

■ Original Article

Evaluation of laryngopharyngeal effects in patients long-Term intubated

Uzun süreli entübasyon yapılmış hastalarda laringofaringeal etkilerin değerlendirilmesi

Eda SIMSEK^{1*}, Ziya SIMSEK², Eyup Serhat CALIK³, Fatih BINGOL⁴, Ayşe CARLIOGLU⁵, Muhammed Recai MAZLUMOGLU⁶, Enise KOZA⁷, Bilgehan ERKUT³

¹University of Health Sciences, Kayseri Education and Research Hospital, Clinic of Ear, Nose and Throat, Kayseri/Turkey

²University of Health Sciences, Kayseri Education and Research Hospital, Clinic of Cardiology, Kayseri /Turkey

³Erzurum Regional Training and Research Hospital, Department of Cardiovascular Surgery, Erzurum/Turkey

⁴Erzurum Regional Training and Research Hospital, Clinic of Ear, Nose and Throat, Erzurum/Turkey

⁵Erzurum Regional Training and Research Hospital, Department of Endocrinology, Erzurum/Turkey

⁶Palandöken State Hospital, Clinic of Ear, Nose and Throat, Erzurum/Turkey

⁷Erzurum Regional Training and Research Hospital, Department of Anesthesiology, Erzurum/Turkey

ABSTRACT

Aim: Open cardiovascular surgery involves prolonged intubation, postoperatively in the intensive care unit monitoring. The purpose of this study was to investigate the effects of long-term intubation after coronary artery surgery on laryngeal and pharyngeal structures and the probable underlying causes for such effects.

Material and Methods: Forty two patients undergoing cardiovascular surgery were included in the study. All patients underwent endoscopic examination in the preoperative period and approximately 7th postoperative day.

Results: Mean age of the patients was 61 ± 9.98 years, mean duration of intubation was 14.80 ± 3.41 hours (h) and mean size of intubation tube used was 8.02 ± 0.45 mm. The number of preoperative smokers was 25(59.52%), and number of patients with preoperative gastroesophageal reflux disease symptoms were 8(19.04%). The level of postoperative laryngeal and pharyngeal pathological findings were 38.09%. Postoperative laryngeal and pharyngeal pathological findings were correlated with age, length of intubation and preoperative presence of the gastroesophageal reflux disease symptoms ($p < 0.05$). However, no statistically significant correlation was determined between postoperative pathological finding and sex, tube type, tube diameter, smoking status.

Conclusion: Age, presence of gastroesophageal reflux disease, length of intubation were identified as risk factors for the development of postoperative pathological laryngopharyngeal findings.

Key words: Endotracheal intubation, coronary arter surgery

Corresponding Author*: Eda Simsek, University of Health Sciences, Kayseri Education and Research Hospital, Clinic of Ear, Nose and Throat, Kayseri/Turkey

E-mail: hekimed@hotmai.com

Received 24.01.2018 accepted 11.02.2018

Doi: 10.18663/tjcl.382946

ÖZ

Amaç: Açık kardiyovasküler cerrahiler hem operasyon süresi hem de postoperatif yoğun bakımda takip süresi göz önüne alındığında entübasyon süresinin uzun olduğu bilinen ameliyatlardır. Biz bu çalışmada koroner cerrahisi sonrası uzun süre entübe kalmış hastalarda postoperatif dönemde gözlenen laringeal ve faringeal etkilenmeyi incelemek ve bu etkilerin oluşumuna zemin hazırlayan olası nedenleri araştırmayı amaçladık.

Materyal ve Metodlar: Çalışmaya kardiyovasküler cerrahi yapılan toplam 42 hasta dahil edildi. Tüm hastalar preoperatif (preop) dönemde ve postoperatif dönemde (ortalama 7.gün) endoskopik muayene edildi ve muayene bulguları kaydedildi.

Bulgular: Hastalar ortalama 61 ± 9.98 yaşında, ortalama entübe kalma süresi 14.80 ± 3.41 saat, kullanılan entübasyon tüpünün iç çapı 8.02 ± 0.4 mm idi. Preoperatif sigara içen hasta sayısı 25 (%59.52) ve preoperatif gastroözofageal reflü semptomu olan hasta sayısı 8 (% 19.04). Postoperatif laringeal ve faringeal patolojik bulgu oranı %38.09 bulundu. Postoperatif laringeal ve faringeal patolojik bulgu olan hastalarda yaş, entübasyon süresi, preoperatif gastroözofageal reflü hastalığı şikayeti arasındaki ilişki istatistiksel açıdan anlamlı bulundu (p 0,05). Ancak postoperatif patolojik bulgu ile cinsiyet, entübasyon tüpünün tipi ve çapı, sigara kullanma arasında anlamlı ilişki bulunmadı.

Sonuç: Yaş, gastroözofageal reflü hastalığı varlığı, entübasyon süresinin uzunluğu postoperatif laringofaringeal bulgu oluşumu için risk faktörü olarak tespit edildi.

Anahtar kelimeler: Endotrakeal entübasyon, koroner arter cerrahisi

Introduction

Endotracheal intubation is the most common procedure used for airway control during general anesthesia; intubation lasting less than 5 h is defined as short-term intubation and conditions exceeding 24 h as prolonged intubation [1-3]. During intubation, the endotracheal tube comes into varying degrees of contact with laryngopharyngeal structures, and this is known to lead to changes such as pressure-related edema, ulceration and the formation of granulation tissue. However, the cause of this change is not yet completely understood. All laryngopharyngeal structures can be affected, particularly the vocal cords [1,4,5].

Intubation causes micro-traumatic inflammation in laryngopharyngeal structures through a mechanical effect. This is a significant cause of morbidity resulting from deleterious effects in the acute or chronic period on respiration, phonation and deglutition. It is therefore of great importance for probable predisposing factors in these structures to be known and for protective measures to be taken before procedures requiring lengthy intubation [3,4].

In surgery for ischemic heart diseases, most patients were extubated by 36 hours and the risk associated with intubation time increased progressively, the increase being greatest after 12 hours of intubation. Intubation prolongation has a significant effect on postoperative mortality, morbidity and cost effectiveness [6].

The purpose of this study is to investigate the effects on larynx and pharynx in patients undergoing coronary artery and cardiac surgery which is requiring long-term intubation, and to examine the possible clinical implications of these events.

Materials And Methods

This study was conducted between January 2013 and September 2015 after obtaining approval from hospital ethics committee. Written consent forms were received from all patients. Forty-two patients aged between 40 and 83 years, 15 women and 27 men, scheduled for coronary artery surgery were recruited in the study. Patients who had previously undergone laryngeal, pharyngeal or head-neck surgery, organic laryngeal disorders, previous radiotherapy, preoperative pathological laryngeal or pharyngeal findings or active infection were not included.

Detailed pre- and postoperative history was taken from each patient. A symptom score developed by Belafsky to facilitate the clinical diagnosis reflux disease was used to evaluate patients' reflux symptoms with a scale from 0 to 5 where Reflux Symptom Index (RSI) above 13 are considered as abnormal as described [7].

All patients were examined preoperatively and on the 5-9th days (mean 7 days) postoperatively using 4 mm rigid 700 or flexible fiberoptic endoscopes (Karl-Storz® GmBH&Co.,Tuttlingen, Germany). All laryngeal and pharyngeal pathological findings and laryngopharyngeal

symptoms were recorded postoperatively. The patients' age, sex, preoperative smoking status and presence of symptoms gastroesophageal reflux disease (GERD), operation performed, diameter and type of intubation tube used and total length of intubation were recorded. Monitoring forms containing pre- and postoperative examination findings, surgical and medical information and information concerning anesthesia were prepared for all patients, and the information and findings obtained were recorded (Table 1).

During endoscopic examination we assessed pharyngeal pathological findings such as vocal cord (VC) mobility and severe inflammation findings in laryngopharyngeal mucosa, hyperemia, edema, hematoma, ulceration, mucosal hypertrophy, granuloma formation, arytenoid subluxation and secretion accumulation. In the postoperative period we inquired into laryngopharyngeal symptoms such as sore throat and difficulty deglutition, cough and phlegm accumulation and voice change, and these were also recorded.

All patients were intubated by the same anesthetist and the same brand tube (Bıçakçılar® brand, 7, 7.5, 8, 8.5 mm diameters, with spiral or flat intubation tube were used in accordance with the patient's sex and weight. Open surgery was performed on all patients, and all were monitored in postoperative intensive care. Total duration of intubation was recorded.

Statistical Analysis

All statistical analyses was performed using SPSS for Windows, version 17.0 , results were expressed as mean ± SD, n or % where appropriate. Mann–Whitney U test or independent sample t test was used between two groups, and analysis of variance was used to assess the significance of differences among 3 groups as appropriate. Multiple regression analysis was used to exclude possible confounding effects of other variables in the results of each correlation analysis. A p value less than 0.05 was considered as statistically significant.

Results

Forty-two patients were enrolled, 15 women and 27 men. Mean age was 61±9.98 (40-83 years). The number of preoperative smokers was 25 (59.52%), and 8 patients (19.04%) had preoperative symptoms GERD. While 31 patients underwent coronary artery-pass graft (CABG), 11 underwent mitral valve replacement (MVR) and tricuspid valvuloplasty (TVP). Mean length of surgery was 6±1.3 hours and mean length of intubation was 14.80±3.41 h. For 20 patients spiral, 22 patients straight tube were used .Two patients were intubated with

size 7 intubation tube, 10 patients with size 7.5 tube, 14 a size 8 tube and 16 a size 8.5 tube. Mean diameter of the intubation tubes used was 8.02±0.45. There was a significant difference between the tube diameter used for male patients and the tube used for women and this difference was statistically significant (p 0.01).(Table 1).

Table 1. Demographic and examination, medical and surgical information of patients.

| | |
|--|-----------|
| N | 42(%) |
| Under 60 years old patients n(%) | 20(47.7) |
| Over 60 years old patients n(%) | 22(52.3) |
| Male, n (%) | 27(64.2) |
| Female, n (%) | 15(35.8) |
| Total length of intubation more than 12 hours | 31(73.8) |
| Total length of intubation less than 12 hours | 11(26.2) |
| Smokers n(%) | 25(59.5) |
| CABG n(%) | 31(73,8) |
| MVR +TVP n(%) | 11(26,2) |
| Presence of preoperative GERD n(%) | 8(19.0) |
| With flat tube intubated patients n(%) | 22 (52.3) |
| With spiral tube intubated patients n(%) | 20(47.7) |
| 7 number tube intubated patients n(%) | 2(4.76) |
| 7.5 number tube intubated patients n(%) | 10(23.80) |
| 8 number tube intubated patients n(%) | 14(33,33) |
| 8.5 number tube intubated patients n(%) | 16(38,09) |
| Mean intubated tube diamater in male | 8,25 |
| Mean intubated tube diamater in female | 7,60 |
| CABG-Coroner arter by-pass graft, MVR-Mitral Valv Replacement, GERD- gastroesophageal reflux disease, TVP-Tricüs pit Valvuloplasty | |

The postoperative laryngeal and pharyngeal pathological findings level was 38.09% (n:16. Interarytenoid granuloma was observed in 2 patient, Reinke's edema in the vocal cords in 2 patients, unilateral vocal cord hematoma in 1 patients, left vocal cord paralysis in 1 patient, mucosal hypertrophy in the posterior pharyngeal wall in 1 patient, and diffuse LF mucosal hyperemia and secretion in 9 patient). The incidence of postoperative laryngopharyngeal symptom was 66.6% (n 28), the most common symptoms being sore throat and difficulty deglutition at 28.57 % (n:12), cough and increased



phlegm at 23.80% (n:10) and voice changes at 14.28% (n:6). Postoperative RSI and laryngopharyngeal symptoms of preoperative GERD diagnosed patients was found to be increased in the postoperative period ($p < 0.05$). (Table 2)

Table 2. Correlation coefficients determined by simple correlation between postoperative change and other clinic factors possibly affecting.

| Variables | Postop Laryngeal And Pharyngeal Pathological Findings | |
|---|---|---|
| | Correlation Coefficient | Pvalue * $p < 0,05$ significantly |
| Age | 0,352 | 0,02* |
| Sex | 0,175 | 0,26 |
| Presence of GERD | 0,546 | 0,00* |
| Diameter intubation tube | 0,177 | 0,26 |
| Type of intubation tube | -0,257 | 0,10 |
| Total length of intubation more than 12 h | 0,337 | 0,02* |
| Smoking | 0,127 | 0,42 |

Postoperative laryngeal and pharyngeal pathological findings and laryngopharyngeal symptoms formation were correlated with age, length of intubation and preoperative presence of the GERD. While no statistically significant correlation was determined between postoperative laryngeal and pharyngeal pathological findings and sex, tube type, tube diameter, smoking status, a significant correlation was observed between laryngopharyngeal symptoms and smoking ($p < 0.05$). (Table 3)

Table 3. The postoperative laryngeal and pharyngeal pathological findings and symptoms

| Laryngeal and pharyngeal pathological findings (n:16) and symptoms (28) | N |
|---|--------|
| Interarytenoid granuloma | 2 |
| Reinke's edema | 2 |
| Unilateral vocal cord hematoma | 1 |
| Left vocal cord paralysis | 1 |
| Mucosal hypertrophy in the posterior pharyngeal wall | 1 |
| Diffuse LF mucosal hyperemia | 9 |
| Sore throat and difficulty deglutition | 1 2 |
| Cough and increased phlegm | 1 0 |
| Voice changes | 6 |

Discussion

In our study, we found postoperative laryngeal and pharyngeal pathological findings were correlated with age, length of intubation and preoperative presence of the gastroesophageal reflux disease symptoms ($p < 0.05$). However, no statistically significant correlation was determined between postoperative pathological finding and sex, tube type, tube diameter, smoking status.

Symptoms such as sore throat, increased secretion and voice thickening and findings such as inflammation and edema in the laryngopharyngeal region may be observed following surgical procedures requiring long-term intubation, and these are a significant cause of morbidity [1,2].

The larynx and pharynx are two neighboring regions consisting of cartilage, muscle and mucosal tissues with significant functions in respiration, phonation and assisting swallowing. Since the laryngeal lumen is narrow, and due to the thin mucosal and flexible submucosal tissue over it, the vocal cords can be affected by even minor mechanical trauma, and the resulting inflammation can give rise to potentially life-threatening problems [2-5]. In addition, chronic lesions in other laryngopharyngeal regions, depending on the severity of trauma, and particularly the vocal cords and interarytenoid region, can cause significant symptoms leading to phonation problems [5,8,9].

The effects of intubation on laryngeal structures have been known for a long time, but the underlying cause and mechanism involved are still unclear [2,3,5]. Various potential intraoperative and patient-related causes have been particularly emphasized. In addition to length of intubation, the intubation technique used and factors associated with the type of material employed and cuff pressure in the development of these changes, other elements involved include patient-related factors such as age, smoking status and the presence of laryngopharyngeal symptoms. These factors are thought to trigger adverse effects in laryngeal or pharyngeal structures in the postoperative period by preparing the foundation for mucosal inflammation [2,5]. The length of prolonged intubation is the most important of these factors [1,2]. Intubation tube contact with laryngeal and pharyngeal structures and compression occur throughout the course of intubation, and this leads to laryngeal and pharyngeal symptoms and findings. A statistically significant correlation was determined in our study was determined between prolonged intubation and pathological laryngeal and pharyngeal pathological findings ($p < 0.05$)

We enrolled patients scheduled for cardiac surgery due to the lengthy intubation involved during surgery and during monitoring in intensive care [10-12]. We observed correlation between total length of intubation and effects in laryngopharyngeal structures. We also determined an increase in laryngopharyngeal inflammation findings and postoperative symptoms in patients intubated for more than 24 h. The most common symptom in these patients was sore throat and increased secretion, followed by a hyperemic appearance in the laryngopharyngeal region.

This study investigated the causes of the increased laryngopharyngeal findings and symptoms in patients undergoing cardiovascular surgery. The most important risk factors identified were age, smoking and GERD.

GERD describes the return to the esophagus of gastric contents without retching or vomiting. Laryngopharyngeal reflux (LPR) is a clinical condition closely associated with GERD, in which gastric contents escape along the mucosa of the larynx, pharynx and upper respiratory tract. A symptom scale, Reflux Symptom Index (RSI) was developed by Belafsky and collaborators [7,13] to facilitate the suspect diagnosis and the clinical follow-up in pharyngolaryngitis. Patients score themselves on a scale from 0 to 5 of nine symptoms often described of the disease. In this table parameters are voice problem, clearing your throat, Excess throat mucus or postnasal drip, difficulty swallowing, coughing after ate or after lying down, breathing difficulties, troublesome or annoying cough, sensations of something sticking in throat or a lump in throat, heartburn, chest pain, indigestion, or stomach acid coming up. Values above 13 are considered abnormal. [7,13-15]. Studies have reported that LPR is associated with various pathologies and symptoms, including chronic laryngitis, laryngeal contact ulcers and granulomas, vocal fold nodules, Reinke's edema, subglottic stenosis, laryngotracheal stenosis, paroxysmal laryngeal spasms, chronic cough, globuspharyngeus and carcinomas of the larynx and hypopharynx [1,13,15]. In our study, we observed that patients who have GERD symptoms, increasing pathological finding and symptoms of laryngopharynx area.

As with all tissues and organs in the body, aging also makes mucosal structures more sensitive to trauma and other stressors. This affects the entire upper respiratory tract, from the oral cavity to the larynx, and can give rise to post-intubation findings and symptoms by sensitizing the region to mechanical trauma such as intubation [16]. In our study, in agreement with the literature, the laryngopharynx was more affected in patients aged over 60.

Smoking causes symptoms and findings in the upper respiratory tract as well as the lower [17,18]. We determined a statistically significant correlation between smoking and laryngopharyngeal symptoms, but none between smoking and laryngeal and pharyngeal pathological findings. We attribute this result to the short monitoring period in terms of development of pathological findings and the low case number involved.

Various postoperative complications are seen in patients undergoing cardiac surgery, particularly vocal cord paralysis associated with recurrent laryngeal and vagal nerve trauma, and these complications may result in prolongation of intubation and of stay in intensive care [9-12]. We determined vocal cord paralysis in one case, but the patient was referred for clinical follow-up since the respiratory functions were not affected.

Another probable etiological agent is the size and type of the intubation tube used. Various studies have investigated the laryngeal effects of intubation and have identified the type and diameter of the tube and duration of intubation as effective factors [2]. We used a spiral tube in 20 cases and a straight tube in 22, but observed no difference between the two groups in terms of symptoms or findings. Diameters of the intubation tubes ranged between 7 and 8.5 mm. Our results showed that the level of laryngopharyngeal effects increased with tube diameter in a statistically significant manner ($p < 0.05$)

Since we observed an increased in these symptoms in elderly patients, smokers and subjects with GERD, we think that a minimally traumatic approach and cuff pressure control, the avoidance of prolonged intubation, smoking cessation and treatment of GERD can reduce the risk of laryngopharyngeal injury.

One of the limitations was short monitoring period. Other limitation video stroboscopic investigation can also provide more objective results, but this was not possible for technical reasons.

Conclusion

An increase in postoperative laryngeal and pharyngeal pathological findings and laryngopharyngeal symptoms levels with length of intubation and with use of large-diameter tubes was observed in patients aged over 60 and with GERD following open coronary surgery, and these were identified as risk factors for adverse postoperative laryngopharyngeal effects. We think that administration of GERD treatment before surgery in which intubation may be prolonged and encouraging patients to quit smoking, as well as keeping intubation as short as possible and the use of tubes with as small a diameter as possible, can reduce postoperative laryngopharyngeal symptoms.



Declaration of conflicting interests

The author declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding The authors received no financial support for the research and/or authorship of this article.

References

1. Skoretz SA, Yau TM, Ivanov J, Granton JT, Martino R. Dysphagia and Associated Risk Factors Following Extubation in CardiovascularSurgical Patients. *Dysphagia* 2014; 29: 647–54
2. House JC, Noordzij PJ, Murgia B, Langmore S. Laryngeal Injury From Prolonged Intubation: A Prospective Analysis of Contributing Factors. *Laryngoscope* 2011; 121: 596–600.
3. Mendels EJ, Brunings JW, Hamaekers AW, Stokroos RJ, Kremer B, BaijensLW. Adverse Laryngeal Effects Following Short-term General Anesthesia A SystematicReview. *Arch Otolaryngol Head Neck Surg* 2012; 138: 257-64
4. Mota LA, Cavalho GB, Brito VA. Laryngeal complications by orotracheal intubation: Literaturereview .*Int. Arch. Otorhinolaryngol* 2012; 16: 236-45.
5. Mencke T, Echternach M, Kleinschmidt S, Lux P, Barth V, Plinkert PK, Buder TF. Laryngeal Morbidity and Quality of Tracheal Intubation A Randomized Controlled Trial. *Anesthesiology* 2003; 98: 1049–56
6. Bouabdallaoui N, Stevens SR, Doenst T et al. Impact of Intubation Time on Survival following Coronary Artery Bypass Grafting: Insights from the Surgical Treatment for Ischemic Heart Failure (STICH) Trial.*J Cardiothorac Vasc Anesth* 2017; 23: 31030-33.
7. Belafsky PC, Postma GN, Koufman JA. Validity and reliability of the reflux symptom index (RSI). *J Voice* 2001; 16: 27–47
8. Su H. et al. Tongue Weakness and Somatosensory Disturbance Following Oral Endotracheal Extubation. *Dysphagia* 2015; 30: 188–95
9. Hamdana AL, Moukarbela RV, Farhata F, Obeidb M. Vocal cord paralysis after open-heart surgery. *Eur J Cardiothorac Surg* 2002; 21: 671–74
10. Yuan SM. Hoarseness subsequent to cardiovascular surgery, intervention, maneuver and endotracheal intubation: Theso-callediatrogenic Ortner's (cardiovocal) syndrome review article. *Cardiology Journal* 2012; 19: 560–66.
11. Rangachari V, Sundararajan I, SumathiV, Kumar KK. Laryngeal sequelae following prolonged intubation: A prospectivestudy. *Indian J Crit Care Med* 2006; 10: 171-75
12. Azarfarin R, Ashouri N, Totonchi Z, Bakhshandeh H, Yaghoubi AR. Factors Influencing Prolonged ICU Stay After Open Heart Surgery. *Res Cardiovasc Med* 2014; 3: 20159
13. Silva CE, Niedermeier BT, Portinho F. Reflux Laryngitis: Correlation between the Symptoms Findings and Indirect Laryngoscopy. *Int Arch Otorhinolaryngol* 2015; 19: 234–37.
14. Martinucci I et al. Optimal treatment of laryngopharyngeal reflux disease. *Ther Adv Chronic Dis* 2013; 4: 287 –301
15. Bain WM, Harrington JW, Thomas LE, Schaefer SD. Head and neck manifestations of gastroesophageal reflux. *Laryngoscope* 1983; 93: 175-79.
16. Johnson KN, Botros DB, Groban L, Bryan YF. Anatomic and physiopathologic changes affecting the airway of the elderly patient: implications for geriatric-focused airway management. *Clinical Interventions in Aging* 2015; 10: 1925–34.
17. Branski RC, Zhou H, KrausDH, Sivasankar M. The Effects of Cigarette Smoke Condensate on Vocal Fold Transepithelial Resistance and Inflammatory Signaling in Vocal Fold Fibroblasts. *Laryngoscope* 2011; 121: 601–05
18. Geraci G, Cupido F, LoNigro C, Sciuto A, Sciumè C, Modica G. Postoperative laryngeal symptoms in a general surgery setting. Clinical study. *Ann Ital Chir* 2013; 84: 377-78