8) Bone and Bone marrow

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Since 1960, we have been studying the clinical application of the radioisotope in the orthopedic surgical field with the cooperation of the Department of Radiology in this University. We have been aiming at its diagnostic application concerning the diagnosis of the bone tumors, especially of the malignant tumors. So far we have experienced 107 cases of scanning. The following is the summary of our study.

1) Bone (mineral) Scanning:

The following findings are based on the 59 cases of the application of RI.

a) The application for the malignant bone tumors:

Osteogenic sarcoma: The scanning of the cases which showed the abnormal sclerosis as well as the spicula formation in the femur, showed remarkable intake. Histologically the bone forming property was changed remarkable. The case which showed the typical triangle of Codman in the femur showed the eccentric existence of the uptake at the both ends of the tumor. The histological findings were correlated with the scanning picture using the removed specimens.

The uptake of ^{85}Sr was revealed to be small in amount in the following portions, namely the central portion where tumor tissue showing strong dysplasia was densely observed and the extra medullary tumorous portion where the necrotic tissue as well as strongly anaplastic cells were seen without any bone forming picture. On the other hand, the proximal portion which showed the positive scanning with normal X-ray picture revealed the tumor cells with bone formation. On the above stated facts, it can be concluded that scanning is superior to X-ray picture as far as the extent of the tumor is concerned, and that the bone forming picture is closely related to the scanning picture. The uptake of the cases showing the osteolytic type was rather unremarkable. The portion which showed weak uptake showed osteoid formation. We also have the case which showed positive ^{85}Sr scanning even in the stage when no noticeable X-ray findings were noted. This case indicated strongly the possibility of the early diagnosis.

Chondrosarcoma: In the case which had the chondrosarcoma arising in the distal portion of the femur, the positive scanning was observed in the portion of the changed X-ray picture. Histologically the portion revealed the chondrosarcomatous picture with the mixed partly zone neoplastic picture.

Another case showed the accumulation of ^{85}Sr in the sternal region which was difficult to make diagnosis in the ordinary X-ray picture, which indicate the great usefulness of its diagnostic application.

b) The application for the benign bone tumors:

The cases with the giant cell tumor showed the various degree of ^{85}Sr accumulation. The portions showing the uptake was though to be related to the surrounding portion of tumor where reactive new bone formation was observed. No uptake was observed in the case with the fibrous dysplasia of the femur.

In summarizing the above stated results of ^{85}Sr scanning for the bone tumors, the positive scanning was observed in 85% of the malignant bone tumors whereas only 45% of the benign bone tumor cases showed the positive result. It seems that there is an obvious % difference of the positive scanning between the benign bone tumors and the malignant bone tumors. However, the obvious uptake was observed in some of the benign bone tumors, namely, giant cell tumor, benign osteoblastoma, chondroblastoma and chondroma, whereas in some of the malignant bone tumors, namely multiple myeloma and fibrosarcoma, the finding was negative. This fact means that the scanning cannot be an absolute differential diagnostic procedure of the malignant bone tumors from the benign bone tumors.

The scanning also showed a strong tendency of uptake in the inflammatory processes including the ostomyelitis and tuberculous arthritis of the hip.

This is one of the disadvantageous points concerning the tumor diagnosis.

The advantage of the ^{85}Sr scanning in the bone tumor diagnosis lies in the following characteristics namely, it shows the location as well as the extent of the tumor; it is useful in making the diagnosis when the tumor is located in the sternum or pelvis where the ordinary X-ray picture reveals little; it makes for us the chance to reexamine the missed pathology; it may help in making the early diagnosis; it helps to determine the extent of the surgical removal and to make indication for the radiotherapy. It has, however, an limited value in the differential diagnosis between the benign and malignant bone tomors, as well as between the tumors and inflammatory process.

II) Bone-marrow scanning.

We have been studying to develop the bone-marrow scanning in order to go further beyond the limit of the conventional ^{85}Sr scanning since 1964. The isotopes used included ^{198}Au, ^{99m}Tc, ^{113m}In as colloid and the cases studied amounted up to 23 cases altogether. We are going to state mainly the results with ^{198}Au scanning in this paper. With the bone marrow scanning, we can get more information concerning the pelvis, lower lumbar spines and the upper portion of the femur.

Osteogenic sarcoma: The case with the osteogenic sarcoma arising in the acetabular region of the pelvis showed the obvious defect of shadow in ^{198}Au scanning. The extent was broader than the finding with ^{85}Sr.

The specimen which was removed after the partial resection of the pelvis was performed showed the infiltration of tumor cells in the central portion of the tumor itself as well as the surrounding portion of the tumor tissue where ^{198}Au scanning was positive.

Metastatic carcinoma of bone: In the case with the metastatic prostatic carcinoma of pelvis, ^{198}Au scanning revealed a broader pathological finding than that with ^{85}Sr. We have also experienced a case with normal ordinary X-ray findings which showed a broad pathological finding with the scanning picture. In summarizing the above stated findings with the bone-marrow scanning, it would be concluded that, as far as the sites of the application are limited to the pelvis and lower lumbar spines, the ^{198}Au scanning often more effective and diagnostic than the ^{85}Sr scanning. IIt would also make an important direction for surgical as well as radiotherapeuptic treatment, however the qualitative differential diagnosis was still imposible even with this procedure.

III) Angioscanography.

We have been performing the scanning intraarterial M.A.A. injection in the bone tumor cases considering the growth activity of the nutritional vascular system in the bone tumors since September 1966.

One case with the osteogenic sarcoma of the humerus showed a remarkable uptake of M.A.A. with only weakly positive uptake of ^{85}Sr. The histological picture of the case revealed the remarkable pleomorphic sarcoma with prominent vascular formation.

Another case with the bone tumor of the femoral diaphysis showed the weakly positive ^{85}Sr uptake with the remarkable M.A.A. uptake and the histological diagnosis was metastatic hypernephroma, clear cell type. The conventional angiography reveals the macroscopic architecture, whereas the angioscanography reveals the microscopic pattern of architecture. The combination of both methods would be really meaningful.

This method is considered to be the third diagnostic weapon which is quite different from the conventional ones.

Concerning the application for the benign bone tumors, we have experienced only a few cases so far. Those cases with giant cell tumor, fibrous dysplasia, chondroma and osteomyelitis revealed mostly the negative scanning.

Whether the scanning with M.A.A. can be an absolute differential diagnostic procedure between the benign and malignant bone tumors is under consideration on the basis of the above stated facts.