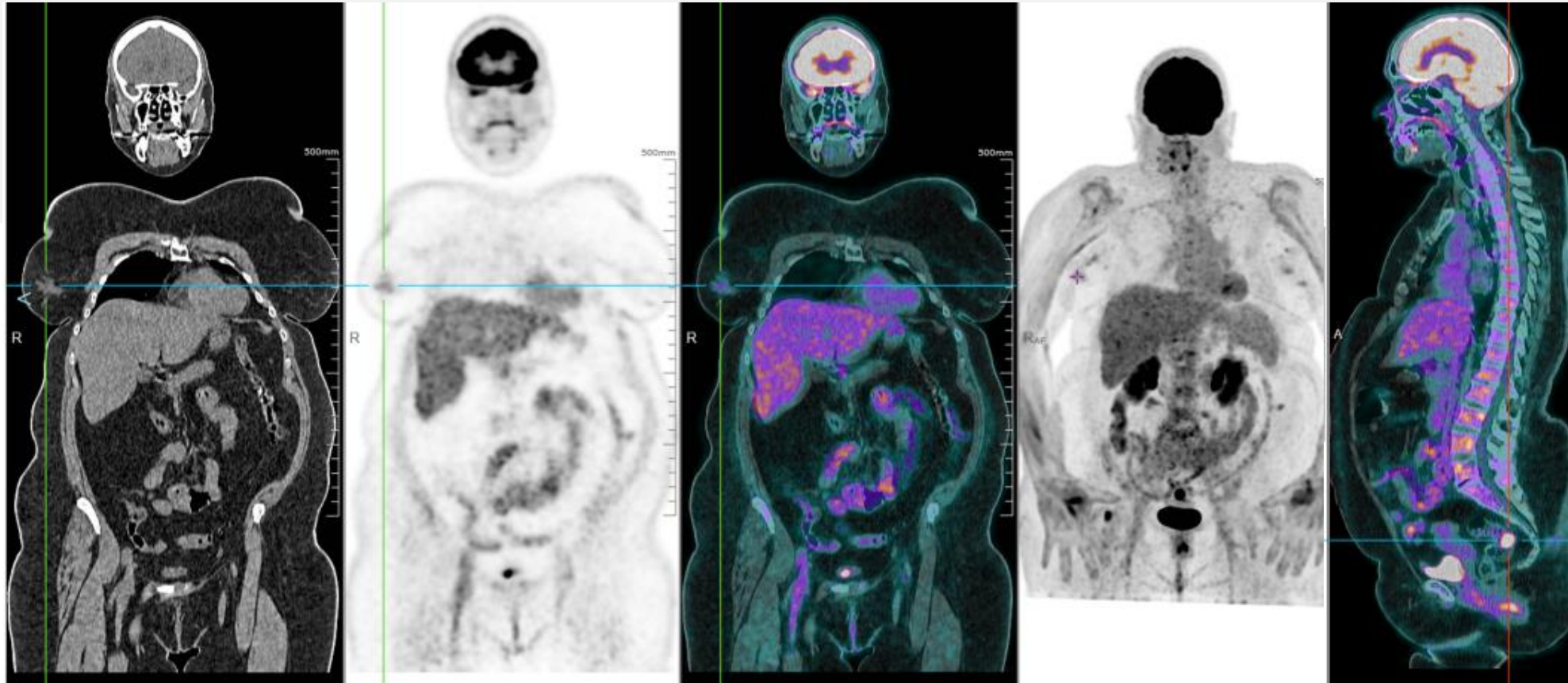


(C) Feature selection and evaluation



(D) Model Construction and evaluation






**FDG PET/CT
at
initial workup
of breast cancer**

- FDG-PET/CT is **recommended** for initial staging in patients with clinical stage \geq IIB breast cancer and is better when performed before surgery.
- FDG-PET/CT **can be proposed** for staging patients with clinical stage IIA (T1N1 or T2N0) breast cancer and is better when performed before surgery.
- FDG-PET/CT is **not recommended** for staging patients with clinical stage I (T1N0) breast cancer.



Article

The Pattern of Metastatic Breast Cancer: A Prospective Head-to-Head Comparison of [¹⁸F]FDG-PET/CT and CE-CT

Rosa Gram-Nielsen ^{1,2}, Ivar Yannick Christensen ³, Mohammad Naghavi-Behzad ^{1,2,4} ,

The study aimed to compare the metastatic pattern of breast cancer and the intermodality proportion of agreement between [¹⁸F]FDG-PET/CT and CE-CT.

Bone and **distant lymph node metastases** were reported more often by [¹⁸F]FDGPET/CT than CE-CT, while **liver** and **lung metastases** were reported more often by CE-CT. The **agreements** between scans were **highest for bone and liver lesions and lowest for lymph node metastases**. These findings may impact treatment decisions, and the choice of diagnostic modality should be considered when staging and planning treatment for MBC patients