Reconstruction of a Nasopharyngeal Defect from Cervical Spine Osteoradionecrosis

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ABSTRACT

Osteoradionecrosis of the cervical spine is a rare complication of radiation treatment of head and neck tumors that requires a multidisciplinary approach to management and reconstruction. The case of a 57-year-old man with osteoradionecrosis of the cervical spine secondary to radiation for metastatic hepatocellular carcinoma is presented. Operative debridement of the necrotic bone was performed and the nasopharyngeal soft tissue defect was reconstructed with a radial forearm free flap. The management and reconstruction options for osteoradionecrosis of the cervical spine are discussed.

KEYWORDS: Head and neck, reconstruction, microvascular, nasopharynx, osteoradionecrosis, cervical spine

Osteoradionecrosis is a complication of radiation treatment for head and neck tumors that is characterized by a loss of bone vascularity leading to a necrotic, often infected, chronic wound. In the head and neck, the mandible and maxilla are most commonly involved. The cervical spine is a rare site of osteoradionecrosis that requires a multidisciplinary approach to management and reconstruction. An attention to treatment of associated infection, stabilization of the cervical spine, and reconstruction of the pharyngeal defect is required.

We present a case of cervical spine osteoradionecrosis that was successfully managed through the combined efforts of the Infectious Disease, Neurosurgical, and Head and Neck Surgery services at our institutions. The management and reconstructive options for this uncommon and complex disease process are reviewed.

CASE REPORT

A 57-year-old man presented with neck pain and a lytic lesion of the C2 cervical spine. Open transoral and fine needle biopsies done in his home country had been nondiagnostic. Magnetic resonance imaging (MRI) of the cervical spine showed a 4-cm vascular tumor involving C2. Computed tomography (CT) of the abdomen revealed a 4-cm liver mass. Fine needle aspiration of the C2 lesion revealed metastatic hepatocellular carcinoma, and subsequent core biopsy of the liver mass confirmed hepatocellular carcinoma in a background of cirrhosis. Because of cervical spine instability he underwent occipitocervical fusion and arthrodesis using autologous iliac crest bone graft and titanium instrumentation. This was followed 3 weeks later by proton beam radiation therapy and chemotherapy with sunitinib. The patient returned to his country and underwent additional external beam radiation therapy and chemotherapy for the treatment of

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Figure 1 (A) Preoperative sagittal computed tomographic (CT) scan demonstrating nasopharyngeal ulceration (arrow) and C2 cervical spine osteoradionecrosis. (B) Postoperative sagittal CT scan demonstrating radial forearm free flap reconstruction of the nasopharyngeal defect (arrow).

the metastatic hepatocellular carcinoma. He had a liver resection 6 months later and soon thereafter developed recurrent neck pain, which prompted return to our institutions for further care.

He was found to have an ulceration of the nasopharynx, and CT and MRI showed osteoradionecrosis and osteomyelitis of the cervical spine with fistula to the nasopharynx (Fig. 1A). The ulceration was

Figure 2 (A) Preoperative view of pharyngeal ulceration, with exposed necrotic cervical spine bone; (B) magnified view of ulceration with necrotic tissue and exposed dura (arrow); (C) postoperative transoral fiberoptic view of radial forearm free flap reconstruction with hair on flap; and (D) transnasal fiberoptic view of radial forearm free flap in nasopharynx.

2.5 × 1.5 cm at the interface of the nasopharynx and oropharynx, visible on oral and nasopharyngeal fiberoptic examination (Fig. 2A and B). Initial cultures of the ulceration obtained by direct swab through the oral cavity grew oral flora, including *Streptococcus intermedius* (*milleri*) group. A biopsy of the ulcerated area was taken to confirm nonrecurrence of the metastatic disease and was found to be negative. Despite intravenous and oral antibiotics for 4 months, and hyperbaric oxygen (HBO) therapy, he failed to improve. He was therefore taken to the operating room for debridement of the cervical spine and reconstruction of the nasopharyngeal defect with a radial forearm free flap.

After completion of the tracheostomy, an endoscopic, transoral debridement of the necrotic cervical spine and intervertebral discs was undertaken by the neurosurgical service. Spinal stability was preserved, and the edges of the nasopharyngeal ulcer were freshened. A right transcervical approach was taken for access to the spine and vessels for microvascular anastomosis. The right neck was chosen because of the presence of a prominent external jugular vein. The prevertebral space was identified at the level of the larynx and bluntly dissected superiorly to the level of the nasopharyngeal defect, freeing it circumferentially. With the wound edges freshened, the defect measured 3.5 × 3 cm. The distal skin island of the radial forearm free flap was created slightly larger than this. The radial forearm free flap was harvested without incident and passed into the nasopharynx through the tunnel. The skin island was delivered into the defect and sutured to the remaining, healthy nasopharyngeal mucosa transorally. Microvascular anastomosis was performed to the facial artery and external jugular vein, and the wound closed with the inclusion of an external skin paddle for monitoring of the free flap.

The patient was decannulated and passed a modified barium swallow on postoperative day 10. Cultures from the operating room grew mixed flora, including *Enterococcus*, *Lactobacillus acidophilus*, and *Candida* species. He was given 6 weeks of postoperative intravenous ampicillin-sulbactam and 2 months of oral fluconazole. Following completion of intravenous ampicillin-sulbactam, he was maintained on oral amoxicillin-clavulanate for an additional year. At 22 months follow-up, the free flap remained intact and healthy, with no evidence of recurrent ulceration, tumor, infection, or osteoradionecrosis (Figs. 1B and 2C and D). He maintains excellent functions of speech and deglutition and has no pain in the region. The donor site is well healed.

DISCUSSION

Osteoradionecrosis is a well-described complication of radiation therapy of the head and neck. Marx¹ described a process of radiation-induced vascular damage leading

to hypoxia, hypovascularity, and hypocellularity in affected tissues. The resulting devitalized, chronic wound often defies conventional management. In the head and neck, the mandible is the most frequently affected site, followed by the maxilla, and rarely, the temporal bone.² The cervical spine is a rare site of osteoradionecrosis, which requires multidisciplinary management to address infectious complications, spinal stability, and associated soft tissue defects.

Conservative management of osteoradionecrosis includes antibiotics, HBO therapy, and serial debridements of necrotic tissue.³ Osteomyelitis often accompanies osteoradionecrosis in the head and neck due to close proximity of oral flora and disruption of normal tissue defenses against infection. Devitalized bone leads to breakdown of the overlying mucosa and secondary infection by the oral flora that continuously bathes the exposed bone. Cultures of the exposed bone may reveal specific pathogens in addition to oral flora and may be helpful. In our case, initial cultures of the exposed bone revealed oral flora, but specifically, *Streptococcus milleri*, a common cause of head and neck abscesses. Despite targeting this organism and oral flora, as well as periodically reculturing and treating any new pathogens, we could not cure the infection with a conservative approach. Conservative treatment rarely leads to cure of osteomyelitis when bone is exposed to a nonsterile site, such as the mouth, unless the amount of bone exposed is small or can be debrided and covered with mucosa. Intraoperative cultures should be obtained, and once healthy bone is covered with mucosa, cure can be obtained in many cases with postoperative intravenous antibiotics given for 6 weeks. In cases where there is underlying hardware that cannot be removed, as in our case, a subsequent prolonged course of oral antibiotics should also be considered. HBO, which induces angiogenesis and fibroplasia in radiated tissue, has been reported as an effective therapy both alone and in conjunction with surgical debridement and reconstruction.⁴ Serial debridements to remove devitalized tissue and allow healing by secondary intention can be attempted in smaller, accessible wounds. Used in combination, these modalities may obviate the need for surgery.^{3,5} Alternatively, when used perioperatively they may increase the likelihood of success of a more definitive resection and reconstruction.

Surgical therapy for cervical spine osteoradionecrosis requires attention to both spinal stability and the associated soft tissue defect. The fibula-free flap is the preferred option to provide vascularized bone for spinal reconstruction and may be superior to conventional bone grafts in an irradiated spine. A long segment of bone and large fasciocutaneous component can be harvested with minimal donor site morbidity. Alternatively, for cases without associated soft tissue defect, a segment of fibula can be harvested alone as an osseous flap. The use of

fibula osteocutaneous free flap has been described in a case where simultaneous reconstruction of a spinal defect and posterior oropharyngeal defect was required.⁶ In our case, spinal stability had previously been addressed by occipitocervical fusion and arthrodesis, leaving the nasopharyngeal defect as the primary reconstructive challenge. Reconstruction of the nasopharynx in the setting of nasopharyngectomy has been described with split thickness skin grafts and nasal mucosal grafts with varying success.⁷ Critical to reconstructive success in our patient was the complete separation of the debrided and poorly vascularized spine from the upper aerodigestive tract. This required a durable, dependable, and well-vascularized tissue flap that could be sewn in place to give a watertight seal.

The radial forearm free flap provides thin, pliable tissue ideally suited for reconstruction of pharyngeal defects and a long vascular pedicle to allow anastomosis to neck vessels.⁷ An adequate tunnel must be created from the defect through the prevertebral space and into the neck to prevent vascular compromise of the pedicle. The use of a separate skin island placed as an external marker in the cervical incision greatly facilitated flap monitoring of this challenging location during the postoperative period.

CONCLUSION

Osteoradionecrosis of the cervical spine is a rare complication of head and neck radiation therapy that requires a multidisciplinary approach to management and reconstruction. Conservative management with intravenous antibiotics and HBO therapy has been described; however, operative management may be required. Following debridement and cervical spine stabilization, the

radial forearm free flap provides thin, pliable, well-vascularized tissue well suited for the reconstruction of associated pharyngeal defects.

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