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Place of Bone Scintigraphy in the Assessment of Extension and Follow-Up of Breast Cancer in Senegal: Study of 165 Cases in the Nuclear Medicine Department of Idrissa Pouye General Hospital (Dakar)

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Abstract

Introduction: Breast cancer is the most common cancer in women worldwide, accounting for an estimated 22% of all female cancers. It is the leading cause of cancer mortality in women, almost all of which is due to metastases, with 73% of metastases occurring in the bone. In oncology, metastable technetium 99-labelled methylene bisphosphonate bone scintigraphy (BS) remains the standard examination for detecting and assessing the extent of bone metastases. The aim of this study was to assess the role of BS in the evaluation and follow-up of breast cancer in Senegal. **Methodology:** This was a retrospective study of breast cancer patients who underwent bone scintigraphy with ^{99m}Tc-HMDP in the nuclear medicine department of Idrissa Pouye General Hospital (IPGHO), from July 2009 to June 2022. **Results:** We enrolled 165 patients, mean age 46.79 years (27 - 87 years). BS was performed in 94.37% of cases for post-therapeutic monitoring and in 5.63% for pre-therapeutic assessment. Results were contributory in 131 patients (92.25%), of whom 72 cases (50.70%) were normal and 59 cases (41.55%) positive or presenting bone metastases; and non-contributory or doubtful in 11 cases (7.75%). Secondary bone locations were multiple in 57 cases (96.61%) and single or solitary in 2 cases (3.39%). The scintigraphic appearance of bone metastases was hyper-fixative in 58 cases (98.31%) and mixed in 1 case (1.69%). Bone lesions

were quantified using the Soloway's grading classification. **Conclusion:** BS with ^{99m}Tc-labelled bisphosphonates remains the examination of choice for skeletal exploration, in the detection and extension of bone metastases in breast cancer. Performance has been enhanced by the development of SPECT coupled with CT (SPECT-CT).

Keywords

Breast Cancer, Bone Scintigraphy, ^{99m}Tc-HMDP, Bone Metastases

1. Introduction

Breast cancer is the most common cancer in women worldwide, accounting for an estimated 22% of all female cancers. In Africa, it was estimated at 186,598 cases with 85,787 deaths, while in Senegal there were 1817 cases with 951 deaths in the same period, almost all due to metastases, 73% of which were bone metastases [1] [2] [3].

The diagnosis of breast cancer metastases is based on a meticulous clinical examination, and on medical imaging examinations of the utmost importance, such as chest X-ray, abdominal ultrasound, thoraco-abdomino-pelvic computed tomography (CT) and magnetic resonance imaging (MRI): chest X-ray, abdominal ultrasound, thoraco-abdomino-pelvic computed tomography (CT), magnetic resonance imaging (MRI), sentinel lymph node technique, bone scintigraphy (BS), fluorodeoxyglucose Positron Emission Tomography (^{18}FDG PET-CT) [4] [5] [6]. In oncology, bone scintigraphy (BS) using Hydroxyl-methylene bisphosphonate (HMDP) labelled with metastable technetium 99 (^{99m}Tc) remains the standard examination for detecting and assessing the extension of bone metastases [7].

The aim of our work was to evaluate the role of bone scintigraphy in the assessment and follow-up of breast cancer in Senegal.

2. Patients and Methods

2.1. Type and Scope of Study

This was a retrospective descriptive and analytical study, from July 2009 to June 2022, of patients with histologically and/or cytological proven breast cancer who underwent bone scintigraphy with ^{99m}Tc-HMDP. It took place in the nuclear medicine department of Dakar's Idrissa Pouye General Hospital (HOGIP). Operational since June 2009, it remains the only functional nuclear medicine department in Senegal.

Whole-body scintigraphy (WBS) bone scans were performed using a dual-head SPECT gamma camera (Mediso Nucline TM Spirit DH-V type) (**Figure 1**), 3 hours after intravenous injection of 8 MBq/kg (555 to 740 MBq) of ^{99m}Tc-HMDP.

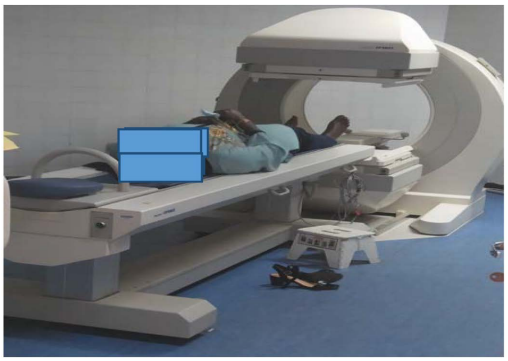

Figure 1. Patient under gamma camera for whole-body bone scintigraphy in the nuclear medicine department of Idrissa Pouye General Hospital (HOGIP).

2.2. Study Population

➢ **Inclusion criteria**

We included in our study all patients with breast cancer who had undergone bone scintigraphy (for initial extension or follow-up) and for whom most of the information relating to the variables studied was available. The variables essential for inclusion were age, cancer location, TNM classification, histological type, Indication for scintigraphy and the bone scintigraphy results.

➢ **Non-inclusion criteria**

Not included in our study:

- Patients who have undergone bone scintigraphy for reasons other than breast tumour extension;
- Patients who had undergone bone scintigraphy for breast cancer extension and for whom the medical record was not available.

2.3. Studied Variables

➢ **Dependent variable**

The study's dependent variable was the presence or absence of bone metastases. It presented three modalities: yes for presence of metastases, no for absence of metastases, and doubtful (doubtful presence of metastases).

➢ **Independent variables**

- General data: gender, age, cancer location (right, left, bilateral), TNM classification;
- Histological and prognostic data: histological type, SRB grade.
- Scintigraphic data:

1) Indication for scintigraphy.

2) Contributory or non-contributory scintigraphy: bone scintigraphy was deemed contributory when it confirmed the presence or absence of bone metastasis; non-contributory when it was doubtful, requiring follow-up or further exploration with other imaging techniques.

3) Solitary or multiple metastasis location(s).

4) Topographies of bone lesions..

5) Type of bone lesions (hyper-fixing, hypo-fixing, mixed).

6) Quantification of bone damage: Soloway score.

2.4. Data Collection

- To collect and process the data, we used:
  1) Patient bone scan records from the software database (InterViewXP/Médiso);
  2) Physical records (clinical observation sheets) for each patient included.
- Bone scan images during the study period were all visualized and analysed.
- For each file, the data were transcribed onto a data processing form designed for the study. This form was tested and corrected on some twenty files.

2.5. Data Processing and Analysis

Data were processed and analysed using SPSS version 22 statistical software and Microsoft Excel 2019.

Quantitative variables are expressed as averages, while qualitative variables are expressed as percentages.

2.6. Ethical Considerations

All ethical requirements relating to health research were respected. Patient data were treated confidentially and in strict compliance with medical secrecy. Data sheets were completed anonymously, using an identification code. Confidentiality of the data collected was ensured.

3. Results

We included a total of 142 patients out of a total of 165. Twenty-three (23) did not meet the inclusion criteria.

3.1. General Data

3.1.1. Gender

Our entire study population was exclusively female, *i.e.* 100% women.

3.1.2. The Age

The mean age of the patients was 46.79 years, with extremes of 27 and 87 years.

The 50 - 54 age group was the most common, representing 21.13% of the study population (**Figure 2**).

3.1.3. Location of Breast Cancer

The location of the primary tumour was unilateral in 91.55% of cases, with 55.23% on the right and 45.77% on the left.

3.2. Histological Types

Invasive ductal carcinoma (IDC) was the most common histological type, accounting for 97.18% of cases (**Figure 3**). Among patients with bone metastases on scintigraphy, 57 cases (96.61%) were of the infiltrating ductal carcinoma (IDC) type.

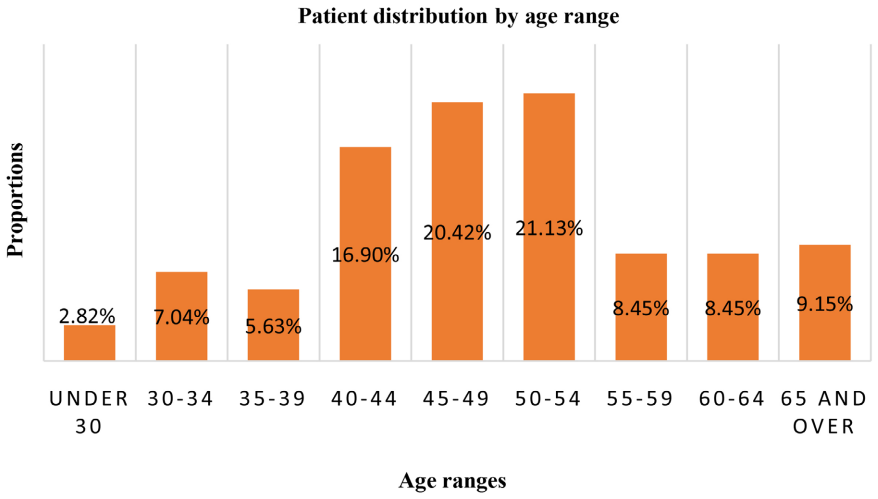

Figure 2. Patient distribution by age range.

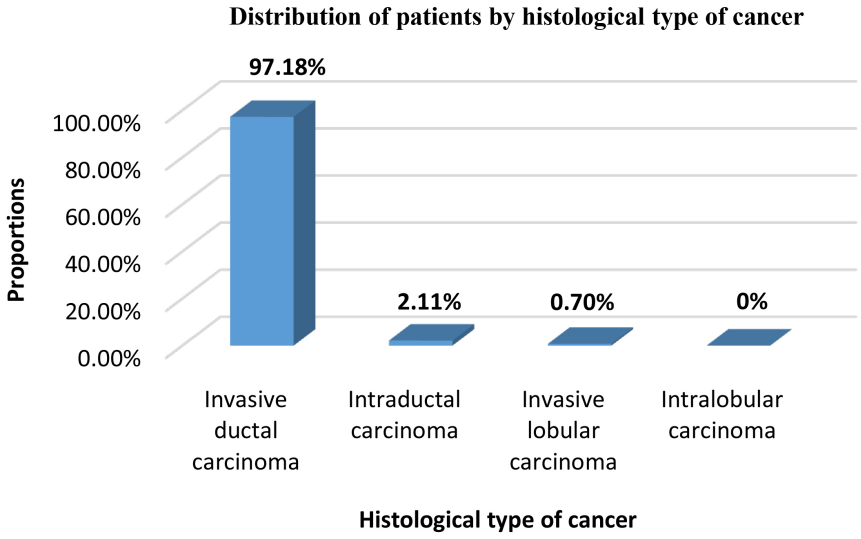

Figure 3. Distribution of patients by histological type of cancer.

3.3. SRB Classification

Grade SRB2 was found in 61.97% of cases, followed by grade SRB3 in 32.39% (**Figure 4**).

3.4. Performing Scintigraphy: Pre-Therapeutic Assessment or Follow-Up Assessment

In our study, bone scintigraphy was performed as part of:

- Post-therapy monitoring in 134 cases (94.37%);
- A pre-therapeutic assessment in 8 cases (5.63%) (**Figure 5**).

3.5. Bone Scan Results

3.5.1. Contribution of Bone Scintigraphy

The whole-body bone scan was:

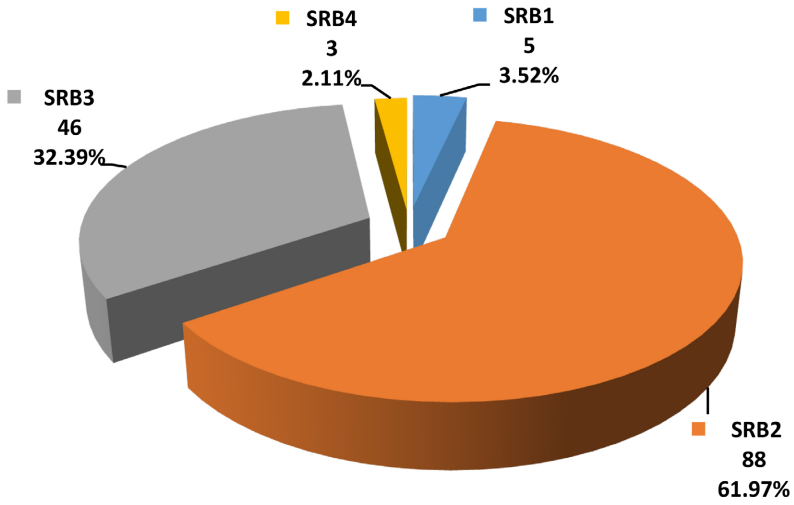

Figure 4. Classification of patients by breast cancer SRB grade.

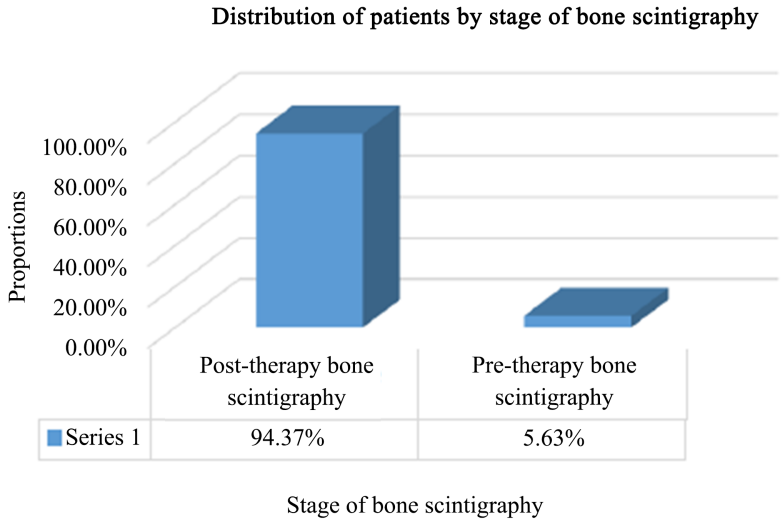

Figure 5. Distribution of patients by stage of bone scintigraphy.

- Contributed in 131 patients (92.25%) including 72 cases (50.70%) normal and 59 cases (41.55%) positive or with bone metastases;
- Non-contributory or doubtful in 11 cases (7.75%) (**Figure 6**).

3.5.2. Topography of Metastatic Bone Lesions

- **Solitary or multiple lesions:** Among the 59 cases of positive bone scintigraphy, the locations were:
- Multiple in almost all patients, 57 cases (96.61%) (**Figure 7**), and
- Solitary only in 2 cases, *i.e.* 3.39% (**Figure 8**).
- **Lesions sites**

The 57 cases with multiple bone locations were:

- Both axial and appendicular in 31 cases (54.39%),
- Exclusively axial in 16 cases (28.07%)(**Figure 8**), and
- Axial, and cranial, in 10 cases (17.54%) (**Figure 9**).

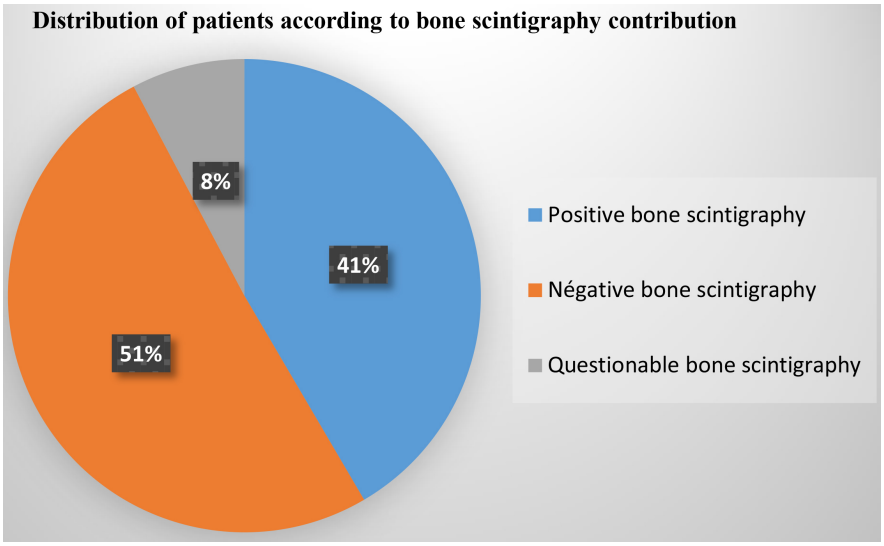

Figure 6. Distribution of patients according to bone scintigraphy contribution.

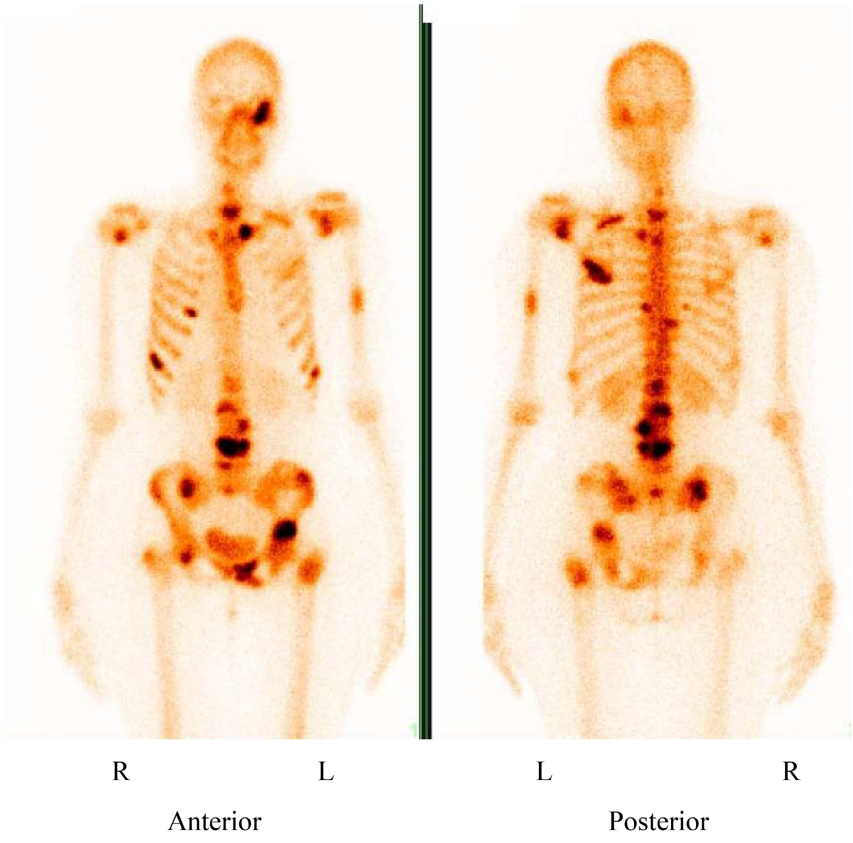

Figure 7. BS (anterior and posterior) showing multiple diffuse hyper-fixations indicative of bone metastases in a 46-year-old breast cancer patient.

No single cranial or appendicular location was found.

The two cases of solitary lesions were axial (sternal and eighth dorsal vertebrae).

Figure 10 shows the proportions of the various locations.

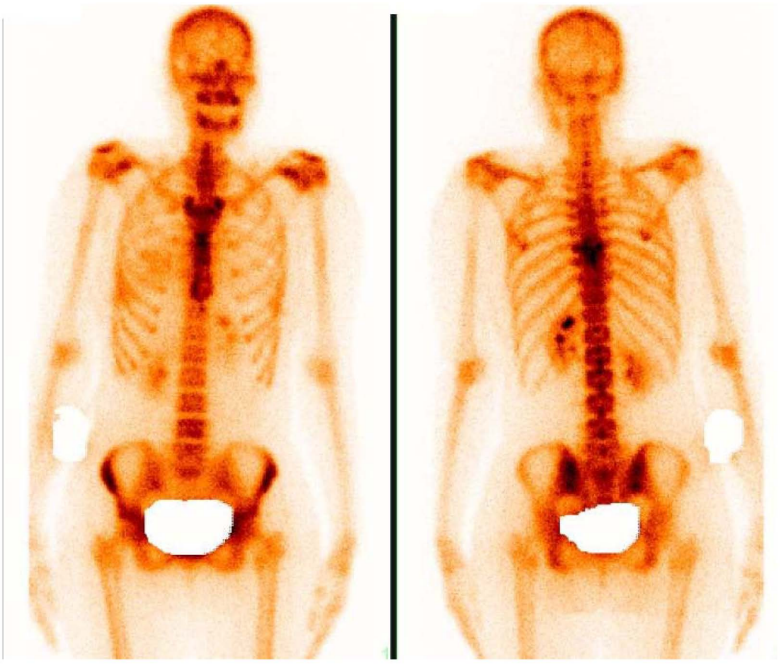

Figure 8. BS (anterior and posterior) showing isolated hyper-fixation of the eighth dorsal vertebra reflecting solitary metastasis in a 40-year-old breast cancer patient; Right urinary retention.

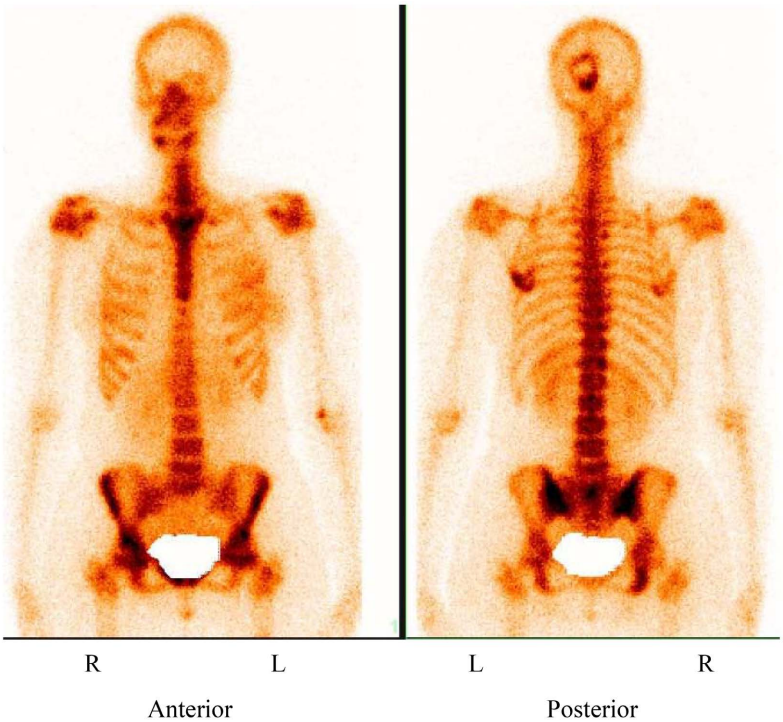

Figure 9. BS (anterior and posterior) showing bone metastases, including a mixed lesion in the skull, in a 32-year-old breast cancer patient.

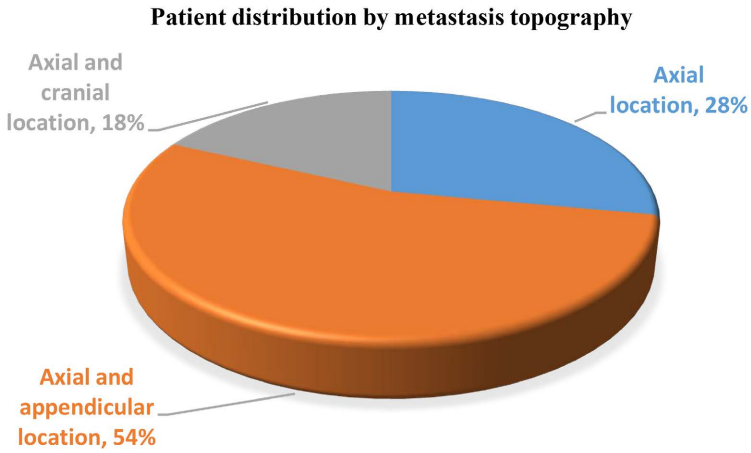

Figure 10. Patient distribution by metastasis topography.

- **Precision on the topography of axial lesions:** Axial secondary bone lesions were located more precisely at the:

- Thoracic in 20 cases (33.90%);
- In the spine, 17 cases (28.81%);
- Of the pelvis in 14 cases (23.73%);
- Of the sternum in 8 cases (13.56%).

3.5.3. Types of Bone Lesions on Scintigraphy (Figure 11)

In our series, the scintigraphic appearance of breast cancer bone metastases was dominated by hyperfixation lesions in 58 cases, *i.e.* 98.31% (**Figure 7** and **Figure 8**); only 1 case of mixed lesion was noted, *i.e.* 1.69% (**Figure 9**).

No exclusive hypo-fixation lesions were found.

3.5.4. Quantification of Bone Lesions (Figure 12)

In our study, the spread of bone lesions from breast cancer was quantified according to Soloway's classification and we found:

- 83 cases (58.45%) of absence of breast cancer bone metastasis or Soloway grade 0;
- 16 cases (11.27%) of poorly disseminated breast cancer or Soloway grade I;
- 11 cases (7.75%) of intermediate dissemination of breast cancer or Soloway grade II;
- 22 cases (15.49%) of extensive breast cancer metastasis or Soloway grade III;
- 10 cases (7.04%) of diffuse or extensive breast cancer metastasis or Soloway grade IV.

3.5.5. Bone Scan (BS) and TNM Stage

- **SO and Stade T**

Tumour size T4 was the most common, accounting for 80.99% of cases, followed by T3 in 15.49% of cases (**Figure 13**).

In our series, T tumour classification correlated well with positive bone scans, with a correlation coefficient of r = 0.9.

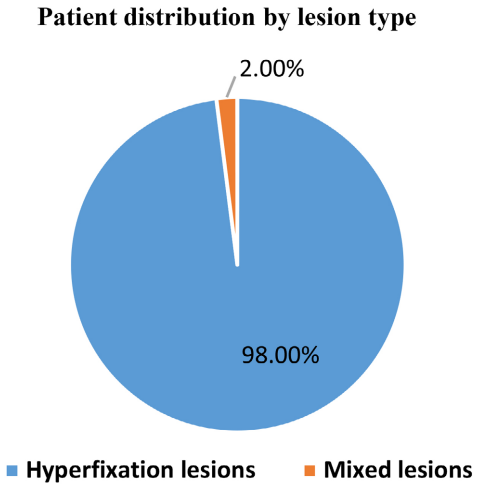

Figure 11. Patient distribution by lesions type.

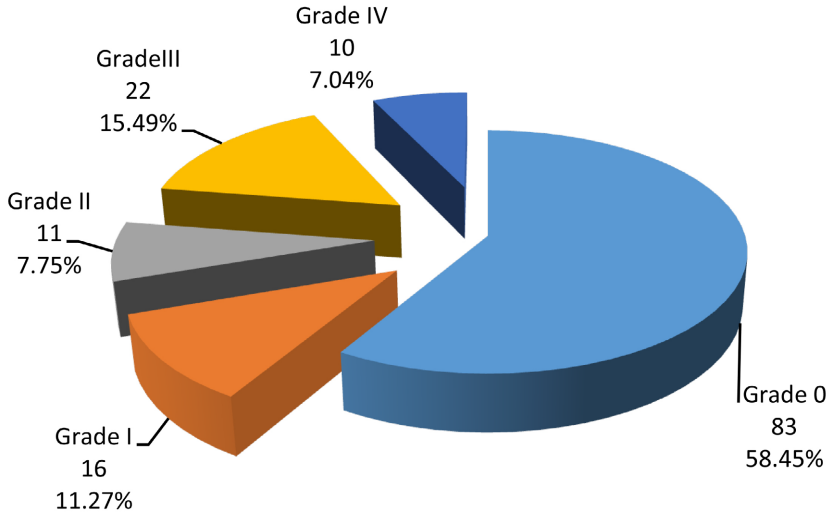

Figure 12. Quantification of bone metastases according to Soloway grade.

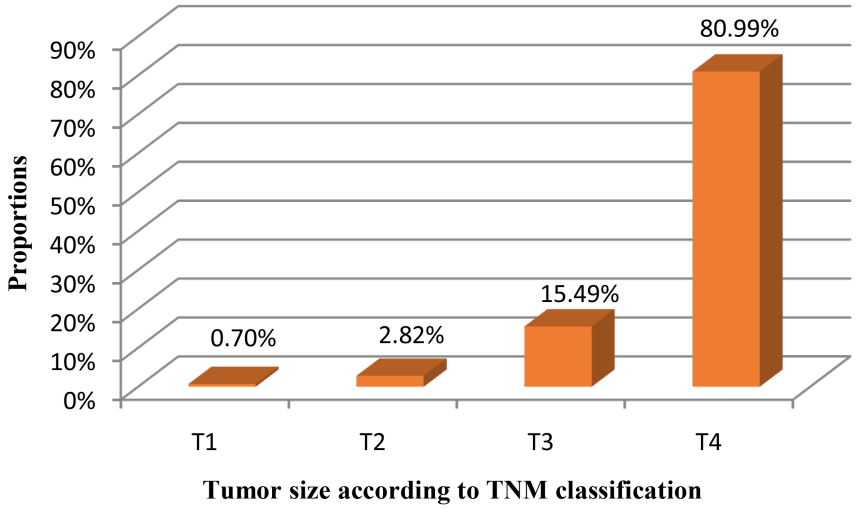

Figure 13. Distribution of patients by tumour size using TNM classification.

We found that scintigraphy positivity increased progressively with tumour size (Table 1).

- **SO and Stade N**

Unilateral adenopathy was present in 45.07% of cases (Figure 14).

In the following table (Table 2) comparing bone scans according to N stage, we found that positive bone scans were more numerous than negative bone scans, the more severe the lymph node involvement. However, the absence of lymph node involvement did not totally rule out bone involvement. Indeed, we found 5 out of 32 cases of positive bone scan at stage N0.

- **SO and Stade M**

Local metastases were more common, accounting for 86.62% of cases (Figure 15).

In the table comparing bone scans according to M stage (Table 3), we noted that the majority of patients (123/142) who underwent bone scans were in MO stage.

Table 1. BS results according to tumour size (TNM classification).

Tumour size (TNM classification)	Positive BS	Negative BS	Questionable BS	Total
T1	**0**	1	0	1
T2	**3**	1	0	4
T3	**12**	18	2	22
T4	**44**	62	9	115
Total	**59**	72	11	142

Table 2. Bone scintigraphy results according to Lymph node status (TNM classification).

Lymph node status	Positive BS	Negative BS	Questionable BS	Total
Nx	0	4	0	4
N0	5	25	2	32
N1	16	16	4	36
N2	32	27	5	64
N3	6	0	0	6
Total	59	72	11	142

Table 3. BS results according to metastatic status (TNM classification).

Metastatic status	Positive BS	Negative BS	Questionable BS	Total
Mx	7	6	0	13
M0	48	64	11	123
M1	4	2	0	6
Total	59	72	11	142

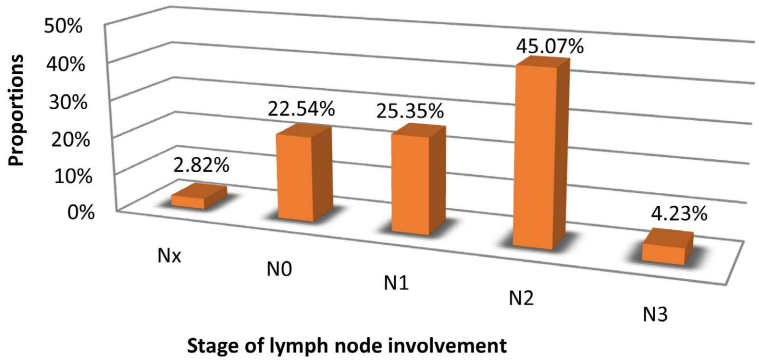

Figure 14. Distribution of patients by lymph node status (TNM classification).

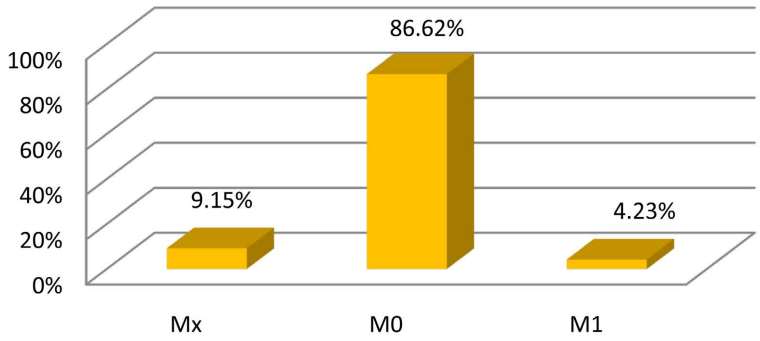

Figure 15. Distribution of patients according to TNM classification metastatic status.

Moreover, in stage M1, the number of positive bone scans was greater than the number of negative bone scans. The same was true for stage Mx.

4. Discussion

The limitations of our study are essentially linked to its retrospective nature, with data sometimes missing and details that should have been collected for a more exhaustive and in-depth analysis.

Breast cancer is a highly heterogeneous and complex disease, with over 90% of deaths caused by distant metastases [8].

Bone scintigraphy is an essential part of oncology disease management.

Numerous studies have demonstrated the value of bone scintigraphy as a conventional work-up for the evaluation of metastatic disease, which has become a routine procedure for detecting metastatic bone lesions and monitoring response to treatment [9].

However, it is tending to be replaced by fluorodeoxyglucose (FDG) positron emission tomography (PET) coupled with computed tomography (CT), which has become the most widely used examination in the initial extension assessment of breast cancers from cT2N1 or cT3Nx stages, in cases of suspected or proven recurrence, and in the evaluation of response to neo-adjuvant and adjuvant systemic treatments [10].

But the most important aspect remains the early detection of breast cancer metastases, with the aim of improving prognosis.

- **The sex**

Our study population was exclusively female. Our results are in line with those of Diop O. *et al.* [11], who noted female exclusivity in their study. The study by Bakhali H. *et al.* [12] also concerned only a population of 30 women.

In the same vein, Colombié M. [13] had identified the female sex as the most important risk factor for breast cancer, and Granier P *et al.* [14] had also specified that breast cancer was the most common cancer in women.

However, it can occur in men in less than 1% of cases, as reported in studies by Mousseau M. *et al.* [15] and Hali Fouzia *et al.* [16]. The study by Mahjoub N. *et al.* [17] found that 99.1% of cases were female, and only 0.9% male.

Camara MA *et al.* [18] found that 97.73% of his patients were female.

The rarity of male breast cancer can be explained by the atrophic nature of the mammary gland, the thinness of the milk ducts, the absence of acini and the abundance of fibrous tissue in men.

- **Age**

Age is the most important risk factor for breast cancer. Breast cancer is rare (around 10%) in women under the age of 30, and the risk increases between the ages of 50 and 75 (nearly 20% or even 2/3 of breast cancers) [19] [20].

The age at which breast cancer is discovered differs according to the populations studied. In developing African countries, the age of discovery is often younger than in developed countries, where breast cancer is a postmenopausal cancer [19].

In our study, the mean age of discovery of breast cancer was 46.6 years.

Our results are practically similar to those of Diop O *et al.* [11], who found a mean age of 46.9 years; Aouad L [21] found a mean age of 45.76 years in his study.

Camara MA *et al.* [18] in Mali also found an average age of 49. Malian studies by Safini F *et al.* [22], Mhamdi F *et al.* [23] found an average age of 49; Chatti K *et al.* [24] found an average age of 42.

On the other hand, other European studies have found a much older average age, in older women, such as those by Mousseau M. *et al.* [15]; Colombié M. [13] reported an average age of 61, and Mayi T. [25] also found an average age of onset of 60.

In America, the study by Gordon P. Watt [26] and Hendrict RE [27] found a median age at first diagnosis of breast cancer of 55 for black women, 53 for Hispanic women and 54 for Asian women, compared with 58 for white women and 56 for North American Indians/Alaska Natives. Similarly, the study by Howlader N [28] found that the median age at diagnosis of breast cancer among women in the USA was 63; and the median age at diagnosis for black women was 60, compared with 64 for white women.

This can be explained, on the one hand, by the inversion of the age pyramid with a younger population in our developing regions and, on the other hand, by the heterogeneity and complexity of breast cancer.

- **Location of breast cancer**

The location of the primary tumour was unilateral in 91.55%, with 55.23% on the right and 45.77% on the left. Among the 59 cases showing bone metastases on scintigraphy, breast cancer was unilateral in 46 cases (77.97%), including 24 cases (52.17%) on the right and 22 cases (47.83%) on the left.

This predominance in the right breast was noted in the study by Diop O. *et al.* [11], who found 62.5% in the right breast versus 32.5% in the left; identical in the study by Lamya A. [21], who found 52.1% in the right breast.

Our results are not in line with those of Bakkali H *et al.* Bakkali H *et al.* [12], who found that the left breast was the most affected. Other studies carried out in Oran found no preference for the site of breast cancer.

- **Histological type of breast cancer**

Invasive ductal carcinoma was the most common histological type (97.18% of cases). Among patients whose scintigraphy showed bone metastases, 57 cases (96.61%) were of the infiltrating ductal carcinoma (IDC) type. H. Bakkali *et al.* [12] found 90% of cases to be infiltrating ductal carcinoma; Chatti K *et al.* [24] in Tunisia confirmed that the most frequent histological type was infiltrating ductal carcinoma (96%); Lamya Aouad [21] in Senegal found 72.9% of IDC.

- **SRB grade**

Grade SRB2 was more common (61.97% of cases), followed by grade SRB3 in 32.39% of cases. These results are in line with those of Chatti K. *et al.* [24], who found SRB2 and SRB3 grades in 81% of cases. In contrast, Loubna Bouggana [29] found grade 2 in 10.1% of cases and grade 3 in 8.9%; Aouad L [21] found grade SRB1 in 5 patients (5.2%), grade SRB2 in 24 patients (25%) and grade SRB3 in 12 patients (12.5%).

- **Scintigraphy as part of pre-therapy assessment or follow-up assessment**

The presence of bone metastases has a direct impact on a patient's survival and quality of life, and consequently on their therapeutic management. Metastatic bone cancer is a frequent and severe complication of advanced disease. It affects up to 70% of patients with breast cancer [30]. Whole-body bone scintigraphy is widely used for the detection of bone lesions, as it is considered to have a high sensitivity for the visualization of both osteolytic and osteoblastic bone metastases [30].

In our study, whole-body bone scintigraphy was performed in 134 cases (94.37%) for therapeutic monitoring and in 8 cases (5.63%) as part of the pre-therapeutic assessment.

Our results are in the same order as those found in Tunisia, with Chatti K. *et al.* [24] who reported that the most requested examination for the evaluation of metastatic treatment (100%) was planar bone scintigraphy. Similarly, Camara MA [18] found that 34.09% of BS cases were carried out in the pre-therapeutic phase, compared with 64.01% for breast cancer surveillance.

- **Bone scintigraphy results**

- **Contribution of bone scintigraphy**

In our study, 131 patients (92.25%) had a contributory bone scan, of which 72

(50.70%) were normal and 59 (41.55%) were positive or had bone metastases; 11 (7.75%) had a non-contributory or doubtful scan.

Our results appear to be similar to those of Taourel P. *et al.* [31] who, in a series including 784 patients with advanced breast cancer, found 48% of cases with bone metastases. The study by Mhamdi F *et al.* [23] showed 57 scans with secondary bone localization, compared with 18 normal cases. The study by Diop O *et al.* [11] found that the examination was contributive in 95% of cases (positive in 12 patients (30%); negative in 26 patients (65%)) and indeterminate in 5% of cases. The study by Granier P. *et al.* [14] of 267 bone scintigraphy abnormalities assessed bone location as precise in 29 cases, probable in 129 and disputed in 109.

Some authors have reported higher proportions of patients with bone metastases than in our study. Indeed, Schroeder H. *et al.* [32] stated that the primary site of breast cancer metastases was bone, and noted that 77% (n = 20) of patients had bone metastases at the time of diagnosis; the study by Safini F. *et al.* [22] found 61 patients, or 72%, with bone metastases.

On the other hand, Francon T *et al.* [33] reported lower proportions of bone metastases: 37% of cases (22/60) with suspected malignant foci, compared with 63% of cases (38/60) with undetermined foci; similarly, Abedi SM [34] found 19 cases (23.25%) with abnormal ^{99m}Tc-MDP fixation among 80 bone scans.

We can testify to the high sensitivity of SO in the early detection of bone metastases, as described in the literature. Indeed, Giammarile F. [35] noted a sensitivity of 95%, Costelloe CM *et al.* [36] and Paycha F [7] a sensitivity close to 100% in the search for bone metastases.

- **Seating and quantification of bone locations on scintigraphy**

In our study, almost all patients had multiple sites, *i.e.* 57 cases (96.61%), and only 2 cases (3.39%) had a single or solitary site.

These bone lesions were quantified according to the Soloway [37] classification in 83 cases (58.45%) as grade I or no bone metastases; 16 cases (11.27%) as grade II or low breast cancer spread; 11 cases (7.75%) grade III or intermediate breast cancer spread; 22 cases (15.49%) grade IV or extensive breast cancer metastasis; and 10 cases (7.04%) grade V with diffuse or very extensive breast cancer metastasis.

In contrast, the study by Ndong *et al.* [38] found grade I: 3/15 patients (20%); grade II: 9/15 patients (60%); grade III: 3/15 patients (20%) and grade IV or super scan: no patients.

Multiple localizations were both axial and appendicular in 31 cases (54.39%); axial in 16 cases (28.07%); axial, cranial and appendicular in 10 cases (17.54%).

We thus observed a strong axial predominance, superimposed on the results of the literature. Axial secondary bone lesions were located more precisely in the thorax in 20 cases (33.90%), the spine in 17 cases (28.81%), the pelvis in 14 cases (23.73%) and the sternum in 8 cases (13.56%).

Our results are almost identical to those of Biyi A D *et al.* [39] (22), who noted a strong axial predominance in 80% of cases. The study by Paycha *et al.* [7]

found metastases in the dorsolumbar spine in 50%, the costal gril in 20%, the pelvic girdle in 15% and the sternum in 10%. Similarly, the study by Ndong *et al.* [38] noted a predominance of spinal locations (66.66%), costal crest (58.33%), pelvis (33%) and skull (17%).

The study by Biyi A. D. [39] reported that the dorsal spine and costal grill were the sites most affected by bone metastases.

Granier P *et al.* [14] found 88% of bone metastases in the dorsolumbar spine and pelvis.

The study by Francon T *et al.* [33] found foci located on the axial skeleton in 90% of patients (54/60) and on the peripheral skeleton in 10% (6/60).

On the other hand, the Franson T *et al.* [33] study found 10.5% of cases presenting an isolated focus, *i.e.* 60 patients out of 572.

Bone metastases from breast cancer most often occur in the axial skeleton and proximal ends of the diaphysis of long bones. The most commonly affected sites are the lumbar and thoracic spine, pelvis, ribs, sternum, femurs, humerus and skull. Distal bone metastases are rarer [40]. The most common sites of single metastases from breast cancer are the sternum (34%), pelvis (18%), thoracic spine (16%), lumbar spine (10%), ribs (7%), pelvis, skull and femur [41].

This axial preference is due to high local osteoblastic activity and abundant local blood flow to the constantly renewing bone matrix.

- **Types of bone lesions on scintigraphy**

Bone metastases from breast cancer are classified into three groups according to their appearance: osteolytic, osteocondensing and mixed. However, bone scintigraphy is more sensitive in detecting purely condensing lesions [42] [43].

In our series, the scintigraphic appearance of breast cancer bone metastases was dominated mainly by hyperfixation lesions in 58 cases (98.31%), with only 1 case of a mixed lesion (1.69%).

Our results are similar to those of Ndiaye M [44], who also found a 75% predominance of hyper-fixing lesions among patients with bone metastases.

Diop O *et al.* [11] who also reported that the scintigraphic appearance of bone metastases always showed bone hyperfixation of the radiotracer.

In the same vein, Mahfouz H [45] stated in his study that bone metastases observed in breast cancer were predominantly hyper-fixating.

- **SO and TNM classification**

In our series, bone scintigraphy correlated well with tumour T stage, with a good correlation coefficient (r = 0.9). There was a progressive increase in scintigraphy positivity with tumour size.

Safini F. *et al.* [22] also reported that the frequency of metastases increased with tumour size, lymph node status and disease stage.

Indeed, the study by Safini F. *et al.* [22] found no metastases in patients with clinical stage I disease, 14.5% of patients with clinical stage II disease had metastases, compared with 19.3% of patients with clinical stage IIIA disease, 53% with clinical stage IIIB disease and 13.2% with clinical stage IIIC disease.

Houssine Boufetta *et al.* [46], in a retrospective study of 22 cases of bilateral synchronous breast cancer in a Maghreb country, found that patients with T3 or T4 tumours were nine times more likely than others to develop metastases.

Several other authors have reported an effect of tumour size on the risk of developing bone metastases, with larger tumours presenting a higher risk [47].

Wei *et al.* found that tumours with bone metastases only had a mean size of 2.8 cm compared with tumours without bone metastases, which had a mean size of 1.8 cm [17] [48].

Yamashiro H *et al.* [49] had shown that patients with T2 tumours had a high risk (HR) of 2.02 of being free of bone metastases, compared with patients with T3 (HR = 4.14) or T4 (HR = 6.40). Nevertheless, when considered in a multifactorial analysis, tumour size did not systematically increase the risk of bone metastases in a statistically significant way.

In contrast, a Japanese study of 9652 breast cancer patients showed no relationship between tumour size and the development of bone metastases [50]. As such, tumour size did not appear to be a major factor in the development of bone metastases [48].

Like tumour stage, lymph node involvement is also a known risk factor for metastasis in breast cancer patients [51].

In our study, we found that positive bone scans outnumbered negative ones as lymph node involvement became more severe. However, the absence of lymph node involvement did not totally rule out bone involvement. Indeed, we found 5 cases out of 32 of positive BS at stage N0.

In contrast, other studies showed no significant relationship between lymph node metastases and the risk of bone metastases in breast cancer patients [52]. Although it may be a factor contributing to the risk of bone metastases, lymph node metastases do not appear to play a dominant role over others such as intrinsic subtype [47].

The isotopic sentinel node technique is a key element in the evaluation of axillary lymph nodes [53].

The EANM and SNMMI, in their best practice guidelines for lymphoscintigraphic localization of the sentinel lymph node in breast cancer, have specified that the current indication for SPECT/CT includes: non-visualization of the sentinel lymph node on conventional planar imaging, patient obesity, presence of the sentinel lymph node extra-axillary, or drainage that is otherwise difficult to characterize (multiple drainage sites, visualization of the lymph node chain) [54].

5. Conclusions

Bone scintigraphy has enabled good post-therapeutic monitoring of cancer in our current context. In oncology, bone scintigraphy remains the basic examination for detecting and assessing the extent of bone metastases. It has the advantage of enabling a global study of the entire skeleton in a single examination, at the price of a favourable dosimetric cost. Added to this is the excellent sensitivity

of OS, evaluated at 100% in many studies. Indeed, OS can detect bone lesions earlier than CT, even at sub-clinical or asymptomatic stages. However, the main drawback of OS remains its limited specificity, which is why it should be coupled with CT (SPECT-CT or SPECT-CT).

Today, it is the nuclear exploration technique available for the proper management of bone metastases from breast cancer in Senegal. In developed countries, bone scintigraphy is increasingly giving way to PET/CT, a nuclear medicine oncology imaging technique that combines the functional information of PET with the morphological information of CT.

Improved nuclear imaging facilities in Senegal (SPECT/CT and PET/CT), improved diagnostic performance with a reduction in doubtful cases and appropriate patient management.

Conflicts of Interest

None.

References

[1] CIRCA: Centre International de recherche sur le Cancer (2020) Rapport sur l'observatoire international sur le cancer. Lyon.

[2] Chlebowski, R.T., Aragaki, A.K. and Pan, K. (2022) Breast Cancer Prevention and Breast Cancer Mortality. *JCO Oncology Practice*, **18**, 522-523. https://doi.org/10.1200/OP.22.00091

[3] OMS: Organisation Mondiale de la Santé (2021) Cancer du sein.

[4] Ban, J., Fock, V., Aryee, D.N.T. and Kovar, H. (2021) Mechanisms, Diagnosis and Treatment of Bone Metastases. *Cells*, **10**, Article 2944. https://doi.org/10.3390/cells10112944

[5] Łukaszewski, B., Nazar, J., Goch, M., Łukaszewska, M., *et al.* (2017) Diagnostic Methods for Detection of Bone Metastases. *Contemporary Oncology,* **21**, 98-103. https://doi.org/10.5114/wo.2017.68617

[6] Talbot, J.N., Paycha, F. and Balogova, S. (2011) Diagnosis of Bone Metastasis: Recent Comparative Studies of Imaging Modalities. *The Quarterly Journal of Nuclear Medicine and Molecular Imaging*, **55**, 374-410.

[7] Paycha, F. and Richard, B. (2001) Exploration scintigraphie du squelette. *Encyclopédie Medico Chirurgicale*, **30**, 480-490.

[8] Seyfried, T.N. and Huysentruyt, L.C. (2013) On the Origin of Cancer Metastasis. *Critical Reviews in Oncogenesis*, **18**, 43-73. https://doi.org/10.1615/CritRevOncog.v18.i1-2.40

[9] Vaz, S.C., Oliveira, C., Teixeira, R., Arias-Bouda, L.M.P., *et al.* (2023) The Current Role of Nuclear Medicine in Breast Cancer. *British Journal of Radiology*, **26**, Article ID: 20221153 https://doi.org/10.1259/bjr.20221153

[10] Rong, Y., Ren, H. and Ding, X. (2019) MRI and Bone Scintigraphy for Breast Cancer Bone Metastase: A Meta-Analysis. *Open Medicine*, **14**, 317-323. https://doi.org/10.1515/med-2019-0029

[11] Diop, O., Ndong, B., Bathily, E.A.L., Sow Diop, W., Senghor, R.S., *et al.* (2014) Place de la scintigraphie osseuse dans le bilan d'extension des métastases osseuses du cancer du sein au Sénégal: Étude préliminaire à propos de 40 cas. *Revu Cames*

Sante, **2**, 57-62.

[12] Bakkali, H., Marchal, C., Lesur-Schwander, A. and Verhaeghe, J.L. (2003) Le cancer du sein chez la femme de 30 ans de moins. *Cancer/Radiothérapie*, **7**, 153-159. https://doi.org/10.1016/S1278-3218(03)00021-0

[13] Colombie, M., Houdebine, S., Meriaux, E., Kraeber-Bodere, F. and Rousseau, C. (2014) Apport de la médecine nucléaire dans le cancer du sein: À propos d'un cas. *Médecine Nucléaire*, **38**, 375-379. https://doi.org/10.1016/j.mednuc.2014.05.003

[14] Granier, P. and Mourad, M. (2008) Evaluation par la TEMP-TDM des lésions classées indéterminées en scintigraphie osseuse chez les patients en cancérologie. *Médecine Nucléaire*, **32**, 266-272. https://doi.org/10.1016/j.mednuc.2007.12.003

[15] Mousseau, M. and Garnier, C. (2002) Cancer du sein: Épidémiologie, bilan d'extension, modalités thérapeutiques. *Médecine Nucléaire—Imagerie fonctionnelle et métabolique*, **26**, 7-15.

[16] Hali, F., Khadir, K.H., Idhammou, W., Bensardi, F.Z., *et al.* (2011) Manifestations cutanées du cancer du sein chez l'homme. *La Presse Médicale*, **40**, e483-e488. https://doi.org/10.1016/j.lpm.2011.04.010

[17] Mahjoub, N., Ben Salem, K., Mokrani, A., Mansouri, H., *et al.* (2021) Epidemiological and Anatomopathological Profile of Breast Cancer in the Region of North-West of Tunisia. *La Tunisie Médicale*, **99**, 441-448.

[18] Camara, M.A., Coulibaly, S., Traoré, M.M., Ndiaye, M., *et al.* (2020) Aspects tomodensitométriques des métastases des cancers mammaires dans le Service d'imagerie médicale du CHU Le Luxembourg. *Jaccr Africa*, **4**, 101-107.

[19] INCA (Institut National du Cancer) (2018) Facteurs de risques du cancer du sein.

[20] Nkondjock, A. and Ghadirian, P. (2005) Facteurs de risque du cancer du sein. *Médecine Sciences*, **21**, 175-180. https://doi.org/10.1051/medsci/2005212175

[21] Aouad, L. (2014) Les métastases du cancer du sein à propos de 96 cas colligés à l'institut Joliot Curie de Dakar. Thèse de Docteur en médecine, FMPO-UCAD, Dakar.

[22] Safini, F., Naqos, N., Bouchbika, Z., Taleb, A., *et al.* (2017) Le bilan d'extension dans le cancer du sein nouvellement diagnostique: Quels examens pour quelles patientes? Centre d'oncologie et radiothérapie, CHU Ibn Rochd, Casablanca.

[23] Mhamdi, F., Guerrouj, H., Elrhoul, M. and Ben Rais, N. (2008) Corrélation entre la scintigraphie osseuse et le taux du marqueur tumoral CA15-3 dans le cancer du sein: A propos de 100 cas. *Médecine Nucléaire*, **32**, 76-84.

[24] Chatti, K., Harrabi, A., Chabchoub, I., Kamoun, T., Sfar, R., *et al.* (2012) Limites de la scintigraphie osseuse dans le suivi des métastases osseuses du carcinome mammaire: Étude du centre tunisien. *Médecine Nucléaire*, **36**, 574-581. https://doi.org/10.1016/j.mednuc.2012.07.008

[25] Mayi-Tsonga, S., Belembaogo, E., Meye, J.F., *et al.* (2009) Les cancers du sein au Gabon: Aspects épidémiologiques, diagnostiques et thérapeutiques. *Journal Afrique Cancer*, **1**, 11-15. https://doi.org/10.1007/s12558-008-0003-y

[26] Watt, G.P., John, E.M., Bandera, E.V., Malone, K.E., Lynch, C.F., Palmer, J.R., *et al.* (2021) Race, Ethnicity and Risk of Second Primary Contralateral Breast Cancer in the United States. *International Journal of Cancer*, **148**, 2748-2758. https://doi.org/10.1002/ijc.33501

[27] Hendrick, R.E., Monticciolo, D.L., Biggs, K.W. and Malak, S.F. (2021) Age Distributions of Breast Cancer Diagnosis and Mortality by Race and Ethnicity in US Women. *Cancer*, **127**, 4384-4392. https://doi.org/10.1002/cncr.33846

[28] Howlader, N., Noone, A.M., Krapcho, M., *et al.* (2021) Breast Cancer-SEER Incidence Rates by Age at Diagnosis, 2014-2018, by Sex, Observed SEER Incidence Rate, All Races (Includes Hispanic). National Cancer Institute. Bethesda. https://seer.cancer.gov/explorer/

[29] Bourgana, L. (2010) Cancer du sein chez la femme jeune. A propos de 178 cas. Thèse de Docteur en médecine, FMPO-UCAD, Dakar.

[30] Bhaludin, B.N., Tunariu, N., Senthivel, N., *et al.* (2022) Does the Addition of Whole-Body MRI to Routine Imaging Influence Real-World Treatment Decisions in Metastatic Breast Cancer? *Cancer Imaging*, **22**, Article No. 26. https://doi.org/10.1186/s40644-022-00464-4

[31] Taourel, P., Cyteval, C., Granier, C., Devaux, M. and Suan, A. (2007) Imagerie de la maladie métastatique dans le cancer du sein. In: *Cancer du sein avancé*, Springer, Paris, 55-66. https://doi.org/10.1007/978-2-287-72615-6_6 https://hal.science/hal-03575123

[32] Schroeder, H., Hanocq, F., Collignon, J., Colin, P.E., Depuis, Z., *et al.* (2015) Cancer du sein: Intérêt du bilan d'extension par imagerie lors du diagnostic initial et du suivi les trois premières années après le diagnostic. *Revue Médicale de Liège*, **70**, 140-147.

[33] Francon, T., Bardet, S., Loiseau, C., Switsers, O., *et al.* (2008) TEMP/TDM et scintigraphie osseuse en cancérologie: Impact d'une acquisition scannographique basse dose chez les patients avec foyer isolé suspect ou de nature indéterminée. *Médecine Nucléaire*, **32**, 273-280. https://doi.org/10.1016/j.mednuc.2008.01.009

[34] Abedi, S.M., Mardanshahi, A. and Zeanali, R. (2021) Added Diagnostic Value of SPECT to Evaluate Bone Metastases in Breast Cancer Patients with Normal Whole Body Bone Scan. *Caspian Journal of Internal Medicine*, **12**, 290-293.

[35] Giammarile, F. (2006) La scintigraphie osseuse. *Médecine nucléaire-imagerie fonctionnelle et metabolique*, **30**, 144-148.

[36] Costelloe, C.M., Rohren, E.M., Madewell, J.E., *et al.* (2009) Imaging Bone Metastases in Breast Cancer: Techniques and Recommendations for Diagnosis. *The Lancet Oncology*, **10**, 606-614. https://doi.org/10.1016/S1470-2045(09)70088-9

[37] Soloway, M.S., Hardeman, S.W., Hickey, D., Raymond, J., *et al.* (1988) Stratification of Patients with Metastatic Prostate Cancer Based on Extent of Disease on Initial Bone Scan. *Cancer*, **61**, 195-202. https://doi.org/10.1002/1097-0142(19880101)61:1<195::AID-CNCR2820610133>3.0.CO;2-Y

[38] Ndong, B., Mboth, M., Mbaye, G., Ndoye, O., Bathily, E.H.A.L., *et al.* (2012) Place de la scintigraphie osseuse dans le bilan d'extension des métastases des cancers de la prostate au Sénégal: Étude préliminaire à propos de 45 cas. *Médecine Nucléaire*, **36**, 586-590. https://doi.org/10.1016/j.mednuc.2012.05.012

[39] Biyi, A., Doudoutt, A., Zekri, A., Caoui, M. and Benrais, M. (2001) Le processus métastatique. *Médecine du Maghreb*, No. 90, 5-10.

[40] Coleman, R.E. (2006) Clinical Features of Metastatic Bone Disease and Risk of Skeletal Morbidity. *Clinical Cancer Research*, **12**, 6243-6249. https://doi.org/10.1158/1078-0432.CCR-06-0931

[41] Iagaru, A. and Minamimoto, R. (2018) Nuclear Medicine Imaging Techniques for Detection of Skeletal Metastases in Breast Cancer. *PET Clinics*, **13**, 383-393. https://doi.org/10.1016/j.cpet.2018.02.002

[42] Israel, O., Goldberg, A., Nachtigal, A., *et al.* (2006) FDG-PET and CT Patterns of Bone Metastases and Their Relationship to Previously Administered Anti-Cancer

Therapy. *European Journal of Nuclear Medicine and Molecular Imaging*, **33**, 1280-1284. https://doi.org/10.1007/s00259-006-0141-3

[43] Withofs, N., Collignon, J. and Hustinx, R. (2011) Imagerie des métastases osseuses du cancer du sein. *Revue Médicale de Liège*, **66**, 291-298.

[44] Ndiaye, M. (2021) Aspects tomodensitométriques des métastases des cancers mammaires dans le service de radiologie du CHUME Le Luxembourg. Master's Thesis, Universitaire de sénologie, Bamako.

[45] Mahfouz, H. (2020) Métastases osseuses du cancer du sein: Revue de la littérature. Thèse de Docteur en médecine, Université Mohamed V de Rabat, Maroc.

[46] Boufettal, H., *et al.* (2015) Cancer du sein bilatéral synchrone au Maroc: Caractéristiques épidémiologiques et cliniques. *Pan African Medical Journal*, **20**, Article 118. https://doi.org/10.11604/pamj.2015.20.118.6136

[47] Pulido, C., Vendrell, I., Ferreira, A.R., Casimiro, S., *et al.* (2017) Bone Metastasis Risk Factors in Breast Cancer. *EcancerMedicalscience*, **11**, Article 175. https://doi.org/10.3332/ecancer.2017.715

[48] IAEA (Agence Internationale de l'Énergie Atomique) (2008) Section Médecine Nucléaire: Critères pour la palliation des métastases osseuses—Applications clinique.

[49] Yamashiro, H., Takada, M., Nakatani, E., Imai, S., *et al.* (2014) Prevalence and Risk Factors of Bone Metastasis and Skeletal Related Events in Patients with Primary Breast Cancer in Japan. *International Journal of Clinical Oncology*, **19**, 852-862. https://doi.org/10.1007/s10147-013-0643-5

[50] Early Breast Cancer Trialists' Collaborative Group (EBCTCG) (2017) Adjuvant Bisphosphonate Treatment in Early Breast Cancer: Meta-Analyses of Individual Patient Data from Randomised Trials. *The Lancet*, **386**, 1353-1361.

[51] Liede, A., Jerzak, K.J., Hernandez, R.K., Wade, S.W., *et al.* (2016) The Incidence of Bone Metastasis after Early-Stage Breast Cancer in Canada. *Breast Cancer Research and Treatment*, **156**, 587-595. https://doi.org/10.1007/s10549-016-3782-3

[52] Diessner, J., Wischnewsky, M., Stüber, T., Stein, R., *et al.* (2016) Evaluation of Clinical Parameters Influencing the Development of Bone Metastasis in Breast Cancer. *BMC Cancer*, **16**, Article No. 307. https://doi.org/10.1186/s12885-016-2345-7

[53] Tafreshi, N.K., Kumar, V., Morse, D.L. and Gatenby, R.A. (2010) Molecular and Functional Imaging of Breast Cancer. *Cancer Control*, **17**, 143-155. https://doi.org/10.1177/107327481001700302

[54] Koizumi, M. and Koyama, M. (2019) Comparison between Single Photon Emissions Computed Tomography with Computed Tomography and Planar Scintigraphy in Sentinel Node Biopsy in Breast Cancer Patients. *Annals of Nuclear Medicine*, **33**, 160-168. https://doi.org/10.1007/s12149-018-1319-z