Clinical Neurology and Neurosurgery 140 (2016) 91–96

Contents lists available at ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro

En bloc spondylectomy combined with chest wall excision for spinal tumor via a modified posterior approach: a retrospective study on 21 patients

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ARTICLE INFO

Article history:
Received 1 October 2015
Received in revised form
19 November 2015
Accepted 24 November 2015
Available online 28 November 2015

Keywords:
Total en bloc spondylectomy
Spinal tumor
Chest wall invasion
Reconstruction

ABSTRACT

Objective: This study was to investigate the feasibility and efficacy of total en bloc spondylectomy (TES) combined with chest wall excision through a modified posterior approach in treating the patients with thoracic spinal tumor and posterior chest wall invasion.
Methods: Clinical data of 21 consecutive patients (7 males, 14 females; average age: 41.5, range: 20–69) who underwent the combined TES and chest wall excision through a modified posterior approach from 08/2005 to 01/2014 were retrospectively analyzed. Reconstruction of the spinal defect following TES was accomplished by dorsal stabilization and carbon cage interposition. All resected specimens were examined histologically. Radiotherapy and chemotherapy were performed according to the results of the surgery and histological examination. All patients were followed up on a regular basis.
Results: The surgery was successfully performed in all patients. Histological analysis revealed primary malignant tumors in 16 patients and solitary vertebral metastases in 5 patients. Three patients with preoperative neurologic deficits of Frankel D recovered to Frankel E 1–3 weeks postoperatively. After the mean follow-up of 31 months (9–70), the 16 patients (16/21, 76.2%) with primary bone tumors were free of recurrence and present no evidence of disease. Four cases (4/21, 19%) with metastatic tumor developed recurrence or distant metastases. Three patients presented with cerebrospinal fluid leakage and one patient suffered pneumonia; they were soon recovered after treatment. No other complications were observed.
Conclusion: The results suggest that the combined TES with chest wall excision via a modified posterior approach seems feasible and effective for treating patients with thoracic spinal tumor and posterior chest wall invasion.

1. Introduction

It is generally accepted that wide surgical margin represents an essential precondition for disease-free survival in patients with primary malignant, aggressive benign, and solitary metastatic bone tumors [1]. En bloc resections are the procedures aimed at surgically removing a tumor in a single and intact piece and fully covered by a continuous shell of healthy tissue which is defined as the 'margin' [2]. These operations can also be performed in the spine where anatomical and surgical constraints make them technically demanding [3–5]. The requirement of a margin encasing the tumor can, sometimes, be met by resecting the relevant anatomical structures (rib, pleura, dura, muscles, nerve roots, nerves, vessels and so on) [6].

Stener et al. [4] and Roy-Camille et al. [3] are the pioneers of en bloc resections in the spine via a posterior approach. Since then, further techniques for total en bloc spondylectomy (TES), including variable approaches and stabilization technique, have been developed and yielded promising results in view of local control and overall prognosis [7–9]. Cloyd et al. [10] reviewed hundreds of literatures and reported that when the margins are tumor free, the average local control by en bloc resection rises to 92.3% in giant cell tumor (GCT), to 78% in chordoma (CH) and to 82% in chondrosarcoma (CHS). These are quite remarkable data when compared with

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http://dx.doi.org/10.1016/j.clineuro.2015.11.018
0303-8467/

the local control achieved by intralesional surgery: 72.2% in GCT, 22% in CH and 0% in CHS. En bloc resection has also proved to be effective in improving the quality of life in patients with isolated metastases, such as those from renal cell carcinoma, thyroid cancer and some other low-grade malignant tumors [11,12].

But there are only a few case reports concerning patients with thoracic spinal tumors and chest wall invasion that treated by TES [8,9]. The aims of this study are to evaluate the feasibility and efficacy of combined TES and chest wall resection for primary malignant bone tumors and solitary metastases of the thoracic spine. The clinical data of 21 consecutive patients admitted to our hospital were retrospectively analyzed.

2. Materials and methods

2.1. Patients

This study was approved by the ethic committee of the hospital and signed informed consent was obtained from all patients. Clinical data of 21 consecutive patients (7 males, 14 females; average age: 41.5, range: 20–69) with thoracic spinal tumor and posterior chest wall invasion, who underwent TES combined with chest wall resection from December 2005 to January 2014, were reviewed (Table 1). The main complaints were back pain in all the patients, sensory and motor deficits of the lower limbs in 3 patients, and occasional intercostal neuralgia in 2 patients. Sixteen patients with primary malignant tumors and five patients with solitary vertebral metastases were included. Seven patients had tumor invasion in dorsal ribs adjacent to costovertebral joint on one side and sixteen patients presented with direct invasion of spinal tumor in partial dorsal pleura. Patients with recurrent or residual disease were excluded. According to the surgical classification of vertebral tumors [5,13], the anatomic sites of the 21 tumors were considered as extracompartmental (Enneking stage 3). The vertebra were divided into 5 areas according to the Tomita typing system, and the tumors were classified as type V (13 cases) and type VI (7 cases) by the Tomita surgical staging system for spine tumors. Tomita staging is widely used to guide spinal tumor resection, depending on the local invasion of spinal tumors, involvement of anatomic site and spinal tumor type. Enneking staging for benign musculoskeletal tumors dictates the extent of surgical resection and margin; Enneking staging for malignant musculoskeletal tumors is based on surgical grade, local extent, and presence or absence of metastasis [14].

2.2. Preoperative examination

Plain radiographic examinations, computed tomography (CT) and magnetic resonance imaging (MRI) scans were performed preoperatively (Fig. 1A–E). MRI enhancement scans were used to evaluate the scope of tumor invasion. Multiplanar CT scans were performed to assess bone destruction and osteotomy sites for preoperative planning. Selective blood vessel embolization was performed the day before the surgery to reduce intraoperative bleeding.

2.3. Surgical procedures

The patients were placed in prone position and under general anesthesia. Fiberoptic bronchoscopy was performed in case of any endobronchial disease or extrabronchial compression in the patients. A double-lumen endotracheal tube was then inserted for selective lung collapse. The arterial and intravenous catheters were placed and patients were draped in sterile fashion.

After a dorsomedian skin incision, the paraspinal muscles were detached from the spinous processes, the laminae and the facet joints. In case of extracompartmental tumor manifestation/extension overlying, soft tissue layers were left untouched. An additional transverse incision (Fig. 2A) was performed in the patients with the rib or pleura tumor invasion proven by preoperative MRI or CT (7 patients). On the unaffected side, the dorsal parts of ribs adjacent to the costotransverse joint were resected to expose the ventral aspect of the affected vertebrae. On the affected side, the ribs were exposed by resecting the normal tissue. The dorsal parts of the ribs were cut, as well as the pleura at least 3–4 cm distant from tumors, if tumor invaded the pleura. The vertebrae and the invasion parts of chest wall were resected as an en bloc entirety (Fig. 2B) according to the technique described by Tomita et al. [15] with slight modifications. Specifically, if the ribs were invaded, nerve roots were cut off epidurally and inside the spinal canal rather than outside the spinal canal.

The spine was reconstructed using the posterior instrumentation, at least two levels above and two levels below the spondylectomy site. Atitanium mesh cage packed with morselized local bone (iliac crest or opposite ribs without tumor contamination) was used in all patients as an anterior structural support. Autogenous ribs with vascular pedicle were implanted intervertebrally for better fusion in some cases. Pedicle screws were used for posterior instrumentation (Fig. 2C). All patients received chest wall reconstruction (Fig. 2D). Teflon mesh was used according to the seriousness of the defects and it was contoured to allow complete the expansion of the lung underlying the chest wall defect and to secure the ribs superiorly. Myocutaneous flap was tightly sutured for better closing of the thoracic cavity. Closed thoracic drainage tubes were placed. The drainage tubes were also placed in the incision site in all the patients.

Postoperatively, wound drainage continued for 3–7 days. The patients were mobilized one week after the surgery and were instructed to wear a thoracolumbar corset for 2–3 months. Radiotherapy and chemotherapy were performed according to the results of the surgery and histological examination under the guidance of two senior oncology doctors. All resected specimens were assessed histologically to determine the surgical margins. Tumor extension was assessed as either intra- or extracompartmental according to the classification by Tomita et al. [5,13].

2.4. Follow-up

Postoperatively, patients were followed up on a regular basis with complications, survival rate and prognosis recorded in detail. X-ray and CT-scan of the thoracic spine and chest as well as bone scintigraphy (radionuclide imaging and technetium bone scan) were performed every 3 months during the two postoperative years and every 6 months afterwards.

3. Results

3.1. Surgical results

TES combined with chest wall resection was successfully performed in all patients. The mean duration of the surgery was 6.3 h (range 5–10). The mean blood loss was 2300 mL (range 1200–5000) without lethal massive bleeding. Seven patients were treated in an intensive care unit for a mean postoperative duration of 3 days (range 2–5). An additional closed thoracic drainage tube was placed unilaterally in 11 patients and bilaterally in 5 patients. The drainage tubes in all patients were pulled out within seven days postoperatively. The resected specimens were identified as free and safe tumor margin (wide or marginal resection) in 18 cases and intralesional surgical margin in 3 cases.