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POST-IRRADIATION INFARCTION OF THE FEMORAL HEAD

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It is widely accepted that irradiation can damage bone, but the exact mechanism by which the process occurs is not fully understood. In those bones which are most frequently affected as a result of heavy irradiation, e.g. the jaw, infection is often superadded and pure radiation changes are difficult to unravel from those of superadded infection.

In bone situated deeply in the soft tissues, far removed from sources of potential infection, the 'pure' effects of radiation on bone may be more clearly observed. The femoral head and neck are constantly subjected to relatively heavy irradiation in justifiable therapeutic attempts to obtain adequate dosage in malignant conditions involving the pelvis. Here, the consequence of heavy therapeutic dosage is paid in the post-irradiation fractures of the neck of the femur. Various authors—Gratzek *et al.* (1945), Hight (1941), Kalayjian (1938), Kok (1953), Kulseng-Hanssen (1946), MacDougall *et al.* (1950), McCrorie (1950), Okrainetz and Biller (1939), Peck (1939), Ruther (1953), Slaughter (1942), Smith (1954), Smithers and Rhys-Lewis (1945), Stampfli and Kerr (1947), Truelsen (1942)—have recorded series of cases where the frequency of this complication has been recorded as being between 0·1 and 3·2% (Vaughan, 1955). But despite the frequency of these changes in the bones themselves no mention has been made in these reports of any changes in the articular surfaces of the joints in the irradiated areas.

The purpose of this communication is to record an example of a localized infarction of the femoral head occurring as a result of heavy therapeutic irradiation unavoidably delivered to this structure in the treatment of a metastatic deposit in an adjoining bone.

CASE REPORT

Mrs. A.B., a female aged 51 years, had been operated on 7 years previously for an enlargement of the thyroid gland with a retrosternal extension. Five years later, she consulted a physician for tiredness and was given ½ gr. of thyroid daily, with improvement. She had remained free from any symptoms until 1 year later, when she suffered slight pain in the right hip when ascending stairs. At this time physiotherapy was prescribed, with some relief of her symptoms. One year later her symptoms recurred and she was X-rayed at this time and an osteolytic deposit was seen in the right ischium.

On clinical examination, she was found to be well nourished and in considerable pain. There was limitation of movement in the right hip with spasm of the surrounding muscles. There were no glands palpable nor was the liver or spleen palpable.

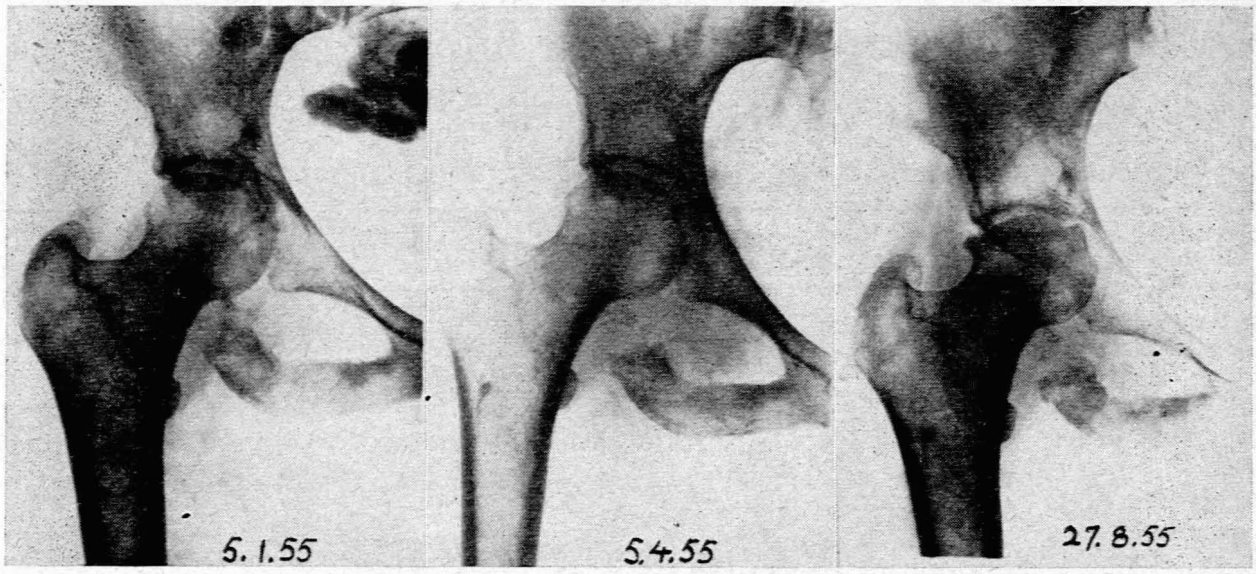
Radiographic examination showed damage to the right ischial bone, with extensive destruction of the ascending ramus of that bone as far as the acetabulum. The bony architecture of the head and neck of the femoral shaft was normal. A radio-active iodine study revealed an increased uptake over the lesion, which was considered to be a metastatic deposit from a malignant thyroid tumour.

Deep X-ray therapy (220 kv. with a Thoraeus filter) was administered from 11 January 1955 to 25 February 1955, a total tumour dose of approximately 5,000 r. being delivered. Partial, but not complete, relief of the symptoms was achieved. In view of continuing symptoms a second course of deep X-ray therapy was commenced on 4 April 1955 and continued to 25 April 1955 when a further total estimated tumour dose of 2,864 r. was administered. A therapeutic dose of 50 mc. radio-active iodine was also given at this time. A radiograph of the right hip joint on 5 April 1955 revealed some slight re-formation of bone within the deposit, but in the ascending ramus of the ischium little regeneration of the new bone had occurred.

The patient remained relatively free of pain but still suffered from some limitation of movement of the right hip. A radiograph of the right hip joint on 27 August 1955 showed a collapse of the articular surface of the femoral head with a loose separated fragment of bone similar to an osteochondrosis dissecans affecting more than one-third of the femoral head. No history of any trauma was obtained and a review of the films taken on 5 April 1955 revealed that the portion of the femoral head showed an increase in density, suggesting an aseptic necrosis—a feature not appreciated at the time of examination.

DISCUSSION

The effects of radiation on bone have been the subject of much investigation. Ewing (1926) classified the changes into 4 stages depending on the degree of radiation. The first stage is a proliferative osteitis, the second stage is a stage of osteo-



Antero-posterior views of the right hip joint demonstrating the development of the area of osteochondritis in the femoral head. The metastatic deposit in the right ischial bone is clearly seen.

sclerosis, the third stage with increasing dosage is an aseptic necrosis with the formation of sequestra, and the last stage is that of a superimposed infection. Ewing (1926) also considered that the secondary irradiation from the inorganic elements affected the organic elements of the bone.

More recently Kok (1953) and Stampfli and Kerr (1947) have stressed that the damage to the blood supply may be one of the causes responsible for the changes in the bone. The persistent dilatation of the vessels in the Haversian canals results in absorption with consequent weakening of the bone. Likewise Truelsen (1942) commented on the absence in histological sections of irradiated bone of osteoclasts and osteoblasts, considering that these features were the result of damage to the vessels although the internal coats of the vessels were intact.

Furthermore, as Stephenson and Cohen (1956) point out in a discussion on post-irradiation fractures of the neck of the femur, in the majority of their series healing of the fractures occurred readily, a feature which would hardly be expected if the blood supply was impaired. In one of the cases in their series, however, heavy dosage of irradiation resulted in necrosis of the femoral head with no apparent healing.

In the findings in post-irradiation fractures of bone it is probable that the changes noted are proportionate to the dosage of irradiation received by the bone. With the lesser degrees of dosage the cellular elements of the bone are probably affected, whilst with heavier dosage changes due to vascular disturbances also play a part in the changes that occur.

Little has been mentioned in the literature about the effect of radiation on joints as opposed to bone, but it is possible that in analogy to bone the cellular elements are destroyed with the lesser degrees of dosage whilst with the heavier dosages the vascular elements are involved.

In the case presented the heavy therapeutic dosage necessarily delivered to the bone resulted in an unusually high dosage being received by the femoral head with the subsequent development of an avascular necrosis and an infarction of the femoral head.

SUMMARY

1. A case showing the appearances of an osteochondritis dissecans of the femoral head is described.

2. It is postulated that these appearances are the result of infarction of the femoral head following heavy irradiation therapy.

3. The mechanism of the infarction is discussed.

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