Acta Orthop. Scand. *57*, 444–446, 1986

Internal pressure in soft-tissue tumors

The internal pressure was measured in 25 soft-tissue tumors in 24 patients. High pressure was associated with pain at rest and tumor necrosis.

Bo Rööser
Anders Rydholm
Björn M. Persson

Department of Orthopedics,
Lund University Hospital,
S-221 85 Lund, Sweden

Pain at rest in soft-tissue sarcoma has been associated with a high histologic grade of malignany and a poor prognosis (Rydholm et al. 1984). Chigira et al. (1984) showed that painful bone tumors had higher internal pressures than painless ones. They did not, however, relate pressure to the grade of malignancy. Young et al. (1959) compared the pressures of normal testis and carcinoma of the testis in the rat and found consistently higher values in the tumors: the maximum pressure recorded was 65 mmHg. Because we have not found any reports on human soft-tissue tumors, we measured the internal pressure in 13 benign and 12 malignant soft-tissue tumors.

Patients and methods

Twenty-four patients with 25 soft-tissue tumors operated on in late 1984 and early 1985 were examined. All except one (Case 23) were referred to us before any surgery.

There were 18 men and 6 women, median age 57 (20–83) years. Thirteen tumors were benign and 12 were malignant (Table 1). The median tumor size (longest axis) was 8 (3–20) cm. Tumor pain was defined as nonradiating pain at rest located in the tumor region. Tumors beneath the deep fascia were designated as deep. In no case was there tumor involvement of bone or major nerves. Fine needle aspiration cytology was performed in all but 2 tumors. The puncture site was tattooed (Åkerman et al. 1985).

A 0.8 mm cannula was inserted perpendicularly through the skin exactly at the site of the aspiration needle and placed in the central part of the tumor. In the 2 patients in whom aspiration was not performed, the cannula was inserted in the most prominent part of the tumor. Care was taken not to perforate the deep side of the tumor. The cannula was connected to a tubing system filled with sterile saline. Pressure was measured by an external transducer (Hewlett & Packard 1280 A.) and recordings were made on a MITAB pressure monitor®.

All the sarcomas were graded histologically in a four-grade scale with I as least and IV as most malignant (Markhede et al. 1982). In the statistical analysis, the two tumors with the I-II malignancy grades were grouped together with the benign tumors, whereas the tumors with the two highest malignancy grades formed the second group. Case 19, a metastasis from a bronchial squamous cell carcinoma, which was histologically highly anaplastic, was classified as highly malignant.

An estimation of the degree of necrosis in the tumors was made histologically. The tumors were divided into two groups: (1) no or little necrosis and (2) extensive necrosis. The criterion for the latter was at least one area of necrosis occupying the diameter of the 4.3 mm visual field in the microscope (×10 ocular, ×2.5 plan lens) when examining slides from different parts of the tumor (N. O. Berg, Department of Pathology, Lund). The metastasis from a bronchial carcinoma was not operated on and therefore was not classified in this respect. The Mann-Whitney U test was used for the statistical analysis.

Results

The pressures in the highly malignant tumors (median 77, range 43–90 mmHg) were higher ($P < 0.001$) than the pressures in low malignant and benign tumors grouped together (median 17, range 8–46 mmHg).

The painful tumors all had a pressure exceeding 65 mmHg (median 84, range 65–90 mmHg), whereas no painless tumor had a pressure greater than 47 mmHg (median 23, range 8–47 mmHg) ($P < 0.001$). Tumors with extensive necrosis had higher pressures (median 82, range 47–89 mmHg) than tumors without or with slight necrosis (median 28, range 8–90 mmHg) ($P < 0.01$).

Table 1. Internal pressures and patient data in 25 soft-tissue tumors

Case	Age	Sex	Histology	Malignancy grade[a]	Size (cm)	Depth[b]	Site	Pain at rest	Necrosis	Pressure (mmHg)
1	46	M	Lipoma	B	11	S	axilla	–	–	8
2	58	M	Lipoma	B	20	D	thigh	–	–	13
3	38	M	Lipoma	B	11	S	shoulder	–	–	13
4	62	M	Lipoma	B	7	S	shoulder	–	–	14
5	50	M	Myxoma	B	3	D	thigh	–	–	14
6	57	F	Lipoma	B	12	D	thigh	–	–	16
7	49	M	Lipoma	B	5	D	thigh	–	–	16
8	62	M	Lipoma	B	7	S	neck	–	–	17
9	59	M	Lipoma	B	12	S	back	–	–	18
10	69	M	Myxofibrosarcoma	I	4	D	thigh	–	–	28
11	51	F	Desmoid tumor	B	5	D	thoracic wall	–	–	32
12	20	M	Angioleiomyoma	B	9	D	thigh	–	–	40
13	83	F	Leiomyosarcoma	III	8	D	lower leg	–	–	43
14	29	F	Angioleiomyoma	B	8	D	supra clavicular region	–	–	44
15	68	M	Hemangioma	B	6	S	thigh	–	–	46
16	72	M	Hemangiopericytoma	II	15	D	buttock	–	–	46
17	57	M	Mesenchymoma	IV	8	S	thigh	–	–	46
18	57	M	Liposarcoma	IV	9	D	buttock	–	+	47
19	64	M	Metastasis – carcinoma	H	4	D	lower leg	+	not class	65
20	52	M	Liposarcoma	IV	7	D	shoulder	+	+	74
21	72	M	Epithelioid sarcoma	III	6	D	forearm	+	+	79
22	76	F	Leiomyosarcoma	IV	5	D	forearm	+	+	84
23	26	M	Synovial sarcoma	IV	16	D	lower leg	+	+	87
24	78	M	Clear cell sarcoma	III	12	D	thigh	+	+	89
25	55	M	Malignant fibrous histiocytoma	III	4	D	thigh	+	–	90

[a] B = benign, H = high-grade malignant.
[b] S = superficial, D = deep.

Of the 10 patients with highly malignant tumors, 7 had pain at rest and a pressure of more than 65 mmHg, whereas 3 patients were painless and had pressures below 65 mmHg. None of the patients with low malignant and benign tumors had pain at rest or a pressure exceeding 46 mmHg.

Discussion

In addition to pain and a high malignancy grade, extensive necrosis in a sarcoma signifies a bad prognosis (Rydholm et al. 1984, Costa et al. 1984). Wiig et al. (1981) measured the pressure in rat mammary carcinoma and found that it increased towards the center of the tumor and was higher in larger tumors. The authors concluded that high tissue pressures could contribute to central tumor necrosis. In our study a high internal tumor pressure was related to pain at rest, and tumor necrosis. In a rapidly growing tumor, increasing internal pressure would cause both pain and necrosis, as in a muscular compartmental syndrome.

Case 23 was a 29-year-old male who developed severe pain at rest from a fast growing tumor in the lower leg. After incisional biopsy the pain disappeared, but the pain recurred 3 weeks later when the wound had healed. A pressure of 87 mm Hg was recorded at this time. After a knee disarticulation, histologic examination showed a highly malignant synovial sarcoma with extensive necrosis.

High intratumoral pressure may thus be a

sign of rapid tumor growth that is correlated with pain at rest, extensive necrosis, and a poor prognosis.

References

Chigira, M., Watanabe, H., Maehara, S. & Shinozaki, (1984) Pain and internal hypertension in bone lesions. *Acta Orthop. Scand.* **55**, 375–377.

Costa, J., Wesley, R. A., Glatstein, E. & Rosenberg, S. A. (1984) The grading of soft-tissue sarcomas. Results of a clinicohistopathologic correlation in series of 163 cases. *Cancer* **53**, 530–541.

Markhede, G., Angervall, L. & Stener, B. (1982) A multivariate analysis of the prognosis after surgical treatment of malignant soft tissue tumors. *Cancer* **49**, 17–21.

Rydholm, A., Berg, N. O., Gullberg, B., Persson, B. M. & Thorngren, K. G. (1984) Prognosis for soft tissue sarcoma in the locomotor system. *Acta Path. Microbiol. Immunol. Scand.* Sect. A. **92**, 375–386.

Wiig, H., Tweit, E., Hultborn, R. & Weiss, L. (1981) Interstitial and vascular pressure in rat mammary tumors. 11th Europ. Conf. Microcirculation, Garmisch-Partenkirchen 1980. *Biblthea Anat.* **20**, 620–623.

Young, J. S. , Lumsden, C. E. & Stalker, A. L. (1959) The significance of the "tissue pressure" of normal testicular and of neoplastic (Brown-Pearce Carcinoma) tissue in the rabbit. *J. Path. Bact.* **62**, 313–333.

Åkerman, M., Rydholm, A. & Persson, B. M. (1985) Aspiration cytology of soft tissue tumors. The 10-year experience at an orthopedic oncology center. *Acta Orthop. Scand.* **56**, 407–412.