

## Chest Ct-Scan Findings in Patients with Multiple Pulmonary Metastases

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### ABSTRACT:

#### BACKGROUND:

Pulmonary metastases are common showing high prevalence in patients with extrathoracic malignancies and a figure of 20-54% is mentioned according to an autopsy study . As many as 90% of patients with lung metastases have a known extrathoracic primary tumor or symptoms of a synchronous primary tumor and chest symptoms are usually absent in patients with multiple metastases (80-95%).

#### AIM OF STUDY:

To elucidate the most common findings detected by chest CT in patients with pulmonary metastases, to be familiar with in the management & follow-up of these patients.

#### METHODS:

The study was conducted on forty-two patients with definite primary extrathoracic malignancies by chest spiral CT(SOMATOM PLUS 4 by Siemens medical systems), those with multiple pulmonary metastatic nodules were selected. Data were collected regarding CT characteristics of the pulmonary nodules and the extraparenchymal chest lesions involving the pleura, lymph nodes and of chest wall bones.

#### RESULTS:

The forty-two patients (twenty-seven females and fifteen males), 81% of them were above forty years. The most common (59.5%) primary tumor was breast carcinoma .All patients had pulmonary nodules enhancing more than 20 Hounsfield units (HU) and (59.5%) of them showed nodule enhancements ranging from 30HU to 50HU.Cavitatng and calcified pulmonary nodules were seen in 9.5% and 2.4% of all patients respectively. Extraparenchymal chest lesions were found collectively in 33.3% of all patients, the most common finding of which were pleural effusion and intrathoracic lymphadenopathy (14.2% and 9.5% respectively), while bone metastases was shown in 7.1% of patients.

#### CONCLUSION:

We concluded that the most common findings detected by chest CT in patients with pulmonary metastases are the enhancing nodules with enhancements of more than 20 Hounsfield units & the extra-parenchymal chest lesions, while other findings like cavitation and calcification are unusual and occur with certain primary tumors.

**KEYWORDS:** Pulmonary Metastases, Multiple Pulmonary Nodules, Chest CT .

### INTRODUCTION:

Pulmonary metastases are common because the entire output of the right heart and the lymphatic system flow through the pulmonary vascular system <sup>1</sup>. The prevalence of pulmonary metastases is high in patients with extrathoracic malignancies & a figure of 20-54% is mentioned according to an autopsy study <sup>2</sup>.

As many as 90% of patients with lung metastases have a known extrathoracic primary tumor or symptoms of a synchronous primary tumor and chest symptoms are usually absent in patients with multiple metastases (80-95%).

The early diagnosis of pulmonary metastases in patients with a known malignancy is critical in the planning of effective therapy, CT is accepted as the state of-the-art modality for detection of possible pulmonary metastases<sup>4</sup>. The hallmark of blood-borne metastases to the lung on imaging is one or more oval or spherical, discrete pulmonary nodules, maximal in the outer portions of the lungs, they vary in size from microscopic to many centimeters in diameter, are usually multiple, and have well or moderately well defined smooth or irregular outlines <sup>5</sup>, but in daily practice, however, unusual radiological features of metastases are frequently encountered that make distinction from other non-malignant pulmonary diseases difficult. These features include; cavitation, calcification, hemorrhage around metastatic nodule, pneumothorax, air-space pattern, tumor emboli,

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endobronchial metastases and solitary mass<sup>4</sup>, this also includes the extrathoracic chest lesions, i.e. lesions involving the pleura, intrathoracic lymph nodes and chest wall bones.

**Chest X Ray (CXR)** is less sensitive than CT and can not routinely demonstrate nodules smaller than 1-1.2 cm in diameter<sup>18</sup>, particularly lesions in the apices, bases & adjacent to the heart, mediastinum, and pleura<sup>1</sup>. **Computed tomography** is currently the most sensitive technique available for the detection of pulmonary metastases because of the better contrast resolution and fewer blind spots. Hematogenous metastases tend to occur in the outer third of the lung & are often subpleural in location, these areas are the most difficult to assess with chest radiograph, in addition, CT can demonstrate disease in the mediastinum, axillae, root of the neck, & upper abdomen<sup>5</sup>.

### PATIENTS AND METHODS:

This prospective study was done in the spiral CT unit in Al-Khadhimia Teaching Hospital from February 2004 to December 2004, a full clinical history was taken & chest X-rays were studied for any features suggestive of pulmonary or extrapulmonary involvement (highly suspicious films were considered as positive ones). The data were collected from forty-two patients all of them have definite extrathoracic primary tumors. All the selected cases are those who have the typical CT features of multiple peripherally located round variable-sized nodules. Patients with solitary pulmonary nodule were excluded from the study. Using the spiral CT unit (SOMATOM PLUS 4

by Siemens medical systems), all patients had performed two sets of chest CT examinations; one without (native) the other with intravenous contrast medium using OMNIPAQUE<sup>TM</sup> (iohexol 350 mgI/ml), a 100ml (or 500mgI per Kg body weight) was given intravenously and manually, as soon as the injection completed (about 30 seconds) the second set of chest CT is performed with scanning time ranging from 20 to 30 seconds. All patients were examined in supine position with caudocranial direction. The protocol used is the built-in examination; kVp=140, mA=159mAs, collimation=5mm. All obtained images were studied in both lung and mediastinal windows. The following criteria concerning the parenchymal nodules were studied: 1-mean enhancement 2-cavitation 3-calcification. The mean enhancement was calculated by measuring the mean density (in Hounsfield units) of at least three pulmonary nodules, noting that small nodules should be electronically magnified before measuring the density to decrease the partial volume effect from surrounding structures. In addition to the parenchymal lesions, extraparenchymal findings regarding pleura, intrathoracic lymph nodes & bones were also studied.

### RESULTS:

The selected forty-two patients; twenty-seven females and fifteen males with female to male ratio of 1.8:1 (figure 1), their age ranged between 20 to 68 years mean age of fifty, 81% of them were older than 40 years (Figure 2).

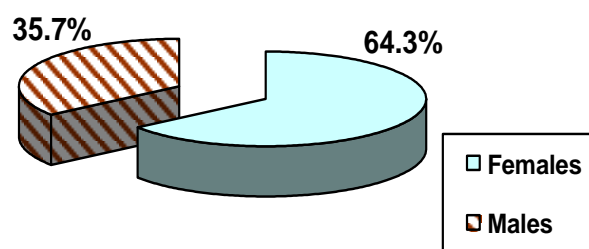


Figure 1: The female to male ratio in patients with pulmonary metastases.

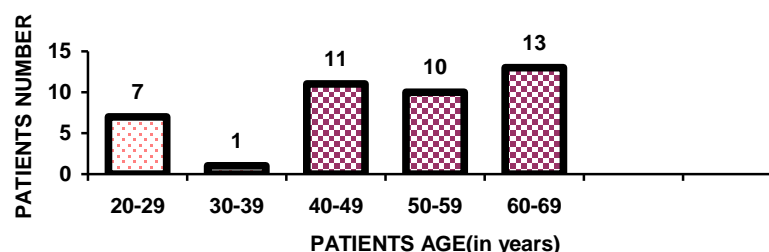
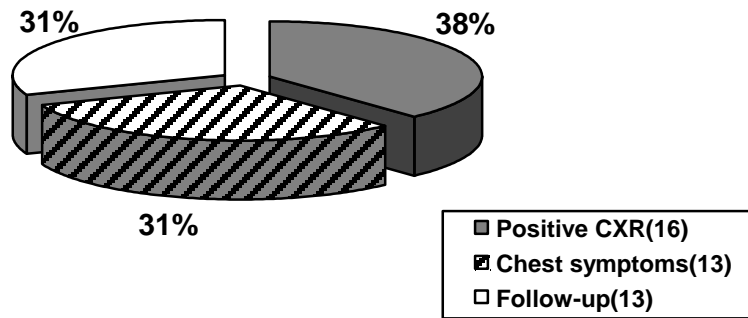


Figure 2: The age distribution of patients with pulmonary metastases.

The causes for referral of these patients to the CT unit showed in figure 3.



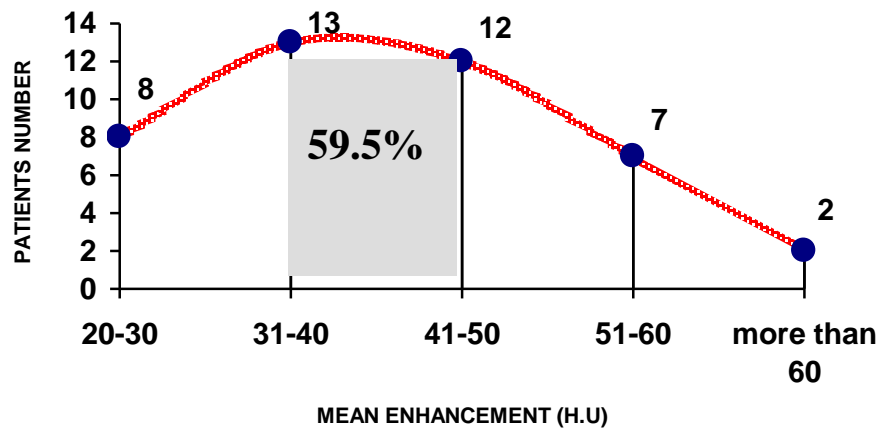
**Figure 3: The referral causes of patients to the CT unit (numbers in brackets representing Number of patients).**

The most common primary tumor was breast carcinoma, which is found in twenty-five patients (24 females and 1 male) (table 1).

**Table1: The relative incidence of primary tumors presented with multiple Pulmonary metastases.**

Primary tumor	Number of patients	%
Breast	25	59.5
Soft-tissue sarcoma	4	9.5
Osteosarcoma	4	9.5
Nasopharyngeal	3	7.1
Renal cell carcinoma	2	4.8
Laryngeal	2	4.8
Ovarian	1	2.4
Testicular	1	2.4
Total	42	

The mean enhancement of pulmonary nodules ranging from 25HU to 65HU, twenty-five patients (59.5%) having mean enhancement ranging from 30-50 HU (figure 4).



**Figure 4: The mean enhancement of metastatic pulmonary nodules.**

Cavitations were identified in four cases (9.5%) and these were; one osteosarcoma, two laryngeal carcinomas and one nasopharyngeal carcinoma, the later three tumors were squamous in histopathology (representing 75% of the cavitating lesions). Calcification was seen in a single case (2.4%), which was an osteosarcoma. Extraparenchymal chest findings were showed in fourteen patients (Figure 5); six of them had pleural effusion, all of them were cases of breast

carcinoma and in only three of them pleural deposits could be identified, while a single case of pleural deposit was presented without effusion, which was a case of breast CA. Hilar or mediastinal LAP was seen in four patients, two of them were breast carcinoma and the other two were testicular seminoma and osteosarcoma. Bone metastases were shown in three patients, all of them were cases of breast carcinoma and all the lesions were osteolytic and multiple.

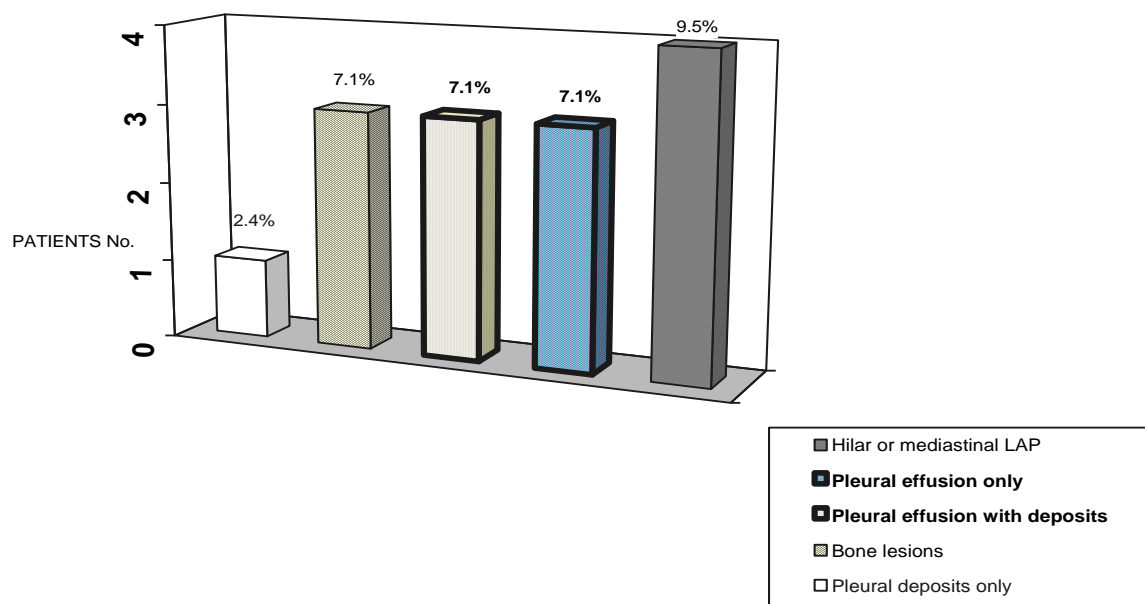


Figure 5: The extraparenchymal chest lesions (percentage relative to the total patients ).

The relative percentage of the findings detected by chest CT in patients with multiple pulmonary metastases shown in figure 6.

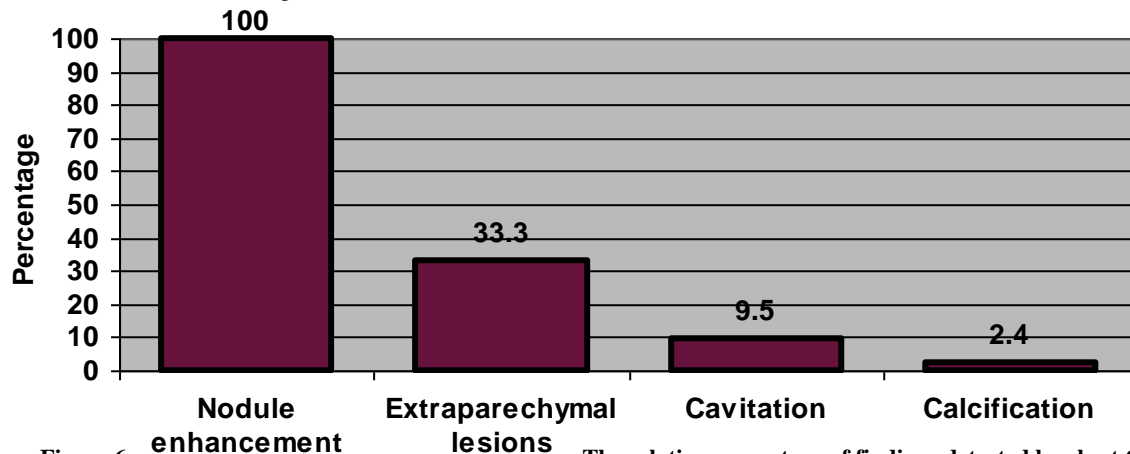


Figure 6: The relative percentage of findings detected by chest CT in patients with multiple pulmonary metastases.

### DISCUSSION:

The most common primary tumor associated with pulmonary metastases was breast carcinoma (59.5%) & this in agreement with different series like Walsh G (1998)<sup>3</sup>, Armstrong P (2000)<sup>5</sup> and Ruben M (1998)<sup>9</sup>, but this high incidence can not be explained only by the prevalence of this tumor in the country but probably by the late presentation & management of these patients, as evidenced by the number of patients who were referred to the CT unit only for routine follow up (31%), while the rest of patients (69%) were referred because their chest radiographs were positive (31%) or developing chest symptoms (31%).

Authors like Davis SD (1991)<sup>20</sup> suggested a routine chest CT follow up regardless of chest radiograph findings, others like Hassan I (2004)<sup>1</sup> recommended chest CT scan every 3-6 months for two years after the diagnosis of primary malignant tumor. We also found that only 38% of all patients with CT-detected metastases had a positive or highly suspicious chest radiograph which means that considering chest radiograph alone in the follow up of patients with malignancy will miss pulmonary metastases in many patients, this is because CT(spiral) can detect nodules as small as 2-3mm, while CXR lower limit for uncalcified nodules is in the range of 7-9mm, on the other

hand, some patients had multiple metastases on their chest radiographs but they were referred to perform chest CT only to confirm the diagnosis, Hassan I(2004)<sup>1</sup> stated that in this condition CT is not recommended for confirmation only but for baseline study for future follow-up.

Another explanation for the high percentage of patients with breast CA in this study, that these patients were relatively healthy at time of diagnosis, so they received more care than patients with other malignancies who were in more advanced age and stage of malignancy.

The ages of most patients (81%) were more than forty years, this is explained by Hassan I (2004)<sup>1</sup> as increasing incidence of common malignant tumors with patients age, though in this study we found 18.4% of patients were young (20-30 years), which is explained by the number of patients with osteosarcoma and testicular seminoma, which are malignancies of young age.

Regarding the enhancement of pulmonary nodules we found that the least enhancing nodule had a mean enhancement of 25HU (nasopharyngeal carcinoma) and twenty-five patients (59.5%) had mean enhancement ranging from 30HU to 50HU, these results were consistent with Swensen S (2000)<sup>21</sup> study, who stated that nodular enhancement of less than 15HU suggests that the lesion is benign, while enhancement greater than 20HU is more likely associated with Malignancy and malignant nodules enhancing significantly more than granulomas and benign neoplasms. Cavitation was identified in four patients (9.5%), while Seo JB (2000)<sup>4</sup> reported an incidence of 4% depending on radiograph study, this means that CT will identify more cavitating lesions.

This study showed that the most common tumor that produce cavitating metastasis is squamous carcinoma (75% of all cavitating metastases), which is comparable to the incidence mentioned by Dodd G (1961)<sup>6</sup> which is 69%. Only one patients (2.6%) showed calcification of pulmonary nodules which was an osteosarcoma while Dahnert W (1999)<sup>7</sup> mentioned an incidence of less than 1%, which means that this finding is unusual in pulmonary metastases<sup>9</sup>.

None of the four cases of osteosarcoma showed pneumothorax, while Hassan I (2004)<sup>1</sup>, mentioned an incidence of 5% of the cases of osteosarcoma may have pneumothorax indicating that this presentation is rare even in osteosarcoma pulmonary metastases. The extraparenchymal chest findings found collectively in fourteen patients (33.3%) and the most common of which is pleural effusion which is found in 14.2% of all patients and this in agreement with Cohen A (1994)<sup>18</sup> who mentioned that the most common manifestation of

pleural metastases is malignant pleural effusion although the underlying focus of malignancy is often difficult to identify but CT is useful in showing small hematogenous lung parenchymal metastases, in our study, in three patients only pleural deposits could be detected which is consistent with what mentioned by McCloud T(1978)<sup>14</sup>, who stated that pleural deposits are often difficult to identify by CT. The most common primary tumor that caused pleural effusion is breast carcinoma which is the same as mentioned by Armstrong P (2000)<sup>5</sup>, on the other hand, a single case (2.4%) presented with pleural deposit without effusion which is less than the incidence mentioned by Meyer P(1966)<sup>12</sup> which was 40% depending on autopsy cases, this could be explained by the relatively late management of our patients that pleural effusion had developed at time of performing chest CT scan. The intrathoracic nodal metastases were found in 9.5% of cases, which is comparable with the findings of Williams M (1987)<sup>13</sup>, who mentioned that parenchymal metastases occur at least ten times as the intrathoracic nodal metastases. Bone metastases were shown in 7.1% of patients which is less than the incidence mentioned by Abrams H (1950)<sup>16</sup> who gave an incidence of 27% of patients, this because his study depended on autopsied patients which mean that they were in more advanced stages of malignancy, in addition that when bone metastasis detected by X rays there is no need for chest CT in staging malignancy. All patients in our study who had bone metastases were cases of breast carcinoma, which is the most common tumor metastasized to the bone in women as mentioned by Watt I(1998)<sup>15</sup>, who also stated that these lesions are predominantly osteolytic, as in our study, we found that all bone lesions were osteolytic and multiple.

### CONCLUSION:

We concluded that the most important findings detected by chest CT in patients with malignancy were the enhancement of pulmonary parenchymal nodules and the presence of extraparenchymal chest lesions, while other findings (cavitation and calcification) were unusual and occurred with certain primary tumors.

Chest CT (especially spiral) is the optimal tool to investigate the chest of patients with malignancy regarding pulmonary metastases detection, surgical planning and follow up. Chest X-ray alone is not sufficient for detection or follow up of these patients, but used as an initial test; if it shows multiple non-calcified metastases then CT is performed to yield a baseline study for future follow up, while if it is negative or shows any other findings then CT is recommended.

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