Extraosseous Localization of $^{99m}$Tc-MDP in Ganglioneuroblastoma

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Abstract. A 21/2-year-old boy with a posterior mediastinal ganglioneuroblastoma was evaluated by bone scintigraphy using $^{99m}$Tc-MDP and showed a marked increased uptake in the tumor mass. Although a routine chest X-ray and body CT scan failed to demonstrate calcification, X-ray examination of the removed tumor specimen revealed small scattered calcification. The proposed mechanisms of the radiopharmaceutical localization in benign and malignant tumors other than calcification/mineralization are discussed. Regardless of the mechanism, localization of a bone scanning agent in a tumor provides a rapid, simple, and noninvasive means of demonstrating tumor size, configuration, and the relation of the surrounding structures to the tumor.

Case Report
A 21/2-year-old boy was hospitalized because of progressive difficulty in walking, associated with some pain, and eventual inability to walk within 3 months. The past medical history revealed that he was the product of a normal pregnancy and uncomplicated delivery. He developed reasonably well and began walking at 11/2 years of age. Physical examination revealed an alert boy; the cranial nerves, funduscopic examination, and upper extremities were essentially normal. The lower extremities were weak and he was unable to walk, but he remained able to sit and crawl. The deep tendon reflexes were increased in both lower extremities. Pinprick sensation in both legs was preserved. A chest X-ray and body thoracic CT scan revealed a large posterior mediastinal mass, more on the right side, with no apparent calcification. The thoracic myelogram demonstrated a large extradural defect with total obstruction at the T8 level. Bone scintigraphy using 7 mCi $^{99m}$Tc-MDP revealed a large area of intense tracer accumulation in the right paravertebral area (Fig. 1). A urine test for vanillylmandelic acid was negative.

Because of the diagnosis of a posterior mediastinal mass with cord compression, he underwent a laminectomy with resection of the portion of tumor extending into the epidural space. There was no evidence of vertebral bone invasion. The fragments of the tumor tissue showed small multiple irregular calcifications in the X-ray examination of the specimen and the histologic diagnosis was ganglioneuroblastoma with areas of calcification.

Six days later he had a right thoracotomy with excision of the posterior mediastinal ganglioneuroblastoma. The mass appeared to be well encapsulated and was $9 \times 7 \times 3$ cm in size (Fig. 2). The histopathologic picture was identical to that of the tumor fragments obtained from the extradural space: there were areas of a cellular neural tissue resembling that seen in

Fig. 1. $^{99m}$Tc-MDP bone scintigrams: Left Anterior view, Right Posterior view. Note a large rounded area of intense tracer accumulation near anterior right thoracic vertebra and a slight increased activity in the adjacent thoracic vertebra

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the central nervous system, interspersed with groups of moderately well-differentiated ganglion cells and clusters of poorly differentiated ganglion round/oval cells. Areas of calcification were frequent (Fig. 3). The specimen X-ray of the tumor mass showed small but multiple irregular calcification (Fig. 4). The postoperative course was complicated by the development of chylous drainage from the chest tube which resolved spontaneously. The strength of the lower extremities improved and he became able to walk with support.

Discussion

The localization of radiolabeled phosphate compounds in benign and malignant tumors other than those of the skeletal system has been previously reported and is summarized in Table 1. Ganglioneuroblastoma usually occurs after 1 year of age and before 10 years of age [22]. Histopathologically it is composed of ganglieneuroma and neuroblastoma components, containing neurofibrils, various stages of ganglion cells and poorly differentiated round cells; calcification may occasionally be seen, as in this case. The exact mechanism of phosphate compound accumulation in the tumor mass is still unknown, however, one of the important contributing factors is related to calcification/mineralization.

In the process of chemosorption the phosphate is deposited in the area of calcification in a way analogous to calcium [18]. More recently Christensen et al. [5] showed by microautoradiography and chromatography that specifically high localization of \(^{99m}\text{Tc-MDP}\) occurs in areas of mineralization in the epiphyseal growth plates of rats. Ell et al. [7] presented a case of \(^{99m}\text{Tc-HEDP}\) concentration in a calcified myoma of the uterus, and 2 of 18 patients with lipoma showed scintigraphic evidence of