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Original Article

Surgical management of metastatic lesions at the cervicothoracic junction

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Abstract

Purpose: The cervicothoracic junction (CTJ) represents a transition from the semirigid thoracic spine to the mobile subaxial cervical spine. Pathologic lesions are prone to kyphotic deformity. The aim of this study was to review our experience with surgical stabilization of metastatic lesions affecting the CTJ (C7-T2). **Materials and Methods:** We reviewed all surgical stabilizations of metastatic spine lesions over the preceding 4 years in our institution. A total of 14 patients with CTJ lesions were identified. Case notes and radiology were reviewed to determine the presentation, outcomes, and specific complications. **Results:** The mean survival was 405 days (standard deviation [s.d.] 352). 8/14 died at a mean time from surgery of 193 days (s.d. 306). Most cases were a result of either lung or breast primary tumors. Half were stabilized with an anterior only approach and two had staged anterior-posterior. There were no cases of neurologic deterioration in this cohort as a result of surgery. There were two cases of deep surgical site infection and two documented cases of pulmonary embolus. There were no reported construct failures over the follow-up period. **Conclusion:** Patients with cervicothoracic metastatic lesions can be treated with either anterior or posterior approaches or a combination after considering each individual's potential instability and disease burden.

Key words: Cervicothoracic spine, instability, metastases

INTRODUCTION

Metastatic spine disease continues to become and ever increasing the burden on health systems. This is a result of improved oncologic treatments and their associated prolonged life expectancy coupled with the growing expectations that patients have. Metastatic disease to the spine with resultant pain from instability is estimated to affect 10% of individuals with cancer.[1]

A majority of metastatic disease affects the lumbar and thoracic spine where the total volume of bone is greater while the cervical spine is less often affected. The cervicothoracic junction (CTJ), defined as C7-T2 is only occasionally involved but represents an area prone to instability as the spine transitions from the mobile cervical spine tot the more rigid thoracic.[2,3] The significance of a junctional lesion in metastatic disease is reflected in the increased allocation of points in the Spinal Instability Neoplasia

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Score where junctional metastatic lesions are more likely to be recommended for surgical stabilization. Indeed, the SINS details C7-T2 inclusive as the junctional cervicothoracic level.[2]

Despite the biomechanical significance of the CTJ, little is reported in the literature regarding the treatment and outcome of metastatic disease affecting this area.[4] The aim of this paper is to report our experience in the surgical management of metastatic disease affecting the CTJ.

MATERIALS AND METHODS

Theatre logbooks were reviewed from 2010 to the end of 2013 to identify surgically stabilized spinal metastatic lesions. Of 140 surgically treated cases, 14 cases (10%) were for lesions involving predominantly C7 to T2. All medical records and radiologic imaging was retrieved to determine basic demographics, presentation, preoperative performance status to give a Karnofsky performance score, preoperative Frankel grading both pre- and post-operatively, primary tumor type, and surgical procedure. The occurrence of specific complications, venous thromboembolism (VTE) and surgical site infection were recorded. Survivorship, calculated from the time of surgery until the time of death, was recorded in days.

A SINS score was calculated for each case. The Oswestry Spinal Risk Index (OSRI) was calculated for each case using the primary tumor type and functional status of the patient.[5] The OSRI has recently been validated externally.[6] We have previously noted that at presentation and the time of surgery, the full complement of investigation are frequently not complete or available so no attempt was made in this case to calculate either Tomita or revised Tokuhashi *et al.* scores.[7] Postoperative neurologic grading, functional outcome, and radiographic follow-up were noted.

All anonymized data were recorded onto an Excel spreadsheet. Basic statistical data are presented using mean and standard deviations (s.ds.).

RESULTS

Details of the cohort overall, including calculated SINS and OSRI are shown in Table 1. The mean survival was 405 days (s.d. 352). 8/14 died at a mean time from surgery of 193 days (s.d. 306). A variety of tumor types were represented with breast (n = 4) and lung (n = 3) accounting for half the cohort. There were no cases of neurologic deterioration in this cohort. The one individual with Frankel C at presentation improved to D.

Most cases were stabilized from the front in isolation with the remainder from the back. The key point in deciding on surgical approach here was whether or not the vertebral body was sufficiently diseased to warrant corpectomy and stabilization using a cage or whether posterior instrumentation alone would suffice. Figures 1 and 2 depict preoperative and postoperative imaging of selected cases.

In Case 1, the patient had previously had a posterior decompression and stabilization. During the study period, she had returned for anterior decompression and insertion of a cage across diseased levels as the tumor process had recurred and she had recurrent symptoms.

In Case 5, an anterior plate was applied in isolation and the stabilization augmented with posterior instrumentation. At the time of surgery, it was evident that appropriate access to the end-plates would not be possible for suitable preparation for cage insertion and the decision was made to stabilize with plate only rather than subject the patient to a sternotomy.

In Case 10, the decision was made to proceed with circumferential decompression and stabilization in a staged manner performing multilevel corpectomy with cage and plate stabilization first, followed by posterior decompression 3 weeks later.

There were two cases of deep surgical site infection (Case 12 and 13). The case had previously had radiotherapy to the region. This patient required multiple trips to the operating room for washouts and application of a negative pressure therapy dressing. Once clean she underwent soft tissue coverage of the defect with a latissimus dorsi flap and healed well. Case 13 was more complicated with the loss of fixation following surgery. Deep specimens from the index surgery, as well as confirming the metastatic disease, also grew coagulase negative *Staphylococcus aureus*. A single revision procedure with washout was sufficient however survivorship was short as a result of generalized medical deterioration after repeat surgery.

There were two documented cases of pulmonary embolus in the medical notes with both patients having to undergo anticoagulation with warfarin therapy. One additionally suffered a hospital-acquired pneumonia and another required a second visit to theatre for washout of a hematoma.

Aside from Case 13 with deep infection there were no cases of loss of fixation or alignment during the follow-up period.

DISCUSSION

We have reviewed our results of surgical stabilization of metastatic lesions affecting the CTJ. This junctional level is prone to catastrophic failure given its propensity to collapse into kyphosis when instability ensues.[4] Due to these biomechanical peculiarities the CTJ attracts interest.[2] Instability at this level can lead to a kyphotic deformity putting the spinal cord at risk of compression with devastating consequences for patients already hampered physiologically from an oncologic disease burden.[4]

Most of the cohort reviewed presented with radiculopathy with a smaller proportion complaining of significant pain suggesting obvious instability. This is perhaps fortunate as it allowed surgical intervention before any chance of neurologic compromise. A majority of patients presented with Frankel E and there were no deteriorations in this series as a result of surgery.

Table 1: Details of all cases including demographics (age in years), primary tumor type, presenting complaints, tumor level, surgical procedure, Frankel grades pre- and post-surgery, survivorship (days), and complications

Age	Gender	Primary tumor	Presentation	Level	SINS	Approach	Procedure	Frankel	OSRI	Survival	Complication
41	Female	Thymoma	U/K	T2	14	Anterior	Corpectomy, cage	E-E	4	802*	None
66	Female	Renal cell	Radiculopathy	T1	7	Posterior	Decompression, stabilization C4-T4	D-D	2	24	None
63	Female	Esophageal	Radiculopathy	C7	12	Posterior	Decompression, stabilization C4-T8	E-E	à	9	None
57	Female	Breast	MSCC	C7	10	Anterior	Corpectomy, cage, plate	C-D	2	536*	PE, HAP
63	Male	Thyroid	Mechanical pain, radiculopathy	T1	9	Anterior; posterior	Plate C5-T3; decompression, stabilization C3-T10	E-E	1	474*	None
60	Female	Unknown[a] (lung)	Radiculopathy	C7	8	Anterior	Corpectomy, cage	D-D	4	38	None
38	Female	Breast	Mechanical pain, radiculopathy	C7	13	Anterior	Corpectomy, cage, plate	D-D	2	222	None
58	Male	Prostate	Mechanical pain	T2	7	Posterior	Decompression, stabilization C5-T6	E-E	1	307	None
54	Female	Breast	MSCC	C7	8	Anterior	Corpectomy, cage, plate	E-E	1	898	None
	Male	Salivary gland	Painless – surveillance imaging	C7	8	Anterior; posterior	Corpectomy, cage, plate Decompression, stabilization C4-T3	E-E	à	835	None
49	Female	Breast	Radiculopathy	C7	14	Posterior	Stabilization C3-T5	E-E	1	796*	SSI
57	Male	Neuroendocrine	Radiculopathy	T1	8	Anterior	Corpectomy, cage, plate	E-E	à	684*	None
63	Female	NSCLC	Mechanical pain, myelopathy	T1	16	Anterior	Corpectomy, cage, plate	E-E	6	27	SSI, loss of fixation
68	Male	NSCLC		T1	9	Anterior	Corpectomy, cage	E-E	6	16	Hematoma, PE

[a]In case 6 the primary tumor was unknown at the time of surgery and therefore the OSRI calculated as such, [a]The OSRI is not available as the primary tumor type is not part of the index paper, *The individual is not deceased.
PE: Pulmonary embolus, HAP: Hospital-acquired pneumonia, SSI: Surgical site infection, OSRI: Oswestry Spinal Risk Index, MSCC: Metastatic spinal cord compression, NSCLC: Nonsmall cell lung cancer

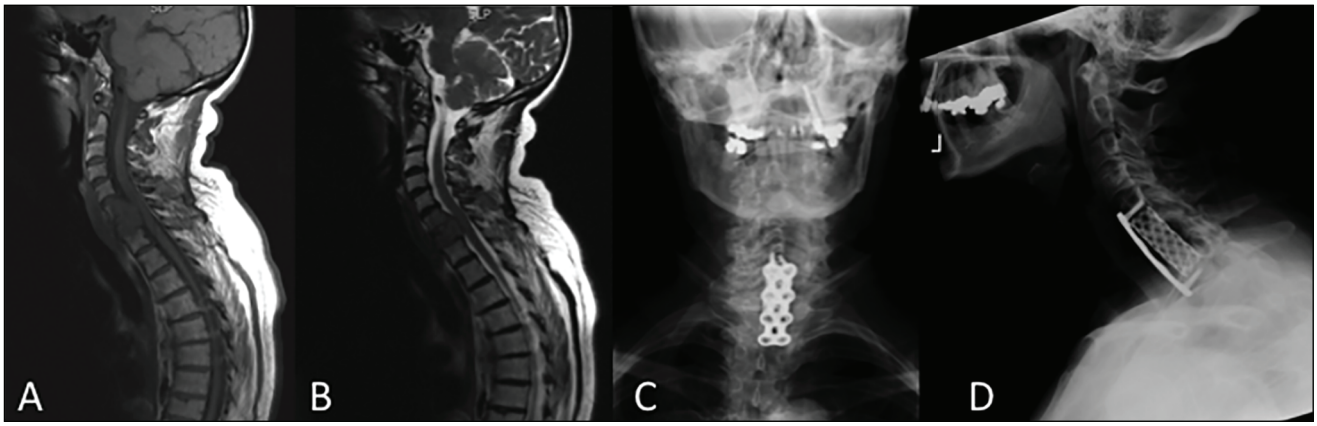

Figure 1: Radiologic images from Case 9, a patient with metastatic breast disease and lysis of C7: (a) T1-weighted magnetic resonance imaging (MRI); (b) T2-weighted MRI; (c and d) plain radiographs of reconstruction

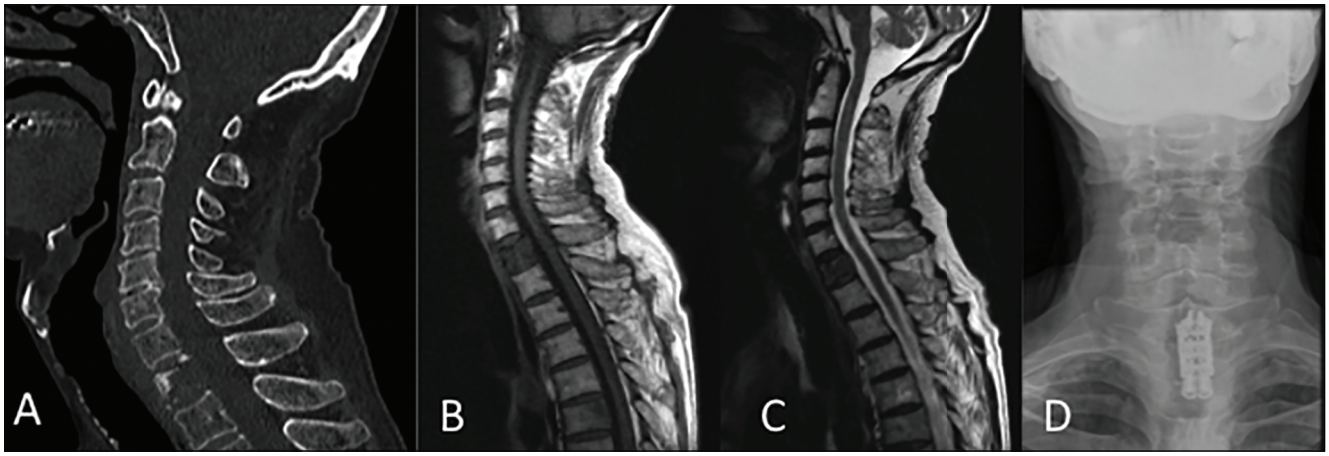

Figure 2: Radiologic images from Case 12, a patient with neuroendocrine origin metastatic disease with T1 vertebral body compromise: (a) Sagittal CT; (b and c) T1- and T2-weighted magnetic resonance imaging; (d) anteroposterior radiograph of reconstruction

Previously, Mazel *et al*. reported on 32 cases of tumor involving the CTJ.[4] Nineteen of the 32 cases underwent anterior stabilization, typically as a result of verterbrectomy, in addition to posterior stabilization using a variety of systems — two plates systems and one-rod system. They found no screw or plate failure but had two construct failures due to too short a posterior segment being stabilized and one anterior column reconstruction being insufficient. In all our cases, top-loading rod systems were used for posterior instrumentation. We found a roughly similar proportion of failure in our series (1/14) although this was an early problem.

A significant difference, however, is that in most of our cases either posterior or anterior fixation was utilized with the exception of two cases (Cases 5 and 10). It has previously been shown that a posterior system provides greater stiffness than an anterior plate only system. Metcalfe *et al*. have previously reported a series of 50 patients undergoing circumferential decompression and stabilization using a transpedicular approach.[8] In their series, they had three cases, two at T1 and one at T2, in whom this approach was effective. One benefit of this over a strategy of approaching via separate incisions through the front and the back is the avoidance either of a staged procedure of having to reposition. In all anterior approaches in our series a corpectomy was planned for and supplemental fixation used with a plate rendering the construct stiffer in most cases. Cages were used for anterior column reconstruction in this current series. Previous reports on reconstruction for spinal metastases have good results with polymethylmethacrylate cement as a reconstructive option although there are reports including catastrophic dislodgement of the construct.[9] Whether to approach from the front, back or both is a decision made on a case-by-case basis both considering the instability, disease process and patient physiology and anatomy.

The survivorship of those patients with lung tumors was very disappointing with a survivorship from the time of surgical intervention no greater than 38 days. Both lung cases scored 6 using the OSRI to determine survivorship and this further shows the utility of this risk assessment tool when other scoring systems are a bit more cumbersome in their reliance on investigation that are not necessarily readily available.[7] This poor survivorship is not surprising and has been noted elsewhere in the literature. Poor survival after spinal surgery for lung metastases previously reported by Weiss and Wedin.[10] Those with breast disease fared significantly better giving a true reflection of the value of

the intervention in those with metastatic spinal disease from breast cancer. A relative strength in this study is the selection of true metastatic disease. Other series have included multiple myeloma, a disease some argue is more hematologic in nature and one that has a nature tendency toward greater survivorship. In only one case was the diagnosis unknown at the time of spine surgery (Case 6). The decision to operate in this case was in part influenced by the need for tissue sampling and nature of perceived instability.

A potential limitation in any study such as this is its retrospective nature. There is a reliance on the accuracy of documentation in the clinical notes. In most cases, the required details could be extracted, although details on accurate neurologic grading were not possible in one case. It is also one reason for narrowing the focus when considering complications, as an accurate search for all complications is dubious at best. Given the significant disease burden than many oncologic patients are under it is not surprising that there is a significant complication rate, hence our decision to focus on those that carry significant morbidity and those that preventative measures, chemical and/or mechanical VTE prophylaxis and prophylactic antibiotics, are available.

In summary, this series of cervicothoracic metastatic lesions treated with surgical decompression and stabilization shows satisfying results with survivorship in excess of 1 year for at least half the cohort. There were no long-term implant failures recorded or neurologic complications as a result of surgery. Patients with cervicothoracic metastatic lesions can be treated with either anterior or posterior approaches or a combination after considering each individual's potential instability and disease burden.

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Conflicts of interest

There are no conflicts of interest.

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