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CLINICAL INVESTIGATION **Benign Disease**

RADIOTHERAPY FOR SYMPTOMATIC VERTEBRAL HEMANGIOMAS: RESULTS OF A MULTICENTER STUDY AND LITERATURE REVIEW

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Purpose: The current study analyzes the potential role of radiotherapy (RT) in symptomatic vertebral hemangioma (SVH).

Methods and Materials: Seven cooperating German institutions collected clinical information, treatment plans, and outcome data for all patients with SVH referred for local RT.

Results: From 1969 to 2008, a total of 84 patients with 96 symptomatic lesions were irradiated for SVH. The primary indication for radiotherapy was pain (97.6%), and 28.6% of patients had additional neurological symptoms. RT was performed at a median total dose of 34 Gy, with a median single dose of 2.0 Gy. After receiving a median follow-up of 68 months, the overall patient response rate was 90.5%. Complete symptom remission occurred in 61.9% of patients, 28.6% of patients had partial pain relief, and 9.5% of patients had no pain relief. In 26.2% of patients, radiological signs of reossification were observed in long-term follow-up but not significantly correlated with pain relief. Most importantly, total doses of ≥34 Gy resulted in significantly greater symptomatic relief and control rate than total doses of <34 Gy.

Conclusions: This study consists of the largest database of cases reported so far using RT for SVH. RT is easy, safe, and effective for pain relief treatment for SVH. Total doses of at least 34 Gy give the best symptomatic response. © **2010 Elsevier Inc.**

Symptomatic vertebral hemangioma, Pain, Paresis, Radiotherapy, Benign disease.

INTRODUCTION

Hemangiomas are benign neoplasms consisting of blood vessels (1, 2, 3, 4). Autopsy studies suggest a prevalence rate of vertebral hemangiomas (VH) of 10% to 12% (5, 6, 7). VH are detected mostly as incidental lesions (1, 4, 8), but only 0.9% to 1.2% of lesions develop clinically relevant symptoms (1, 9,10).

The age distribution peaks between the third and fifth decades, and there is a slight predominance in females, with a female-to-male ratio of about 2:1 (1, 2, 4, 11, 12). Predominant anatomical sites are the thoracic and the upper lumbar spine (1–4, 8, 11–13).

The first histological description of SVH was given by Rudolf Virchow (1821–1902) (14). Three different histological types are differentiated: capillary, cavernous, and mixed VH (1, 2) (Fig. 1). Hemangiomas are hamartomas, and they do not expand with mitotic activity (11, 15). Possible causes of clinical symptoms include hemorrhage and thrombosis, organization and recanalization, hemodynamic stress, or a decrease in the supporting stroma (4, 8, 15). Approximately 55% of VH are associated with painful symptoms (1), and in about 15% of cases, they cause neurological emergencies like acute spinal cord compression (15–17).

The diagnosis is usually confirmed by radiological examination. Plain X-ray films may reveal the so-called ''honeycomb'' appearance of coarse vertical striations if at least one-third of the vertebral body is involved (17–19). Computed tomography (CT) scans (Fig. 2) may show a so-

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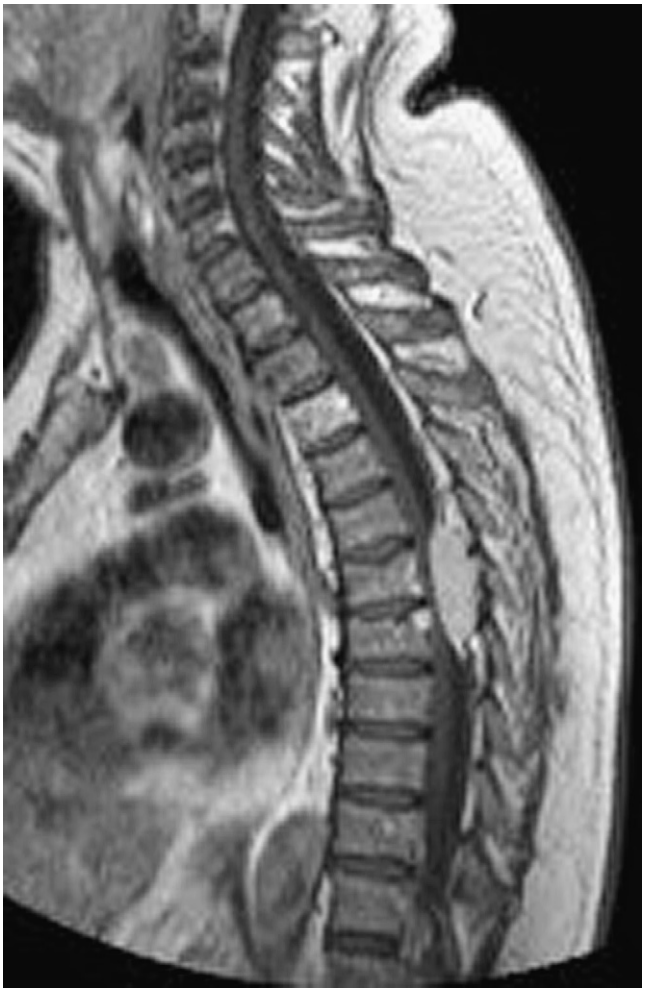

Fig. 1. MRI sagittal view of the thoracic spine demonstrating a severe narrowing of the spinal canal caused by a capillary hemangioma.

called polka-dotted appearance representing axial cuts of the compensatorily thickened vertical trabeculae (18, 20–23, 24, 25).

Symptomatic VH (SVH) necessitates treatment and the use of surgical procedures such as decompressive laminectomy (1, 7–12, 15–17, 20, 26–28), vertebrectomy (7, 8), or ligation of segmental arteries (29). Conservative methods include embolization (7, 8, 15, 30–32), vertebroplasty (7, 10, 33–35), and/or intralesional alcohol injection (13, 30, 36, 37). The management of SVH depends on the type and severity of symptoms. In clinical practice, it is convenient to divide patients into four categories (12, 16) (Table 1), as follows.

Group I patients do not require any treatment because there are no symptoms or minor symptoms; whereas group II and III patients have a relative indication for treatment. Group IV patients require immediate surgical decompression to avoid an imminent or persistent myelopathy (7, 8). Postsurgical radiotherapy (RT) is recommended to avoid relapse symptoms that otherwise occur in up to 90% of cases within 3 years (13).

RT has long been applied to treatment of SVH as a single modality or in combination with other measures (38, 39). The

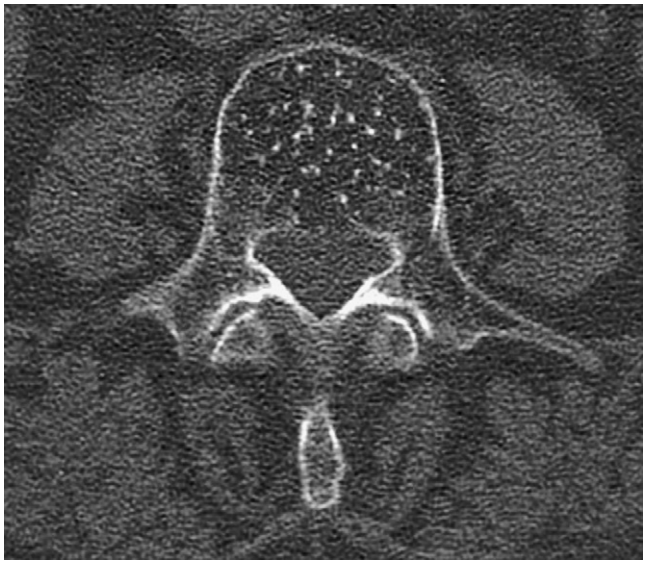

Fig. 2. Transverse CT image of the third lumbar vertebra showing typical signs of a symptomatic vertebral hemangioma with thickened and rarified bony trabeculae embedded in enlarged vascular spaces (polka-dot appearance).

first successful treatment of SVH by RT was reported by Bailey and Bucy as early as 1929 (17). There are several clinical reports of the effectiveness of RT in SVH (11, 38–40), but the optimal dose, fractionation schemes, and possible long-term effects are controversial (41). Thus, a retrospective multicenter cohort study was conducted. The results are compared to those of an extensive literature review.

METHODS AND MATERIALS

In 2002, the German Cooperative Group on Radiotherapy for Benign Diseases (GCG-BD) initiated a Registry for Rare Benign Disorders (RRBD) in Germany (42, 43). The standardized GCG-BD evaluation concept was published in 2002 (44).

Based on the RRBD, seven major German institutions collected data for all patients with SVH referred for RT over the last 39 years. With a systematic approach, all clinical features, number, and type of pretreatments; specific pain record; applied radiotherapy with target volume; and long-term clinical outcome were collected for each patient; and the most recent follow-up notes and outcome were determined from case history notes in charts, tumor registry correspondence, or by individual telephone interviews with patients. The primary study endpoints were pain relief after RT, the response of specific symptoms, and radiological responses (reossification) to RT; secondary endpoints were the occurrence of and time to recurrent disease activity and treatment-related side effects. The median follow-up was 68 months (range, 6–422 months).

Pain relief was defined as follows: CR = complete response, PR = partial response, NC = no change. CR patients reported ''complete pain relief'' or were ''pain free''; PR patients reported ''partial pain relief'' or had ''substantial improvement of pain''; NC patients reported ''unchanged pain'' (45). The overall response was defined as the combination of CR and PR. A multivariate analysis of prognostic factors was performed by logistic regression (46). Values of $p < 0.05$ were considered statistically significant. All statistical analyses were performed using SPSS version 10.0.7 software (SPSS, Chicago, IL).