OPEN VERTEBROPLASTY FOR CERVICAL SPINE AGGRESSIVE HEMANGIOMA

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Objective. To analyze results of open vertebroplasty for aggressive hemangioma of the cervical spine.
Material and Methods. Surgical treatment was performed in 12 patients with aggressive hemangioma of the cervical spine. Vertebroplasty was performed through an open anterolateral approach under the control of an image intensifier.
Results. Pain intensity was 7.0 ± 1.0 on VAS before surgery and 1.8 ± 1.2 immediately after surgery. Neck disability index (NDI) was 17.5 ± 6.5 before surgery and 4.3 ± 1.7 after surgery. One month after surgery VAS and NDI scores were 0. There were no complications in the postoperative period. A control study visualized from 82 % to 98 % completeness of filling the bone defect with polymethyl methacrylate. Bone composite migration outside the vertebral body was not detected in any of the operated patients. Control images taken 6 and 12 months after surgical treatment did not reveal continued tumor growth and signs of any osteonecrotic processes in bone tissue as a response to PMMA bone cement in any case.
Conclusion. Despite the widespread and rather long period of using vertebroplasty, the issues of the choice of approaches when performing it on the cervical spine are still debatable. In order to reduce the risk of iatrogenic complications in cervical vertebroplasty, the open approach can be used which increases the treatment effectiveness.
Key Words: spine, aggressive hemangioma, cervical spine, open anterolateral approach, vertebroplasty.
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The rate of spinal hemangiomas in the population is 11.0%, with 3.7 % of hemangiomas being aggressive [1]. The aggressiveness is assessed using an evaluation score scale for spinal hemangioma aggressiveness, which includes 9 radiological and clinical criteria [2]. Each criterion is assigned a certain score (from 1 to 5): if the total score is 5 or more, a hemangioma is considered aggressive.

Hemangiomas can occur in any part of the spine, more often in the thoracic (70–76 %) and lumbar (22–25 %) spine and less often in the cervical (2–8 %) and sacrococcygeal (1%) spine [3, 4]. Histologically, spinal hemangiomas are divided into three types: capillary, the incidence rate is 15.8 %; cavernous, the incidence rate is 29.2 %; and mixed, the incidence rate is 55.0 % [2]. CT and MRI are the leading techniques for diagnosis of hemangiomas [5]. Local pain in 55–90 % of cases is the main and, sometimes the only, symptom of the disease [6]. As the hemangioma grows, the vertebral bone is continually restructured, which can lead to its pathological fracture and neurological deficit [7].

Puncture vertebroplasty is currently the priority technique for treating aggressive vertebral hemangiomas [8]. The main task is to restore the supporting ability of an affected vertebra and provide an analgesic effect [2]. The introduction of bone cement into the defect area promotes mechanical strengthening of the affected vertebral body, and the cytotoxic effect of polymethyl methacrylate, embolization of the pathological vascular bed, and thermochemical necrosis of the nerve endings provide regression of pain syndrome [9].

The cervical spine is a region less affected by hemangiomas [10]. Probably, this is the cause for many controversial questions about the choice of approaches for vertebroplasty at this level. In the literature, there are only a few reports on the use of the open approach, which gives the ground to present our own results on open vertebroplasty for aggressive cervical hemangiomas.

The study objective was to analyze the outcomes of open vertebroplasty for aggressive cervical hemangiomas.

Material and Methods

Surgical treatment was performed through the open anterolateral approach in 12 patients (3 males, 9 females) with aggressive hemangiomas of the cervical spine. Most patients (n = 8) were of working age (30–45 years old), and the lesion caused a limitation of their working capacity. All patients had single-level cervical spine disease: C2 level – 1 case, C3 level – 1 case, C4 level – 2 cases, C5 level – 3 cases, C6 level – 4 cases, and C7 level – 1 case.

The diagnosis of aggressive vertebral hemangioma was made based on assessing the aggressiveness using the score scale. The type of aggressive vertebral hemangioma was determined according to the topographic and anatomical classification by Nguyen et al. [11]. The severity of pain in the examined patients was assessed using the visual analogue scale (VAS), and activity limitation due to pain was determined using the neck disability index (NDI). Indications for vertebroplasty of hemangioma were primarily based on its proven aggressive-

ness that was determined by X-ray and clinical signs [2]: compression fracture of the vertebral body affected by hemangioma; bone expansion with protrusion of the cortical layer; the extent of vertebral body involvement of more than 50 %; cortical thinning or destruction; a coarse trabecular structure of hemangioma; extension of hemangioma from the body to the vertebral arch; low T1–WI and high T2–WI signal from hemangioma in MRI scans, high T2–WI signal in the fat suppression mode; severe vertebrogenic pain.

Vertebroplasty was performed with the patient in the supine position, through the open anterolateral approach under control of an image intensifier (II), using a 10 cm needle 13G with a quadrangular distal end. The vertebral bodies were accessed under general anesthesia, from the right side. A 1.5–2 cm transverse incision of the skin and subcutaneous tissue was made at the affected vertebra level. The subcutaneous tissue and subcutaneous muscle of the neck were opened by sharp and blunt dissection, and the interfascial space between the neurovascular bundle on one side and the midline organs of the neck (larynx, pharynx, esophagus, thyroid gland) on the other was accessed. The omohyoid muscle was mobilized and displaced cranially or caudally, depending on the lesion level. In the depth of the wound, the anterolateral surface of the affected vertebral body was exposed, and, after preliminary control with an image intensifier, a puncture needle was inserted in the body (closer to the midline). For vertebroplasty, we used highly viscous bone cement that was injected into the vertebral body manually, being guided by a pin.

Results and Discussion

CT examination of the affected vertebrae revealed 5 cavernous hemangiomas and 7 mixed hemangiomas. Cavernous hemangioma, in contrast to mixed hemangioma, is associated with a high risk of a pathological fracture of the affected vertebra because hypertrophied, rare, vertical spongy bone trabeculae no longer provide normal strength properties. For this reason, cavernous vertebral hemangioma may be considered an absolute indication for vertebroplasty.

The topographic and anatomical classification by Nguyen et al. [11] includes (depending on location) 5 hemangioma types. In our series, there were 11 cases of type 2 hemangioma (Fig. 1) and 1 case of type 4 hemangioma (Fig. 2). All patients underwent vertebroplasty through the open anterolateral approach under image intensifier control. Vertebroplasty was performed using highly viscous bone cement and sufficient working time to reduce the risk of extravertebral polymethyl methacrylate leakage. Depending on the affected cervical level, the amount of cement injected into a vertebral body defect was 3 to 4 ml.

After surgical treatment, the patients underwent control CT. CT scans were used to evaluate the percentage of bone defect filling with polymethyl methacrylate, which ranged from 82 to 98%. No bone composite migration outside the vertebral body was found in the operated patients. The length of hospital stay of patients was 2–3 days. At 6 and 12 months after surgery, patients underwent follow-up CT, which confirmed the absence of recurrent hemangiomas. There were no signs of any osteonecrotic processes in bone tissue as a response to polymethyl methacrylate-based bone cement.

The efficacy of vertebroplasty was also assessed based on clinical data. The intensity of pain assessed by the VAS score was 7.0 ± 1.0 in the preoperative period and 1.8 ± 1.2 immediately after puncture vertebroplasty. The neck disability index (NDI) for cervical pain was 17.5 ± 6.5 before surgery and 4.3 ± 1.7 after surgery. One month after surgical treatment, the VAS and NDI scores were 0. The surgical treatment outcomes for each patient are presented in Table.

Clinical case. In September 2018, a 42-year-old female patient A. applied to an outpatient clinic with complaints of cervical pain that was persistent, intense, and aggravated by moving the head. The patient had a three-year pain history, with the pain significantly increasing the last year, so she had to constantly take pain medications. Palpation of the C5 spinous process caused a sharp increase in pain. The severity of pain was scored 7 with VAS and 16 with NDI. MRI examination of the cervical spine revealed a hemangioma of the C5 vertebral body, which manifested by high T2–WI and high Fat-Suppressed T2–WI signal (Fig. 3). The patient also underwent CT examination that revealed signs of an aggressive hemangioma: the extent of vertebral body involvement of more than 50 % and cortical thinning (Fig. 4).

The patient was admitted to a hospital where she underwent open vertebroplasty of the C5 vertebral body. Bone cement (4 ml) was injected into the vertebral body. After surgery, the pain regressed to a score of 2 (VAS) and 4 (NDI). Postoperative CT scans revealed total filling of the tumor-associated vertebral defect with bone cement; there was no polymethyl methacrylate migration (Fig. 5). The patient was discharged on the 3rd day after surgery. Follow-up CT was performed at 6 and 12 months; there was no tumor recurrence. VAS and NDI scores were 0.

It should be noted that in the present series, there was one case of a pathological vertebral fracture due to a hemangioma of the C6 vertebra (Fig. 6). The patient underwent open vertebroplasty of the affected vertebra. Control CT scans showed no extravertebral leakage of polymethyl methacrylate (Fig. 7).

In puncture vertebroplasty of the cervical spine, various puncture approaches can be used depending on the lesion level: posterior, transoral, anterolateral, and transpedicular [12]. In the case of C1 aggressive vertebral hemangioma, the method of choice is a percutaneous puncture approach under the atlas posterior arch [13]. Placement of a puncture needle and subsequent injection of a bone composite are performed exclusively under X-ray control using intraoperative CT. However, if a CT unit is unavailable, an image intensifier is used, which does not provide full visualization of the affected vertebra, thereby increasing the risk of iatrogenic complications

Fig. 1
CT scan of the C6 vertebra (type 2 according to Nguyen et al.)

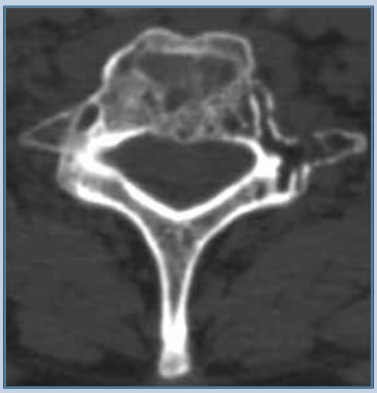

Fig. 2
CT scan of C7 vertebra (type 4 according to Nguyen et al.)

during puncture vertebroplasty [14, 15]. For vertebroplasty of the C2 and C3 bodies, a transoral approach can be used [12], which is anatomically justified by the proximity of the pharynx and C2 and C3 bodies as well as a decreased risk of damage to the nearby anatomical structures, but this approach is performed in the primary contaminated area, and there is a certain limitation on the use of a special retractor for the oral cavity [16]. At the middle and lower cervical levels (C4–C7), a transcutaneous puncture anterolateral approach is used; however, advancing the needle in this case is associated with a risk of damage to important anatomical structures (especially in patients with a brachymorphic body type) and development of further severe iatrogenic complications, such as injury to the great vessels and midline structures of the neck [17, 18]. Due to a small size of the cervical vertebral arches and the proximity of the vertebral artery, spinal cord, and nerve roots, a transpedicular approach to the cervical spine is technically quite difficult and is accompanied by a high risk of severe complications [19]. In addition, visualization with image intensifier of the main X-ray landmarks at the C7 level may be limited due to the so-called the X-ray shadow effect of the upper limb girdle, which complicates control of puncturing the vertebra with a needle [20, 21]. Given these facts, the open anterolateral approach can be more widely used for vertebroplasty at all cervical levels, which provides a full view of the surface of the vertebral bodies, thereby reducing the risk of severe iatrogenic complications.

Conclusion

Vertebroplasty is effective for aggressive vertebral hemangiomas at different levels. Vertebroplasty provides regression of pain in almost all operated patients and the absence of recurrent hemangiomas.

Despite the prevalence of this technique and a long period of its application, the issues of choosing approaches for vertebroplasty of the cervical spine are still debatable. To reduce the risk of iatrogenic complications, vertebroplasty of the cervical spine can be performed through the open approach, which increases the efficacy of treatment.

The study was conducted without financial support.
The authors declare no conflict of interest.

Table

Surgical treatment outcomes in patients with aggressive cervical hemangiomas

Parameter	Patient											
	1	2	3	4	5	6	7	8	9	10	11	12
Age, years; gender	39; f	43; f	40; f	49; m	33; f	51; f	45; m	48; m	42; f	34; f	53; f	42; f
Lesion level	C6	C4	C5	C2	C4	C6	C6	C5	C7	C5	C3	C6
Type of hemangioma	Mixed	Mixed	Cavernous	Mixed	Cavernous	Mixed	Cavernous	Mixed	Cavernous	Mixed	Mixed	Cavernous
Type according to Nguyen et al.	2	2	2	2	2	2	2	2	4	2	2	2
Aggressiveness, points [2]	11	9	12	8	11	12	8	10	15	11	9	13
Pathological fracture	No	No	No	No	No	No	No	No	No	No	No	Yes
VAS before surgery	7	7	7	6	6	7	8	7	8	7	6	8
NDI before surgery	17	16	16	15	15	17	22	16	21	15	16	24
Surgery	Open vertebro-plasty	Open vertebro-plasty	Open vertebro-plasty	Open vertebro-plasty	Open vertebro-plasty	Open vertebro-plasty	Open vertebro-plasty	Open vertebro-plasty	Open vertebro-plasty	Open vertebro-plasty	Open vertebro-plasty	Open vertebro-plasty
Surgery duration, min	43	46	50	55	42	47	49	41	38	44	42	60
Blood loss, ml	20	15	22	25	20	15	15	10	25	15	25	30
Volume of injected composite, ml	4	3	4	3	3	4	4	4	4	4	3	4
Filling percentage, %	90	88	94	85	82	87	95	98	87	92	89	92
Complications	No	No	No	No	No	No	No	No	No	No	No	No
VAS: day 3 after surgery	2	2	1	2	1	1	2	2	3	2	1	3
NDI: day 3 after surgery	4	3	5	3	4	4	6	4	5	4	3	6
NDI: 1 month after surgery	0	0	0	0	0	0	0	0	0	0	0	0
NDI: 1 month after surgery	0	0	0	0	0	0	0	0	0	0	0	0
Recurrence	No	No	No	No	No	No	No	No	No	No	No	No

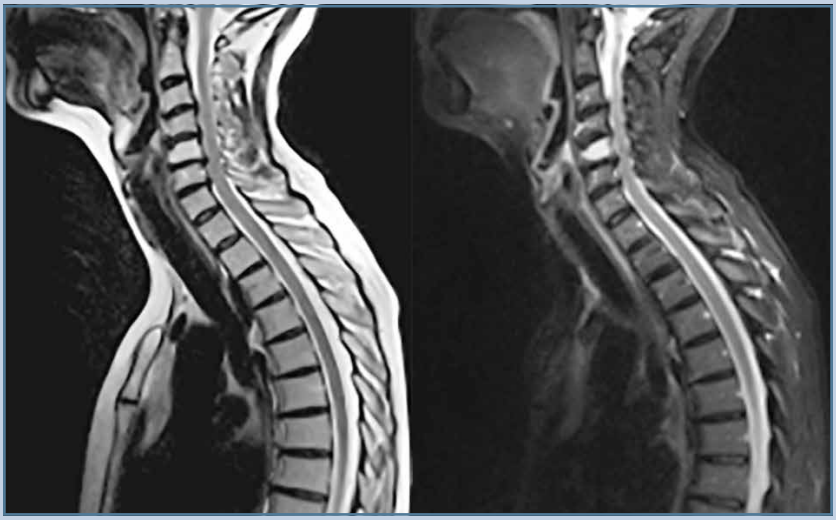

Fig. 3
MRI scans of a 42-year-old female patient A. before surgery

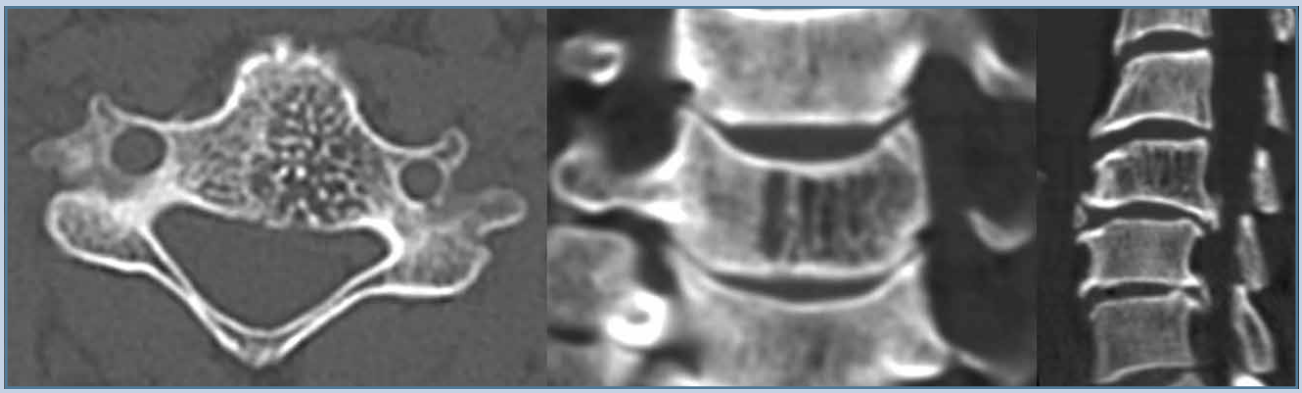

Fig. 4
CT scans of the C5 vertebra of a 42-year-old female patient A. before surgery

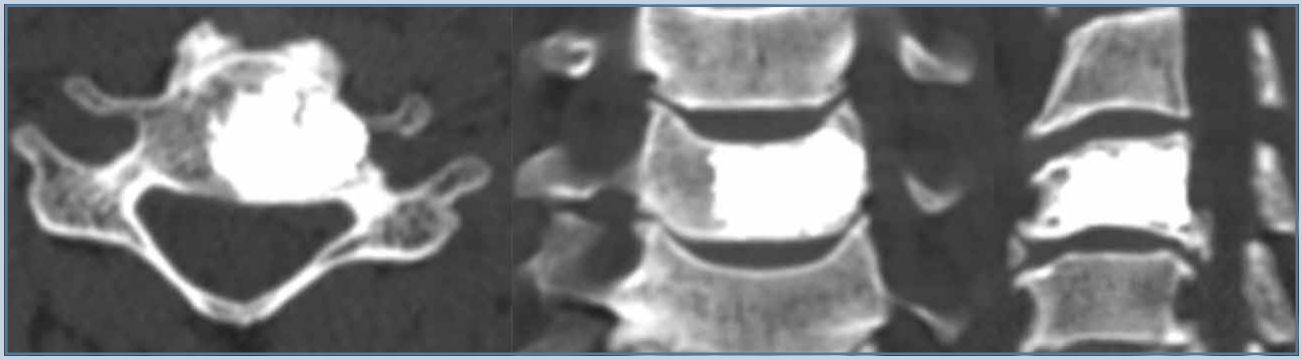

Fig. 5
CT scans of the C5 vertebra of a 42-year-old female patient A. after surgery

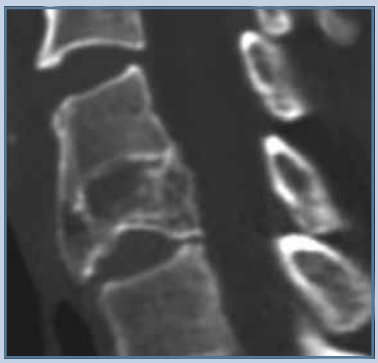

Fig. 6
Preoperative CT scan of the C6 vertebra of a patient with a pathological fracture from a vertebral hemangioma

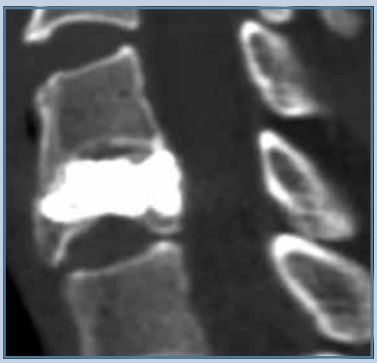

Fig. 7
Postoperative CT scan of the C6 vertebra of a patient with a pathological fracture from a vertebral hemangioma

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