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Debridement and Bone Grafting With Internal Fixation via Anterior Approach for Treatment of Cervicothoracic Tuberculosis

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The objective of this study was to investigate the outcome of the patients with cervicothoracic tuberculosis who underwent radical debridement, reconstruction with bone autograft or allograft, and plate internal fixation via anterior approach. From June 2000 to December 2010, 20 patients with tuberculosis in cervicothoracic junction underwent a standard cervical approach, which was combined with a partial median osteotomy and transverse osteotomy through the synostosis between the manubrium and body of the sternum to expose the lesion adequately. Radical debridement was performed, then tricortical iliac crest bone autograft or allograft was placed and internal fixation was done to reconstruct the spinal column. The pathologic change regions were as follows: 10 in the C7-T1 segment, 6 in the T1 segment, 3 in the T1–T3 segment, and 1 in the T2–T3 segment. The classifications of Frankel were as follows: 2 at grade A, 4 at grade B, 7 at grade C, 2 at grade D, and 5 at grade E. There was no injury of blood vessel, spinal cord, or recurrent nerve during the surgery. The follow-up period ranged approximately 16 to 39 months. Bony fusion was obtained in all patients, and there was no internal fixation failure and tuberculosis recurrence in any of these patients. The nerve function of the spinal cord recovered at different degrees: 2 at grade A , 1 at grade B, 1 at grade C, 3 at grade D, and 13 at grade E. The anterior approach can provide direct and safe access to the lesion. The structural iliac crest autograft or allograft and anterior instrumentation could work effectively to stabilize the cervicothoracic junction.

Key words: Cervicothoracic junction – Tuberculosis – Bone grafting – Internal fixation

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The anterior approach to the cervicothoracic junction is generally considered to be difficult because the operative field is narrow. It is limited by the sternum, the clavicles, and the vascular and neural structures of the superior mediastinum. The posterior approach may appear to be simpler, but it is less logical because most lesions are situated in the vertebral bodies. Moreover, if the posterior approach is used, postoperative care is more demanding, with a higher level of pain and a greater risk of sepsis. Consequently, many specialized centers prefer the anterior approach. In most cases, this approach is a standard anterolateral cervical approach extended caudally by full sternotomy or partial sternotomy. We analyzed the technical results of a series of 20 patients operated on at the cervicothoracic junction through an anterior approach. The technique used was a standard cervical approach anterior to the carotid sheath. Distal extension of this exposure was as straightforward and minimally invasive as possible.

Methods

We treated 20 patients with cervicothoracic tuberculosis; the follow-up period ranged approximately 16 to 39 months. There were 17 male and 3 female patients who ranged in age from 25 to 46 years. The pathologic change regions were as follows: 10 in the C7-T1 segment, 6 in the T1 segment, 3 in the T1–T3 segment, and 1 in the T2–T3 segment. The classifications of Frankel were as follows: 2 at grade A, 4 at grade B, 7 at grade C, 2 at grade D, and 5 at grade E. All of the patients who had tuberculosis were operated on under chemotherapeutic coverage according to category I Directly Observed Therapy. All of the patients with tuberculosis in the cervicothoracic junction underwent a standard anterolateral cervical approach, which was combined with a partial median osteotomy and transverse osteotomy through the synostosis between the manubrium and body of the sternum to expose the lesion adequately. Radical debridement was performed, then tricortical iliac crest bone autograft or allograft was placed and internal fixation was done to reconstruct the spinal column (Fig. 1).

We use a standard anterolateral cervical exposure extended caudally. When access was limited by the sternum, a median bone resection in the manubrium provided sufficient access to the spine. It permitted spinal cord decompression and vertebral osteosynthesis while protecting the clavicles, sternoclavicular joints, and sternal body. Paramedial lesions were also accessible because there was no longer a risk of lesions of the vertebral artery distal to C7. To limit the risk of damaging the recurrent laryngeal nerve, we prefer performing a standard anterior cervical approach on the left side. Patients were placed in the supine position with the table slightly tilted so the feet were lower than the head to limit bleeding. The cervical spine was placed in moderate extension, avoiding hyperextension. This is important because hyperextension reduces the dimensions of the spinal canal and creates tension in the supra-aortic vessels, which could then constitute a lateral obstacle. The image intensifier was used for verification on lateral views.

The skin incision followed the anterior edge of the sternocleidomastoid muscle, then was extended to a few centimeters along the anterior aspect of the sternum. Dissection began with a standard anterolateral cervical approach, which is familiar to spinal surgeons. Extending the spinal exposure caudally was then relatively easy by following the vessel-free area anterior to the vertebrae along the deep cervical fascia. The sternal portions of the sternocleidomastoid and infrahyoid muscles were located and cut roughly 2 cm from their sternal insertion. If access was limited by the manubrium sternum, the anterior aspect of the manubrium was exposed to the medial limits of the sternoclavicular joints. Careful finger dissection was used to free the posterior aspect of the manubrium, and then the bone was excised. This bone resection was limited by the sternoclavicular joints laterally, and by the junction between the manubrium and the sternal body caudally. The posterior cortex of the manubrium was exposed using a high-speed drill to reduce the risk of injuring retrosternal structures. The powerful interclavicular ligament was cut with large scissors. The retrosternal fat and large vessels were then retracted together caudally and anteriorly to attain the anterior aspect of the thoracic vertebrae. The dissection of the large vessels was unnecessary and even appeared dangerous to us. During the decompressive stage of the procedure, it was possible to improve the exposure by excising the anteroinferior corner of the suprajacent vertebra. In every case, the procedure was completed by osteosynthesis using an anterior plate from the level overlying the one underlying the decompression.

Results

All of the patients were satisfied with the results and regained ambulatory status. There was no injury of

Fig. 1 A 42-year-old man with cervicothoracic tuberculosis related to C7~T1 disc. (a) Magnetic resonance imaging before operation. (b) AP and lateral X-ray film after operation. (c) Computed tomography postoperatively after 6 months.

blood vessel, spinal cord, or recurrent nerve during the surgery. The follow-up period was a range of approximately 16 to 39 months. Bony fusion was obtained in all patients, and there was no internal fixation failure or tuberculosis recurrence in any of these patients. The nerve function of the spinal cord recovered at different degrees: 2 at grade A, 1 at grade B, 1 at grade C, 3 at grade D, and 13 at grade E.

Discussion

Access to the cervicothoracic junction through an anterior approach is generally considered to be difficult. The bony rampart constituted by the thoracic wall and the vascular rampart formed by the supra-aortic vessels are the principal obstacles. The superior approach, caudal extension of a standard anterolateral cervical approach, is limited by thoracic kyphosis and the sternum, whereas the scapula, plexus brachial, and major vessels limit the access by thoracotomy.[1] The difficulty of this surgery is reflected in the variety of reported techniques. The cervical approach with full sternotomy provides extensive access to the cervicothoracic junction, but there is substantial accompanying morbidity. Moreover, despite the sternotomy, exposure remains limited distally by the left brachiocephalic trunk and by the aortic arch. Pointillart et al[2] used an approach between the aorta and the vena cava for corpectomy of T2 with osteosynthesis from T1–T3. This technique calls for dissection of the large vessels and appears to be relatively invasive. Numerous alternatives to the approach have been reported, including partial sternotomies with or without clavicular osteotomies. Xie et al[3] practiced a partial upper sternotomy associated with resection of the medial third of the left clavicle, for which approach the severity of the cosmetic and functional sequelae was not evaluated. The partial sternotomy reported by Zhang et al[4] includes two segments. The first is vertical, from the manubrium sternum to the fourth intercostal space; the second is horizontal in the same intercostal space to open the chest using a superior ''trapdoor.'' For most spinal lesions, such a wide exposure is superfluous. Spinal cord decompression and osteosynthesis generally require a strictly median access. Consequently, the osteotomy of the medial third of the clavicle or a sternocostal flap to widen the approach appears somewhat excessive, except in certain cases for which the anterolateral aspect of the vertebrae must be exposed.[5] For more distal access, bone resection limited to the manubrium sternum may be necessary. Because the resection of bone remained sagittal, no destabilization of the sternoclavicular joint and no fracture or opening of the sternum occurred.[6] Therefore, we consider that this bony resection is not a sternotomy. It is sufficient to expose the upper thoracic spine caudally to T5. It causes no functional changes and eliminates the risk of pseudarthrosis involving sternal and clavicular osteotomies. Distal osteosynthesis screws were often slightly oblique in an inferior and posterior direction, but this had no adverse effect on the stability of the construct.

This approach is less invasive than full or partial sternotomies. It allows central spinal cord decompression and vertebral osteosynthesis caudally to T5 with few complications. Even though the anatomy of this region is complex, the procedure is relatively straightforward. Extensive dissection of vascular and neural structures of the superior mediastinum is unnecessary. The avascular space anterior to the vertebrae constitutes a safe pathway to follow from the cervical region to the upper thoracic vertebrae.[7] If wider access to anterolateral aspects of the vertebrae is necessary, the trapdoor sternotomy proposed by Crocker et al[8] is a useful alternative because it allows anatomic reconstruction. The anterior approach to the cervicothoracic junction as often described may appear demanding and invasive. Most spinal lesions down to T4 can be operated using a standard anterior cervical approach extended caudally and associated with limited manubrial resection, if necessary. The systematic dissection of surrounding vascular and neural structures needlessly increases the duration of surgery and the risk of complications. This approach is particularly adapted to the management of patients with severe systemic disorders, including individuals with metastases, because it facilitates postoperative care.

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