MALIGNANT TUMOUR AT SITE OF BONE PLATING

A. McDougall, Glasgow, Scotland

The literature on the use of metals in bone surgery is now extensive and the effects of electrolysis and corrosion on the tissues have been studied by many writers. While much has been written about the damage to bone by the conjoint use of dissimilar metals, the surrounding soft-tissue reactions have received secondary attention. A search of the literature has failed to reveal any record of malignant changes from the use of metals in bone surgery or any suggestion that the possibility had ever been considered. This we believe is the first account of a malignant growth caused by tissue reaction at the site of a metal plate and screws used for the fixation of a simple fracture.

CASE REPORT

A butcher, aged forty-two years, complained of a large discoloured swelling in the right upper arm (Fig. 1). The swelling had appeared about ten weeks previously and had increased in size gradually until a week before he reported, when there had been a sudden increase and the arm had become discoloured. There was no history of injury. At no time had he suffered any pain or discomfort and he was still at work. The swelling, which was soft and fluctuant in parts, extended from the origin of the deltoid muscle to the middle of the arm. The overlying skin was shiny and atrophic, and the swelling threatened to point anteriorly. The humerus, which could be palpated deep to the swelling, felt thickened and irregular. On the antero-lateral aspect of the arm was a scar three inches long; when questioned about it the patient gave the following story.
Thirty years before, when twelve years of age, he broke his right arm; the fragments were plated. Union occurred within a normal period and he was discharged from hospital six weeks after the injury. He had no further trouble with the arm until June 1949, when he fell on a slippery road with little force and was surprised to learn that he had broken his arm. The radiograph (Fig. 2) showed an oblique fracture through the middle of the humerus at the site of a screw hole. There was some bone absorption about the upper two screws and both were loose. A plaster was applied and retained for four weeks. After a spell in a broad sling he was able to resume work; clinical evidence of union was not checked radiographically. When questioned about the appearance of the arm after the fracture the patient stated that it appeared to him to be a bit thickened about the break and had remained so.

A radiograph taken when we first saw him (Fig. 3) showed an ununited fracture of the middle of the humerus with sclerosis and overgrowth of bone. The plate was shown detached and angled away from the humerus at its upper end; the screws were loose and the top one lay in the soft tissues. Figure 4 shows the soft-tissue swelling over the upper arm.

No definite diagnosis of the swelling was made. Clinically it resembled a haemangiomaticous type of lesion; but it was agreed that it was due to the presence of the plate and screws and that these should be removed and a biopsy performed. Several weeks passed before the patient was admitted, but the arm remained symptomless and looked the same.

Operation—The humerus was approached through a curved lateral incision, behind the swelling. After the biceps had been retracted medially the swelling, which did not involve bone, was stripped from the humerus, and the uppermost screw at the top of the plate was exposed; the
lower end was buried in osteoid tissue, and broke while being removed. The plate and screws were blackened and corroded (Fig. 5), both bone and soft tissues were discoloured, and a dark serous exudate was present around the area. The swelling was soft and friable and bled freely, and it was now obvious that it was a highly vascular malignant growth involving the soft tissues. When a piece was removed for examination bleeding became profuse, and two pints of blood were given during the course of the operation. A piece of bone was also taken from the fracture site.

Pathology—Dr R. McAndrew reported that the soft-tissue specimen consisted entirely of a malignant neoplasm of uncertain type. It was largely necrotic and haemorrhagic. In the
less necrotic areas it sometimes resembled a carcinoma, but more often a tumour of mesoblastic origin, for instance an endothelioma. The cells were polygonal and closely packed and lay in vascular spaces. The most probable diagnosis was a sarcoma of the Ewing type (Fig. 6). In the bone section there was evidence of old injury but none of tumour.

Analysis of plate and screws—The plate and screws were analysed by Dr J. McLeod of the Royal Technical College, Glasgow, who found that the plate consisted of stainless steel and that its composition was: iron 74 per cent, chrome 18 per cent, nickel 8 per cent. The screws were composed of iron 88 per cent, chrome 12 per cent, carbon a trace. There was a difference in potential of 80 millivolts between the plate and screws.

Progress—The patient refused an interscapulo-thoracic amputation: the arm was painless, he could use it and he required both hands for his job. The tumour diminished considerably with a course of deep x-ray treatment. Radiographic examination of the chest and skeleton revealed no evidence of dissemination and the patient was allowed to return to work.

He was reviewed periodically and remained in good health and at work until a year after he was first seen, when he began to lose weight and feel tired. Two months later there was clinical evidence of lung metastasis, and a month later the liver was enlarged and tender; the abdomen contained free fluid. He died a few weeks later. No necropsy was possible. There had been no clinical change in the appearance of the arm.

DISCUSSION

When the pathological report was received a complete investigation was carried out to exclude the possibility that this might be a secondary deposit, but there was no clinical or radiological evidence of a growth elsewhere.

The possibility that the tumour had arisen independently was discussed. That a malignant growth should appear fortuitously at this site seemed most improbable, because there was radiological evidence of electrolytic changes five years before, and, from the patient's description of the arm, soft-tissue changes were probably present as well.

The plate and screws showed signs of corrosion and there was a difference in potential, sufficient to act as a source of irritation for close on thirty years. Malignant disease at the site of metallic foreign bodies in the lung was reported by Siddons and MacArthur (1952). In their two cases, thirty-two and thirty-five years respectively elapsed before the appearance of the malignant changes. Jones and Lieberman (1936) noted the marked soft-tissue changes that occurred around iron plates used experimentally in animals. Scales and Zarek (1955) issued a reminder that iron and chrome react with the protein molecule. Schinz and Uehlinger (1942) were able to produce sarcomatous changes in animals with chrome implants, and Hueper (1952) produced malignant changes with nickel. It is impossible to state in this case whether the tumour arose because of the presence of a single metal with carcinogenic properties, or because of the conjoint use of dissimilar metals.

The period of thirty years which passed between the insertion of the metals and the appearance of the malignant change accords with the observation by Willis (1948) that usually there is a long latent period between the application of the carcinogenic stimuli and the development of the tumour.

SUMMARY

1. A case is described in which a malignant tumour developed in the soft tissues at the site of a bone-plating operation performed thirty years before.
2. The plate and screws were found to be composed of dissimilar metals and a difference of potential existed between them.
3. A careful consideration of the history and clinical course indicates that the tumour arose because of the presence of the metals.

I wish to express my thanks to Mr James Patrick, who had charge of this case, to Dr J. Leith for the colour photograph and to Mr W. Towler, clinical photographer at the Glasgow Royal Infirmary, for the remaining reproductions.
REFERENCES


