International Journal of Otorhinolaryngology and Head and Neck Surgery
Periasamy C et al. Int J Otorhinolaryngol Head Neck Surg. 2019 Sep;5(5):1379-1383
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2454-5929.ijohns20193887

Penetrating neck injuries with laryngeal framework involvement: in a tertiary care centre

Chozhan Periasamy*, Malarvizhi Ravisankar, Mathumithaa Subburayalu

Department of Otorhinolarygology and Head and Neck Surgery, Government Stanley Medical College, Chennai, Tamil Nadu, India

Received: 31 May 2019
Revised: 05 July 2019
Accepted: 11 July 2019

***Correspondence:**
Dr. Chozhan Periasamy,
E-mail: chozhenp@gmail.com

ABSTRACT

Background: Penetrating neck injuries are very common as a mode of homicidal and suicidal injuries. Not many of them are deep enough to affect the laryngeal framework.
Methods: Prospective study in the Department of ENT Stanley Medical College, Chennai. The study period was from January 2018 to December 2018. Follow up of 3 months was done.
Results: Penetrating neck injuries treated on emergency care with tracheostomy and wound exploration and repair. It was found to be more common in young male population.
Conclusions: Laryngeal framework involvement necessitates tracheostomy during wound exploration. On table laryngeal injury repair improves prognosis and early post-operative vocal fold assessment helps frame a treatment plan designed specifically for the patient.

Keywords: Self-inflicted neck injury, Laryngeal injury

INTRODUCTION

Neck injuries which breach the platysma are classified under penetrating neck injuries. This study was conducted over a period of one year which penetrated neck injuries presenting in a tertiary care centre situated in an urban area surrounded by working class population, we found that laryngeal framework injuries with minimal mucosal injury and cartilage laceration fared better compared to injuries with extensive cartilage destruction.

Anatomy of neck

Anatomical division

The neck is divided into two major triangles: anterior and posterior. The vital structures in the anterior triangle make it a more detailed study material than any other region in the body.

The anterior triangle is bound by sternocleidomastoids on both side, mandible superiorly and the sternal notch inferiorly. The anterior triangle is further divided into submandibular, submental, carotid, muscular and central compartments. It contains the trachea, esophagus, thyroid gland, carotid arteries, internal jugular veins, subclavian vessels, sympathetic chains, vagal nerve and its branches, lymphatic chain with its cervical lymph nodes.[1,2,3]

The posterior triangle is bound by trapezius posteriorly, sternomastoids anteriorly and clavicle inferiorly. The contents are the brachial plexus, muscles and spinal accessory nerve along with the lymphatic chain system.

Fascial compartments

The neck is covered by superficial and deep cervical fascia. These fascial coverings produce various compartments of neck. These help in identification of

structures and aid in dissection. They also help in limiting spread of infection and metastasis from one compartment to another.[4,5]

Superficial fascia is a single layer of fibro-fatty that covers the subcutaneous tissue and platysma. Deep cervical fascia with its three layers:

- Superficial (investing) layer covering whole of neck and splits to surround two muscles the trapezius and sternomastoids on both sides and two glands the submandibular and parotid salivary glands.
- Visceral (pretracheal) layer surrounds the middle compartment of neck and covers the trachea and the thyroid gland.
- Internal (prevertebral) layer surrounds the deep muscles of neck.

Injuries to neck

Injuries to neck can be blunt or penetrating based on integrity of platysma and self-inflicted, accidental or homicidal based on mode of injury. In general stab wounds and blunt trauma wounds are more localized injuries than bomb injuries and gunshot wounds.

Roon and Christensen's classification of zones of neck aids in assessment of severity of neck injury. All three zones contain vital structures of vascular and aero digestive tract.[5]

- Zone 1: Sternal notch/clavicle to cricoid cartilage.
- Zone 2: Cricoid cartilage to angle of mandible.
- Zone 3: Angle of mandible to base of skull.

Laryngeal framework along with vasculature around it is the most commonly involved in any type of neck injury in the anterior compartment. Trone et al classified laryngotracheal injury as below.[1,5]

Table 1: Trone et al classification for laryngotracheal injury.

Group	Injury
1	Minor endolaryngeal hematoma without detectable fracture.
2	Oedema hematoma, minor mucosal disruption without exposed cartilage, undisplaced fractures noted on CT.
3	Massive oedema, mucosal tears, exposed cartilage, cord immobility.
4	As group 3, with more than two fracture lines or massive trauma to laryngeal mucosa.
5	Complete laryngotracheal separation.

METHODS

Study design: A prospective study.

Study place: The study was conducted at Department of ENT, Stanley Medical College, Chennai.

Study period: The study was conducted from January 2018 to December 2018.

Sample size: Consisted of 7 patients. Follow up was done for 3 months.

Inclusion criteria

Patients of age group 18 to 95 years with penetrating neck injury and laryngeal framework involvement were included in the study.

Exclusion criteria

Patients of age <18 years and >95 years and polytrauma with head injury were excluded from the study.

Tracheostomy and wound exploration. The selected cases that were studied where those that presented to the ER of our tertiary care hospital with airway compromise because of laryngeal framework injury. Subjects with Polytrauma such as those with orofacial injuries and lung injuries were not included due to their grave prognosis compared to laryngotracheal zone 2 injuries.

Steps

Patients with suspicion of laryngotracheal injury are evaluated with history and examination. The examination of wound included that of laryngeal and tracheal injuries; which when are open wounds by water leak test (a few drops of distilled water are poured over wound. During respiration air bubbles are seen due to leak/injury in airway) and when are closed wounds-by subcutaneous emphysema. Associated vascular injuries (hematoma/ tenderness over neck in closed injuries and active bleeding in penetrating injuries) and voice assessment done. Voice assessment is done in patient with good GCS. It supports the relation of vocal folds to injury as in (a) Visualization of vocal folds mobility and immobility through the open neck injury and by (b) augments air leak test for effort induced air leak. The associated injuries to mandible and oral cavity may increase the airway compromise imaging studies are routinely not done. Most cases taken up with clinical examination warranting need for emergency neck exploration and airway securing. In suspected cases as in closed injury and minor doubtful airway injuries emergency computer tomogram of neck is taken to assess air compartments in tissues places and their relation to the laryngotracheal framework. Major detailing can be done on integrity of laryngotracheal framework. The following are the steps followed for management. Tracheostomy is done under local anaesthesia preferably in neck neutral position with supports of hemostat clamps and bipolar cautery. Precautions such as never to insert the endotracheal tube or tracheostomy tube through the portal of site of injury

should be taken as it may aggravate the injury. The site of tracheostoma is in the anterior triangle below the injured site; most commonly over 2nd to 4th tracheal ring. Vertical midline incision is made between cricoid cartilage and sternal notch. Fascia along with subcutaneous tissue retracted laterally. Thyroid gland identified. Care not to injure the gland as it may increase the blood loss of the field. Thyroid is retracted as whole superiorly with a single hook retractor. The trachea identified and pretracheal fascia incised and retracted. Tracheal window created at level of 3rd tracheal ring. Bjork flap may be created instead of a window to prevent future risk of stenosis. Tracheostomy tube of appropriate size inserted and secured with sutures to skin and cuffed inflated with air of adequate volume. Further procedures can be continued with general anaesthesia given through the tracheostomy tube.

Neck exploration steps are as follows. Post tracheostomy the wound is washed with saline and checked for vessel, esophageal and laryngeal framework injuries.

Vessel injures to attain hemostasis; all vessel injuries are ligated with double ligation and cautery. Care taken near the trachea-esophageal groove as recurrent laryngeal nerve may get injured. Esophageal injuries are predominantly mucosal tears of pharynx, as the esophagus is behind the trachea and larynx which bear the brunt of major force. Mucosal tears are closed with vicryl 2-o or 3-o continuous sutures. Laryngeal framework injuries- the perichondrium of larynx is most commonly injured- it is repaired with 3-o vicryl sutures. When the cartilage framework is injured they are approximated with perichondrium with smoothening of frayed edges with vicryl sutures. The knots are placed external to framework. Never facing the interior as it may aggravate the granulation tissue during healing. Tracheal separation and tears are approximated with vicryl sutures with knots facing externally. Care not to injure the nerves running parallel to it. Internal fixation of fractures of laryngeal framework is thus managed.

Nasogastric tube is inserted and position confirmed. Neck wound is closed in layers after establishing the hemostasis. Drain is kept-either a corrugated drain or vacuum drain -never along the suture lines but away and below. General anesthesia is reversed and observed in post-operative care ward for vitals. If and when needed mandibular and palatal injuries are addressed at the earliest; to avoid blood loss and early recovery. Post operatively patients were monitored for wound healing and drains removed when less than 30 ml and sutures removed on day 7. Serial monitoring of vocal fold mobility is done to assess recovery. Tracheostomy decannulated unless complications ensue; (a) Aspiration wherein the tracheostomy tube is maintained in cuffed state; (b) vocal fold immobility in adducted position for airway; (c) delayed wound healing/poor GCS need mechanical ventilation.

Post-operative assessment is done in weeks 2, 3and 4. Thereafter monthly, patients are discharged when decannulated. When complications are managed and patient develops self-care discharged with tracheostomy tube.

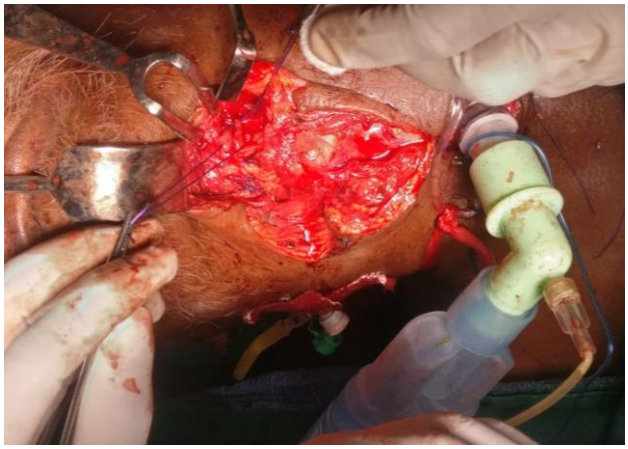

Figure 1: Intraoperative picture (Grade 3 zone 2 injury after tracheostomy and closure of mucosal and perichondrial injury).

Statistical analysis

The collected data were analysed with IBM.SPSS statistics software 23.0 Version. To describe about the data descriptive statistics frequency analysis, percentage analysis were used. For categorical variables and the mean, S.D. was used for continuous variables.

RESULTS

Incidence of neck injuries that were penetrating in nature was less than 1% in the emergency rooms of our centre over one year. Majority involved vasculature injury with only 7 cases over the last one year requiring laryngeal framework repair. The common mode of injury in our referral centre was self-inflicted closely followed by homicidal assault. Gunshot wounds and blunt injuries were rare and nil in our study period. Of the 33 cases that presented for penetrating injury needing tracheostomy only 7 had laryngeal framework intervention in terms of perichondrial/laryngeal cartilage repair or tracheal re-anastomosis. Remaining 26 needed only tracheostomy and vessel repair. The statistics are discussed only of the 7 were laryngeal framework needed repair.

The distribution over gender was 14% in female and 86% in males. The spectrum extremes had male gender predominance.

The age groups affected was according to decade and sex distribution over the cases. 57 % cases were in the 3rd decade, of which only 25% was a female. Remaining 43 % distributed as 14 % in each of the 4th, 7th and 9th decade

of life. The wide range of age from 20 years to 90 years was the presentation.

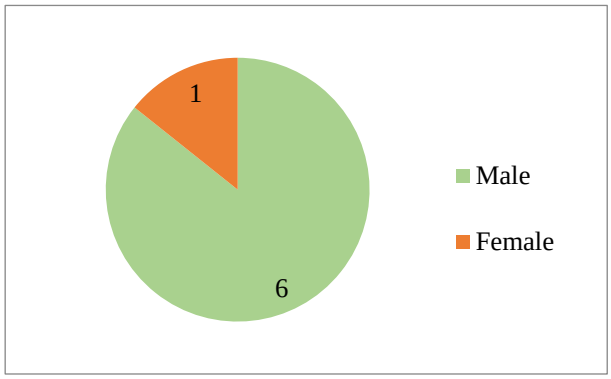

Figure 2: Sex distribution.

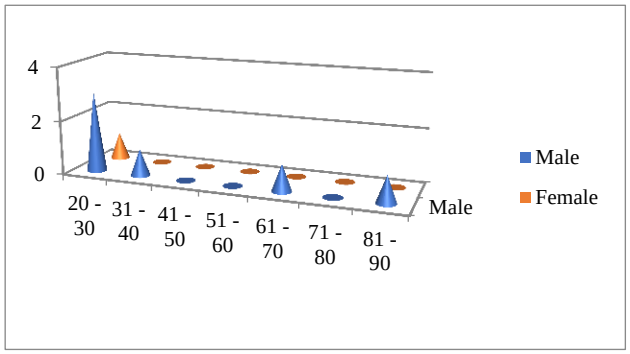

Figure 3: Age group and sex distribution.

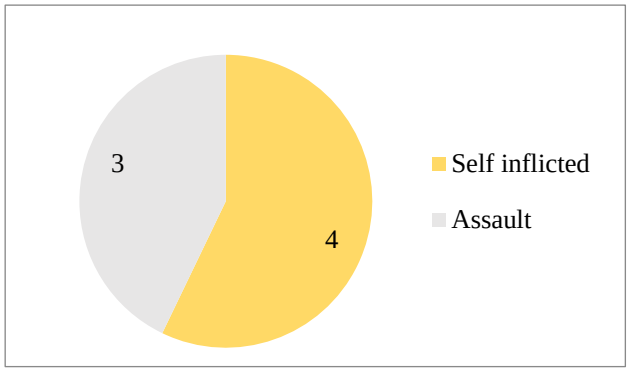

Figure 4: Mode of injury.

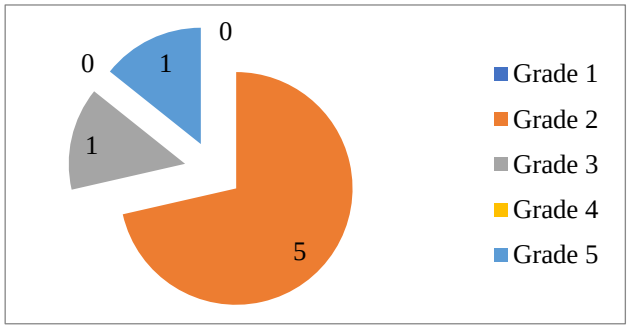

Figure 5: Grade of injury.

The mode of injury was self-inflicted in 57% followed by 43% due to assault. The grade of injury presented with was 71.4 % grade 2 and 14.2 % grade 5 and remaining 14.4 % grade 3.

The zone involved was zone 2 in all the cases needing laryngeal framework surgery. Overlap with other zones was not seen during the study period of one year.

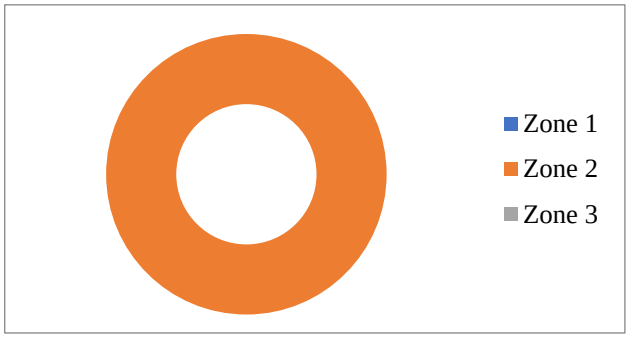

Figure 6: Zone involved.

The complications were pharyngeal anaesthesia in 28.5 % due to the grade 3 and grade 5 injuries in 2 cases, out of 7. Vocal fold paralysis in 14.2%, which was expected in the grade 5 injuries. Delayed wound healing contributed to the remaining 14.2% which was a grade 3 injury in poorly nourished 7th decade aged patient.

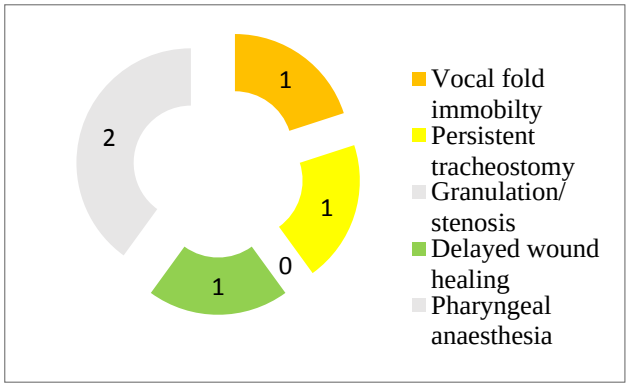

Figure 7: Complications.

DISCUSSION

Ahmed et al reported an incidence of 172 neck injuries over 1 year, of which only 18 were penetrating.[6] All cases were evaluated clinically and when warranted radiologically as well. Emergency neck exploration was the protocol dictated intervention. They also gave a result that self-inflicted injuries were less likely to be associated with vascular injuries. The incidence in our study was low compared to their study.

Ibraheem et al study used clinical examination in guiding the need for surgical exploration. And thus only few cases were subjected to computer tomography angiogram.[7] This helped in avoiding unnecessary imaging

and time delay. Our centre advocates early surgical intervention in open injures and only closed injuries are subjected to imaging studies of neck on emergency basis.

Kasbekar et al with their 7 year study saw an increased incidence in 3rd decade. They gave the most common cause as self-inflicted and only 9 of their 63 cases underwent surgical exploration under general anaesthesia for laryngotracheal trauma.[8] The current study too has similar proportion of cases. As with the study we emphasise the need for clinical findings rather than solely relying on imaging studies to diagnose breach in airway and vasculature.

Vishwanatha et al study of 6 years aimed at primary repair to aid in 3 main functions-voice, breathing and swallowing.[9] They give an observation that, 6 of the 42 cases were affected with vocal fold paralysis. In the current study its only 1 of the 7 cases had vocal fold paralysis.

CONCLUSION

The study of over year dealing with cases needing tracheostomy and laryngeal framework surgery conducted in our centre showed that male population was more afflicted with penetrating neck injuries. It gave a predilection for zone 2 and grade 2 level of injuries. Imaging is not necessary in all conditions and needed only when clinical findings are dubious. Primary reconstruction with tracheostomy is ideal.

ACKNOWLEDGEMENTS

I wish to express my sincere thanks to Prof. Dr. M. Gowri Shankar, M.S., D.L.O, D.N.B Professor and current Head of the Department of Otorhinolaryngology and Head & Neck Surgery, Prof. Dr. S. Muthuchitra M.S, D.L.O Professor and former Head of Department of Otorhinolaryngology and Head & Neck Surgery and Prof Dr. V. Rajarajan, M.S., D.N.B., Professor in Department of Otorhinolaryngology and Head & Neck Surgery, Government Stanley Medical College for their ever valuable suggestions and academic guidance.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Gullane PJ, Palme CE, Gilbert RW. Trauma of the larynx and cervical trachea. In: Watkinson JC, Gilbert RW, eds. Stell and Maran's Textbook of Head and Neck Surgery and Oncology. 5th ed. CRC Press; 2012: 281-294.
2. Leighton S, Robson A, Russell J. Anatomy and Examination of the neck. In: Burton M, ed. Hall and Colman's Diseases of the Ear, Nose and Throat. 15th ed. Churchill Livingstone; 2000: 129-131.
3. Moeng S, Boffard K. Penetrating neck injuries. Scand J Surg. 2002;91:34-40.
4. Thompson EC, Porter JM, Fernandez LG. Penetrating neck trauma: an overview of management. J Oral Maxillofac Surg. 2002;60:918-23
5. Nicol AJ, Fagan JJ. Neck trauma. Scott-Brown's Otorhinolaryngology Head and Neck Surgery. 2018:3(8):597-605.
6. Ahmed N, Amin K, Madden T, Fan K. Managing penetrating neck injuries-the Kings' experience. Br J Oral Maxillofac Surg. 2012;50:S9.
7. Ibraheem K, Khan M, Rhee P, Azim A, O'Keeffe T, Tang A, et al. "No zone" approach in penetrating neck trauma reduces unnecessary computed tomography, angiography and negative explorations. J Surg Res. 2018;221:113-20.
8. Kasbekar AV, Combellack EJ, Derbyshire SG, Swift AC. Penetrating neck trauma and the need for surgical exploration: six-year experience within a regional trauma centre. J Laryngol Otol. 2017;131:8-12.
9. Vishwanatha B, Sagayaraj A, Huddar SG, Kumar P, Datta RK. Penetrating neck injuries. Indian J Otolaryngol Head Neck Surg. 2007;59(3):221-4.

Cite this article as: Periasamy C, Ravisankar M, Subburayalu M. Penetrating neck injuries with laryngeal framework involvement: in a tertiary care centre. Int J Otorhinolaryngol Head Neck Surg 2019;5:1379-83.