A Case of Multiple Osteochondroma in the Rat

Hijiri IWATA, Shinji YAMAMOTO, Shinichi MIKAMI, Seiki YAMAKAWA, Yasuhiko HIROUCHI, Kazuo KOBAYASHI, and Makoto ENOMOTO
Bioassay Research Center, Foods, Drugs and Pesticides, 582-2 Arakama Shiothinden, Fukude-cho, Iwata-gun, Shizuoka 437-12, Japan
(Received 8 September 1994/Accepted 25 November 1994)

ABSTRACT. The occurrence of spontaneous osteochondroma in rats is extremely rare and only a few cases have been reported. Spontaneous multiple osteochondroma was found in a male SD strain rat, at the age of 58 weeks from the control group in a toxicity study. Histological findings of both a walnut-sized mass involving the humerus and scapula of right forelimb and a soybean-sized mass adjacent to the costochondral junction of the right posterior rib were similar in appearance. The outer layer of the tumors consisted of hyaline cartilage and the core of the tumors consisted of trabecular bone with abundant fatty bone marrow. The periosteum of the surface was continuous with that of the parent bone, and cortical bone and the medullary cavity of the parent bone communicated with those of the tumors. Because of showing progressive enlargement, multiple osteochondromas in the rat were considered to be neoplastic in nature.—KEY WORDS: osteochondroma, rat.


Osteochondroma is an expansile cartilage-capped osseous mass arising from endochondral bone surface, usually adjacent to the growth plate of cartilage. Its outer layer is composed of cartilage showing endochondral ossification and core of the tumor consists of lamellar bone trabeculae and abundant bone marrow [6–8, 13].

The occurrence of spontaneous osteochondroma is extremely rare in rats. Only one record which included 3 cases of osteochondroma in a Sprague Dawley (SD) rat, a Fischer 344 rat, and a Wistar rat, was reported by Ernst et al. [3]. However, osteochondroma is known to be induced in rats by exposure to vinylchloride vapors [15] or radiation [2], and by surgical reflection of the perichondrial ring [1]. This paper describes one case of multiple osteochondroma in a SD (Crl: CD) male rat, which was used in a toxicological test.

Spontaneous multiple osteochondroma was found in one male SD rat from the control group of a repeated dose toxicity study for 12 months. The animal was sacrificed at Week 52 at the age of 58 weeks. Massive nodules involving the humerus and scapula of the right forelimb had been observed clinically since eight weeks before necropsy and was determined to consist of two tumors by soft x-ray observation. One tumor was found in the diaphyseal part of the humerus, and the other was found in the area involving the apophysis of the humerus and scapula. These tumors revealed low radiodensity and a sponge-like structure. However, neither the border to the normal bone at the apophyseal side nor articulatio humeri were included. Another tumor showing a sponge-like structure as same as the forelimb mass was also found on the right rib. Blood examination revealed no remarkable changes except a higher white blood cell count (16,000/ mm³) and lower content of triglyceride (42.5 mg/dl). After a complete necropsy, all organs and tumors were fixed in 10% neutral buffered formalin. The bone and bony mass were decalcified in formic acid/formalin followed by sufficient neutralization. These tissues were embedded in paraffin, cut and stained with hematoxylin and eosin (H.E.) or Alucian blue-H.E.

Gross findings: A walnut-sized mass involving the humerus and scapula of the right forelimb and a soybean-sized mass adjacent to the costochondral junction of the right rearmost rib were found. Both masses were covered with a grayish-white thin layer and were hard to cut with a knife, and their cut surfaces were sponge-like. Other organs revealed no remarkable changes, macroscopically.

Histological findings: Both the mass on the forelimb and that of rib showed the same histological feature. They each consisted of a concentric structure with a slightly rugged surface. The outer layer of the tumors consisted of hyaline cartilage and the core of the tumors was comprised of trabecular bone with abundant fatty bone marrow (Fig. 1). The surface of the tumors was covered with periosteum continuous with that of the parent bone. Cortical bone and the medullary cavity of the parent bone was also in communication with those of the tumors. The outer cartilage layer, so-called cartilage cap, consisted of ballooned chondrocytes showed a row-arrangement and were occasionally lobulated by the fibrous periosteum extending into the cartilage layer, and of cartilagenous matrix stained positive with Alucian blue. The cells were usually larger than the normal chondrocytes of age-matched rats and revealed typical endochondral ossification, but without atypia or pleomorphism (Fig. 2). Islets of cartilage observed sporadically in the bone marrow suggested rapid growth of the tumor. Hematopoietic cells in the fatty marrow of the tumor were less in number than those in normal bone marrow at distal part of the parent bone.

Electron-microscopically, tumor cells had many microvilli on their surface and were rich in organelles in their cytoplasm including rough endoplasmic reticulum, Golgi complex, and mitochondria, suggesting they were well-differentiated chondrocytes. In addition, the tumor matrix also showed characteristics of the cartilagenous matrix including type II collagen, matrix vesicles and calcospherites.

Consequently, this case was considered to be a kind of osteochondroma, and diagnosed as multiple osteochondromas or osteochondromatosis because of their multiple occurrence. Osteochondroma occurs singly or multicentrically in animals [6, 8]. Multiple osteochondromas (multiple cartilagenous exostosis) in humans [14], horses [4, 5], and dogs [8] are considered to be inherited as an
autosomal dominant trait. They appear usually in young animals and their growth stops concomitantly with parent bone growth. Multiple osteochondromas are occasionally considered to be a malformation with many synonyms including osteocartilagenous exostoses, aclasis, hereditary deforming chondroplasia or dyschondroplasia. On the other hand, multiple osteochondromas in cats occurs in mature animals and are considered not to be an inherited disease but a true tumor [9–12]. Some cases of cats were positive for feline leukemia virus, and C-type feline leukemia virus-like particles were found at the surface of chondrocyte in the cartilage cap. Morphological findings of the present case were similar to those of multiple osteochondromas in rats reported by Ernst et al. [3]. All cases of multiple osteochondromas in rats occurred in aged animals and they demonstrated progressive enlargement which is a characteristic feature of true tumor. There was no evidence suggesting the involvement of heredity or infection of specific pathogenic organism such as a virus which was found in the cases of feline multiple osteochondromas. Consequently, multiple osteochondromas in rats were considered to be true tumor, presumably originating from chondroblasts of the growth plate of the cartilage or mesenchymal cells of the periosteum [7].

REFERENCES