CHAPTER 10

SEVERE KYPHOSIS WITH SPINAL CORD COMPRESSION AFTER RESECTION OF A SUPERIOR SULCUS TUMOR

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ABSTRACT

Vertebral involvement is no longer a contraindication for resection of superior sulcus tumors. We describe a patient who developed a kyphoscoliosis with spinal cord compression after resection of a superior sulcus tumor that invaded the vertebral column. Risk factors for spinal instability and indications for stabilization are discussed.
INTRODUCTION

Vertebral involvement is no longer a contraindication for resection of superior sulcus tumors. In selected patients, en bloc resection of the tumor and invaded vertebra by partial or total vertebrectomy is feasible and improves survival compared with historical control patients.\textsuperscript{1-3} The need for additional stabilization after (partial) resection of vertebrae is determined by the extent of the resection. Resections that do not compromise the mechanical integrity of the spinal segment involved will not require additional instrumental stabilization. In cases of hemivertebrectomy or total vertebrectomy reconstruction with dorsal and ventral stabilization is recommended.\textsuperscript{1-3}

We describe a patient who developed a severe kyphosis with spinal cord compression after resection of a superior sulcus tumor invading the vertebral column.

CASE REPORT

A 54-year-old Caucasian woman with no past medical history presented with continuous radiating pain of the right arm for 5 months. There were no other complaints. She had smoked 20 cigarettes a day for 25 years. Physical examination demonstrated no abnormalities. A chest X-ray demonstrated a solid mass in the right upper lobe. Computed tomographic (CT) scanning and magnetic resonance imaging (MRI) of the cervicothoracic junction demonstrated a right upper lobe tumor invading the chest wall (rib 1 - 3) and the right neuroforamen of the first and second thoracic vertebrae (Figure 1).

A CT-guided core biopsy demonstrated a squamous cell carcinoma. Positron emission tomography scanning demonstrated a fluorodeoxyglucose-avid tumor. There were no distant metastases. Brain metastases were excluded by MRI. Clinical staging was cT\textsubscript{4}N\textsubscript{0}M\textsubscript{0}, stage IIIB. The patient was treated with concurrent chemoradiation induction therapy (3 cycles of cisplatin and etoposide; radiotherapy dose 50 Gray).

Post-induction chest CT showed a significant reduction in tumor size, but still invasion of the chest wall and right neuroforamen of the upper 2 thoracic vertebra. Staging after induction was unchanged; cT\textsubscript{4}N\textsubscript{0}M\textsubscript{0}, stage IIIB. Six weeks after completion of the radiotherapy a lobectomy of the right upper lobe was performed with en bloc resection of the right transverse processes, hemilamina and facet joints of the first and second thoracic vertebrae, the first 3 right ribs, and the first branch of the brachial plexus (T1) using an extended right posterolateral thoracotomy (Figure 2).
The vertebral pedicles and the dural sac remained intact during the operation. Mediastinal lymph node dissection and bronchial stump reinforcement with an intercostal muscle flap was performed. The remaining cervico-thoracic junction was considered stable and no stabilization was performed.

In the first postoperative week, she developed a kyphosis at the cervico-thoracic junction of 15 to 20 degrees. There were no complaints and no neurologic deficit. She was diagnosed with torticollis due to muscle weakness and pain, which was treated with physiotherapy. Further postoperative course was uneventful and she was discharged 10 days after surgery. Final histopathologic classification was ypT1N0M0R0.

After 18 months she slowly developed progressive numbness from the C8/T1 level with paresthesia (tingling and burning sensations). She also had subtle weakness of both legs, altered sensation during micturition, and minimal fecal incontinence. On neurologic examination no evident paresis was found. A clonus was found on knee and Achilles tendon reflex testing. The Babinski sign was positive on both sides. Sensation, both vital and gnostic, was reduced from the T1 level and below. An MRI of the spine demonstrated progressive kyphosis with anterior dislocation of the T1 vertebra with compression of the myelum (Figure 3 and 4).

Because of the symptomatic spinal cord compression, reduction under traction was performed using a halo frame. Two weeks later a dorsal laminectomy and anterior (C7 - T1) and posterior spondylodesis (C5 - T4) were performed (Figure 5). Postoperative course was
uneventful and the patient was discharged 7 days after surgery. On follow-up visits there was only minimal remaining loss of sensation in the left leg without any paresis and normal continence. The kyphosis was corrected and the scoliosis evidently improved.

Figure 3. Magnetic resonance image 18 months after surgery showing a remarkable kyphosis of 60 degrees at the Th1-2 level with spinal cord compression (arrow).

Figure 4. Three-dimensional reconstruction of the cervicothoracic spine computed tomography demonstrating the kyphosis of 60 degrees at the Th1-2 level.

Figure 5. Postoperative roentgenogram demonstrating the dorsal and ventral spondylodesis instrumentation.
COMMENT

Due to multimodality treatment and improved surgical techniques, survival is improved and more patients become amenable for curative resection.\(^4,5\) Vertebral involvement is no longer a contraindication for surgery.\(^4,5\) Because of improved survival, spinal osteosynthesis and reconstructions should be durable.

In case of extensive resection such as (multilevel) total vertebrectomy or hemicorporectomy, stabilization or spinal reconstruction is indicated.\(^6,7\) Stabilization seems unnecessary in case of resections limited to the transverse processes or facet joints.\(^1,3\)

Jain and colleagues\(^2\) described 3 tumor types with the required extent of resection and the need for stabilization and reconstruction in superior sulcus tumor patients. Type A lesions require resection of the transverse process and no stabilization is needed. Type B lesions invade the neural foramen and lateral part of the vertebral body and resection of the facet joint and partial vertebral body is required. Posterior stabilization is advocated for type B lesions. In type C lesions vertebral body involvement is more extensive and requires (near) total vertebrectomy. For these lesions both posterior and anterior stabilization is recommended.\(^2\)

Taneichi and colleagues\(^8\) developed a model to predict impending collapse of a vertebral body caused by vertebral metastases. Risk factors included the following: (1) percentage of vertebral body invaded by metastasis; (2) destruction of the pedicle; (3) posterior elements; and (4) the costo-vertebral joint. Vertebral involvement was graded from A to F, with increasing probability of collapse. Multivariate logistic regression analysis identified destruction of the costo-vertebral joint as the most important risk factor for vertebral collapse in the thoracic spine. From a mechanical point of view these risk factors for vertebral body collapse could probably be applied to (partial) resections of the vertebra as well.

In our patient the affected spine segment was included in the radiation field during induction treatment. Chemoradiation is known to impair bone mineral metabolism and is associated with an increased risk of (osteoporotic) fractures.\(^3,9,10\) The impaired bone quality might have had an additional effect on the instability and subsequent collapse of the spine segment in this case.

Retrospectively, the resection performed in our patient should have been followed by additional spinal stabilization. In cases where stabilization is not performed, early correction should be considered at the first signs of angulation because deformity can increase over time, with the risk of spinal cord compression. A multidisciplinary approach is recommended.
REFERENCES


