Eosinophilic Granuloma of the Cervical Spine

A Case Report and Review of the Literature

Lawrence D. Dickinson, M.D., and Saeed M. Farhat, M.D.

Section of Neurosurgery, University of Michigan Hospitals, and Section of Neurosurgery, St. Joseph Mercy Hospital, Ann Arbor, Michigan

Dickinson LD, Farhat SM. Eosinophilic granuloma of the cervical spine. A case report and review of the literature. Surg Neurol 1991;35:57–63.

This is a report of a case of eosinophilic granuloma involving the second cervical vertebra in a 33-year-old woman. There have been 32 case reports in the literature describing eosinophilic granuloma presenting as cervical spine disease. Due to its intimate relation to the central nervous system, the opportunity for neurological sequelae and neurosurgical intervention is common in cervical eosinophilic granuloma. In this report a brief history of eosinophilic granluoma is reviewed and case histories from the literature with cervical spine involvement are summarized. The therapeutic options are described and a recommended protocol for management is outlined.

KEY WORDS: Cervical spine; Eosinophilic granuloma

Eosinophilic granuloma of bone is a granulomatous process causing focal osteolytic lesions, characterized by histiocyte proliferation and eosinophilic infiltration. It is one of a triad of disorders collectively termed histiocytosis X. The etiology is unknown. In this report we describe a case of a solitary eosinophilic granuloma involving the second cervical vertebra in an adult.

Case Report

A 33-year-old woman presented complaining of an 8-week history of progressive neck and occipital region pain. The discomfort was provoked by neck flexion or rotation. Chiropractic manipulations were nonpalliative. A soft collar provided her with mild symptom relief. Examination revealed tenderness over the upper cervical spinous processes and limited cervical range of motion. Torticollis was present with rotation of the head to the right. The neurological examination was normal. Roentgenograms of the cervical spine were reportedly normal. The patient was admitted to the hospital when leukocytosis was observed on laboratory examination.

Computed tomography (CT) scan of the cervical spine (Figure 1) revealed an expansile soft-tissue lesion in the right side of the body, odontoid process, and right pedicle of C-2. A CT-guided needle biopsy of the C-2 vertebral body was performed. The specimen revealed inflammatory tissue, but was reported as nondiagnostic. A follow-up magnetic resonance imaging (MRI) study was performed, which confirmed a soft-tissue mass in the medullary cavity of C-2 (Figure 2). A skeletal survey revealed no other bone lesions. A liver/spleen scan was normal. A chest x-ray film suggested increased interstitial markings, but pulmonary function tests were normal.

The patient underwent posterior cervical exploration with biopsy and curettage of the right pedicle and body lesion. A C-1 to C-3 fusion was then achieved using 20-gauge wire and iliac bone graft. The biopsy specimen revealed eosinophilic granuloma. The patient was maintained in halo vest traction for 3 months. She received radiation therapy to the cervical spine. The patient reported improvement in her neck pain at the time of discharge, and at follow up 4-months later she was symptom-free. A CT scan showed resolution of the C-2 body lesion, no vertebral body collapse, and fusion of C-1 through C-3.

Discussion

Eosinophilic granuloma is a rare, focal, granulomatous process of bone that has a strong childhood predominance, but has been described in adults. The first case report by Finzi [11] involved a skull lesion in a child. Lichtenstein and Jaffe [20] presented a detailed histologic description in 1940. The basic lesion was described as an infiltration of the medullary cavity of bone by an immense proliferation of histiocytes. These large phagocytic cells form vast sheets of compact aggregates in

Address reprint requests to: Lawrence D. Dickinson, M.D., Crosby Neurosurgical Laboratories, Kresge I, Room 5605, 1500 East Medical Center Drive, Ann Arbor, Michigan.

Received April 16, 1990; accepted August 1, 1990.

© 1991 by Elsevier Science Publishing Co., Inc.

0090-3019/91/$3.50

Figure 1. *Computed tomography scan through the C-2 vertebra showing expansile mass in the right pedicle and body. Superior images (not presented) showed involvement of the odontoid process.*

which mitotic figures are rare. The picture is one of a reactive rather than neoplastic proliferation. Eosinophilic leukocyte aggregates are present to a variable degree, and they are often associated with areas of necrosis. A subpopulation of histiocytes often present are foam cells, vacuolated phagocytes containing sudanophilic material thought to be secondary to the phagocytosis of necrotic debris. Multinucleated giant cells are also common [20,22,26,27].

Otani and Ehrlich [28] pointed out the histologic similarity of the lesion to Hand–Schüller–Christian disease, and Farber [10] hypothesized that eosinophilic granuloma of bone represented a localized form of this chronic, disseminated, granulomatous syndrome and the acute systemic granulomatous syndrome, Letterer-Siwe disease. Believing that these disorders were related manifestations of a single nosologic entity, and in an attempt to descriptively categorize them, Lichtenstein [19] coined the title histiocytosis X. It has been debated that the degree of eosinophilic infiltrate and the number of foam cells are characteristics of the subgroups of the histiocytosis, but no correlation to aggressiveness or prognostic significance has been proven [22,26,39]. Extraskeletal lesions in lymph nodes, skin, oral cavity, anogenital region, lungs, liver, and spleen are hallmarks of the disseminated varieties of the disease [19,22].

Eosinophilic granuloma involving the spine was first recognized by Compere et al [8] in 1954. They reported four children with clinical and radiographic manifestations of Calvé's disease [4] that had histopathologic evidence of eosinophilic granuloma upon open biopsy of the involved thoracic vertebra. They proposed that eosinophilic granuloma was the histopathologic identity of Calvé's disease. Granulomas in the vertebra cause areas of bone resorption in the medullary cavity, replacing the space with soft, yellow–brown tissue. The lesion has a tendency to be expansile and can erode the cortical bone. This structural weakening can cause partial or total collapse of the vertebra. Perforation of the cortex by the granuloma results in expansion of the lesion in the paravertebral soft tissues. Collapse and extracortical expansion of eosinophilic granuloma are the two processes that can cause compromise to nervous system tissue. As these lesions age, there is a tendency toward fibrosis with eosinophil and histiocyte diminution. Healed lesions become sclerotic on radiographs [7,22] or can entirely resolve [9,22,23]. Several authors have reported reconstitution of part or all of the vertebral height in patients who suffered from vertebral body collapse [3,16,18, 25,36].

Eosinophilic granuloma of the cervical spine was first reported by Macnab [22], who described a biopsy-proven lesion of C-2 without collapse of the vertebral body. Twenty-three reports describing 31 case studies of eosinophilic granuloma presenting as cervical involvement without systemic disease were found after an extensive review of the literature. The cases are summarized in chronologic order of publication in Table 1. No cases of disseminated eosinophilic granuloma were found that initially presented as cervical disease. Two reports of patients with previously diagnosed isolated eosinophilic granuloma of bone who subsequently developed cervical lesions were excluded from this report [25,36].

The 33-year-old patient described in this report is one of only four cases of adult cervical eosinophilic granuloma. Interestingly, all four were females. Eighty-two percent of cases involved children between 2 and 19 years of age. There was no sex preference in this population.

The most common presenting complaint was neck pain (87%). Eleven patients (37%) had associated arm pain. Torticollis (30%) and stiffness (17%) were also common complaints. Ten patients (33%) presented with evidence of radiculopathy in one upper extremity. Three patients (9%) presented with evidence of myelopathy.

In most cases the cervical lesion was the only lesion reported; however, the majority of studies did not mention the outcome of a skeletal review, such as bone scan or x-ray survey. It would be inaccurate to assume that other bone involvement is infrequent, as the five cases

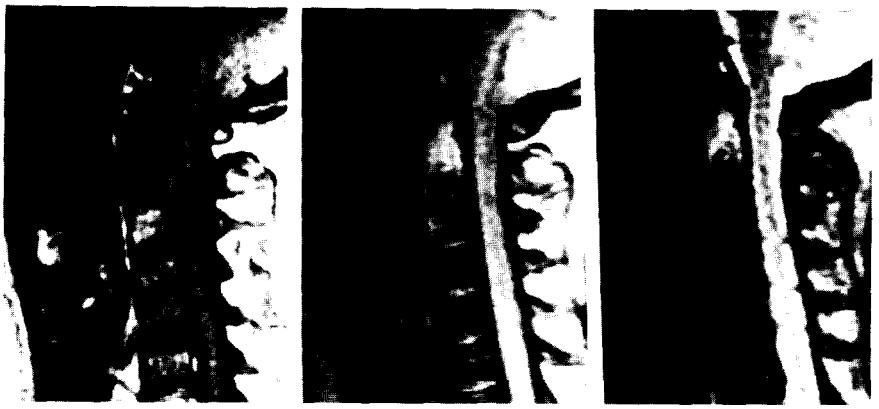

Figure 2. *Magnetic resonance images of the cervical region after nondiagnostic biopsy attempt. Images from left to right are T1-weighted, proton density, and T2-weighted images, respectively.*

in which other skeletal lesions were found had no symptoms referable to the other lesions. A bone survey is necessary to discriminate the extent of the patient's disease.

The body of the vertebra was involved most often, but there were nine reports of isolated posterior element involvement, and three reports documented lesions in both. Computed tomography findings were described in four cases, all of which documented posterior element involvement, suggesting that newer imaging techniques have increased the sensitivity of identifying posterior element involvement. The current report was the first to illustrate the MRI characteristics of the osteolytic lesion.

Unlike thoracic eosinophilic granuloma, in which total collapse of the involved vertebra at presentation is common, patients with cervical eosinophilic granuloma usually present with osteolytic lesions without collapse. Cervical lesions may produce greater symptoms earlier in the disease, as previously hypothesized [33], or it is possible that the natural history of cervical lesions less often evolves to collapse. This is predictable from a structural standpoint, as the weight-bearing load responsible for the force of compression is less in the cervical region.

The patient reported here had an osteolytic lesion of C-2. This was the most frequently involved vertebra. Of the 39 cervical vertebra involved on initial presentation in the 33 patients, nine involved C-2. Four C-2 lesions were associated with subluxation or C-1/C-2 dislocation. There were no reports of collapse among the C-2 lesions.

There is no classic presentation or radiographic finding that would assure the physician of the diagnosis of cervical spine eosinophilic granuloma. The differential diagnosis of a lytic vertebral lesion, with or without collapse, would include osteoblastoma, aneurysmal bone cyst, metastatic disease, osteomyelitis, and Ewing's sarcoma [1,12,30,38]. Biopsy is essential to rule out the more serious and treatable pathologies. Needle biopsies have proved to be difficult in this region, and the diagnostic yield in this review was poor. Only one out of four needle biopsy specimens were diagnostic. The other three cases went on to open procedures, which confirmed the diagnosis of eosinophilic granuloma.

Radiographic evidence of vertebral collapse and/or extracortical expansion of the granuloma was present in all patients with radicular complaints. In all the cases reporting patient follow up, radicular symptoms and signs resolved with treatment.

The three patients presenting with signs of myelopathy had osteolytic lesions without vertebral body collapse. There was myelographic evidence for extramedullary masses in all three cases. A 10-year-old child that initially presented with hemiparesis progressed to quadriparesis before undergoing surgical decompression and radiation therapy with resolution of the deficit [31]. A second child also had resolution of myelopathy with surgical and radiation therapy [9]; however, the one adult case yielded a persistent quadriparesis despite surgery, radiation, and chemotherapy [33]. This was the only persistent neurologic deficit in the 33 case reports.

All authors reported improvement in patient complaints after initiating therapy. Significant improvement in pain was achieved with immobilization. The type of immobilization ranged from soft collar to halter traction. Radiation therapy was instituted in 17 of the 29 cases reporting treatment. Doses ranged from 450 to 4000 rads, with one report describing the use of 60 Gy of cobalt teletherapy [16]. Three patients received chemotherapy.

As one would suspect after reviewing the variety of radiographic findings and vertebral levels involved, the surgical procedures performed were varied. Twenty-six open procedures were reported. There were 10 posterior operations, 14 anterior operations, and two reports

Table 1. *Clinical Summaries from Literature Review*

Case no.	Age	Symptoms	Neurologic exam	Radiographic findings	Procedure	Treatment	Outcome	Reference
1	2 yr	Neck stiffness, torticollis	Normal	C-2 lytic body, C-23 subluxation	Biopsy & curettage	Minerva jacket	AS, resolution (4 mo)	Macnab [22]
2	2 yr	Arm weakness	R UE paresis	C-5 lytic posterior elements	Laminectomy	Radiation, collar	New lytic lesions T-3, T-5, skull, femur, phalanx	Davidson and Shillito [9]
3	7 yr	Neck pain, stiffness	Normal	C-2 lytic body, prevertebral soft-tissue shadow	Anterior biopsy	Radiation, traction, minerva jacket	AS, resolution (5 mo)	[9]
4	17 yr	Neck pain, torticollis	L UE hyperreflexia, Hoffman's sign	C-1 lytic lateral process, prevertebral soft-tissue shadow	Posterior fusion	Radiation, minerva	AS (NR)	[9]
5	3 mo	Neck pain	Normal	C-3 lytic body	Needle biopsy	Radiation, traction, collar	AS (NR)	[9]
6	8 mo	Neck pain, torticollis	Normal	C-1 lytic posterior elements	Needle biopsy (skull lesion)	Radiation, chemo-therapy	AS (3 yr)	[9]
7	11 yr	Neck & arm pain	R triceps weakness	C-5 partial collapse	Anterior C-5 corpectomy, C-46 fusion	Radiation, minerva	AS (10 mo)	Lindenbaum and Gettes [21]
8	16 yr	Neck & arm pain	Normal	C-3 vertebra plana, C-23 subluxation	Anterior C-24 fusion	Minerva cast	New lytic lesions C-4, C-5 (5 mo), AS (7 mo)	Verbiest [38]
9	7 yr	Neck pain, torticollis	Normal	C-4 vertebra plana	Anterior C-4 curettage, bone graft	Radiation, minerva	AS, partial reconstitution of vertebral height (4 yr)	Bonneville et al [3]
10	9 yr	NR	L UE paresis, paresthesia	C-4 partial collapse	Anterior biopsy	Traction, collar	C-4 vertebra plana, AS (3 yr)	Chaca and Khong [6]
11	12 yr	NR	Normal	C-2 lytic body & posterior elements	None	Traction, collar	New lytic C-3 lesion, AS (15 mo)	[6]
12	3 yr	Neck stiffness, torticollis	Hyperreflexia	C-2, C-3, & C-4 lytic bodies, C-12 dislocation, C-34 subluxation	Open biopsy	Traction, minerva jacket	AS, resolution (4 mo)	Marar and Balachandrar [23]
13	4 yr	Neck pain, torticollis	NR	C-2 lytic area with fracture, C-12 dislocation	None	Traction, minerva jacket	AS, resolution (18 mo)	[23]
14	18 yr	Neck pain	Normal	C-2 lytic arch, C-23 subluxation, C-4 partial collapse	Posterior biopsy	Radiation, collar	AS (4 yr)	Scarfi and Sassi [34]
15	10 yr	Neck pain	Quadriparesis	C-6 lytic spinous process, prevertebral soft-tissue shadow	C-6 laminectomy	Radiation, corticosteroid	AS (NR)	Reed et al [31]

Table 1 *(continued)*

16	11 yr	Neck pain	Normal	C-3 partial collapse, C-34 subluxation	None	Traction	C-7 partial collapse (4 mo), C-6 partial collapse (2 yr), AS (9 yr)	Poulson and Thommesen [29]
17	13 yr	Neck & arm pain	L wrist extensor weakness	C-2 & C-3 lytic pedicles, extramedullary mass	C-24 laminectomy	Collar	Swan neck deformity	Sherk et al [36]
18	9 yr	Neck pain, torticollis	L triceps, wrist extensor weakness	C-6 vertebra plana	Anterior biopsy	Collar	AS, partial reconstitution of vertebral height (6 mo)	[36]
19	15 yr	Neck & arm pain	R UE radiculopathy	C-5 partial collapse	Anterior C-46 fusion	Chest cast	AS (6 mo)	Rumyantsev [32]
20	4 yr	Neck & arm pain	R UE radiculopathy	C-5 lytic body	Anterior biopsy	Radiation, halo vest	AS (2 yr)	Green et al [14]
21	58 yr	Neck & arm pain	L UE radiculopathy	C-5 partial collapse, prevertebral soft-tissue shadow	Anterior C-5 corpectomy, bone graft	NR	AS (6 mo)	Casson et al [5]
22	5 yr	Neck pain, torticollis	Normal	C-4 lytic arch & spinous process	Posterior curettage, bone graft	Halo vest	AS (7 yr)	Biehl and Mittelmeier [2]
23	5 yr	Neck & arm pain	Normal	C-3 partial collapse	C-3 corpectomy & fusion	Radiation, collar	AS (4 mo)	Gaudara et al [13]
24	12 yr	Neck pain, stiffness	Normal	C-4 partial collapse	Anterior curettage, acrylic graft	Radiation, collar	As (9 mo)	[13]
25	5 yr	NR	NR	C-6 vertebra plana	Anterior C-56 fusion	Radiation	AS, reconstitution of vertebral height (3 yr)	Hamel et al [16]
26	17 yr	Neck & arm pain	Normal	C-4 partial collapse	Anterior C-35 acrylic fusion	Radiation, chemotherapy	AS (NR)	Sanchez et al [33]
27	55 yr	Neck pain	Quadriparesis	C-6 & C-7 lytic bodies, extramedullary mass	Anterior decompression, metal/acrylic fixation	Radiation, chemotherapy	Persistent quadriparesis	[33]
28	4 yr	Neck & arm pain	R UE weakness	C-4 vertebra plana	None	NR	NR	Charnoff [7]
29	10 yr	Torticollis	Normal	C-2 lytic arch	Occiput–C-2 fusion	Halo	NR	Hardy et al [17]
30	4 yr	Neck pain	Normal	C-4 lytic body & posterior elements	Biopsy	NR	NR	Silberstein et al [37]
31	31 yr	Neck & arm pain	R triceps weakness	C-5 & C-6 lytic pedicles	Posterior biopsy & curettage	NR	AS (NR)	Martin et al [24]
32	5 yr	Neck & arm pain	Normal	C-5 lytic posterior elements	Posterior fusion	Radiation	AS (1 yr)	Baber et al [1]
33	33 yr	Neck pain	Normal	C-2 lytic body, odontoid & pedicle	Posterior C-13 fusion	Radiation, halo vest	AS (6 mo)	Present report (1990)

Abbreviations: AS, resolution of symptoms; L, left; NR, not reported; R, right; UE, upper extremity.

that did not specify the approach. Operative descriptions of the anterior approach included biopsy, curettage, subtotal corpectomy, and corpectomy with fusion. Posterior operative descriptions include biopsy, curettage, laminectomy, and fusion. All patients reported to have neurologic deficits on examination underwent surgical procedures. There was one postoperative complication involving a swan neck deformity following multilevel laminectomy [36].

Although the arrest of vertebral collapse following radiation therapy has been reported [8], there is no clear evidence that treatment affects the natural history of cervical lesions with respect to collapse. In the majority of patients there was no progression to collapse in the involved vertebra.

New bone lesions occurred in four of the 29 cases reporting outcome. New lesions occurred in all treatment groups, irrespective of radiation therapy or surgical curettage; however, two of the four patients that did not receive radiation or curettage developed new lesions. Local therapy to active granulomas may not affect the development of new lesions.

Eosinophilic granuloma appears to be a self-limiting disease and the necessity for aggressive therapy has been debated. Granulomas have been reported to respond rapidly to radiation, and thoracolumbar lesions with neurological signs have been managed with radiation only [15]. Authors have recommended that surgical intervention be reserved for cases of cord compression [14,35]. With the advent of CT and MRI, one can now easily determine the existence of extraosseous expansion of the granuloma and the threat to nerve roots and spinal cord. Magnetic resonance imaging should prove to be exceptionally useful in the evaluation of these lesions. Early surgical intervention in cases presenting with physical or radiographic evidence of impending cord or radicular compression is recommended, before the onset of a possible catastrophic event. Although the bone lesions in eosinophilic granuloma are self-limiting, central nervous system injury from the sequelae of expanding granuloma or vertebral collapse may be irreversible.

In conclusion, the management of cervical eosinophilic granuloma should include detailed imaging, skeletal survey, and tissue diagnosis. Immobilization of the spine will palliate symptoms. In cases with evidence for instability or impending neurologic compromise, surgical intervention is recommended. There is no clear evidence that radiation therapy is of benefit.

We wish to thank Dr. Russell Rothrock for referring this patient to our service.

References

1. Baber WW, Numaguchi Y, Nadell JM, Culicchia F, Robinson AE. Eosinophilic granuloma of the cervical spine without vertebra plana. J Comput Tomogr 1987;11:346–9.
2. Biehl VG, Mittelmeier H. Unilokulare Histiocytosis X an der kindlichen halswirbelsaule. Beitr Orthop Traumatol 1982;29:83–6.
3. Bonneville JF, Jacquet G, Louchamp D, Weill F, Raffi A, Steimlé B. Isolated cervical eosinophilic granuloma in a child. Cah Med 1971;12:641–5.
4. Calvé J. A localized affection of the spine suggesting osteochondritis of the vertebral body with the clinical aspect of Pott's disease. J Bone Joint Surg 1925;7:41–6.
5. Casson IR, Blair D, Gerard G. Eosinophilic granuloma of the cervical spine in an adult. NY State J Med 1981;81;1102–4.
6. Chaca PB, Khong BT, Eosinophilic granuloma of bone, a diagnostic problem. Clin Orthop 1971;80:79–88.
7. Charnoff SK. Radiology notes, case 1. Mt Sinai J Med (NY) 1985;52:133–5.
8. Compere EL, Johnson WE, Coventry MD. Vertebra plana (Calvé's disease) due to eosinophilic granuloma. J Bone Joint Surg 1954;36A:969–80.
9. Davidson RI, Shillito J. Eosinophilic granuloma of the cervical spine in children. Pediatrics 1970;45:746–52.
10. Farber S. The nature of "solitary or eosinophilic granuloma" of bone. Am J Pathol 1941;17:625–9.
11. Finzi O. Mieloma con prevalenza delle cellule eosinofile, circoscritto all'osso frontale in un giovane di 15 anni. Minerva Med 1929;91:239–4.
12. Fowles JV, Bobechko WP. Solitary eosinophilic granuloma in bone. J Bone Joint Surg 1955;52B:238–43.
13. Gaudara FS, Gallegos XA, Costa PO, Vigueras R. Granuloma eosinofilo de columna cervical. Rev Child Pediatr 1982; 53:140–13.
14. Green NE, Robertson WW, Kilroy AW. Eosinophilic granuloma of the spine with associated neural deficit. J Bone Joint Surg 1980;62A:1198–202.
15. Haggstrom JA, Brown JC, Marsh PW. Eosinophilic granuloma of the spine: MR demonstration. J Comput Assist Tomogr 1988;12:344–5.
16. Hamel E, Frowein RA, Karimi-Nejad A, Müller W. Tumoreu der en halswirbelsäule. Nervenarzt 1984;55:285–92.
17. Hardy JR, Pouliquen JC, Pennecot GF. Posterior fusion of the upper cervical spine in children and teenagers. A review of 19 cases. Rev Chir Orthop 1985;71:153–66.
18. Kieffer SA, Nesbit ME, D'Angio GJ. Vertebra plana due to histiocytosis X, serial studies. Acta Radiol [Diagn] (Stockh) 1969;8:241–50.
19. Lichtenstein L. Histiocytosis X: integration of eosinophilic granuloma of bone, "Letterer–Siwe disease" and "Schuller–Christian disease" as related manifestations of a single nosologic entity. Arch Pathol 1953;56:84–102.
20. Lichtenstein L, Jaffe HL. Eosinophilic granuloma of bone, with report of a case. Am J Pathol 1940;16:595–604.
21. Lindenbaum B, Gettes NI. Solitary eosinophilic granuloma of the cervical region. Clin Orthop 1970;68:112–4.
22. Macnab GH. Discussion: eosinophilic granuloma, Letterer–Siwe disease, Hand–Schüller–Christian disease. Proc R Soc Med 1955;48:711–20.
23. Marar BC, Balachandran N. Non-traumatic atlanto-axial dislocation in children. Clin Orthop 1973;92:220–6.
24. Martin N, Helias A, Pottuz GJ, Nahum H. Localisation pediculaire cervicale isolee d'un granuloma éosinophile chez un adulte. Ann Radiol (Paris) 1985;28:391–3.
25. Nesbit ME, Kieffer S, D'Augio GJ. Reconstruction of vertebral height in histiocytosis X: a long term follow up. J Bone Joint Surg 1969;51:1360–7.

26. Oberman HA. Idiopathic histiocytosis. Pediatrics 1961;28: 307–27.
27. Ochsner SF. Eosinophilic granuloma of bone. AJR 1966; 97:719–26.
28. Otani S, Ehrlich JC. Solitary granuloma of bone simulating a neoplasm. Am J Pathol 1940;16:479–90.
29. Poulson JO, Thommesen P. An unusual case of histiocytosis X in the spine. Acta Orthop Scand 1976;47:59–62.
30. Price HI, Betnitzky S. The computed tomography findings in benign diseases of the vertebral column. CRC Crit Rev Diagn Imaging 1985;24:39–89.
31. Reed VC, Bresolin AU, Lefeure AB. Granuloma eosinofilo da coluna cervical com manifestacao neurologica, liquorica, eradiologica atipica. Arq Neuropsiquiatr 1975;33:168–77.
32. Rumyantsev. Eosinophilic granuloma of the cervical spine. Zh Vopr Neirokhir 1979;(June):49–51.
33. Sanchez RL, Llovet J, Moreno A, Galito E. Symptomatic eosinophilic granuloma of the spine. Orthopedics 1984;7:1721–6.
34. Scarfi G, Sassi N. Forma osteolitico-distrutitiva del granuloma eosinofilo a localizzazione vertebrale. Minerva Ort 1974; 25:298–303.
35. Seimon LP. Eosinophil granuloma of the spine. J Pediatr Orthop 1981;1:371–6.
36. Sherk HH, Nicholson JT, Nixon JE. Vertebra plana and eosinophilic granuloma of the cervical spine in children. Spine 1978;3:116–21.
37. Silberstein MJ, Sundaram M, Akbarnia B, Luisiri A, McGuire M. Eosinophilic granuloma of the spine. Orthopedics 1985;8: 264–74.
38. Verbiest H. La chirurgic antérieure oet latérale du rachis cervical. Neurochirurgie 1970;16(suppl 2):181–9.
39. Whitehouse GH, Cheyne C, Price CHG, Lewis JG. Histiocytosis X (abridged). Proc R Soc Med 1971;64:333–40.