TITLE: Blunt Neck Trauma and Laryngotracheal Injury
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Introduction

Blunt neck trauma and its associated injuries is a clinically important situation that can have devastating results if unrecognized. This serves as a review of blunt neck trauma from its injuries to evaluation, management, and prognosis.

Anatomy of the Neck and Larynx

The neck is such that it is bordered posteriorly by the spine, anteriorly by the larynx/trachea, superiorly by the head, and inferiorly by the chest. It contains several structures including musculoskeletal structures such the vertebrae, the cervical and strap muscles, various tendons and ligaments, and the hyoid bone. It also contains very important neurologic structures including the spinal cord, cervical roots including those of the phrenic nerve and brachial plexus, the recurrent laryngeal nerve, and stellate ganglion. The vasculature of the neck is important not only in regards to its purpose but as surgical landmarks. The vasculature of the neck includes the more often noted, carotid arteries and the jugular veins. The vertebral arteries and veins along with the brachiocephalic vasculature, although less mentioned, remain part of the vasculature of the neck. The neck also contains glandular structures like the thyroid, parathyroids, and submandibular glands as well as visceral structures such as the thoracic duct, esophagus, pharynx, and trachea.

Another visceral structure of the neck is the larynx. The larynx is the narrowest part of the airway; it houses the phonatory apparatus and protects the airway from aspiration during swallowing. It is protected by the mandible superiorly, the sternocleidomastoid laterally, cervical spine posteriorly, and the sternum inferiorly. It consists of three cartilages: the thyroid cartilage, cricoid cartilage, and the arytenoids all made of hyaline cartilage. The epiglottis is also part of the larynx but is made of fibroelastic cartilage. The thyroid cartilage is suspended between the hyoid bone via the thyrohyoid membrane and the sternum; it is also secured by the extrinsic muscles of the larynx. The thyroid cartilage articulates with the cricoid via the cricothyroid joint and the cricothyroid membrane. Paired hyaline structures called arytenoids sit posteriorly on the cricoid. Prominences called vocal processes project from the arytenoids and serve as the attachment for the vocal ligaments and assist vocal cord movement. Likewise, the intrinsic muscles of the larynx alter the position, shape, and tension of the vocal folds.

Zones of the Neck

Although the zones of the neck are used to classify penetrating neck injuries, they should be review when discussing neck anatomy. There are three zones of the neck labeled numerically. Zone three is the highest zone in the neck and is bordered by the skull base superiorly and the angle of the mandible inferiorly. Zone two extends from the angle of the mandible to the cricoid cartilage. Zone one extends from the cricoid cartilage to the thoracic inlet. Management and evaluation of penetrating injuries to the neck are mediated by the zone of injury.

Injuries of Blunt Neck Trauma

Blunt neck trauma (BNT) is known to be rare occurring about 5% of time of all neck traumas. There are various sources of blunt neck trauma and each is associated with pattern of injury. The most common mechanism of BNT is motor vehicle collisions. These injuries are associated with rapid acceleration or deceleration and a direct blow of the anterior neck on the steering column or dashboard; hence it is also known as padded dash syndrome. This leads to crushing of the trachea usually at the cricoid ring as well as possible compression of the esophagus against the vertebrae.

Clothesline injuries are often associated with major blunt trauma to the neck. These injuries occur in typically young adolescent patients who ride motorcycles, all-terrain vehicles, or snow mobiles when they strike a stationary object such as a wire fence or tree limb. Clothesline injuries can also occur in high contact sports. With these injuries, a large amount of energy is transferred to a small neck and this leads to crushed laryngeal cartilage and frequently cricotracheal separation. With cricotracheal separation, the injured airway is held together by intervening mucous membranes.

Strangulation is a form of BNT that consists of homicidal strangulation either via ligature suffocation or manual choking, suicidal strangulation (hanging), and postural asphyxiation seen in children when the neck is placed over an object and the body weight produces compression. With strangulation, a steady compressive force is applied to the neck and can be associated with delayed laryngeal edema. Homicidal strangulation injures via carotid artery occlusion or carotid sinus reflex death, a disputed mechanism of death in which manual stimulation of the carotid sinus is believed to cause strong glossopharyngeal nerve impulses leading to terminal cardiac arrest. In suicidal strangulation, there is an association with laryngotracheal separation and neurovascular injuries. The mechanism of action for suicidal strangulation is the following: pressure is applied to jugular veins leading to obstruction of venous return from the brain. This results in venous congestion in the brain and loss of consciousness ensues. The patient falls with his or her full weight against the ligature and the trachea is compressed, restricting airflow to the lungs. This results in irreversible asphyxiation or death.

Esophageal injuries

In blunt trauma, the mechanism of esophageal injury is caused by compression of the cornu of the thyroid cartilage or other parts of the laryngeal cartilage against the cervical spine. This leads to the laceration of the pharyngeal mucosa. This is infrequently associated with BNT and is present 3%-14% of the time with laryngeal fractures. Symptoms of injury include: dysphagia, odynophagia, hematemesis, hemoptysis, bloody saliva, tachycardia, fever. Subcutaneous emphysema can be seen on imaging. A gastrografin study is recommended as first line. If negative, barium swallow is recommended as it has a greater sensitivity of 90%. Evaluation also includes endoscopy, either rigid &/or flexible endoscopy. Weigelt et al reported 100% of esophageal injuries were found with BS and rigid endoscopy and other studies have shown that 100% of perforations were found with a combination of flexible and rigid endoscopy. After the injury has been isolated, treatment ranges from observation, if clinical exam is benign, to surgery. Surgical intervention involves debridement with a two-layered primary closure +/- muscle flap over the suture line to prevent TE fistula and intra-operative drain placement.

Cervical Spine Injuries

Cervical spine injury is highly associated with BNT. This can result from severe hyperextension during rapid acceleration or deceleration in motor injuries. Also, significant cervical spine and spinal cord damage can occur in hangings that involve a fall from a distance greater than the body height. Cervical spinal disruption subsequent to strangulation is almost uniformly fatal. Symptoms of this kind of injury include hemiplegia, quadriplegia, CN deficits, changes of sensorium, Horner's syndrome secondary to disturbance of stellate ganglion, and neurogenic shock. Evaluation of this injury includes AP and lateral cervical radiography plain films and CT scan. Management of this injury should include a neurosurgery consult. From the ENT standpoint, cervical stability is important to establish especially in the event of tracheostomy placement or endoscopy. Cervical spine precautions including cervical spine immobilization and supine placement of the patient on a backboard are necessary.

Vascular Injuries

Vascular injury occurs in 1-3% of all BNT and is associated with 20-30% mortality. It mostly occurs with motor vehicle collisions. Rapid deceleration causes hyperflexion, hyperextension, and rotation of the neck. As a result, the vascular structures are stretched over the cervical spine leading to shearing forces on the vessels and subsequent intimal tears in the vessel wall. "Hard signs" of injury include bruits or thrills, expanding or pulsatile hematomas, pulsatile or severe hemorrhage, and pulse deficits. "Soft signs" include hypotension, shock, stable hematoma, and CNS/PNS ischemia. Of note, often blunt vascular injury initially manifests in the form of acute ischemic stroke and can be delayed in onset. Classic presentation includes a neurologically intact patient who develops hemiparesis after a high-speed MVC. Evaluation by four-vessel angiography remains the gold standard given its sensitivity of 99%. CT angiogram is 68% sensitive and 67% specific and MRA is 75% and 67% for specificity and sensitivity, resp. These modalities can be used as adjuncts to evaluation but are not first-line. Duplex US have a sensitivity 90-95% but only with a skilled technician. Managing vascular injury depends on the extent of injury. Grading systems like the Denver grading scale for blunt carotid artery injury can provide a prognosis and treatment for this injury. In general, surgical repair is preferred over ligation and primary repair is preferred over grafting.

Laryngotracheal injuries

Epidemiology

The incidence of laryngotracheal injuries is such that it is rare. According to some sources it occurs in 1 out every 5,000-47,000 adults and in 0.05% of trauma admissions in children. The incidence can be as high as 1 in 445 in major urban trauma centers. Jewett et al found an incidence of 1:137,000 in population-based, time series analysis of external laryngeal trauma in 11 states. Although not prevalent, it is second to only intracranial injury as the most common cause of death among patients with head and neck trauma and is a clinically important injury. In fact, Line et al reported that 112 (65%) of 171 blunt neck trauma patients in their series did not survive. About 60% of all external laryngotracheal traumas are due to blunt neck trauma and in this setting there is a concern for these injuries to be overlooked in situations of multitrauma (maxillofacial, cervical, and intracranial injuries). The final common pathway of laryngotracheal injury is compressive force on the larynx. This is modified by the degree of laryngeal calcification present.

Clinical Presentation

The most common presenting symptom for laryngotracheal trauma is hoarseness. Juutilainen et al found that in a review of 33 cases of external laryngeal trauma, hoarseness was the presenting symptom in 85% of cases (28 patients). This finding is consistent with other studies. Other presenting symptoms include: dysphagia, pain, dypsnea, hemoptysis, and symptoms of airway obstruction such as stridor or tachypnea. Other signs include drooling and cervical subcutaneous emphysema or crepitation. As for crepitation/subcutaneous emphysema, interestingly, Goudy et al found that of 236 patients admitted with aerodigestive tracheal injury or subcutaneous emphysema, only 8% (19 patients) were identified with cervical emphysema/crepitations thought to be caused by aerodigestive injury, thus indicating that this is a low yield sign of laryngotracheal injury. In addition to crepitations, physical examination reveals skin abrasions, bruising, laryngeal tenderness, and distortion of the anterior neck anatomy.

Examination/Classification

A systematic and concise approach is needed to accurately identify the injuries to the laryngotracheal system. The mode of injury should be determined – either blunt or penetrating. The site should be identified as supraglottic, glottic, or subglottic. The structures injured should be assessed such as hyoid bone, thyroid cartilage, cricoid cartilage, or arytenoids injury. As per Cumming's Otolaryngology: Head & Neck Surgery, the systematic approach proposed by the author includes an assessment of the laryngeal framework as stable, unstable, or potentially nonviable and an assessment of the mucosa as intact/minimal injured, injured, or massively injured. The vibratory apparatus is described as intact or injured and the laryngotracheal junction is described as intact or with any degree of separation. A more commonly referenced classification of laryngotracheal injury is the Schaefer-Fuhrman classification which separates the extent of injury into five groups. Group one includes minor endolaryngeal hematoma or lacerations, no laryngeal fracture, and is treated with observation and humidified O_2. Groups 2, 3, and 4 presents with symptoms of airway compromise; however, group 2 involves edema and mucosal disruption and is treated with a tracheostomy to secure the airway along with panendoscopy. Group 3 injury presents with massive edema and injury that involves cartilage exposure and vocal cord immobility. Management of these patients includes tracheostomy along with exploration and repair. Group 4 injury involves massive edema, exposed cartilage, disruption of the anterior commissure and unstable fractures. The injury is so severe that stent placement is needed in addition to tracheostomy, exploration, and repair. Group 5 presents with cricotracheal separation and requires urgent tracheostomy along with exploration and repair. Other similar classifications exist such as the Lee Eliashar classification and the proposed Legacy Emmanuel Hospital and Health Center laryngeal injury classification that takes into account CT findings.

Evaluation of Laryngotracheal Trauma: Securing an Airway

As these injuries in the setting of trauma, laryngotracheal injury at times may be addressed during the primary survey of assessing airway, breathing, and circulation. It is a priority to establish an airway with cervical spine protection as indicated. Tracheostomy preferred to intubation because intubation can exacerbate laryngeal injury with the feared outcome being precipitation of total airway obstruction. Further, it is difficult to perform in the presence of concomitant maxillofacial injuries in patients with immobile necks. However, if it is to be performed such as in patient with signs of acute or impending respiratory distress, it is recommended it be done by the most experienced medical professional.

Imaging

High resolution computed tomography is performed in all patients with laryngotracheal injuries once their airway is secure. Given advances with CT, such as multidetector row CT (MDCT), high resolution can be obtained in shorter scan times. Cut thickness for imaging in patients with concerns for laryngotracheal trauma should not exceed 1mm in thickness. Robinson et al in their review of MDCT also recommend obtaining multiplanar reconstructions as it allows for confirmation of fractures lines and fragments as well as suspected dislocation on transverse scans. Further, horizontal fractures are difficult to appreciate on as the run parallel to the acquisition plan of the CT scan and would be missed without review of coronal and sagittal reconstructions. It is necessary to review the image under soft tissue windows to evaluate for mucosal or vocal cord asymmetry and swelling and bone windows. IV contrast is not necessary unless there are concerns for vascular injury.

The thyroid cartilage is most commonly affected in laryngeal fractures. Robinson et al found that of the 41 scans they reviewed, 33 thyroid fractures were found, 23 of which were isolated fractures. 19 cricoid fractures were present and only 1 arytenoid fracture was identified. They also discuss that horizontal fractures often cross the midline and usually occur with supraglottic soft tissue injury. Isolated fractures of the upper and lower horns of the thyroid were uncommon. Further, they discuss that, as expected, visualization of a fracture is easier in ossified cartilages and with displaced fractures. Of note, they did find that cricoid fractures are typically bilateral and cause airway collapse should the mobile fragment of cricoid retropulse into the airway.

As discussed by Robinson et al, radiographically, fractures can be classified by the Schafer-Fuhrman classification but the limitation is the scheme requires endoscopic evaluation. In their series, they classified their patients into 8 with Schafer grade 2 classifications, 26 with grade 3 classifications, and 7 with grade 4 classifications. They do discuss the purely radiologic classification proposed by Ogura et al which is recommended in radiologic text. This classification has five levels. Level A includes soft tissue injuries with or without non-displaced fractures. Level B involves supraglottic fracture and injuries. Level C involves glottic injuries which includes midline vertical thyroid fractures or cricoid fractures and injury of the vocal cords. Level D is cricoid fractures with varying degrees of airway obstruction and level E involves tracheal fractures to complete transaction injuries.

Flexible fiberoptic nasolaryngoscopy

There is a role for fiberoptic nasolaryngoscopy for a preliminary assessment of the extent of trauma and vocal cord mobility in stable patients. Care should be taken during this exam to not exacerbate compromise to the airway. Clinical findings seen on endoscopy include deformities of the larynx, swelling, lacerations, exposed cartilage, complete or partial vocal cord fixation indicative of RLN injury or dislocation of the cricoarytenoid joint, and hematoma. Of note, prior to any manipulation of the neck for positioning, the examiner should be aware of c-spine injury and this should be ruled out.

Conservative management

Conservative management is indicated in patients that fall under group 1 and some in group 2 of Schafer's classification and involves observation. Specifically, observable conditions include: edema, small hematomas with intact mucosal coverage, small glottic or supraglottic lacerations without exposed cartilage, and single non-displaced thyroid cartilage fractures in a stable larynx. The following should be implemented: admission to the ICU for strict monitoring and some sources recommend serial flexible nasolaryngoscopy examinations. Humidified oxygen should be at the bedside and serves to help prevent crust formation in the presence of mucosal damage and transient ciliary paralysis. The patient's head of bed should be elevated to reduce swelling in addition to steroids. Anti-reflux precautions are always recommended as they serve to prevent scar formation in the setting of mucosal injury. Prophylactic broad spectrum antibiotics should be given if laryngeal mucosa injury has occurred.

Surgical options for laryngotracheal repair

Situations requiring surgical repair include: lacerations involving the free margin of the vocal fold, large mucosal lacerations, exposed cartilage, multiple and displaced cartilage fractures, avulsed or dislocated arytenoids cartilages, and vocal fold immobility. The ultimate long-term goal is to restore laryngeal function including phonation, protection from aspiration, ventilation, and deglutition to as near baseline as possible. It is recommended that all surgical patients receive panendoscopy intraoperatively for a detailed examination of the injury before surgical repair. Direct laryngoscopy, bronchoscopy, and esophagoscopy are integral in diagnosing aerodigestive injury and should be done after an airway is secured, specifically once the tracheostomy is done.

As per Cummings Otolaryngology: Head & Neck Surgery, the indications for open laryngeal repair are as follows: injuries involving unstable fractures or comminuted fractures, cricotracheal separation, detachment of the anterior commissure, and mucosal disruption. Other indications include fractures of the median or paramedian parts of the thyroid alae, cricoid fractures, and injury involving vocal cord paralysis. The more conventional approach is an open procedure. Closed endoscopic reductions are possible for injuries such as arytenoids dislocation or minimally displaced laryngeal fractures +/- stenting. However, there is limited experience with closed reductions; thus, most procedures are done open. Thyrotomy or an anterior vertical laryngofissure is the approach to open procedures involving intralaryngeal repair such as reapproximation/repair of fixed vocal cords or repairing endolaryngeal soft tissue lacerations or avulsions. This approach is begun by a horizontal skin incision made at the level of the cricothyroid membrane. Subplatysmal flaps are elevated superiorly to hyoid and inferiorly to the cricoid. The straps are separated at midline and retract laterally. The thyroid cartilage is incised vertically at its midline. It is very important to enter at midline rather than on either side of the anterior commissure as this adversely affects repair. This is done by incising at the cricothyroid membrane and incising the mucosa superiorly under direct visualization. Of note, if a vertical fracture already exists near midline, this can be utilized as opposed to creating a vertical incision. The endolarynx is entered through cricothyroid membrane and incision is extended superiorly through the anterior commissure to the thyroid membrane.

For procedures not involving intralaryngeal repair such as plating a fracture, after splitting the strap muscles and exposing the thyroid cartilage and the cricoid, the perichondrium is incised at the midline and perichondrial flaps are raised on both sides of the fracture. Fractures can be re-approximated using suture, wire, and plating. As opposed to suture and wire, plating helps to not only approximate but helps to stabilize the fracture. This is beneficial as it is known that motion of fracture fragments increases bleeding, hematoma formation, inflammation, and, thus, the likelihood or infection or scar. When plating, Ballenger's Otolaryngology: Head and Neck suggests that paramedian fractures be plated using a four hole "box-type" plate around the fracture aka four point fixation. For midline fractures, consideration must be made for the curvature of the thyroid cartilage anteriorly. Four point fixation is still recommended. As for the cricoid, its height will not allow for four point fixation, thus, a single horizontal plate is adequate to re-establish the integrity of the cricoid. The success of plating as been documented in literature. Sasaki et al evaluated the efficacy of both MacroPore and Leibinger resorbable reconstruction plates in 3 adult male patients and found both plates to be equally easy to use. In addition, adequate skeletal stabilization was achieved, which allowed for early phonation and respiratory function without long-term stenting. In Brazil, de Mello-Filho et al performed a retrospective study on the efficacy of adaptation plate fixation (APF) to repair the larynx. This group had no complications with the use of APF, and 19 out of 20 patients recovered their voices.

Cricotracheal Separation

Separation of the airway most often occurs between the cricoid and the trachea and at times between the rings of the upper trachea. This condition is highly associated with clothesline injuries. As blunt neck trauma rarely yields clean cuts, cricotracheal separation is usually associated with cricoid fractures and avulsion of the mucosa from the anterior surface of the posterior cricoid plate. This situation can be grave given the possibility of a precarious airway and subsequent asphyxiation and is associated with a high mortality. When managing cricotracheal separation, the airway is secured by tracheostomy. As the inferior portion of the trachea retracts substernally, it is mobilized into the surgical field with a cricoid hook or the like, a tracheostomy is performed, and a small ET tube is placed through the tracheostomy for ventilation during surgery. Primary re-anastamosis proceeds from posterior to anterior with a combination of 3-0 absorbable and non-absorbable suture. If the cricoid is intact after the injury, only the mucous membrane needs to be repaired primarily with absorbable suture. Tension should be distributed away from the anastamosis by placing non-absorbable sutures from the superior cricoid to the inferior portion of the first or second tracheal ring. If the cricoid is fractured, internal fixation of the cricoid cartilage should occur first as the strength of the repair is limited by stability of the cricoid cartilage. Stenting may be considered given the extent of injury. Avascular and damaged tissue should be resected. Of note, cricotracheal separation is highly associated with recurrent laryngeal nerve injury. If fact, in a study by Couraud et al where 19 laryngotracheal disruption patients were studied, it was found that 14 of the patients have bilateral RLN injury and 4 had unilateral RLN injury. Mucosa was retracted in all patients to expose cricoid cartilage.

Exposed cartilage

Covering exposed cartilage – mucous membrane, dermis, STSG; responsible for granulation tissue and scar formation. Unfortunately, this graft wound heals be secondary intent and the risk of scar formation is greater than primary closure of innate lacerated mucosa over the exposed area. Mucous membranes closely resemble the normal endolaryngeal epithelium but use of the graft is associated with high donor site morbidity and the need to enter the mouth to harvest graft.

Endolaryngeal stenting

Endolaryngeal stenting is indicated when extensive lacerations involving the anterior commissure are present as it is used to prevent webbing of the anterior commissure in cases of bilateral vocal cord epithelial loss. It is also indicated with multiple cartilaginous fractures that cannot be stabilized adequately with open reduction. However, it is controversial given it can be a source of mucosal injury and its placement is associated with an increased risk of infection and granulation tissue formation. Its purpose aside from prevent webbing, is to stabilize the internal configuration of the larynx. It should be fixed in a fashion that it moves with the larynx during swallowing and can be accessed endoscopically. Securing this apparatus is described as passing a suture through the stent and larynx at level of laryngeal ventricle and at cricothyroid membrane and tying it over buttons over the skin. The stent is usually left in place for 10-14 days and removed early to avoid granulation tissue formation.

Post op care

The guidelines for post op care are very similar to that of conservative management. The patient should be instructed to voice rest for 48-72hrs and anti-reflux and prophylactic antibiotic precautions should be given to prevent scar formation from irritation or infection. The head of bed should be elevated to aid swelling and early ambulation should be encouraged. If stents have been placed, it is recommended they be removed in 10-14 days so as to not contribute to mucosal irritation/injury with subsequent scar formation. Regular endoscopic exams should be performed to assess recovery. Of note, in patients with cricotracheal separation, neck flexion for 7 days in is recommended to prevent traction on the anastamosis. As for diet, it is recommended a nasogastric tube be placed intraoperatively until PO intake is safe. Tracheal care is always necessary given tracheostomy placement.

Complications and Long-term Management

Granulation tissue is the most common complication of not only laryngotracheal injury but surgery. The best mode of cure is prevention when possible by meticulous primary closure and covering exposed cartilage. Endolaryngeal stent use should be limited to groups 4 and 5 of the Schafer classification and should be removed as soon as indicated. Other complications include laryngeal and tracheal stenosis which can be treated with surgical repair or dilatation. Anterior and posterior glottic webbing may also occur from injury or surgery and can also be managed surgically. Persistent vocal cord immobility may results from RLN injury or cricoarytenoid joint separation. Endoscopic evaluation, either rigid or flexible, should be employed and vocal cord immobility should be managed according to etiology.

Follow-up after injury and surgery is recommended for at least 1 year to evaluate for a combination of laryngeal stenosis, dysphonia, aspiration, both structural and neurovascular injuries, and monitoring for recovery of vocal cord paralysis. Of note, procedures to correct vocal cord immobility can be done after 9-12mos of observation with the possibility of full recovery. In the study by de Mello-Filho et al, after 3-108 months of follow-up with 20 patients, ranging from grade III-V of the Schafer's classification for laryngotracheal trauma, 19/20 reported good airway and 18/20 reported fair to good voice outcome. All patients with tracheostomy placement were decannulated. As this and others studies have demonstrated, outcome of patients with laryngeal trauma who receive prompt treatment is favorable.

Special Considerations: Pediatric Laryngotracheal Trauma

Although blunt neck trauma is not common in children, laryngotracheal injury is most commonly related to BNT when it does occur in children. As opposed to adults, the most common cause of BNT and subsequent laryngotracheal injury is bicycle accidents and falls. Anatomically, the larynx in children is situated high in the neck and protected by the mandible. In neonates, it lies at level C3 and starts to descend during the first 3 years of life to its final adult position at level C6. The high riding larynx in children serves as protection. Further, the pediatric larynx has a higher amount of elasticity compared to adults and is, thus, less susceptible to laryngeal fractures. In addition, the cricothyroid membrane is narrower in children and less likely to have laryngotracheal separation. Conversely, as the submucosal tissues are loosely attached to the perichondrium in children. This increased the likelihood of soft tissue damage, edema, and hematoma with possible airway obstruction.

Securing an airway in the setting of laryngotracheal trauma in the pediatric population is controversial. In children it is usually not possible to perform an awake tracheostomy. However, there is a fear of worsening laryngotracheal injury with intubation. The current recommendation, however, is rapid sequence intubation followed by prompt tracheostomy.

Further, there is a very high association with cervical spine injury and laryngotracheal trauma. It is quoted that this association can be as high as 50% of children with laryngotracheal trauma. As a result, it is important to have a low threshold of suspicion for cervical spine injury in this population and appropriate cervical spine stability and management should follow identification of injury.

Conclusion

Overall, blunt neck trauma is a medical situation that is uncommon but associated with very clinically important. It is important for otolaryngologists to stay aware of the evaluation and management of this situation

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Discussant's Remarks – Dr. Siddiqui on Laryngotracheal Injuries, Dec 16, 2010

That was a very good presentation, Dr. Edionwe, a very complete review of laryngotracheal trauma and blunt neck injury. You were very correct in highlighting the fact that in children you have to worry about C-spine injuries. In fact, in neck trauma the C-spine is more commonly injured than the airway because the airway is in a more protected location. In any case, with all the subcutaneous swelling at times you do have to intubate children being very careful not to hyperextend the neck and cause even more injury to the C-spine.

In children with a high C-spine injury, they may have a vascular injury as well and it may not present itself as clearly as in an adult. The signs and symptoms may not be apparent if the patient is already in shock. For this reason it's important to get a CTA and to look at their neck vasculature,

In adults, we have a very good algorithm that you presented that classifies all the different grades of injury allowing one to move towards more conservative management, doing an emergency tracheotomy, or taking the patient to the O.R. In the patient with laryngotracheal injuries one should always go the O.R. for a direct look. If you are planning a tracheotomy, you always need to do a pan-endoscopy even if you have a CT scan. The CT scan will help you out, but taking a good look yourself is always the best for it will show mobility of the fragments, whether something needs to be plated or fixed or watched. It gives you a much, much better information about what's going on.

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Discussant's Remarks: Francis B. Quinn, Jr., MD

Doctor Siddiqui has given an excellent and up-to-date summary of the diagnosis and treatment of penetrating injuries of the neck, with emphasis on the wide range of approaches made possible by newer imaging techniques. She has pointed out that the earlier "zone" protocol may be soon overwhelmed by the more modern "selective" management strategies.

The question of evaluating various series of cases is made complicated by the several mechanisms of injury as drawn from different cultures and environments. We note that 75% of South African patients present with incised wounds, 50% of U.S. urban patients seek treatment for gunshot wounds, and our military casualties suffer wounds from low-velocity

shell fragments, as well as high velocity small caliber rifle bullets, often accompanied by substantial loss of tissue.

Thus, reports of treatment results should allow us to picture the biomechanics of injury, for as has been shown in previous Grand Rounds, the high velocity projectile creates instantaneous and extensive tissue expansion with shearing stress leading to delayed devitalization and unanticipated late complications. (See References below.)

Further, even low velocity (800 fps) bullets are known to tumble and fragment, causing tissue injury far from the missile track. In contrast, stabbing or cutting injury causes tissue injury limited to the track of the weapon.

Doctor Siddiqui's presentation has shown us that the newer treatment methods have laid upon faculty of resident training institutions the requirement to distill the reports of these methods into a doctrine suitable for the instruction of those aspiring young surgeons under our direction, a doctrine which takes into account the local weapons culture as well as the technical and imaging support available.

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- **Penetrating Neck Trauma [Jan 27, 1999]**

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