Results of percutaneous cervical vertebroplasty using an anterolateral approach for cervical spine tumors

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ABSTRACT

Objective: The aim of this study was to report the results of percutaneous vertebroplasty in managing symptomatic osteolytic cervical spine tumors.

Methods: This study comprised a retrospective examination of patients who received percutaneous vertebroplasty between 2008 and 2020 for the treatment of tumor-induced symptomatic cervical vertebra involvement. The study summarized the demographics, vertebral levels, pain control rates, clinical results, and complications of percutaneous vertebroplasty using an anterolateral approach.

Results: The study sample consisted of 6 female and 2 male patients aged between 20 and 56 (mean = 41.37) years. Tumors were located at C2 in 6 cases, at C3 in 1 case, and at C5 in another. The mean volume of poly (methyl methacrylate) injected was 1.5 mL (range: 1-2 mL). Biopsy results showed the presence of metastasis in 5 cases and plasmacytoma in 3. No postoperative complications or mortality were observed after the procedure. Preoperative mean 7.75 visual analog scale score decreased to 2.62. Pain control was reported to be 66.2%.

Conclusion: Anterolateral cervical vertebroplasty seems to be a safe, effective, and helpful therapeutic alternative for the treatment of cervical spine tumors. It reduces the risk of infection compared to the transoral method.

Level of Evidence: Level IV, Therapeutic Study

Introduction

Spinal metastasis is observed in over two-thirds of patients who die from cancer. In 10%-20% of these cases, the spinal cord is affected by pathologic fracture covering the posterior wall. Approximately 60% of metastases are found in the thoracic spine segment of the spine. Location in the thoracic spine is followed by the lumbar (20%) and cervical spine (10%-20%). However, involvement is extremely rare in the upper cervical vertebra.

Percutaneous vertebroplasty (PVP) is a minimally invasive procedure for the treatment of dorsopathy stemming from osteoporotic vertebral fracture, vertebral metastases, multiple myeloma, and aggressive hemangioma. However, PVP is a well-established technique for the treatment of benign and malignant compression fractures, as well as for the consolidation and palliation of painful lytic tumors. Developed in France in 1984, PVP was designed to treat aggressive hemangioma with epidural extension in the C2 localization.

The aim is to deaden the pain by strengthening the vertebra. Percutaneous vertebroplasty indications are extended to cover patients with osteoporotic fractures and vertebral metastases.

Percutaneous vertebroplasty is performed in the upper cervical vertebra by anterolateral and transoral approaches. The anatomical structure of the cervical region increases the risk of complications. In osteolytic lesions, cement is more prone to leak into the spinal tract, putting pressure on the spinal cord and nerve roots. In these cases, PVP is highly risky due to regional anatomy and the risk of cement leakage.

When applied with an appropriate method, cervical PVP is a viable procedure with acceptable complication rates in pain control. This study examined the clinical results of patients receiving PVP in the cervical region using an anterolateral approach.

Materials and Methods

Ethical approval for the study was obtained from Ümraniye Training and Research Hospital Ethics Committee (B10.1.TKH.4.34.H.GP.01/54 ID). Preoperatively, informed consent about the operation and the use of their data was obtained from the patients. The study comprises a retrospective examination of patients who received PVP between 2008 and 2020 for the treatment of tumor-induced symptomatic cervical vertebrae involvement. The study examined...
Results

In the 2008-2020 period, vertebroplasty was performed in 350 patients. Cervical vertebroplasty was performed in 8 (2.28%) of the 350 cases, where 6 patients were female, 2 were male, and the average age was 41.37 (20-56) years. Tumors were located at C2 in 6 cases, at C3 in 1 case, and at C5 in another. All patients were given biopsy and vertebroplasty using the anterolateral approach. The patients were injected with between 1 and 1.5 mL of PMMA. Biopsy results showed the presence of metastasis in 5 cases and plasmacytoma in 3. In postoperative neurological examinations, no regression, no cement leakage from the vertebrae, and no cement embolism were observed. The preoperative 7.75 VAS score dropped to a postoperative score of 2.62. The pain control rate was 66.2% (Table 1). The d-value, which is the effect size index, was calculated as 7.93 for the Wilcoxon signed-ranks test, in which the difference between the 2 measurements (pre VAS → 7.75 ± 0.46 vs. post VAS → 2.63; P = .010) levels is measured. In this context, the power was found to be 1 – β = 0.99 for α = 0.05 (the margin of error) and d = 7.93. While the mean preoperative KPS was 76.25 (70-80), it was found to be 85 (80-90) postoperatively. Neurological deterioration was not detected in any patient. No complications, infections, or surgical mortality were seen on postoperative follow-up.

Discussion

Although cervical bone metastases are very rare lesions, the methods used for pain control and treatment of these patients are very limited. Cervical vertebroplasty is an effective method that can be used in the pain control and treatment of these patients. However, in the literature review, articles about the clinical success and complications of this method are limited. This study demonstrates the safety of cervical PVP using the anterolateral approach and its effectiveness in pain control.

Multiple myeloma and metastasis are the most frequent types of malignant tumors in the vertebrae.2,9,10 These tumors are present mostly in the thoracic and lumbar vertebrae. In many cases, pain control is assured, and vertebral height is restored by vertebroplasty.2,11 Vertebroplasty is rarely applicable in the cervical region. In a single clinical study that performed PVP in 117 patients for vertebral metastasis, 10% of the patients were given PVP in the cervical region and only 2% at C2.24 In our series, C2 PVP was performed in only 6 of the 350 cases (1.7%). This is because metastasis and/or multiple myeloma involvement is rare in the C1 and C2 vertebrae,24 and the region is risky for operation.

With the exception of some meta-studies, there are few small PVP series in the literature (Table 2). Anterolateral,10,11,13-25 posterolateral,14 and transoral13,17 approaches are identified for cervical PVP. Anterolateral10,11,13-25 and transoral13,17 approaches have recently been recommended in the upper cervical region. In the anterolateral approach, the risk of damaging neurovascular, esophageal, and tracheal structures is high in the cervical region, whereas the risk of infection is low.16 In the transoral approach, the risk of damaging such visceral structures is lower but that of infection is higher.26 In the lower cervical region, both anterolateral and posterolateral approaches are preferable with regard to the location of the lesion.24

The aim of cervical PVP is to control pain and restore vertebral height.21 In many studies, 85%-89% pain control was reported.19,21,27 Masala et al13 reported 40% pain control. The pain

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**HIGHLIGHTS**

- Percutaneous vertebroplasty in the cervical spine is a technically demanding and complication prone procedure. However, when applied with an appropriate method it is a viable procedure with acceptable complication rates. This study examined the clinical results of patients receiving PVP in the cervical region using an anterolateral approach.
- The results from this study showed a decrease in pain scores and an increase in performance scores with no complications in 8 patients who underwent PVP via an anterolateral approach.
- This indicates that the cervical PVP using the anterolateral approach is a safe and effective option for providing pain control in cervical spine tumors.
control rate was 66.2% in the present study. As cervical PVP is performed on smaller vertebrae than thoracic and lumbar vertebrae, cement leakage may occur due to a lack of experience and the small size of these vertebrae. Many studies have reported 17% asymptomatic cement leakage (Table 2).

Using the PubMed and Medline databases, Garza-Ramos et al. examined 125 cervical PVP cases, 83 of which were performed at C2. In that series, asymptomatic cement leakage into the paraspinal lesion was observed in 22 patients, and symptomatic cement leakage was found in 5 cases (4%). Odynophagia was observed in 3 of the 5 cases with symptomatic cement leakage. In addition, there was leakage-based ocipital neuralgia in one case and cement embolism in another.

In a 12-case C2 PVP series, Mont’Alverno et al. reported asymptomatic cement leakage in 7 cases and symptomatic complications in 2 (occipital neuralgia in 1 case and ischemic stroke the other). Using

| Author                  | Case # | Level | Approach                        | Diagnosis                | Complication                                                                 |
|-------------------------|--------|-------|---------------------------------|--------------------------|-----------------------------------------------------------------------------|
| Tong et al (2000)       | 1      | C2    | Transoral                       | MM                       | None                                                                        |
| Mont’Alverno et al (2005) | 12     | C2    | Anterolateral PVP               | Carcinoma metastasis    | 1 transient occipital neuralgia, 1 ischemic stroke, 7 asymptomatic cement leakage |
| Rodriguez Catarino (2006) | 5      | C2-7  | Anteriolateral PVP              | MM                       | 1 asymptomatic cement leakage                                               |
| Pflugmacher et al (2006) | 1      | C2    | Anterolateral PVP               | MM                       | Asymptomatic cement leakage in 2 of 12 levels                                |
| David Dang et al (2007) | 1      | C2-C3 | Posterolateral                   | Fibrous dysplasia        | None                                                                        |
| Masala et al (2010)     | 62     | Monolateral (anterolateral or posterolateral) PVP or transoral PVP | MM                       | 2 asymptomatic cement leakage                                               |
| Sun et al (2010)        | 1      | C2    | Anterolateral and posterolateral | Carcinoma metastasis    | 3 slight odynophagia, 4 asymptomatic cement leakage                         |
| Blondel et al (2012)    | 6      | C2-5  | Anterolateral                    | Carcinoma metastasis    | 2 asymptomatic cement leakage                                               |
| Kordeki et al (2015)    | 1      | C2-7  | Anterolateral                    | Carcinoma metastasis, MM, vertebral hemangioma | None                                                                               |
| Li Bao et al (2017)     | 9      | C2-6  | Anterolateral                    | Carcinoma metastasis    | Asymptomatic cement leakage in 14 of 22 levels (63.6%)                      |

MM, multiple myeloma; PVP, percutaneous vertebroplasty.

Figure 1. A-E. Preoperative and postoperative images of a case of C2 plasmocytoma. (A) Preoperative T2-weighted sagittal MRI showing the tumor. (B) Preoperative cervical spine CT showing osteolytic changes of C2 vertebra. (C) Postoperative cervical spine CT showing cement inside of C2 body and odontoid process. MRI, magnetic resonance imaging; CT, computed tomography.
the transoral approach for cervical vertebroplasty has a risk rate of between 2 and 4.5%. In our series, no complications, infection, or surgical mortality were seen on postoperative follow-up.

The most important limitation of our study is the small number of cases and retrospective planning. However, this situation is inevitable due to the small number of these patients and the rarity of using this method as a treatment. Therefore, prospective studies with multicentric and large numbers of cases are required.

Anterolateral cervical vertebroplasty seems to be a safe, effective, and helpful therapeutic alternative for the treatment of cervical spine tumors. It reduces the risk of infection compared to the transoral method.

*Supplementary video file associated with this article can be found in the online version of the journal.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Umraniye Training and Research Hospital. [Approval No: B10. 1/TKH. 4.34. H.GP. 0/1 (54 ID)].

Informed Consent: Written informed consent was obtained from the patients.

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