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CASE REPORT/OLGU SUNUMU

FINDINGS OF EXTENSIVE COSTAL AND STERNAL METASTASIS OF A PATIENT WITH BREAST CARCINOMA BY DYNAMIC, DIFFUSION WEIGHTED AND THREE DIMENSIONAL BREAST MAGNETIC RESONANCE IMAGING

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MEME KARSİNOMLU OLGUDA YAYGIN KOSTAL VE STERNAL METASTAZININ DİNAMİK, DİFÜZYON AĞIRLIKLI VE ÜÇ BOYUTLU MEME MANYETİK REZONANS GÖRÜNTÜLEME BULGULARI

ÖZET

Meme manyetik rezonans görüntüleme (MRG) meme kanserinin lokal evrelemesinde kullanılan yüksek duyarlılık ve doğruluğa sahip bir inceleme yöntemidir. Bu inceleme sırasında başta sternum ve ön kostalar olmak üzere görüntü alanına giren toraks ön duvarı kemik yapıları da görüntülenir. Patolojik kırık oluşmadan, sadece medüller kemik infiltrasyonu bulunan olgularda kosta metastazlarının direkt grafi ve bilgisayarlı tomografi ile görüntülenmesi güçtür. Dinamik meme MRG, meme karsinomunda kortikal destrüksiyon oluşmadan önce kemik metastazını saptayabilir. Özellikle postkontrast substrakte görüntülerden elde olunan multiplanar maksimum intensite projeksiyon (MIP) görüntüler, kemik tutulumunun saptanmasında yararlıdır. Koronal MIP görüntüler kemik kostalardaki infiltrasyonu netlikle gösterirken, metastazın çok nadir olduğu kıkırdak kostaların ise korunması dikkat çekicidir. Kemik metastazı için altın standart olarak kabul edilen kemik sintigrafisine kıyasla meme MRG'de uzaysal rezolüsyon oldukça yüksektir. Meme malignitesi olgularında metastatik tutulumun sık görüldüğü kemik, plevra, periton ve karaciğer gibi oluşumlar meme MRG'de dikkatle değerlendirilmelidir. MIP ve difüzyon ağırlıklı görüntülerin tanısal katkı sağladığı unutulmamalıdır.

Anahtar sözcükler: Meme karsinomu, kemik metastazı, manyetik rezonans görüntüleme, multiplanar maksimum intensite projeksiyon (MIP), difüzyon ağırlıklı görüntüleme

ABSTRACT

Breast magnetic resonance imaging (MRI) is used in local staging of breast carcinoma with high sensitivity and accuracy. During this technique bony structures of the thorax such as sternum and anterior ribs are also evaluated. Direct graphy and computed tomography are not diagnostic in the patients with costal metastasis which have medullary bone infiltration without pathological fracture. Dynamic breast MRI can determine bone metastasis without cortical destruction. Especially multiplanary maximum intensity projection (MIP) images which are obtained from postcontrast substructed images are helpful in determining bone metastasis. Coronal MIP images can show infiltration of bony costas. Chondromateus costas are usually preserved. Bone syntigraphy is accepted as the gold standard for determining bone metastasis, however the spatial resolution of MRI is higher than scintigraphy. In breast carcinoma cases, bone, pleura, peritonum and liver metastasis are seen commonly and these localizations must be evaluated carefully with breast MRI. MIP and diffusion weighted images provide diagnostic contributions.

Key words: Breast carcinoma, bone metastasis, diffusion weighted imaging, magnetic resonance imaging, multiplanary maximum intensity projection (MIP)

Purpose

Bone tissue is the most common localization for metastasis in malignancies. Bone metastasis is seen in 30-85% of patients with metastatic breast cancer (1). Vertebra (thoracal and lomber vertebra, the most common) and costa-sternum-scapula (costa, the most common) sites are the most common bone metastasis regions in breast carcinoma. Because of cellular construction and no vascularization, metastasis is not seen in chondral tissue.

In diagnosing metastasis, direct anatomic imaging of bone and tumor techiques such as plain radiograms, computed tomography (CT) or magnetic resonance imaging (MRI) are used. In indirect diagnostic imaging techniques bone scintigraphy is used (2). Positron emmision tomography (PET) or single photon emission CT are also used in diagnosis. PET-CT is a hybrid imaging technique with high sensitivity. This technique, combines the advantages of anatomic and physiologic imaging. In fact there is still no correct concencus for the most sensitive method used in diagnosis.

Diffusion weighted MRI reflects the mobility of water molecules in vivo. It is basicly used in evaluation of acute cerebral ischemia (3). The basis of this method depends on the discrimination of sitotoxic and vasogenic edema. Because of the decrease of water molecules mobility in metastatic disease, restricted diffusion is seen in diffusion weighted imaging (DWI).

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In this paper, we aimed to offer breast MRI, three dimensionel minimun intensity projection (MIP), DWI, whole body CT and bone scintigraphy findings of a breast carcinoma patient with diffuse microcalcifications and bone metastasis.

Material and methods

A 62-year-old, female patient with weakness, weight loss, diffuse bone pain, and intraabdominal findings was referred to our clinic with the mammograms taken at another center with a primary unknown malignancy prediagnosis. At our imaging center, the patient was examined with breast ultrasonography (US) and breast MRI. Within a conducted research in our clinic, the patient was also evaluated with DWI. DWI was realized with b=0 and b=600 values in axial plan. With the help of software in the work station, "Apparent Diffusion Coeffcient" (ADC) maps and MIP images of three dimensional images of breast and thorax were obtained. In order to evaluate distant organ metastasis, thorax-abdomen CT and bone scintigraphy methods were used.

Findings

There was areolar retraction and and skin thickening in her right breast. In mammograms, multiple clustered microcalcifications were seen but in US examination no focal lesion was seen (Fig. 1a, 1b).

In dynamic MRI and DWI, there were multiple multicentric and multipl multifocal malignant foci. Additionally diffuse assit was examined in the abdomen (Fig 2a, 2b).

In postenhanced images, there were many enhanced foci at the right breast. Sternal and costal enhanced regions compatible with metastasis were also seen (Fig. 3a, 3b).

There were increased signal intensities at the breast lesions, sternum and costa in DWI (Fig. 4) and in ADC mapping decreased signals were observed. These findings were compatible with restricted diffusion. Numerical value was low in comparison with the diffusion decrease (Fig. 5).

In MIP images, arterial prominence with sternal and anterior costal enhancement was determined (Fig. 6).

In thorax-abdominal CT examinations, All the lytic lesions compatible with bone metastasis at the vertebral, costal and sternal regions which were also seen in MRI investigation (Fig. 7, 8a, 8b).

In bone scintigraphy, similar to CT examination, many bone involvement regions were examined (Fig. 9).

After tru-cut biopsy the patient was diagnosed with invasive ductal carcinoma-invasive lobulary carcinoma in situ. With the distant metastasis determined by imaging methods the patient was diagnosed as stage 4 breast carcinoma.

Discussion and result

Even in the first diagnostic stage in breast carcinoma it is accepted that there is systemic spread of the disease in 2/3 of the cases (4, 5). In these cases, skelatal system is the most important region for the first metastasis site. Recently, in determining bone metastasis conventional bone scintigraphy method is commonly used. There are many restrictions in using other imaging techniques. Direct graphies can be diagnostic when there is more than a 50% decrease or increase in the bone density. As a result the diagnosis can be late. By CT investigation, cortical destruction can be

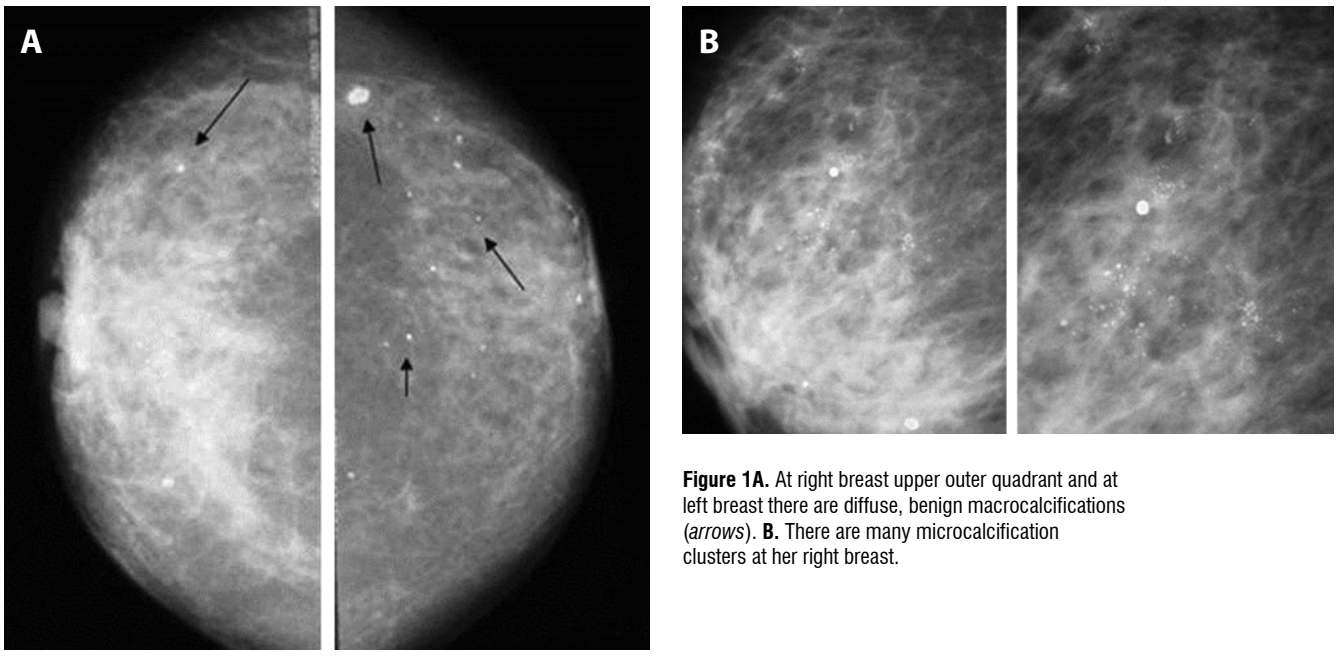
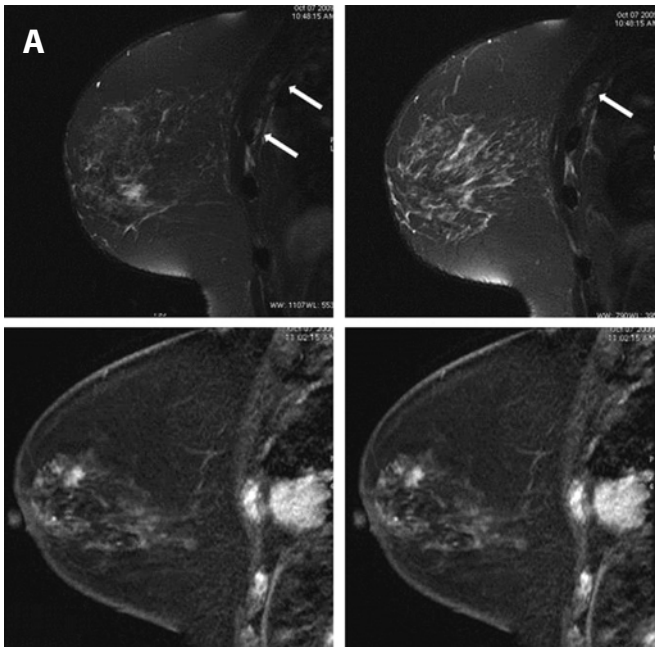


Figure 1A. At right breast upper outer quadrant and at left breast there are diffuse, benign macrocalcifications (*arrows*). **B.** There are many microcalcification clusters at her right breast.



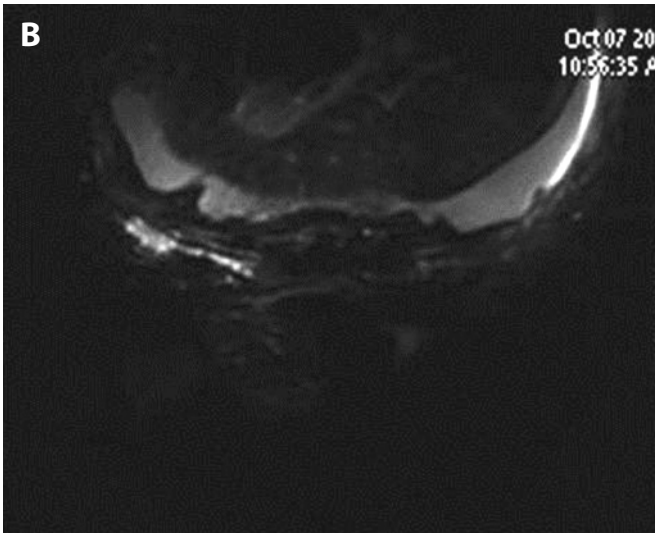


Figure 2A. In fat saturated T2W images, there are signal increases in costas (*Thick arrows*). In post-enhancement images, at the retroareolar region of the right breast, there are many multifocal and multicentric malignant foci.
B. There is diffuse assit in DWI.

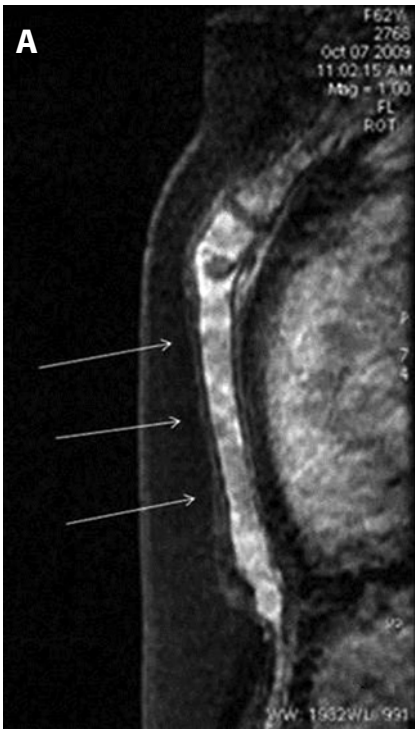


Figure 3a. There are diffuse enhancement competible with metastatic involvement in sternum (*Arrows*).
Figure 3b. There are metastatic involvement regions in costas (*In circles*).

determined early. But this technique is limited in imaging medullary pathologies. Additionally, as a result of unremitting scanning of the whole body, the patient is exposed to high dose radiation. The scanning takes a long time because of the usage of non-spiral devices. With these devices, axial plane imaging can be done. As a result of this, sometimes anatomic orientation can be difficult. Because of these reasons, CT examination is not used in practice (6). Scintigraphic examinations are more sensitive than both of the adjasent techniques used in metastasis determination. So they are used routinely. In fact, spesificity of scintigraphy is low. Sometimes additional imaging techiniques should be used in order to verify the abnormal scintigraphic results as to whetherthey are metastasis or not (6,7).

Figure 4. In b=600 value DWI, there are signal increases in sternum competible with diffusion restriction.

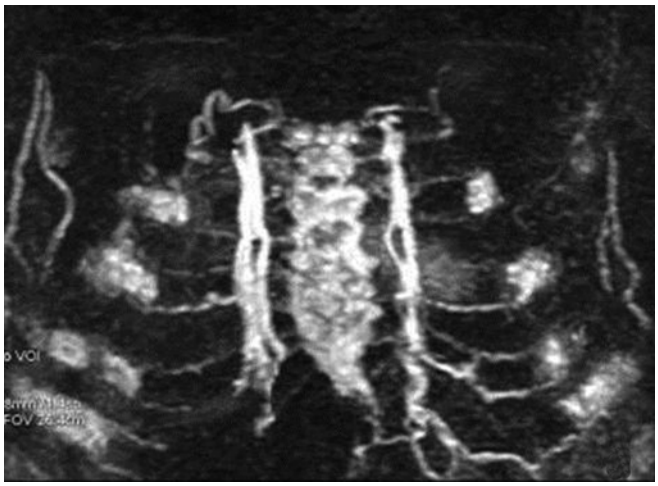


Figure 6. In coronal MIP images, there are metastatic enhancements at sternum and anterior costa, there is prominance in bilateral internal mammarian and intercostal arters.

Previously, because MRI examination used to take a long time and was expensive, it was not used in whole body imaging. But recently, with the technologic developments, use of fast imaging techniques without contrast and spacial resolutions decrease, MRI has begun to be used in whole body examination (6- 8).

Whole body MRI examination has been increasingly used in bone metastasis evaluation, evaluation of tumors with an unknown primary, bone marrow scanning, determination of multiorgan traumas in pediatric group, bone marrow biopsy planning, and metastasis scanning in pregnancy (7). Whole body MRI examination is becoming more common in bone metastasis scanning. Easy application and evaluation are advantages of conventional scintigraphy. But because of low spacial and contrast resolutions there are restrictions in using scintigraphy

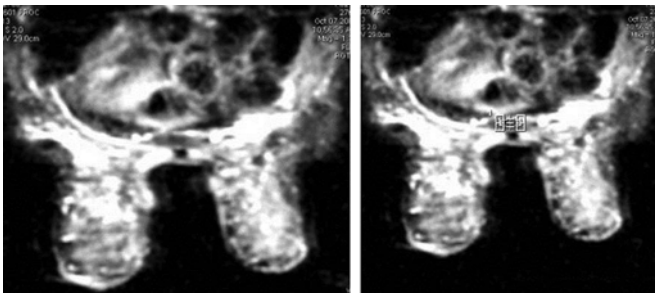


Figure 5. In ADC map, there is signal decrease in sternum competible with diffusion restriction. ADC value is 1.08x x10-3mm²/sec.

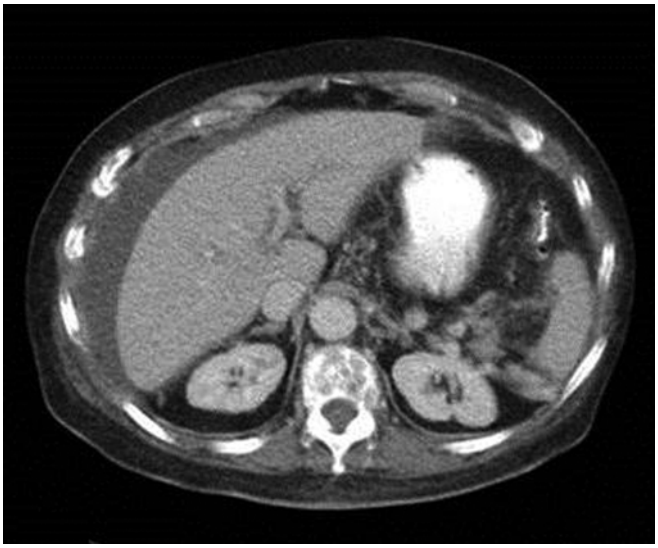


Figure 7. In postenhancement abdominal CT examination, there are perihepatic free liquid and metastatic lytic lesions at vertebras.

for metastasis determination (6, 7). Better spacial and contrast resolution, imaging of anatomic details, direct determination of bone marrow and tumor tissue are the advantages of MRI. These advantages have led the researchers to use MRI for bone metastasis scanning.

In MRI-scintigraphy comparative studies which were done for scanning bone metastasis of breast carcinoma, the sensitivity and spesificity of MRI was found to be higher than scintigraphy (9). Besides the studies arguing that, T2 weighted (W) spin echo and gradient echo sequences are more effective than T1W sequnces (10), there are other studies which argue that STIR sequence is more sensitive than T1W, T2W and gradient echo sequences (9, 11, 12). It is reported that, by using the moving table systems, gradient echo, spin echo and inversion recovery sequences with echo planar imaging the whole body can be examined in short time with MRI (8).

Three dimensional imaging techiques are valuable methods for providing easy anatomic orientation and clear lesion determination in terms of evaluating metastasis.

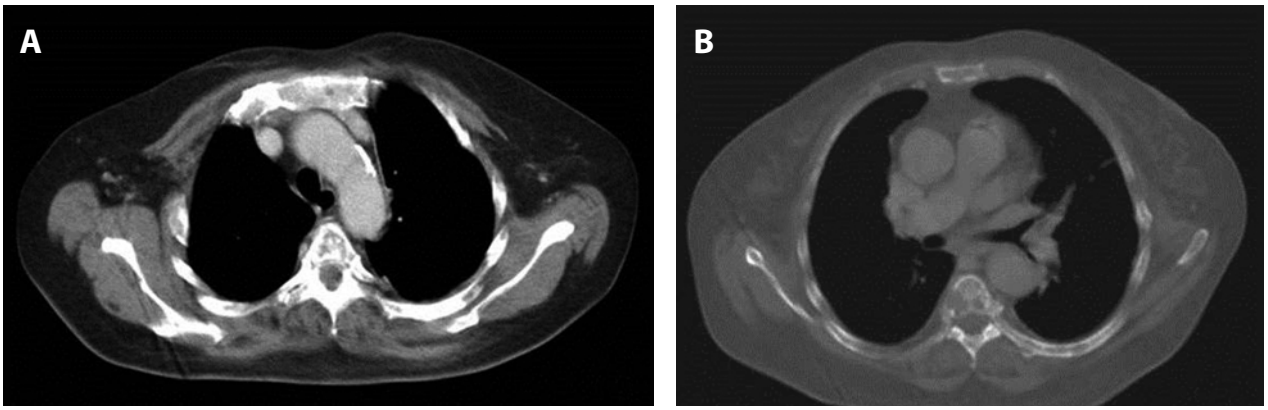


Figure 8. In thorax CT examination soft tissue window (**8A**), bone tissue window (**8B**), there are diffuse lytic bone metastasis at costas and thoracal vertebras.

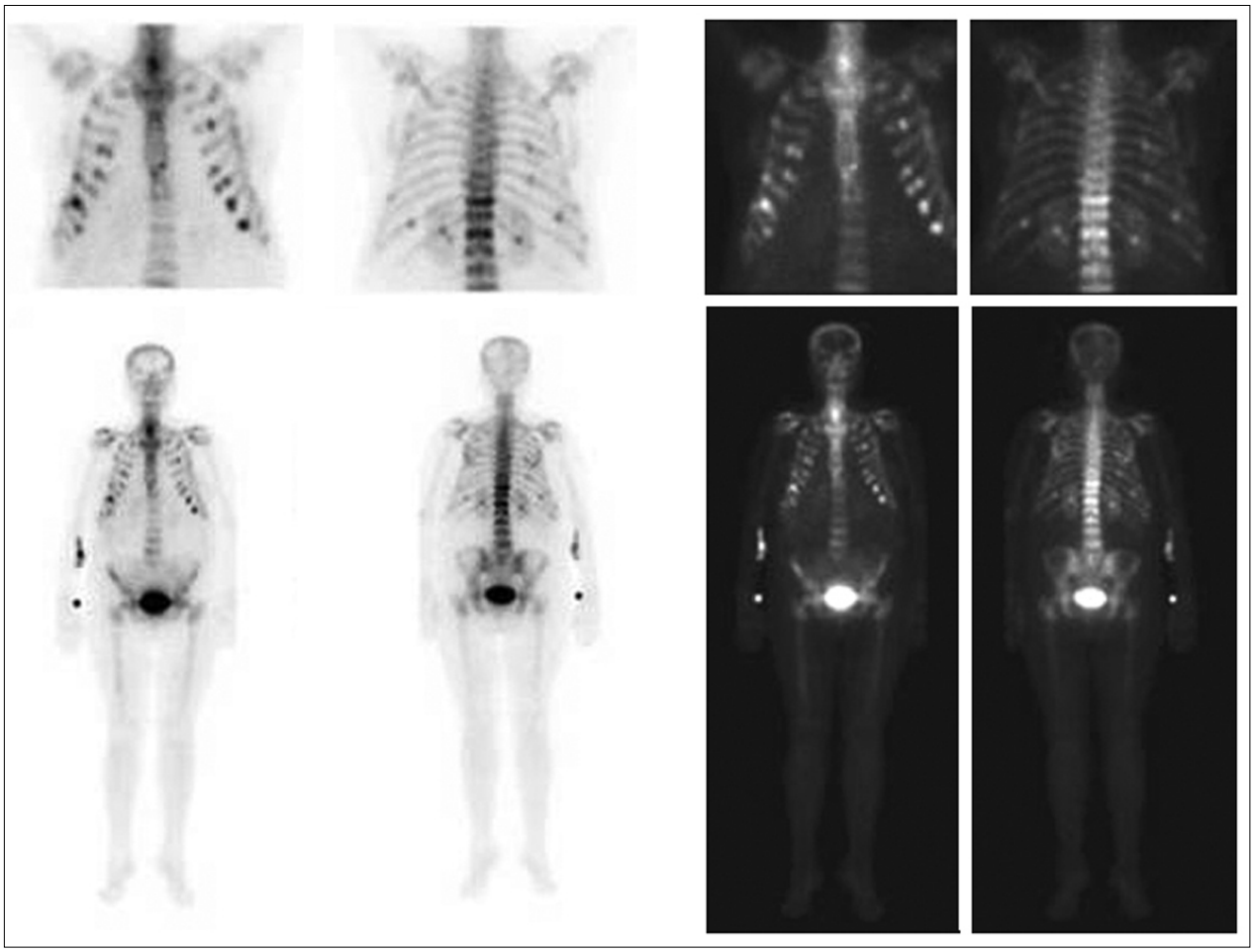


Figure 9. In bone scintigraphy, there are diffuse metastatic involment sites at costas and vertebras.

Diffusion expresses the random movement of water molecules in liquid form with thermal energy. Diffusion of water protons in tissues occur from extracelluar, transmembranal and intracellular water protons. Latour et al., showed that, movements of extracellular water protons are more restrictive than the movements of transmembranal or intracellular water protons (13). Barriers such as cellular organels and lypomembranes restrict water movement. Essentially, ADC value depends on extracellular water protons (13, 14). DWI and ADC value reflect the free movement of water molecules in interstisiel tissue. Acute benign vertebral compression fractures, hemorrhage and edema in vertebral corpus result in an increase in extracellular volume. Signal intensities decrease and ADC values are high. Whereas, in malign vertebral lesions, extracellular volume decreases as a result

of increase of tumoral cellularity. Signal intensities increase and ADC values are low (15).

In our case, in metastasis evaluated by conventional scintigraphy, thorax-abdominal CT, conventional breast MRI, DWI and coronal MIP images were very helpful in determining infiltrations in bony costas clearly. The conservation of chondral costa where metastasis is very rare was remarkable. In DWI, there is prominent diffusion restriction in malignant metastatic lesions. In breast malinancy cases, the tissues such as bone, pleura, peritoneum and liver where metastasis are commonly seen are included in imaging site on breast MRI should be evaluated carefully.

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