Malignant Schwannoma in the Spinal Root of a Dog

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Schwannoma (neurilemmoma) and neurofibroma defined as neoplasms arising from schwann cells of peripheral nerve sheaths have been reported in several species of animal such as cattle and dogs [2, 3, 8, 10, 11, 13]. In dogs, schwannoma was most commonly observed in the cranial, spinal roots or brachial plexus [4, 9] and most of that neoplasm was described to be benign [4, 8, 13]. Malignant schwannoma [1, 9, 10] having metastatic lesion was rare. This paper describes a canine case of malignant schwannoma which arise from spinal roots with metastasis to the thoracic cavity.

The dog suffered from the neoplasm was a West Highland white terrier, male, 8 years old. He showed claudication of frontal limbs on June 1989. The examinations with myelography and CT-scanning revealed small mass of neoplasm in the spinal roots of the 5th to 6th cervical vertebrae. Then, claudication increasingly progressed and 3 months after the clinical symptom onset, surgical operation was undertaken to remove the neoplasms of the spinal roots. At that time, the neoplasm was found to grow along the peripheral nerve and reached to the axillary fossa. In January 1990, clinical conditions including claudication aggravated, and a mass measuring about 10 cm in diameter occupied axillary fossa. By radiological examination, there were numerous masses of varying size in the thoracic cavity. The dog died on June

10, 1990 and was autopsied on the same day.

At autopsy slight swelling and hemorrhage in the spinal roots and cords of the 5th cervical vertebrae (Fig. 1) were observed. Their corpus vertebrae showed necrosis and hemorrhage. A large soft tumor mass measuring about 10×15 cm surrounded by soft fibrous tissue was found around axillary fossa and that invaded to the thoracic cavity at the site of the 2nd and 3rd costa liquefied by the infiltration of the tumor. On the cut surface of the tumor mass, several necrotic foci with hemorrhage were observed (Fig. 2). On the pleura and pericardium in the thoracic cavity, numerous white-soft tumor masses varied in size, were seen. In the other visceral organs, there were no neoplastic lesions.

For histopathological studies, tissue samples were fixed in 10% neutral buffered formalin and Bouin's solution. Paraffin sections of tumor mass were stained with hematoxyline and eosin, luxol fast blue (LFB), Masson's trichrome, alucian blue (pH 2.5) and Watanabe's silver impregnation. Avidin-biotin peroxidase complex (ABC) method was also applied for immunohistochemical studies to determine the origin of the tumor. As primary antibodies, immune rabbit sera against S-100 protein, desmin, and glial fibrillary acidic protein (GFAP) (Dakopatts, Carpinteria, CA., U.S.A.), immune guinea pig serum against keratin (Biomakor, Israel), and monoclonal mouse antibody against vimentin (Dakopatts, Carpinteria, CA., U.S.A.) were used. For secondary anti-bodies, biotinylated goat sera against rabbit IgG (Jackson Lab. West Grove, PA., U.S.A.), guinea pig IgG and mouse IgG (Kirkegaard and Perry Lab. Gaithersburg, MD., U.S.A.) were employed. ABC reagent (Vector

Fig. 1. Swelling and hemorrhage of spinal cord and root (arrow heads) of 5th cervical vertebrae.

Fig. 2. The cut surface of the tumor mass in axillary fossa. Obvious necrosis and hemorrhage were observed.

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Fig. 3. Proliferation of neoplastic cells in the spinal root (A) and cord (B), and sever fibrosis in the spinal root (C) of 5th cervical vertebrae. LFB-HE. $\times 45$.

Fig. 4. Onion bulb-like structures in the spinal root with sever fibrosis. Masson's trichrome stain. $\times 165$.

Fig. 5. Proliferation of neoplastic cells arranged in whorl or interlacing fascicles with mucinous stroma. HE. $\times 125$.

Lab. Burlingame, CA., U.S.A.) and diaminobenzidine (Sigma, St. Louis, MO., U.S.A.) were also used for visualizing.

Histopathologically, in the anterior roots of the 5th cervical vertebrae, plump spindle shaped neoplastic cells

Fig. 6. Collagen fibers observed in the stroma of tumor. Masson's trichrome stain. $\times 250$.

Fig. 7. Psuedopalisade-form of neoplastic cells around necrotic foci. HE. $\times 165$.

proliferated with slight fibrosis and were arranged in whorl or interlacing fascicles (Fig. 3A). The nuclei of tumor cells was hypochromatic and varied in size and the cytoplasm was spindle in shape and eosinophilic. The proliferation of collagen and reticulum fibers was seen in the stroma. These tumor cells invaded into the anterior horn of spinal cord with slight fibrous tissues (Fig. 3B) and many vacuoles were present in the white matter. Some parts of the anterior root exhibited thickening of capsules and severe fibrosis (Fig. 3C). In these area, collagen fibers formed small whorl-rings resembling "onion bulb" around the axons (Fig. 4), but neoplastic cells were not clearly seen.

The tumor mass around the plexus of axillary fossa and in the thoracic cavity consisted of solid proliferation of tumor cells arranged in interlacing fascicles or sometimes in palisade-like form and mucinous stroma stained with alucian blue (Fig. 5). Collagen fibers (Fig. 6) and reticulum fibers were also prominent in the stroma. Massive necrosis and hemorrhage were seen in the tumor mass. The neoplastic cells at the margin of necrotic foci showed palisade-like arrangement called as "pseudopalisade" (Fig. 7). Dilated blood vessels with thin wall

Fig. 8. Plump spindle shaped neoplastic cells (a) and their immunoreactivity with anti-S-100 protein serum (b). Arrow head shows a mitotic figure. a: HE, b: Immunostain. $\times 330$.

were frequently seen in the necrotic area. The tumor cells proliferating around the plexus of axillary fossa and in the thoracic cavity exhibited obvious cellular atypia. Mitotic figures were occasionally observed (Fig. 8a).

Immunohistochemically, the cytoplasm of tumor cells reacted intensely with anti-S-100 protein serum (Fig. 8b), and feebly with antisera against vimentin and GFAP, but not with antisera against keratin and desmin.

Onion bulb-like structures were seen in anterior roots of this case, were also observed in bovine or human peripheral nerve sheath tumors [2, 3, 7], and suggested that the lesion might appear as a non-neoplastic reaction to nerve trunk damage due to tumor-growth [4]. In this case, the physical damage induced by surgical operation must be also considered to elucidate the histopathogenesis of this lesion.

Several investigators reported the value of S-100 protein in the diagnosis of schwannoma [5, 12]. The intense immunoreactivity of neoplastic cells with anti-S-100 protein serum might indicate that the neoplasm of present case originated from the schwann cells of spinal roots.

Morphological features of the tumor such as the tend to fall in necrosis, cellular atypia and metastasis to the thoracic cavity, showed the malignancy of this tumor. Moreover, the pseudopalisade arrangement of tumor cells around the necrotic area could be emphasized the characteristics of malignant tumor in peripheral nerves of man [6]. From these findings, the tumor presented herein was diagnosed as "malignant schwannoma which originated from spinal roots of the 5th cervical vertebrae with metastasis to the thoracic cavity".

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