Transplantable Osteogenic Tumor in the Rat

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Summary

Histochemical and morphologic characteristics of a rat osteogenic sarcoma-like tumor are described. Inorganic material, mainly calcium phosphate and carbonate, has been histochemically demonstrated in all subsequent transplants. The tumor, which occurred spontaneously in an adult Sprague-Dawley rat, is being maintained by serial transplantation in Holtzman rats.

Introduction

Spontaneous osteogenic sarcomas which are transplantable and which produce bone in subsequent transplants are rarely found (2, 9). Horie (4) was successful in producing bone formation in sarcomatous tissue transplanted into the medullary cavity of bone of a Wistar rat. The following paper reports the serial transplantation of a spontaneous chondroblastic osteogenic tumor in Holtzman rats.

Materials and Methods

The original growth, found in a female Sprague-Dawley rat 1.5 years old, was a nodular mass 6 x 5 x 3.5 cm (Fig. 1). The tumor, which involved all of the lumbar and several of the lower thoracic vertebrae, was difficult to penetrate and bled freely upon incision. A smaller growth, probably a metastatic extension, involved the right knee joint. The tumor, now in its 8th generation of trocar transplants in the Holtzman strain has a record of 90% takes and has never regressed in a transplant.

Observations

The gross, microscopic, and histochemical characteristics of the tumor have remained essentially similar in all transplants (Figs. 2, 6, 7). Dense or soft components of the tumor appear to grow equally well in either Holtzman or Sprague-Dawley rats of either sex. Transplants become palpable in the subcutaneous tissue in 2 weeks. The tumor grows slowly, does not become necrotic, and attains a diameter of about 4 cm in a 2-month period (Fig. 2). Within a 6-month period after transfer metastases did not occur.

Histochemically, the tumor resembles a human osteogenic sarcoma as described by Dahlin (1). As may be observed microscopically (Figs. 6, 7), the hard peripheral crust of the transplant is made up of hyaline cartilage with a dense fibrous capsule. The matrix of these tumors is in some way altered biochemically and this is reflected in the staining reaction.

Transformation of many of the normal characteristics of endochondral bone growth were observed morphologically and histochemically in this tumor. These changes have not been recorded of a transplantable rat osteogenic tumor to date.

References

3. Gersh, I., and Catchpole, H. R. The Organization of Ground Substance and Basement Membrane and Its Significance in
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Fig. 1. Roentgenogram of original tumor mass involving the lumbar and lower thoracic vertebrae in a 1.5-year-old female Sprague-Dawley rat. A, Width of neoplasm; B, vertebral column in the background. Denser bone is visible in the periphery of the tumor. The less dense central portion consists of spongy bone and normal appearing elements of bone marrow. × 1.

Fig. 2. Roentgenogram of transplanted tumor in a donor animal 2 months after inoculation. As in the original tumor, cartilage and bone surrounds a core of cancellous bone containing marrow. × 0.5.

Fig. 3. Cross section of a transplanted tumor, impregnated with silver nitrate which was subsequently reduced by light. The cartilage, in various stages of maturation, surrounds the periphery of the tumor and is replaced by bone simulating the transition one observes at the epiphysis of a growing bone. × 2.5.
FIG. 4. Portion of original tumor which was sectioned without decalcification. Peripheral cartilage gives place to scattered bony spicules along an uneven inner border. Fat cells and normal appearing marrow elements are found among the spicules. Periodic acid-Schiff, × 25.

FIG. 5. Section of marrow from undecalcified original tumor. A bizarre mottled pattern is observed in the bony spicules, while the marrow elements appear relatively normal. Periodic acid-Schiff, × 125.

FIG. 6. Section of a spheric transplanted tumor. Sequence in the zones of maturing cartilage are disrupted. Bony spicules are dispersed in a marrow of decreased cellularity. Toluidine blue, × 25.

FIG. 7. Section of marrow of the transplanted tumor in Fig. 6. Few marrow cells are to be found. Numerous metachromatic red collagen fibers and spindle-shaped osteoblasts are present. Toluidine blue, × 125.
Fig. 8. Differentiation of the cartilage of the 6th generation of the transplanted neoplasm. H & E, × 160.

Fig. 9. Marrow of the original bone tumor. Hematopoietic activity is evident. H & E, × 160.

Fig. 10. Cellular elements in the marrow of the 6th generation of the transplanted tumor. Many of the marrow cells were spindle-shaped. H & E, × 400.
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