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Emergent Cricothyrotomy in a Hospitalized Patient Awaiting Surgery for Hypopharyngeal Cancer

A Case Study

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Desired outcomes learnt from the case study:

1. Always include head and neck malignancy in the differential of patients with progressive dysphagia, particularly in the context of smoking history.
2. Biopsy and diagnostic imaging are the two mainstay investigations prior to consolidating an oncologic treatment plan for patients. In recent years, PET-CT has arisen as a high-fidelity nuclear medicine imaging modality to stage malignancies and concurrently screen for distant metastatic disease.
3. Admit high risk airway patients to a specialized otolaryngology surgical unit when possible.
4. Emergent interventions for bleeding from the upper airway include the following:
    1. Immediate management of bleeding: tranexamic acid, epinephrine nebules, manual tamponade if possible;
    2. Protect the airway if it is unstable: spectrum of interventions ranging from supraglottic airway device to endotracheal tube versus surgical airway;
    3. Definitive control of bleeding entails: surgical intervention versus interventional radiology embolization.
5. The role of a physician assistant on a head and neck surgery service includes identifying critically ill patients, providing temporizing measures, and expediting emergent intervention.

Introduction to the Scenario

This case study describes an emergent cricothyrotomy in a hospitalized patient awaiting surgery for hypopharyngeal cancer. The incidence of cricothyrotomies varies from 0-18.5%, with healthcare provider skill, patient status and patient location as factors that will influence the rates of surgical airways (1). This case is interesting to the authors as cricothyrotomy had not been seen before in their practices; there were many valuable learning points. After reading this case study, readers will better understand how to: 1) quickly recognize a rescue situation, 2) manage airway hemorrhage, and 3) successfully collaborate with other services in emergency situations.

A 67-year-old gentleman was admitted to a local hospital in the context of failure to thrive. In the preceding 5 weeks, the patient described 50-pound weight loss and progressive dysphagia to a solid and liquid diet. His past medical history was significant for prior stroke, hypertension, and anxiety. His home medications included Alprazolam, Citalopram, Zopiclone, Amlodipine and Telmisartan.

The patient initially had a nasogastric tube inserted for nutritional supplementation. Diagnostic workup consisting primarily of a PET-CT scan demonstrated a "hypermetabolic hypopharyngeal mass involving both lateral pharyngeal walls. The mass encases the superior thyroid cartilage and involves the hyoid bone on the left. Bilateral level two lymph nodes and a right retropharyngeal lymph node are in keeping with regional metastatic disease. There is no evidence of distant metastatic disease." The lesion and nodal disease are appreciated in Figures 1-3.

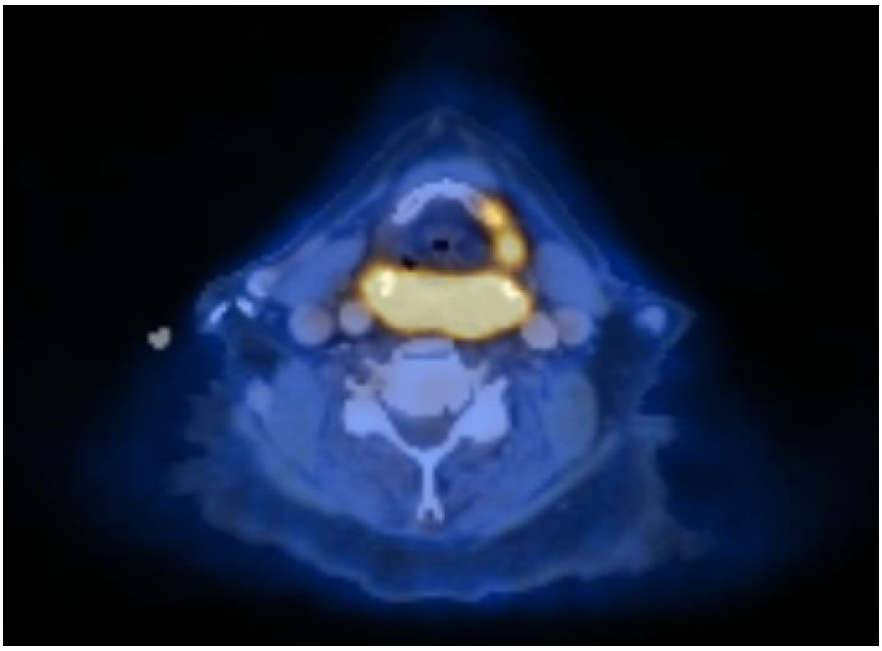

Figure 1. PET-CT showing hypermetabolic FDG avidity of primary hypopharyngeal tumor with hyoid involvement.

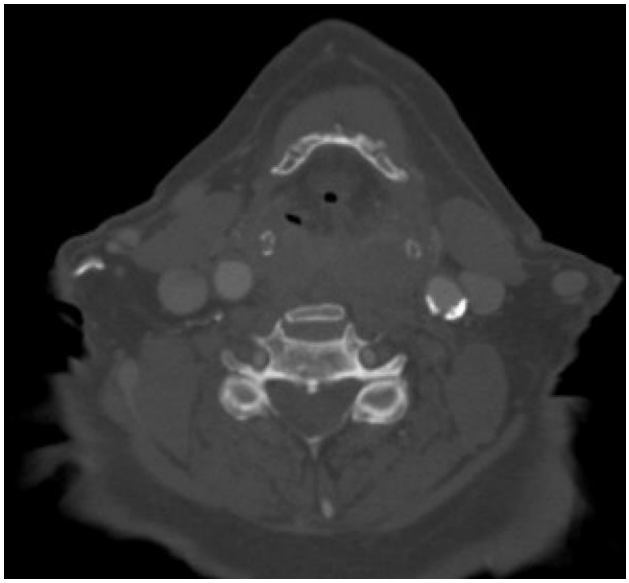

Figure 2 (left). CT soft tissue neck axial view showing large hypopharyngeal primary with involvement of lateral pharynx bilaterally. **Figure 3** (right). CT soft tissue neck axial view bone window showing destruction of hyoid bone, more prominent on left side.

During this same admission, the patient underwent suspension laryngoscopy and biopsy of this mass. The intraoperative report describes an "infiltrative ulcerative mass extending in the mid portion of the posterior pharyngeal wall. The ulceration is posterior and deep to the area of the NG tube, and this extends down to the level of the postcricoid area. The larynx itself is within normal limits. The piriform sinuses are relatively clear. Base of tongue was unremarkable." Pathology from this procedure revealed moderately differentiated non-keratinizing squamous cell carcinoma (SCC). The patient subsequently underwent a percutaneous endoscopic gastrostomy (PEG) tube insertion, given the ongoing need for nutritional supplementation and the likely worsening dysphagia secondary to the obstructive hypopharyngeal mass.

Course of Care

This gentleman was referred to our otolaryngology head and neck surgery (OHNS) service for definitive management of this biopsy proven cancer. He was admitted for preoperative planning and to expedite care. Due to limitations in hospital bed capacity, he was admitted to a general surgical unit as opposed to the OHNS inpatient unit. His preoperative stay was largely unremarkable until post-admission day #9. The physician assistant (PA) was notified by chance in the hallway that a patient was bleeding on the ward. Upon arrival to the patient, he was alert and oriented, holding a large basin collecting fresh bright red blood and clots. Nurses were at bedside suctioning the clots. He was able to speak full sentences and was seated upright. The PA ordered continuous oxygen saturation monitoring, STAT vital signs and bloodwork, intravenous fluids,

nebulized epinephrine and alerted the senior otolaryngology resident. The PA performed a transnasal endoscopy noting obvious blood in the upper airway and the hypopharyngeal lesion, though no site of active bleeding. Blood was not appearing to spill into the airway, as the patient was able to clear it with coughing. Given the volume of blood however, it was clear the patient required emergent surgical care due to risk of hemorrhagic shock and/or airway obstruction.

The senior resident came to assess the patient and left the room to mobilize this patient as an E1 (emergency) case for an awake tracheostomy and hemostatic control. At the time, the patient was maintaining his airway with oxygen saturation >92%. The patient was awaiting transfusion of 2U of blood and administered tranexamic acid intravenously. Within minutes the patient desaturated to 60% and began to lose consciousness, therefore a Medical Emergency Team (MET) call was activated to obtain critical care assistance with ongoing resuscitation. The MET call was subsequently superseded with a Code Blue overhead page for more urgent assistance as vital signs were now absent. At this point it was determined that the patient required immediate interventions for securing the airway, which would not be able to be deferred to the operating theatre setting. As the patient was in a pulseless electrical activity (PEA) rhythm, advanced cardiac life support (ACLS) measures began, and the patient underwent 3 cycles of cardiopulmonary resuscitation (CPR) with epinephrine administration. The clinical fellow of the OHNS service simultaneously performed a bedside cricothyrotomy. An endotracheal tube (ETT) was successfully inserted into the surgical airway. Bagged ventilation proceeded, and return of spontaneous circulation (ROSC) was achieved following a period of suctioning and repositioning of the ETT.

Given the instability of the surgical airway and high risk for repeat cardiac arrest secondary to ongoing hypovolemic and hemorrhagic shock, it was collectively decided the patient would be taken to the operating theatre immediately. Optimization of ongoing resuscitative measures, including arterial line and central venous catheter insertion was deferred until the patient was brought to the operating theatre. The patient was transferred to the OR with continuous bagging, suctioning and manually securing the cricothyrotomy tube.

Treatments of Choice

The patient underwent a tracheostomy revision, suspension laryngoscopy, bronchoscopy, and control of primary tumour hemorrhage. He was also transfused intraoperatively. Throat packing was placed to help further tamponade any bleeding from the primary malignancy site. He was cared for in the intensive care unit where he underwent further resuscitation and bronchoscopy to evacuate exsanguinated clots from his airway. The management plan was to wean the sedation over the next 24-hours for assessment of neurologic function following the cardiac arrest. His neurologic recovery would inform further surgical planning.

Ultimately the patient had full neurologic recovery, though experienced a period of moderate delirium. Five days following his cardiac arrest, he was taken back to the operating theatre for treatment of curative intent of his hypopharyngeal cancer. He underwent bilateral neck dissection, total laryngopharyngectomy, left hemithyroidectomy with parathyroid

autotransplantation, reconstruction with a radial forearm fasciocutaneous free flap and primary tracheoesophageal puncture. His postoperative course was remarkable for a neck abscess requiring percutaneous drainage and intravenous antibiotics. Otherwise, during his postoperative course he completed the major head and neck surgery postoperative care protocol reflecting successful reconstruction, had returned to baseline cognition, and received appropriate education for self-care of his gastrostomy tube and laryngectomy tube. He was repatriated to his local hospital in Red Deer for further rehabilitation. Surgical pathology revealed a pT3N2c squamous cell carcinoma. The primary tumour was 7.5 cm large, with eight bilateral positive regional lymph node metastases. The patient received six weeks of adjuvant radiotherapy given the advanced staging of his malignancy, but declined recommended chemotherapy.

Evaluation of Outcomes

Reflection and debrief of this clinical scenario identified several learning points. The patient had a minimum five week preceding history of progressive dysphagia prior to clinical presentation. As part of the initial consultation and assessment of these patients, particularly those with high risk features of smoking and alcohol consumption on social history, head and neck cancer should remain high on the differential diagnosis. The patient underwent a biopsy and PET-CT imaging modality for diagnostic workup, as the pathology and radiographic characterization are the two mainstay variables in diagnoses of new cancers.

The patient was admitted to a general surgical unit instead of the dedicated OHNS inpatient ward within the hospital. For individuals at higher risk of airway obstruction or history of prior bleeding, perioperative care and surveillance on the specialized ward is imperative. As the OHNS inpatient ward has experienced nursing staff familiar with upper airway emergency situations and the support of respiratory therapists who are stationed on the unit, these patients should be allocated to the appropriate specialized ward whenever possible. The OHNS service identifies patients as those at greatest risk of airway obstruction and orders precautions as they await for stabilization in the OR. These orders include head of bed greater than 30^{o}, tracheostomy tray at bedside, continuous pulse oximetry, and often intravenous steroids. This patient was not identified as an obstruction risk given this was a sentinel bleed and he did not have any airway symptoms on presentation. Moving forward, patients on off-service wards with known upper airway malignancies could have the above airway precautions in place regardless of initial clinical presentation.

Once the patient was noted to be in distress, the PA quickly enacted the appropriate interventions. However, initial notification to the PA of the patient's poor status was delayed and occurred by coincidence in the hallway. Successful outcomes require interventions that address both immediate, as well as more definitive therapeutic measures. The immediate interventions that can be performed on the ward to mitigate bleeding include medications such as tranexamic acid and epinephrine nebule administration. Immediately notifying the remainder of the team to mobilize the appropriate resources for definitive management is imperative. In addition, activating

a code early should be considered given that a patient's inability to cough the blood will lead to aspiration, desaturation, reduced consciousness and poor airway protection, leading to exponential decline. Interventions including emergent control of the bleeding in the operating theatre led to prompt definitive treatment of the precipitating bleeding. Evidently, undertaking interventions in the better equipped and more controlled environment of the operating theatre should be performed when the situation permits. Lastly, adhering to the ABCs mantra of resuscitation led to the early appreciation of the need for a more secure airway.

This case study describes a successful cricothyrotomy in the setting of an airway hemorrhage. A cricothyrotomy is typically performed in unanticipated and emergent situations, similar to the one outlined in this case. The OHNS service quickly identified that the patient required a more secure airway due to the bleeding and anatomic obstruction of the hypopharyngeal cancer, and that an emergent surgical airway was appropriate. In these circumstances, the most experienced individual should be performing the cricothyrotomy. The individual should accompany the patient to the operating theatre as done in this scenario, to manage the airway while it is in a more tenuous state. Our clinical fellow needed to manually hold the tube to maintain its position in the airway, and held onto the tube as the patient was wheeled to the operating theatre.

The success rate of cricothyrotomies is quite variable in the literature, and also dependent on the technique utilized - surgical versus percutaneous versus transtracheal. Kwon et al. reported a cricothyrotomy success rate of 74% in their academic institution with only 2/23 performed surgically (2). The rate of success may be influenced by oxygenation, experience and organization of the healthcare personnel, equipment availability and environmental preparation (3). Multiple attempts at intubating or establishing a surgical airway allow more time for desaturation; therefore, the fact the clinical fellow was able to secure the airway quickly and on the first attempt led to the success of this patient's cricothyrotomy. It was also not long following establishment of the airway and ROSC that the patient was taken to the operating theatre. In our academic centre, these above factors of personnel and environment contributed to the success of this patient's recovery. Ultimately, we were able to prevent an anoxic brain injury, otherwise common when the cricothyrotomy is too late or complicated by a multitude of reasons (4, 5).

Upper airway hemorrhage may occur from other medical conditions such as hemophilia (6), supratherapeutic warfarin levels (7), esophageal varices (8), military combat or trauma (9), regurgitated blood from tracheal or esophageal lesions (10), epistaxis, post-tonsillectomy bleeding, iatrogenically, or from other bleeding lesions elsewhere in the upper airway. The difficulty in managing the airway is poor visualization due to the volume of blood. Supraglottic airways devices may be used emergently, though with risk of aspiration (3) and virtually impossible to safely place in the head and neck cancer population. Regardless of the cause of airway hemorrhage, the principles of ABCs apply with consideration of any possible reversible therapies, eg. vitamin K for warfarin toxicity.

The management of airway obstruction is familiar for the OHNS service, for example, from an obstructing neoplasm or infectious process such as cervical necrotizing fasciitis or Ludwig's Angina. The authors had not yet managed upper airway hemorrhage leading to airway obstruction. The PA is now better familiarized with the cricothyrotomy technique having seen one, though recognizes an experienced healthcare provider is critical for patient outcome. Performing a cricothyrotomy is not currently an expected treatment within the scope of PA clinical practice on this OHNS service. On the other hand, military service PAs have likely performed a cricothyrotomy under supervision during their careers (11). The PA has identified the key clinical points from this airway hemorrhage case, which are the early recognition of a potentially insecure airway, when to mobilize help, and what immediate measures may be implemented to prevent worsening of patient status.

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