

Blunt Laryngeal Trauma: A Case Report with Voice Analysis

Künt Larengel Travma: Ses Analizi ile Birlikte Bir Vaka Takdimi

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ABSTRACT

Blunt laryngeal trauma is a rarely seen condition with an incidence of approximately 1%. Since cartilage framework is intact, if not suspected, it is easily underdiagnosed. Due to the crucial importance of the airway, it may cause a rapid obstruction. In a patient with a history of trauma but lack of any external physical sign, keeping this condition in mind and securing the airway are essential for life saving. In this case, we report a patient with blunt laryngeal trauma causing intralaryngeal hematoma. Being alert, close follow-up and securing the airway resulted in this patient with complete healing. Progressive resorption of the hematoma was documented by videolaryngostroboscopy. Effect of the trauma on voice characteristics was evaluated by voice analysis. Initial mild increasing of voice turbulence index (VTI) and peak-to-peak amplitude variation (VAM) and smoothed amplitude perturbation quotient (SAPQ) in acoustic analysis diagram due to edema in vocal folds was improved at fourth week.

Keyword:

Larynx, voice disorders, voice, injuries, laryngoscopy

ÖZET

Künt larengel travma ortalama %1 sıklıkta görülen, kıkırdak çatının sağlam olması nedeniyle şüphelenilmediğinde kolaylıkla gözden kaçabilen nadir bir durumdur. Bu tip travmalarda havayolunun yaşamsal önemi nedeniyle hızlı havayolu tıkanıklığı gelişebilir. Travma ile başvuran ancak dışarıdan bakıldığında herhangi bir bulgu gözlenmeyen hastalarda solunum sıkıntısı gelişmesi durumunda bu ihtimalin akılda tutulması ve havayolunun güvence altına alınması yaşam kurtarıcı bir yaklaşımdır. Bu yazıda boynun sol tarafına aldığı künt travma sonrası sağ taraf intralarengel hematoma gelişen bir hasta sunulmuş olup, dikkatli takip ve düzenli endoskopik kontroller sonucunda invaziv bir müdahaleye ihtiyaç olmaksızın hasta tamamen iyileşmiştir. Hematomun progresif olarak rezorbe olması videolarengostroboskopik olarak dökümente edilmiştir. Travma sonucu oluşan hematomun ses karakteristikleri üzerine etkisi ses analizi ile değerlendirilmiştir. Başlangıçta vokal fold'lardaki ödeme bağlı olarak akustik analiz diagramında görülen ses türbülans indeksi (VTI) ve tepeler arası amplitüd varyasyonu (VAM) ile yumuşatılmış amplitüd pertürbasyon katsayısındaki (SAPQ) hafif bir artış dördüncü haftada düzelmiştir.

Anahtar Sözcükler

Larenks, ses bozuklukları, ses, travma, larengoskopi

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INTRODUCTION

Blunt laryngotracheal trauma with intact cartilage structural framework is a rare condition, but may lead rapidly to serious, life-threatening airway obstruction.¹ Therefore, immediate recognition and treatment are vital for a successful outcome.² The incidence of laryngotracheal injury is less than 1% in blunt trauma series.³ Of all laryngotracheal traumas, roughly 60 percent are blunt.^{4,5} Injury to the endolarynx from an external source commonly includes mucosal disruption, distortion of normal anatomy, vocal fold immobility, less frequently bilateral vocal cord paralysis, arytenoid subluxation, and arytenoid degloving.⁶

Frequency perturbation parameters like jitter percent (Jitt), noise to harmonic ratio (NHR), and amplitude perturbation parameters like shimmer percent (Shim) are often used for the description of pathological voice quality. These parameters are usually measured by analysis of the radiated speech wave. For this purpose, the vowel [a], sustained at a comfortable pitch and loudness level is generally suggested and used.^{7,8}

Here, we present a case with blunt laryngeal trauma resulting in a contralateral intralaryngeal hematoma of larynx without cartilage fractures. Effects of the trauma on endolaryngeal structure was followed by videolaryngoscopic examination.

An informed consent was obtained from the patient.

CASE REPORT

An otherwise healthy 30-year-old man complained of neck pain, hoarseness,odynophagia and difficulty during breathing upon rotating his neck. Two days prior to admission he was struck on the left side of his neck by a fist. The patient had no symptoms at the time of assault.

On examination, the right neck was tender on palpation. He had no signs of any other injuries. His vital signs were normal. The remainder of the systemic examination showed no abnormality.

After routine otorhinolaryngologic examination (history, indirect laryngeal examination and X-ray of the neck and thorax), the larynx was evaluated by videolaryngostroboscopy (VLS). VLS was performed with a 90° rigid laryngoscope connected to a stroboscope (Karl Storz Endoscopy, America Inc., Culver City, CA, USA) and images were recorded on VHS tape. The VLS sys-

tem was used to examine the endolarynx endoscopically and for follow-up records. VLS examination revealed a hematoma covering the right arytenoid cartilage restricting mobility of the right arytenoid and right vocal cord. The medial wall of right pyriform sinus was filled by hematoma. The mucosal wave amplitude was decreased on the right and aperiodicity was noted. VLS examination was repeated at 3rd, 5th, 12th and 30th days (Figures 1, 2, 3). At fourth week, the hematoma was completely resorbed. Also the function of the right arytenoid and vocal cord was completely restored.

Computed tomography (CT) revealed no derangement of the laryngeal cartilaginous structure, but swelling and hyperdensity-heterogenicity of the right arytenoid cartilage and aryepiglottic fold. The right pyriform sinus had an asymmetry that narrowed the airway pas-

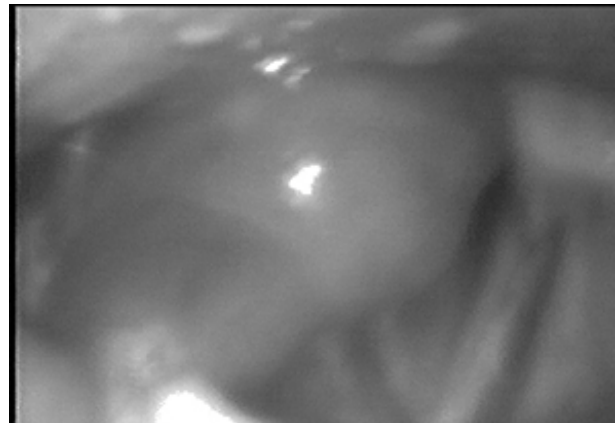


Figure 1. Videolaryngostroboscopic examination revealed a hematoma covering the right arytenoid cartilage on 3rd day, restricting mobility of the right arytenoid.

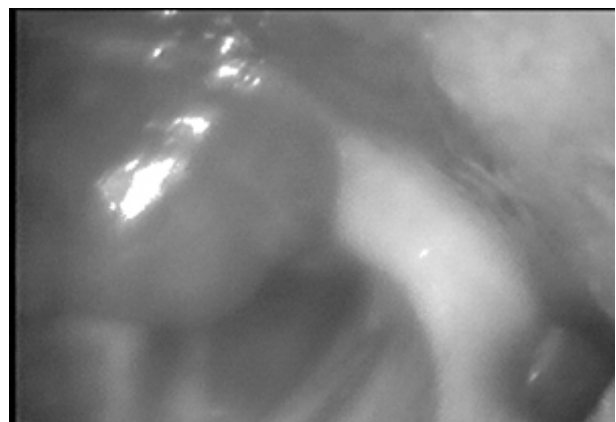


Figure 2. Videolaryngostroboscopic examination revealed a hematoma covering the right arytenoid cartilage which then slightly resorbed on 5th day.

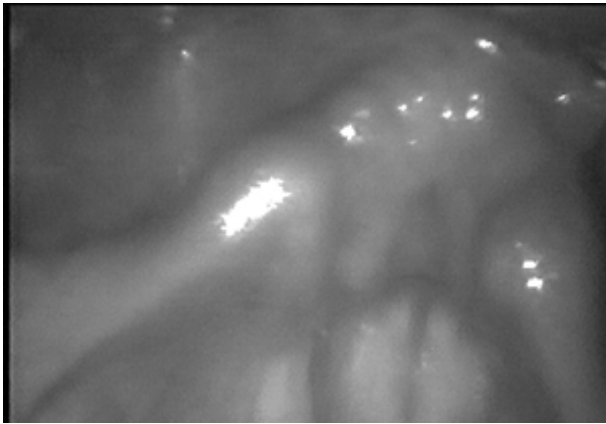


Figure 3. Videolaryngostroboscopic examination revealed the hematoma had been completely resorbed in 4th week.



Figure 4. Computed tomography (CT) revealed no derangement of the laryngeal cartilaginous structure, but swelling and hyperdensity-heterogeneity of the right arytenoid cartilage and aryepiglottic fold. The right pyriform sinus had an asymmetry that caused narrowing in the airway passage.

sage. There were no signs of either vascular or vertebral injuries (Figure 4). No fracture or dislocation of cervical vertebra was observed on the lateral radiograph of the neck.

Acoustic analysis was performed (first day and 30th day) using the Multi Dimensional Voice Program 5105 version 2.5.2 with the computerized Speech Lab (Kay Elemetrics Ltd, NJ) in a sound-treated room with 15 dB background noise level. A Speech-Language Pathologist (SLP) completed all of the acoustic measurements. A standardized protocol was used for each voice assessment session. The subject was positioned adjacent to a microphone held at a fixed distance (10 cm) and at a 45-degree off-axis position to reduce aerodynamic noise from the mouth. The subject was then instructed to vocalize and sustain (3 seconds) the

vowel/a/in a flat tone, and original acoustic signal data were sampled at a rate of 44.1 KHz. Fundamental frequency (F_0), jitter (Jit), shimmer (Shim) and noise to harmonic ratio (NHR) were calculated.

Subject-related and instrumentation-related factors may affect the results. Subject-related factors develop at either the vocal fold or the supraglottic vocal tract level. The vocal tract may affect the perturbation values in two different ways: biomechanical (i.e., by increasing the laryngeal tension, indirectly) and acoustic (by changing the shape of the speech wave).

A mild increasing of voice turbulence index (VTI) and peak-to-peak amplitude variation (VAM) and smoothed amplitude perturbation quotient (SAPQ) in acoustic analysis diagram were observed because of edema in vocal folds due to laryngeal trauma and submucosal hemorrhage. A mild increasing of voice turbulence index (VTI) and smoothed amplitude perturbation quotient (SAPQ) persisted in the analysis at fourth week in spite of detection of improvement in peak-to-peak amplitude variation (VAM) and smoothed amplitude perturbation quotient (SAPQ) (Figures 5, 6 and Table 1).

He was treated with analgesic anti-inflammatory and proton pump inhibitory agents. In addition, he was also given corticosteroids (methyl prednisolon) at a dose of 1 mg/kg/day for 10 days. Humidified oxygen was administered. He was advised to elevate his head and to rest his voice for 1 week and limit physical activity for 2 weeks.

Surgical treatment was not required. As part of ambulatory follow-up in our clinic, the patient was

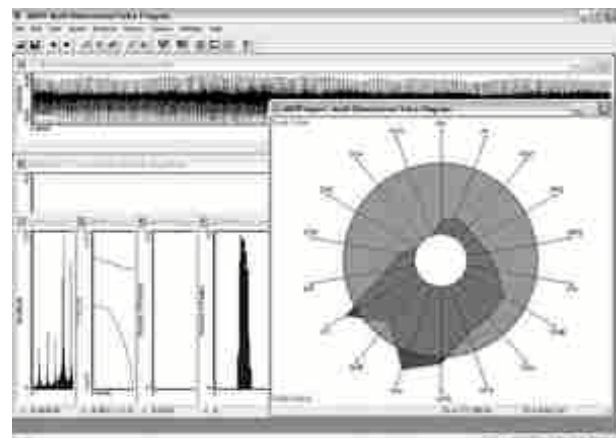


Figure 5. A mild increasing of voice turbulence index (VTI) and peak-to-peak amplitude variation (VAM) and smoothed amplitude perturbation quotient (SAPQ) in acoustic analysis diagram was observed because of changes in vocal folds due to laryngeal trauma and submucosal hemorrhage (first day).

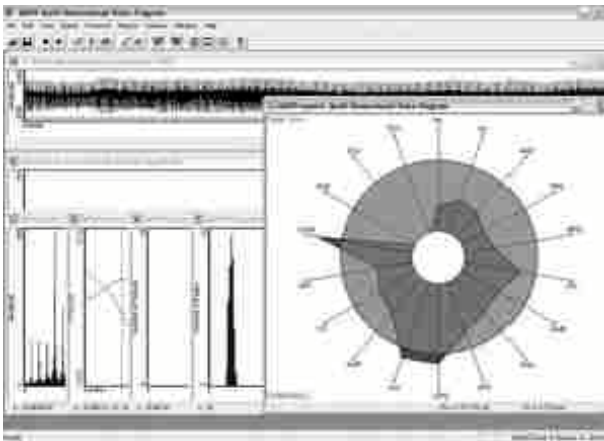


Figure 6. A mild increasing of voice turbulence index (VTI) and smoothed amplitude perturbation quotient (SAPQ) persisted in the analysis at fourth week in spite of detection of improvement in peak-to-peak amplitude variation (VAM) and smoothed amplitude perturbation quotient (SAPQ) (30 th day).

Table 1. Voice analysis of the patient, 1 and 30 days after the accident.

MDVP (Parameter)	1 st day	30 th day
Average Fundamental Frequency (Fo)	177.905 Hz	174.731 Hz
Mean Fundamental Frequency (MFO)	177.901 Hz	174.719 Hz
Smoothed Pitch Perturbation Quotient (SPPQ)	0.314 %	0.439 %
Jitter Percen (Jitt)	0.283 %	0.520 %
Shimmer Percent (Shim)	2.575 %	2.411 %
Noise to Harmonic Ratio (NHR)	0.141	0.125
Peak-to-Peak Amplitude Variation (vAm)	10.261 %	9.303 %
Smoothed Ampl Perturbation Quotient Index (SAPQ)	4.549 %	4.765 %
Voice Turbulence Index (VTI)	0.072	0.036

examined several times during 4 weeks after his injury. At the end of fourth week, hematoma was completely resorbed and vocal cord motion was completely normal.

DISCUSSION

In practice, blunt trauma to the larynx is not common for several reasons. Most important is shielding effect of mandible, providing significant protection from anterior blows. Posteriorly, the larynx is protected by the rigid cervical spine. In addition, the mobility of the trachea itself gives important resistance to larynx against trauma.¹

Motor vehicle crashes are still the most common cause of blunt laryngeal injury, but they can also occur

after assaults and hangings.⁹ There has been a relative increase in the number of reports of external laryngeal trauma due to sporting activities such as “clothesline” injuries during motorcycling and snowmobiling.^{9,10} However the widespread use of restraint and safety devices in automobiles has led to a dramatic decline in the number of cases of blunt laryngeal trauma in recent years.⁴

There are numerous classifications of blunt laryngeal injuries. A simple classification is as follows (4): a) Mild: mucosal laceration, mild edema or haematoma, b) Moderate: exposed cartilage, cartilage fracture or dislocation, moderate edema or haematoma, c) Severe: massive haematoma or hemorrhage, false passage or fistula, complete transection. Our patient had a mild injury according to this classification.

This type laryngeal injury is similar to a coup-contrecoup type injury in brain trauma.⁶ Forces in this mechanism are probably transmitted through the more rigid cricoid cartilage to the contralateral hypopharynx resulting in the pyriform sinus injury. This can occur without fracturing the cricoid ring. This would be consistent with an impact at the level of the cricoid and thyroid cartilages with transmission of forces through the cervical spine on contralateral side. The resultant limited motion of the right vocal fold seen in our patient was probably due to a mass effect of the hematoma.

Review of the literature on blunt laryngeal trauma reported that even minor injuries to the larynx may be followed by secondary changes in phonation.¹¹ More commonly the voice is altered because of the change in architecture of the larynx. These injuries may subsequently (in 12 to 24 hours) cause significant laryngeal edema and threaten the airway.¹² Hematomas of the true vocal folds add a mass affect to this vibratory unit and lower the fundamental frequency of vibration. Finally, any alteration in the larynx that changes the airflow patterns has the potential of altering the voice. Leopold states that ‘if surgical treatment is not required, the results for airway and voice are usually excellent’¹³ Many patients require speech therapy in order to reduce the risk of secondary disturbed vocal compensation and avoid permanent restrictions of phonation.²

After the initial examination, securing the airway is essential. On examination of the laryngeal structures and in existence of hematoma, a careful inspection of the airway should be performed and voice function should be noted. In our case, we performed the video-laryngostroboscopic examination to evaluate the endolaryngeal structures. Voice analysis was done in order to demonstrate effect of hematoma on voice function.

Significant differences were also found between initial analyses during submucosal hemorrhage and then on the fourth week results of acoustic voice analyses in terms of F₀, jitter, shimmer, NHR, VTI, SAPQ and VAM.

Computed tomography (CT) allows evaluation of the laryngeal framework in a non-invasive manner. CT should be reserved for patients in whom laryngeal injury is suspected by history and physical examination without obvious surgical indications. This may include patients who have only one sign or symptom relating to laryngeal injury, such as hoarseness, and minimal findings suggesting laryngeal injury. In this instance, CT may allow the surgeon to confirm evidence of serious injury in a non-invasive manner without direct laryngoscopy and the concomitant need for general anesthesia.¹⁴ An assessment of potential vascular and esophageal injuries must also be done.¹⁵

In cases of blunt laryngeal trauma with an intact cartilage framework, conservative measures, such as administration of corticosteroids, analgesic anti-inflammatories, resting the voice and use of a vaporizer, represent the therapy of choice.² Close follow-up with immediate tracheostomy if needed has been suggested. Elevation of

the head side of the bed might help to minimize edema. The patient should be encouraged to ambulate as soon as he or she can tolerate it. Antacids, proton pump inhibitors and H₂-blockers should be routinely used to prevent reflux, which may cause increased scarring of laryngeal tissues. Antibiotics should be reserved for patients with mucosal injuries.

Teşekkür

Ses analizindeki katkılarından dolayı Sn. Işıl Satı'ya teşekkür ederiz.

CONCLUSION

Initial mild increasing of voice turbulence index (VTI) and peak-to-peak amplitude variation (VAM) and smoothed amplitude perturbation quotient (SAPQ) in acoustic analysis diagram due to edema in vocal folds was improved at fourth week. The outcome of laryngeal trauma depends on the extent of the original injury and the quality of subsequent therapies. In patients who do not require surgical intervention, the prognosis and the possibility for full return of function are excellent.¹⁶

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