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Original Research Paper

Radiology

ROLE OF CT ATTENUATION VALUE IN DIFFERENTIATING ENOSTOSIS FROM OSTEOBLASTIC METASTASES.

Kosinipalli Naveen kumar — Resident, Department of Radiology and Imageology, NIMS, Hyderabad.

Sujata patnaik* — Additional Professor, Department of Radiology and Imageology, NIMS, Hyderabad. *Corresponding Author

Rammurti.S — Senior Professor and Head of department, Department of Radiology and Imageology, NIMS, Hyderabad.

ABSTRACT

Aims And Objective: To differentiate Osteoblastic metastases from bone islands using CT attenuation value.

Methods; Enostosis Group: 30 patients between the age group of 10 to 90 years of both genders who underwent thoracoabdominal CT in our department for various etiologies. All lesions are incidentally detected and not pathological. Patients with a known history of malignancy are excluded.

Osteoblastic Metastases: 30 patients with known history of malignancy. The diagnosis of osteoblastic metastases was radiological, confirmed on biopsy, on follow up and compared with previous studies.

Results: In this study mean attenuation of enostosis group is 1218 ±218 HU and mean attenuation of osteoblastic metastases was 707±150 HU. Maximum and minimum attenuation noted in enostosis group was 1480 HU and 880 HU. Maximum and minimum attenuation noted in metastases group was 905 HU and 450 HU.

Conclusion: CT attenuation value can accurately differentiate enostosis and osteoblastic metastases

KEYWORDS : CT attenuation value, enostosis, osteoblastic metastases

INTRODUCTION

An enostosis or bone island represents a focus of mature compact (cortical) bone within the cancellous bone (spongiosa). Typically asymptomatic, the lesion is usually an incidental finding, with a preference for the pelvis, femur, and other long bones, although it may be found anywhere in the skeleton, including the spine[1]. Plain radiography reveals a homogeneously dense, sclerotic focus in the cancellous bone with distinctive radiating bony streaks ("thorny radiation") that blend with the trabecular of the host bone, creating a feathered or brush-like border. There is increased incidence of enostosis because of increased use of CT for diagnostic purposes[1].

Osteoblastic metastases represent sclerotic foci of tumor originating from a distant primary neoplasm, and they may be focal, multifocal, or diffuse. The primary tumors that most commonly cause sclerotic metastases in adults include carcinomas of the prostate, breast, lung, and bladder; and carcinoid and Hodgkin lymphoma. In children, the most frequent primary tumors causing sclerotic metastases are medulloblastoma, neuroblastoma, and Ewing sarcoma. The vertebrae, proximal femur, ribs, sternum, pelvis, skull, and shoulder girdle are involved most commonly, because these areas contain red marrow that persists into adulthood[3].

Enostosis is often a close differential of osteoblastic metastasis. Accurate characterization and differentiation of these lesions are important because these lesions can change staging and treatment plan. There are certain clues to differentiate these entities .since it is not well described in literature we are writing our experience

AIMS AND OBJECTIVES:

To differentiate Osteoblastic metastases from bone islands using CT attenuation value.

MATERIALS AND METHODS:

It is retrospective observational study conducted between April 2018 to April 2020.

Study Population:

Enostosis Group: 30 patients between the age group of 10 to 90 years of both genders who underwent thoracoabdominal CT in our department for various etiologies. These lesions are incidentally detected and not pathological. Patients with a known history of malignancy are excluded.

Osteoblastic Metastases Group: 30 patients with known history of malignancy. The diagnosis of osteoblastic metastases was radiological, confirmed on biopsy, on follow up and compared with previous studies. Patients who received prior radiotherapy or chemotherapy are excluded from study.

CT Aquisition:

Ct examinations were done using 16 slice CT (PHILIPS) and 128 slice CT (SIEMENS SOMOTOM). 20 patients of metastasis group underwent plain and contrast enhanced abdomen studies 10 underwent chest study with following parameters :Slice thickness 5mm , tube voltage -120 kvp , sagittal and coronal reconstructions 2mm with 2mm intervals. 10 patients underwent. Contrast studies were done using iohexol (300mg/ml).

Enostosis were incidentally detected in patients who underwent CT chest (12), CT abdomen (10) and CT spine (8) for other indications with same parameters described above.

Measurement Of Attenuation Values:

All involved bones in both metastasis and enostosis group are examined. In each lesion 4 Hounsfield unit (HU) values were calculated using region of interest (ROI) drawn in four quadrants of lesion and mean attenuation was calculated from the four measurements (figure 1). Average area of attenuation taken was 1mm^2.

Observations And Results:

This study comprised of total 60 cases out of which 30 cases are enostosis and 30 cases are metastases.

Table 1 Showing Distribution Of Study Population As Per Age Incidence In Enostosis Group.

AGE GROUP	NUMBER	PERCENTAGE%
10-20 years	1	3.3
20-30 years	2	6.6

30-40 years	2	6.6
40-50 years	6	20
50-60 years	11	36.6
60- 70 years	5	16.6
70-80 years	3	10
80-90 years	0	0
90-100 years	0	0
TOTAL	30	100

Above table depicts maximum incidence of enostosis were in age group of 50-60 years.

Table 2 Showing Distribution Of Study Population As Per Age Incidence In Metastases Group

AGE GROUP	NUMBER	PERCENTAGE %
10-20 years	1	3.3
20-30 years	0	0
30-40 years	1	3.3
40- 50 years	2	6.6
50-60 years	5	16.6
60- 70 years	15	50
70-80 years	2	6.6
80-90 years	3	10
90-100 years	1	3.3
TOTAL	30	100

Most of the cases of metastases were belonged to age group of 60-70years followed by 50-60 years.

Table 3 Showing Distribution Of Study Population As Per Gender In Enostosis And Metastasis Group

	ENOSTOSIS	METASTASIS
MALES	24	21
FEMALES	6	9

In this study incidence of both enostosis and metastases shows male predominance.

Table 4 Showing Incidence Of Primary Malignancies In Osteoblastic Metastases.

PRIMARY MALIGNANCY	NUMBER	PEERCENTAGE
CA PROSTATE	13	43.3
CA LUNG	7	3.3
CA PANCREAS	2	6.6
CA BRAEST	1	3.3
CA THYROID	2	6.6
GBM	1	3.3
CA OVARY	1	3.3
CA RECTUM	1	3.3
SCC OF THIGH	1	3.3
CA CERVIX	1	3.3
TOTAL	30	100

In this study of 30 cases of Osteoblastic metastases, majority of primary cases were carcinoma prostate (43.3%) followed by carcinoma lung (23.3%) and carcinoma pancreas (6.6%). Least common primary malignancies presenting with Osteoblastic metastases were carcinoma ovary, carcinoma rectum, carcinoma cervix and squamous cell carcinoma of thigh.

Table 5 Showing Order Of Bones Involved In Enostosis Group.

SITE OF INVOLVEMENT	NUMBER	PERCENTAGE	MEAN ATTENUATION (HU)
VERTEBRAL BODY	10	33.3	1206
FEMUR	6	20	1209
PELVIC BONES	5	16.6	1197
POSTERIOR ELEMENTS	4	13.3	1206
HUMERUS	3	10	1225
STERNUM	1	3.3	1451
CLAVICLE	1	3.3	1275
TOTAL	30	100	

Most of the cases of enostosis show single bone involvement (84%), four out of thirty cases (16%) had shown multiple bone involvement. Most common sites of involvement were vertebral bodies (33.3%) followed by head of femur (20%),pelvic bones(16.6%),posterior elements(13.3%),head of humerus (10%).Least common sites of involvement were sternum and clavicle seen in each one case.

Table 6 Showing Order Wise Involvement Of Bones In Osteoblastic Metastases

ORDER OF BONES INVOLVED	MEAN ATTENUATION(HU)
VERTEBRAL BODY	668
POSTERIOR ELEMENTS	789
PELVIC BONES	741
RIBS	750
FEMUR	716
STERNUM	599
SCAPULA	873

In this almost all the cases of Osteoblastic metastasis show multiple bones involvement (93.3%).only two case has shown single bone involvement.

Most common site of involvement was a vertebral body seen in 27 cases followed by posterior elements seen in 15 cases, pelvic bones in 13 cases, ribs in 8 cases, femur in 8 cases, sternum in 8 cases, scapula in 5 cases.

In this study mean attenuation of enostosis group is 1218 ±218 HU and mean attenuation of osteoblastic metastases was 707±150 HU. Maximum and minimum attenuation noted in enostosis group was 1480 HU and 880 HU. Maximum and minimum attenuation noted in metastases group was 905 HU and 450 HU.

Mean attenuation was higher in enostosis group compared to osteoblastic metastases which was statistically significant. ($p<0.005$).

DISCUSSION

We have studied 30 cases of enostosis and 30 cases of osteoblastic metastases.

We found that 36% of cases of enostosis are in the age group of 50 – 60 years and 20% of cases were in the age group of 40 – 50years. Our study findings are similar a study conducted by greenspan et al[1] in which frequency of incidence of enostosis was most common in adults than children.

Most common sites of involvement of enostosis were vertebral bodies (33.3%) followed by head of femur (20%), pelvic bones (16.6%), posterior elements (13.3%), head of humerus (10%). These findings are different to study conducted by greenspan et al[1], in which pelvis, femur and long bones are preferred sites of involvement of enostosis, spine involvement is rare .This may be due to selection of the patients 50% of osteoblastic metastasis are in the age group of 60-70 years followed by 10 % in 50-60 years. This is similar to study conducted by boker sm et al[2], in which mean age group of skeletal metastases is 54.5± 14.3 years.

Out of 30 of our metastases cases majority of primary cases were carcinoma prostate (43.3%) followed by carcinoma lung (23.3%) and carcinoma pancreas (6.6%). Filipa Macedo et al[3] had similar experience and prostate and breast cancers were the most common causes of skeletal metastases.

In our study most common site of involvement of osteoblastic metastases was a vertebral body seen in 27 cases followed by

posterior elements seen in 15 cases, pelvic bones in 13 cases, ribs in 8 cases, femur in 8 cases, sternum in 8 cases, scapula in 5 cases. Our study findings consistent with study conducted by Clain et al[4] in which he reported the highest incidence of skeletal metastases was in the vertebrae (33.5%), pelvis (19.9%), ribs (12.2%), femora (12.3%), skull (6.8%), and humeri (4.7%).

The reason why metastases are common in in vertebrae and pelvis was due batsons venous plexus, which are valve less epidural veins which communicate with abdominal, pelvic, thoracic organs, in raised intraabdominal and intrathoracic pressure causes reflux of blood into these veins, which provide pathophysiology for bony metastases[5].

We observed that mean attenuation of enostosis group is 1218 ±218 HU and mean attenuation of osteoblastic metastases was 707±150 HU with maximum and minimum attenuation noted in enostosis group was 1480 HU and 880 HU and maximum and in metastases group was 905 HU and 450 HU. Mean attenuation was higher in enostosis group compared to osteoblastic metastases which was statistically significant ($p<0.002$).

This study finding was similar to study conducted by sala et al[6], in which two observers took attenuation values from enostosis in 46 patients who underwent thoracoabdominal for trauma and from untreated Osteoblastic metastases in 20 cases of breast, lung, bladder, prostate cancers. They concluded that average density of Bone Island was 1007±122 HU for the first radiologist and 1019±105 HU for the second. The metastases average density measured was 679±156 HU for the first radiologist and 728±196 HU for the second radiologist and cutoff value for differentiating enostosis from untreated osteoblastic metastases was 881 HU with sensitivity of 98%, and specificity 95%.

CONCLUSION:

Osteoblastic metastases are common. When these are focal, it is confused with enostosis. CT attenuation value can resolve the issue to a great extent.

Illustrations:

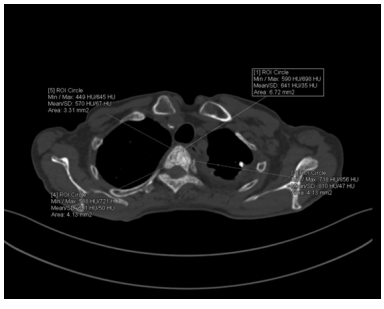

Figure 1: CT attenuation value was taken by drawing ROI in four quadrants of lesion. This is case of vertebral metastases in a known case of prostatic carcinoma.

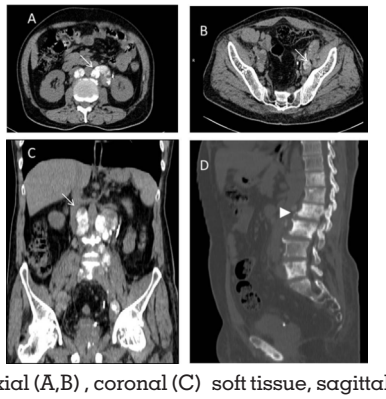

Figure 2: Axial (A,B) , coronal (C) soft tissue, sagittal (D) bone window images of non-contrast CT showing denovo calcified lymph nodal metastases (arrow) and sclerotic skeletal metastases (arrow head) in 78 years old male who is a known case of CA prostate , mean attenuation of metastases measuring 780 HU.

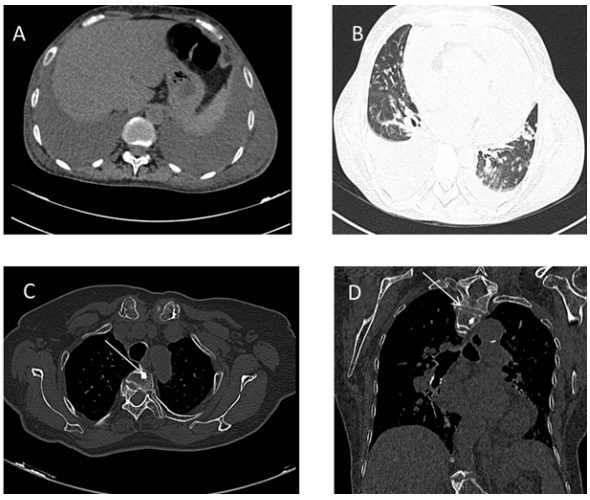

Figure 3: Axial (A,B,C) coronal (D) mediastinal, lung , bone window images of HRCT chest showing incidentally detected bone island in D2 vertebral body (arrow) in 45 year old female, who routinely underwent HRCT for Broncho pneumonia. Mean attenuation bone island was 1250 HU.

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