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MOLECULAR SURGERY IN BREAST CANCER: OUR FIRST EXPERIENCE

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Aim

The aim of this paper was to analyze the usefulness of molecular imaging in the localization and assessment of surgical margins in breast cancer. Additionally, the effectiveness and safety of the standardized work protocols (SWP) developed in our center were evaluated.

Materials and Methods

Descriptive, prospective study involving breast cancer patients with surgical indication and hypermetabolic lesions detected on preoperative positron emission tomography (PET) and computed tomography (CT) scans, conducted between November 2023 and March 2024. A SWP for radioguided surgery was developed. The procedure included preoperative intravenous injection of [18F]FDG, followed by lesion localization using a gamma probe by a nuclear medicine physician during surgery. Post-surgery, a 5-minute PET-CT scan was performed to assess the surgical specimen and margins, followed by histopathological analysis (HA). A dosimetric study in collaboration with radiological protection physicists was conducted during the first two surgeries.

Results

Seven radioguided surgeries (4 lumpectomies, 2 mastectomies and a systemic ROLL of an axillary adenopathy) were performed. The surgical specimens corresponded to 6 breast lesions (luminal A infiltrating carcinoma, 2 luminal B infiltrating carcinoma with neoadjuvant treatment, luminal A infiltrating lobular carcinoma, triple negative with neoadjuvant treatment and a local relapse due to spindle cell sarcoma) and a triple negative axillary lymphadenopathy. The 100% of the lesions were located, 6 pieces and 36 surgical margins were analysed. There was a correlation between PET-CT imaging results and HA in 33 surgical margins (25 negative and 8 positive, 91,7% agreement). However, discordances were found in 3 of the analysed margins. There were no complications associated with the nuclear medicine procedure or the surgical intervention.

	Lumpectomies	Mastectomies	Systemic ROLL
Percentage	57,1	28,6	14,3
Number	4	2	1

Fig. 1: Distribution of radioguided surgeries in our patients from November 2023 to March 2024, showing the higher prevalence of lumpectomies (57.1%) compared to mastectomies (28.6%) and systemic ROLL procedures (14.3%).

Fig. 2: Percentage distribution of different histological types of breast cancer in our patients, highlighting the predominance of luminal B infiltrating carcinoma at 33%.

	Negative surgical margin concordance	Positive surgical margin concordance	Discordances
Number	25	8	3
Percentage	69,4	22,2	8,3

Fig. 3: Surgical margin concordance between PET-CT imaging and histopathological analysis: 69.4% negative and 22.2% positive, with 8.3% discordance in the results.

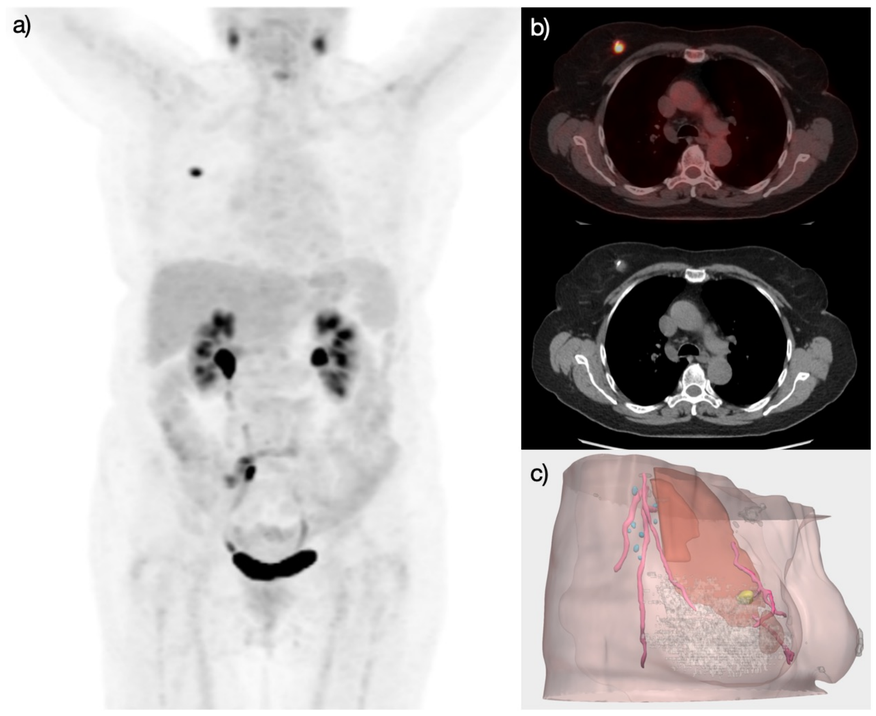

Fig. 4: a) Whole-body PET image with MIP reconstruction showing a hypermetabolic nodular lesion in the right breast, corresponding to a triple-negative breast carcinoma. b) Axial PET-CT fusion image (top) showing a hypermetabolic lesion in the upper inner quadrant (UIQ) of the right breast, and CT scan (bottom) showing the morphological characteristics of the lesion, which includes a radiological marker (scout). c) AI-based segmentation with three-dimensional reconstruction from PET-CT, showing the tumor lesion and the different anatomical structures.

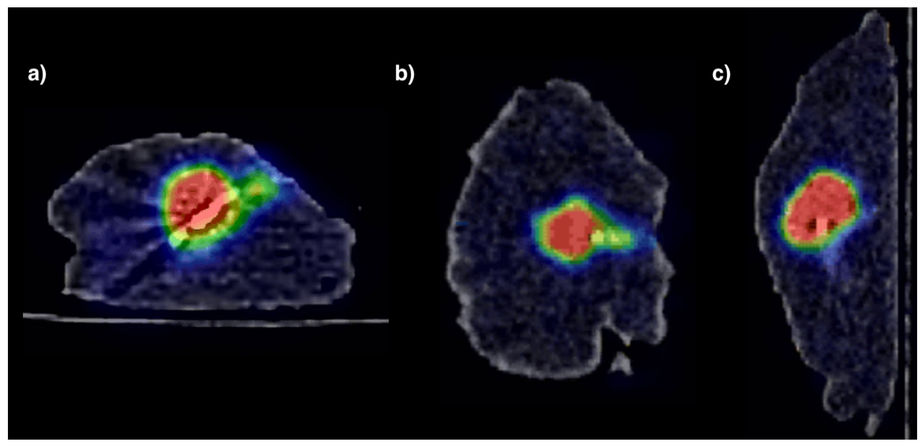

Fig. 5: PET-CT image of the surgical specimen in axial (a), coronal (b), and sagital (c) views, showing a centrally located hypermetabolic tumor lesion with a scout marker inside. A hypermetabolic spicule, not previously identified in the preoperative PET-CT, is seen extending toward the superficial margin.

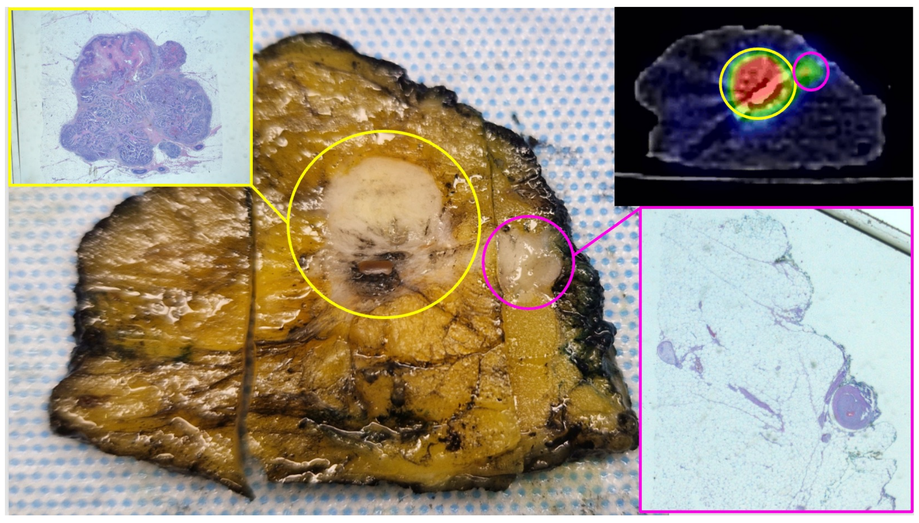

Fig. 6: Correlation between the surgical specimen and imaging studies. In the center, the macroscopic specimen shows the known tumor lesion (yellow circle) and an additional tumor spicule (pink circle), both visible in the PET-CT image (upper right corner). The corresponding histological sections are located in the upper left and lower right corners, confirming the correlation between imaging and histopathological findings.

Conclusion

Hybrid molecular imaging techniques following our SWP have shown to be helpful in lesion's localization and the assessment of surgical margins without increasing surgical timing or an additional dosimetric risk. Despite our reduced sample, this technique could be used in the future as an intraoperative tool, reducing the need for other surgical interventions, but further investigation is needed.