Published in final edited form as:

Anesth Analg. 2013 January ; 116(1): 112–117. doi:10.1213/ANE.0b013e31826f9125.

Airway Trauma in a High Patient Volume Academic Cardiac Electrophysiology Laboratory Center

Zhe Yan, MD, MS,

Department of Anesthesiology, Hospital of University of Pennsylvania, Philadelphia, Pennsylvania

Jonathan W. Tanner, MD, PhD,

Department of Anesthesiology and Critical Care, Hospital of University of Pennsylvania, Philadelphia, Pennsylvania

David Lin, MD,

Penn Heart and Vascular Center, Hospital of University of Pennsylvania, Philadelphia, Pennsylvania

Ara A. Chalian, MD,

Otorhinolaryngology: Head and Neck Surgery, Hospital of University of Pennsylvania, Philadelphia, Pennsylvania

Joseph S. Savino, MD,

Corresponding Author: Renyu Liu, MD, PhD, Department of Anesthesiology and Critical Care, Hospital of University of Pennsylvania, 336 John Morgan Building, 3620 Hamilton Walk, Philadelphia, PA, 19104, Phone: 2156623750, FAX: 2153495078, liur@uphs.upenn.edu.

Current Affiliation: Zhe Yan, MD, MS Department of Anesthesiology, The First People's Hospital of Foshan, Guangdong, China
Drs Zhe Yan and Jonathan W. Tanner contributed equally to this project as co-first author.

The authors declare no conflicts of interest.

Reprints will not be available from the authors.

This report was previously presented, in part, at the ICISA Congress

DISCLOSURES:

Name: Zhe Yan, MD, MS

Contribution: This author helped design the study, conduct the study, analyze the data, and write the manuscript

Attestation: Zhe Yan has seen the original study data, reviewed the analysis of the data, approved the final manuscript, and is the author responsible for archiving the study files

Name: Jonathan W. Tanner, MD, PhD

Contribution: This author helped design the study, conduct the study, analyze the data, and write the manuscript

Attestation: Jonathan W. Tanner has seen the original study data, reviewed the analysis of the data, and approved the final manuscript

Name: David Lin, MD

Contribution: This author helped analyze the data and write the manuscript

Attestation: David Lin has seen the original study data, reviewed the analysis of the data, and approved the final manuscript

Name: Ara A. Chalian, MD

Contribution: This author helped design the study, analyze the data, and write the manuscript

Attestation: Ara A. Chalian has seen the original study data, reviewed the analysis of the data, and approved the final manuscript

Name: Joseph S. Savino, MD

Contribution: This author helped design the study, analyze the data, and write the manuscript

Attestation: Joseph S. Savino has seen the original study data, reviewed the analysis of the data, and approved the final manuscript

Name: Lee A. Fleisher, MD

Contribution: This author helped analyze the data and write the manuscript

Attestation: Lee A. Fleisher has seen the original study data, reviewed the analysis of the data, and approved the final manuscript

Name: Renyu Liu, MD, PhD

Contribution: This author helped design the study, conduct the study, analyze the data, and write the manuscript

Attestation: Renyu Liu has seen the original study data, reviewed the analysis of the data, approved the final manuscript, and is the author responsible for archiving the study files

This manuscript was handled by: Sorin J. Brull, MD, FCARCSI (Hon)

Department of Anesthesiology and Critical Care, Hospital of University of Pennsylvania, Philadelphia, Pennsylvania

Lee A. Fleisher, MD, and

Department of Anesthesiology and Critical Care, Hospital of University of Pennsylvania, Philadelphia, Pennsylvania

Renyu Liu, MD, PhD

Department of Anesthesiology and Critical Care, Hospital of University of Pennsylvania, Philadelphia, Pennsylvania

Abstract

Background—Providing anesthesia and managing airways in the electrophysiology suite can be challenging because of its unique setting outside of the conventional operating room. We report our experience of several cases of reported airway trauma including tongue and pharyngeal hematoma and vocal cord paralysis in this setting.

Methods—We analyzed all of the reported airway trauma cases between December 2009 and January 2011 in our cardiac electrophysiology laboratories, and compared these cases to those without airway trauma. Data from 87 cases, including 16 cases with reported airway trauma (trauma group) and 71 cases without reported airway trauma from the same patient population pool at the same time period (control group), were collected via review of medical records.

Results—Airway trauma was reported for 16 patients (0.7%) in 14 months among 2434 anesthetic cases. None of these patients had life-threatening airway obstruction. The avoidance of muscle relaxants during induction in patients with a body mass index less than 30 was found to be a significant risk factor for airway trauma ($p=0.04$, odds ratio 10, 95% confidence interval 1.1 to 482). Tongue or soft tissue bite occurred in two cases where soft bite block was not used during cardioversion. No statistically significant difference was found between the trauma and control groups for preprocedure anticoagulation, anticoagulation during the procedure, or reversal of heparin at the end of the procedure.

Conclusion—The overall incidence of reported airway trauma was 0.7% in our study population. Tongue injury was the most common airway trauma. The cause seems to have been multifactorial; however, airway management without muscle relaxant emerged as a potential risk factor. Intubation with muscle relaxant is recommended, as is placing a soft bite block and ensuring no soft tissue is between the teeth before cardioversion.

Introduction

The use of catheter ablation therapy in patients with atrial fibrillation (AF) has become significantly more prevalent over the past decade. Increasingly, patients who are elderly with multiple co-morbidities and those with more persistent AF are now considered candidates for ablation.¹ Given the typical long duration and complexities of this procedure, adequate sedation is essential for patient comfort, safety, and optimal outcome. Ablations can be performed under general anesthesia or sedation. Although the use of general anesthesia for catheter ablation has been shown to have improved long-term outcome compared with conscious sedation,² data regarding complications and outcomes related to anesthesia in this setting are too limited to make any recommendations or guidelines for providing anesthesia specifically in electrophysiology laboratories.

Providing anesthesia in a nonstandard operating room setting such as an electrophysiology laboratory can be challenging, and equipment (radiograph cameras, mapping systems, etc.) can limit the working space and make intubation awkward. Furthermore, muscle relaxants are often avoided for cardiac catheter ablations, to facilitate identification of the phrenic

nerve and avoid its injury. Moreover, patients in electrophysiology laboratories are often under therapeutic anticoagulation, so minor airway injury, which could otherwise be inconsequential, could potentially trigger severe complications. Retropharyngeal, lingual, and epiglottic hematomas have been reported as complications of anticoagulation therapy.^{3–6} In the Hospital of University of Pennsylvania, there has been a shift from the use of conscious sedation to general anesthesia for electrophysiology procedures over the past few years. During this time, several cases of airway trauma have been reported and discussed as part of quality improvement. Many of the cases triggered otolaryngologist (ENT) consultation for potential upper airway obstruction. All of these cases underscore the need to investigate airway trauma in cardiac electrophysiology patients.

This study was designed to investigate type of airway trauma and to identify risk factors in patients having electrophysiology procedures. We hypothesized that some patient-specific features (such as body mass index [BMI]), anesthesia-specific factors (such as avoidance of neuromuscular blocking drugs (NMBDs) and use of high-frequency jet ventilation), and procedure-specific factors (such as cardioversion and anticoagulation) may have contributed to airway trauma. We analyzed all of our reported cases of airway trauma and compared these with cases without reported airway trauma. The goal was to develop recommendations to avoid this potentially life-threatening complication.

Methods

This investigation was approved by the IRB of the University of Pennsylvania. Written informed consent was waived by the IRB. Patients involved in this study underwent electrophysiology procedures (mostly catheter ablation for AF) between December, 2009, and January, 2011. All anesthesia care, including tracheal intubation, was provided by certified registered nurse anesthetists with years of practice experience who were supervised by experienced anesthesiologists; no residents nor any trainees were involved in any of the cases included. We analyzed 16 cases with reported airway trauma (trauma group) and compared them with 71 cases without reported airway trauma from the same patient population pool at the same time period (control group) who underwent interventional cardiac electrophysiological procedures. All patients were under general anesthesia with endotracheal intubation except two patients in the trauma group and one patient in the control group who had a laryngeal mask airway (LMA). The following data were collected via review of medical records by multiple experienced anesthesiologists: demographic data, preoperative airway assessment, type of airway trauma, anticoagulation management, use of muscle relaxant, temperature probe insertion, use of jet ventilation, bite block insertion, Glidescope use, and number and energy of cardioversions during the procedure. Anticoagulation at the time of intubation was defined as the presence of any anticoagulation therapy, generally IV heparin, started before intubation.

Categorical data are presented using percentage; quantitative data are expressed as mean $\pm$ standard deviation. Fisher's exact test was used for statistical analysis of categorical data for the two groups. Confidence interval and odds ratio were calculated via a web-based calculator (<http://www.hutchon.net/ConfidOR.htm>)⁷ and Stata (V11, StataCorp LP, Texas). The confidence interval is for the odds ratio. The P value is for the Fisher's exact test and are considered statistically significant when less than 0.05.

Results

Demographic data

Of the 2434 anesthetic cases during these 14 months, 16 patients had reported airway trauma. These cases were evenly distributed over this timeframe, not clustered. The patient

population consisted predominantly of older male, over-weight patients (BMI > 30), with one-third of the patients having obstructive sleep apnea (OSA). There was no significant difference in age, gender, weight, height, BMI, left ventricular ejection fraction, history of OSA, or duration of the procedure (Table 1) between the trauma and control groups.

Types of airway injury and outcome

Airway trauma could be classified into three types (Table 2): tongue injury, pharyngeal hematoma, and multiple traumas. There were 10 patients who suffered tongue injury. There were 5 patients who sustained complex injuries, including hoarseness, sore throat, difficulty swallowing, bruised uvula, lacerated uvula, vocal cord paralysis, oral bleeding, and palate trauma; two of them were treated with steroids.

Ten patients required urgent otolaryngologist evaluation; two patients needed a swallow test, and one patient needed intensive care unit (ICU) admission for potential airway obstruction (Figure 1). There were no life-threatening airway obstruction consequences reported in any of the 16 trauma patients. However, almost all of the patients required temporary withholding of the needed heparin infusion. Fortunately, none of the patients in the current study had apparent (symptomatic) thromboembolic complications as a result of withholding heparin temporarily. All patients recovered well without known adverse consequences.

Risk factors

There was no distinct demographic characteristic identified as a significant risk factor (Table 1). No statistically significant differences were found in anticoagulation management, use of a Glidescope, soft bite block, or jet ventilation between the two groups (Table 3). Avoidance of a muscle relaxant for airway management in patients with a BMI less than 30 was identified as a potential significant risk factor for airway trauma.

Thirty-eight percent (38%) of patients in the trauma group and 65% in the control group received a NMBD during induction ($p = 0.053$). However, for the patients whose BMI was below 30, there was a statistically significant difference in rate of NMBD use between these two groups. In the trauma group, there were 6 cases without NMBD (86% vs. control group, 38%; $p = 0.035$). The odds ratio is 10; however, the 95% confidence interval is wide (1.0 to 482.0) and the P-value was not corrected for the effect of multiple comparisons. Although the difference for the predicted difficult intubation (Mallampati III) did not reach statistical significance, the odds ratio is nearly 6.

In the present study, airway injury was reported in two patients who had a LMA. One patient reported hoarseness, sore throat, and difficulty swallowing, with a bruised and lacerated uvula; otolaryngology evaluation revealed left vocal cord paralysis, which resolved completely after a month. The other patient had a sore throat but no ENT consultation was needed. In the control group, a LMA was only used in one case. Two patients bit their tongue or soft tissue during cardioversion without a bite block.

Discussion

In this study, we found that the rate of reported severe airway trauma in patients undergoing cardiac electrophysiology procedures overall is about 0.7%. Avoidance of a muscle relaxant during induction in patients with BMI < 30 was identified as a statistically significant risk factor. Airway trauma was also reported in patients using a LMA. The most common airway trauma is tongue injury. These injuries can be severe enough to need ENT consultation and close observation in the ICU for potential airway obstruction.

Incidence of airway injury and significance

Endotracheal intubation can cause airway injury that could potentially lead to life-threatening complications including tracheal injury and rupture.^{8,9} The common airway injuries related to anesthesia are vocal cord paralysis, granuloma, arytenoid dislocation, hematoma, perforation, lacerations, and dental injury.^{10–16} The most common claims against the anesthesiologist are from dental injury.¹⁷ Two recent large studies indicated that the rate of dental injury is approximately 0.13% under general anesthesia¹⁷ and 0.2% in emergent intubation situations.¹⁸ In contrast, the most common reported injury in the present study was to the tongue, without any reported dental injury. Most were severe enough to necessitate ENT consultation, and one patient needed additional ICU observation due to airway patency concerns. The overall incidence is 0.7%, three times that of dental injury reported in an emergent setting.¹⁹ It is worth noting that airway trauma including trauma to the tongue and larynx, as seen in this study, accounted for 30% of airway claims in an analysis of claims against the National Health Service in England 1995–2007.²⁰ It is vital to analyze the potential risks and find solutions to reduce airway-related complications in this new frontier of anesthesiology.

Risk factor analysis and potential solutions

Demographic factors—Although obesity has been associated with difficult intubation, only BMI more than 40 was found to be a risk factor.¹⁸ OSA has been considered a risk factor for difficult airway,²¹ and the combination of obesity and OSA is always a challenge to anesthesiologists due to a potentially difficult airway.^{22,23} While we initially thought that obesity and/or OSA could be significant risk factors for airway injury, no significant difference was revealed between the two groups. This finding may have been due to small sample size or anesthesiologist precautions when managing this subgroup of patients.

Muscle relaxants—Monitoring the phrenic nerve is important during ablation of AF, so anesthesia without muscle relaxants is desired by cardiologists for these procedures. Intubation without a muscle relaxant is achievable with deep anesthesia or with the combination of propofol and remifentanyl.^{24–27} However, difficult intubations and adverse hemodynamic events are more frequently related to intubation without muscle relaxants,^{25,26} and excellent intubation conditions are more frequent when muscle relaxation is used.²⁴

Airway management without muscle relaxants has been favored by some anesthesia providers, especially for patients who are not obese and not anticipated to be difficult to intubate. Unfortunately, this study indicated that airway trauma might be associated with absence of muscle relaxants during induction. It is interesting that the potential association is only seen in the subgroup of patients with BMI less than 30 with an odds ratio of 10. It is important to note that there is a discrepancy between the statistical analysis for P value for Fisher's exact test for this potential risk factor and the wide confidence interval for the odds ratio as demonstrated and explained in Table 3. The wide 95% confidence interval may have been caused by the small number of patients in the trauma group. The loss of a statistically significant difference when the patients with BMI more than 30 were added into the data analysis was probably because the anesthesia providers tended to use a muscle relaxant or other airway precautions for morbidly obese patients. Based on these findings, use of a muscle relaxant for airway management in electrophysiology patients is recommended.

Anticoagulation and airway trauma

Hematoma in the upper airway has been reported to be a complication for patients who were anticoagulated, with severity varying from asymptomatic to obstruction requiring a surgical airway.^{3,4,28,29} Thus, anticoagulated patients are at risk of spontaneous hematoma, and even

a minor injury caused by any event in the upper airway such as intubation and vigorous oral suctioning could lead to a hematoma. During ablation procedures for AF and any left-sided ablations, the activated clotting times are typically kept in the 350 second range. We did not find any difference between the two groups in terms of anticoagulation management; thus, we cannot conclude that anticoagulation is a significant risk factor. However, it is likely that anticoagulation at the time of intubation could be an important precipitating factor. Thus, it is recommended to intubate patients before heparinization, to reduce potential airway hematoma associated with minor airway trauma.

Clinicians should be aware that an initially asymptomatic lingual bruise could worsen to a hematoma, completely obstructing the airway,^{11,12} although this did not apply to any of the patients in this study except for one patient who needed additional ICU observation. Withholding of heparin infusion might have prevented life-threatening airway obstruction. However, withholding heparin could potentially put these post-ablation patients at risk of clot formation. Fortunately, this catastrophe did not occur in this small number of reported patients.

LMA—The LMA was developed as an alternative method to manage the airway, especially in patients with a difficult airway.³⁰ Although LMA insertion is technically easier than endotracheal intubation, it can be associated with airway injuries, including sore throat, hoarse voice, and epiglottic edema.³¹

In a recent study comparing two different methods of LMA insertion, 16% to 32% of LMAs became blood-stained, indicating soft tissue abrasion.³² This high rate of blood staining is not generally a significant issue; however, it could be problematic in patients with high-intensity anticoagulation. The frequency of blood-stained LMAs in anticoagulated patients is unknown, but severe laryngeal hematoma after LMA insertion in a patient with a bleeding diathesis has been reported.³³ In the present study, airway injury was reported in two patients using a LMA in the trauma group. While no conclusion can be made from this small number of cases, a LMA might not be a good choice for airway management in anticoagulated electrophysiology patients.

Bite block—Two cases in this study involve bite-related injury during cardioversion. It is critical to place a soft bite block between patients' teeth and ensure there is no tongue or soft tissue between the teeth before cardioversion, to avoid this complication.

Limitations

The major limitation of this study is that it is retrospective and only reported airway injuries were included. With the small sample size, it is not powered enough to reveal all contributing factors. There may have been occult cases of airway trauma, which may have been relatively minor and therefore not reported by patients and/or care providers.

In summary, the overall incidence of airway trauma was 0.7% of our study population. Tongue injury was the most common injury in the current study population. The cause seems to be multifactorial; however, airway management without a muscle relaxant emerged as a potential risk factor. A muscle relaxant is recommended for intubating these anticoagulated patients. Tongue biting can occur during cardioversion, without proper precautions, which include placing a soft bite block and ensuring that no soft tissue is between the teeth before cardioversion. Although no statistically significant difference was obtained between the groups for variables related to anticoagulation, the fact that these patients were typically anticoagulated at a high level probably contributed to the severity of airway trauma. Intubation before heparin administration is recommended.

Acknowledgments

Funding: This study was supported by departmental funding from the Department of Anesthesiology and Critical Care at the University of Pennsylvania and by NIH grants K08-GM093115 (RL).

The authors thank Dr. Marshall Joffe, Associate Professor of Biostatistics in Biostatistics and Epidemiology, and Rebecca M. Speck, MPH, at the department of Anesthesiology at the University of Pennsylvania for advice and help on statistical analysis. The authors also thank Mary S. Hammond, BSN, for her work on IRB approval and waiver, and Ida Micaily, BS, for help with data collection.

References

1. Kneeland PP, Fang MC. Trends in catheter ablation for atrial fibrillation in the United States. *J Hosp Med.* 2009; 4:E1–5. [PubMed: 19753578]
2. Di Biase L, Conti S, Mohanty P, Bai R, Sanchez J, Walton D, John A, Santangeli P, Elayi CS, Beheiry S, Gallinghouse GJ, Mohanty S, Horton R, Bailey S, Burkhardt JD, Natale A. General anesthesia reduces the prevalence of pulmonary vein reconnection during repeat ablation when compared with conscious sedation: results from a randomized study. *Heart Rhythm.* 2011; 8:368–72. [PubMed: 21055479]
3. Akoglu E, Seyfeli E, Akoglu S, Karazincir S, Okuyucu S, Dagli AS. Retropharyngeal hematoma as a complication of anticoagulation therapy. *Ear Nose Throat J.* 2008; 87:156–9. [PubMed: 18404913]
4. Brown I, Kleinman B. Epiglottic hematoma leading to airway obstruction after general anesthesia. *J Clin Anesth.* 2002; 14:34–5. [PubMed: 11880019]
5. Shaps HJ, Snyder GE, Sama AE, Rudolph GS. Airway compromise secondary to lingual hematoma complicating administration of tissue plasminogen activator for acute ischemic stroke. *Ann Emerg Med.* 2001; 38:447–9. [PubMed: 11574803]
6. Vijayan S, Chase A. Images in clinical medicine. Lingual hematoma after thrombolytic therapy. *N Engl J Med.* 2011; 364:e13. [PubMed: 21323537]
7. Bland JM, Altman DG. Statistics notes. The odds ratio. *BMJ.* 2000; 320:1468. [PubMed: 10827061]
8. Borasio P, Ardisson F, Chiampo G. Post-intubation tracheal rupture. A report on ten cases. *Eur J Cardiothorac Surg.* 1997; 12:98–100. [PubMed: 9262088]
9. Medina CR, de Camargo JJ, Felicetti JC, Machuca TN, de Gomes BM, Melo IA. Post-intubation tracheal injury: report of three cases and literature review. *J Bras Pneumol.* 2009; 35:809–13. [PubMed: 19750335]
10. Domino KB, Posner KL, Caplan RA, Cheney FW. Airway injury during anesthesia: a closed claims analysis. *Anesthesiology.* 1999; 91:1703–11. [PubMed: 10598613]
11. Getnick GS, Lin SJ, Raviv JR, Walsh WE, Altman KW. Lingual hematoma and heparin-induced thrombocytopenia: a case report. *Ear Nose Throat J.* 2008; 87:163–5. [PubMed: 18404915]
12. Keogh IJ, Rowley H, Russell J. Critical airway compromise caused by neck haematoma. *Clin Otolaryngol Allied Sci.* 2002; 27:244–5. [PubMed: 12169124]
13. Koscielny S, Gottschall R. Perforation of the hypopharynx as a rare life-threatening complication of endotracheal intubation. *Anaesthesia.* 2006; 55:45–52. [PubMed: 16003544]
14. Oczenski W, Krenn H, Dahaba AA, Binder M, El-Schahawi-Kienzl I, Kohout S, Schwarz S, Fitzgerald RD. Complications following the use of the Combitube, tracheal tube and laryngeal mask airway. *Anaesthesia.* 1999; 54:1161–5. [PubMed: 10594413]
15. Newland MC, Ellis SJ, Peters KR, Simonson JA, Durham TM, Ullrich FA, Tinker JH. Dental injury associated with anesthesia: a report of 161,687 anesthetics given over 14 years. *J Clin Anesth.* 2007; 19:339–45. [PubMed: 17869983]
16. Warner ME, Benenfeld SM, Warner MA, Schroeder DR, Maxson PM. Perianesthetic dental injuries: frequency, outcomes, and risk factors. *Anesthesiology.* 1999; 90:1302–5. [PubMed: 10319777]
17. Gaudio RM, Feltracco P, Barbieri S, Tiano L, Alberti M, Delantone M, Ori C, Avato FM. Traumatic dental injuries during anaesthesia: part I: clinical evaluation (vol 26, pg 459, 2010). *Dental Traumatology.* 2011; 27:163.

18. Holmberg TJ, Bowman SM, Warner KJ, Vavilala MS, Bulger EM, Copass MK, Sharar SR. The association between obesity and difficult prehospital tracheal intubation. *Anesth Analg*. 2011; 112:1132–8. [PubMed: 21346165]
19. Martin LD, Mhyre JM, Shanks AM, Tremper KK, Kheterpal S. 3,423 emergency tracheal intubations at a university hospital: airway outcomes and complications. *Anesthesiology*. 2011; 114:42–8. [PubMed: 21150574]
20. Cook TM, Scott S, Mihai R. Litigation related to airway and respiratory complications of anaesthesia: an analysis of claims against the NHS in England 1995–2007. *Anaesthesia*. 2010; 65:556–63. [PubMed: 20345420]
21. Corso RM, Piraccini E, Calli M, Berger M, Gorini MC, Agnoletti V, Gambale G, Vicini C. Obstructive sleep apnea is a risk factor for difficult endotracheal intubation. *Minerva Anesthesiol*. 2011; 77:99–100. [PubMed: 21273972]
22. Benumof JL. Obesity, sleep apnea, the airway and anesthesia. *Curr Opin Anaesthesiol*. 2004; 17:21–30. [PubMed: 17021525]
23. Benumof JL. Obstructive sleep apnea in the adult obese patient: implications for airway management. *Anesthesiol Clin North America*. 2002; 20:789–811. [PubMed: 12512263]
24. Baillard C, Adnet F, Borron SW, Racine SX, Ait Kaci F, Fournier JL, Larmignat P, Cupa M, Samama CM. Tracheal intubation in routine practice with and without muscular relaxation: an observational study. *Eur J Anaesthesiol*. 2005; 22:672–7. [PubMed: 16163913]
25. Alexander R, Olufolabi AJ, Booth J, El-Moalem HE, Glass PS. Dosing study of remifentanyl and propofol for tracheal intubation without the use of muscle relaxants. *Anaesthesia*. 1999; 54:1037–40. [PubMed: 10540091]
26. Trabold F, Casetta M, Duranteau J, Albaladejo P, Mazoit JX, Samii K, Benhamou D, Sitbon P. Propofol and remifentanyl for intubation without muscle relaxant: the effect of the order of injection. *Acta Anaesthesiol Scand*. 2004; 48:35–9. [PubMed: 14674971]
27. Fotopoulou G, Theocharis S, Vasileiou I, Kouskouni E, Xanthos T. Management of the airway without the use of neuromuscular blocking agents: the use of remifentanyl. *Fundam Clin Pharmacol*. 2011; 26(1):72–85. [PubMed: 21771056]
28. Baptista P, Gimeno CV, Salvinelli F, Rinaldi V, Casale M. Acute upper airway obstruction caused by massive oedema of the tongue: unusual complication of sialoendoscopy. *J Laryngol Otol*. 2009; 123:1402–3. [PubMed: 19470191]
29. Bloom DC, Haegen T, Keefe MA. Anticoagulation and spontaneous retropharyngeal hematoma. *J Emerg Med*. 2003; 24:389–94. [PubMed: 12745040]
30. Teoh WH, Lim Y. Comparison of the single use and reusable intubating laryngeal mask airway. *Anaesthesia*. 2007; 62:381–4. [PubMed: 17381575]
31. Caponas G. Intubating laryngeal mask airway. *Anaesth Intensive Care*. 2002; 30:551–69. [PubMed: 12413253]
32. Haghighi M, Mohammadzadeh A, Naderi B, Seddighinejad A, Movahedi H. Comparing two methods of LMA insertion; classic versus simplified (airway). *Middle East J Anesthesiol*. 2010; 20:509–14. [PubMed: 20394246]
33. Thompson C, Cundy JM. Use of the laryngeal mask airway in the presence of a bleeding diathesis. *Anaesthesia*. 1992; 47:530–1. [PubMed: 1616095]

Figure 1.

Picture of the neck of a 63-year-old woman who underwent catheter ablation of atrial fibrillation under general anesthesia with endotracheal intubation. After the procedure, she complained of throat pain and dysphagia. The otolaryngologist found hematoma of her soft palate, tonsillar pillar, and epiglottis. She was transferred to intensive care for monitoring but developed no airway compromise.

Table 1

Demographic data

	Trauma group (n=16)	Control group (n=71)	P value
Age (years)	63 ± 11	59 ± 10	0.208
Gender (% male)	88	72	0.339
Height (inches)	71 ± 4	70 ± 4	0.470
Weight (pounds)	220 ± 55	216 ± 49	0.761
Body mass index (kg/m ²)	32 ± 7	31 ± 7	0.660
Ejection fraction (%)	51 ± 17	54 ± 12	0.481
History of sleep apnea (%)	38	30	0.548
Length of procedure (hours)	6 ± 2	6 ± 2	0.888

Table 2

Types of injury

Type of injury	Details
Tongue (10)	tongue hematoma(6) tongue bruising(2) tongue laceration and swelling(1) tongue bite(1)
pharyngeal hematoma (1)	
multiple trauma (5)	Sore throat, uvula lesion (1) hoarseness, sore throat, difficulty swallowing, uvula appeared bruised and lacerated, left vocal cord paralysis (1) Oral trauma, bleeding in mouth, soft tissue bite(1) Sore throat, upper palate trauma (2)

Table 3

Potential risk factors

	Trauma (n=16)	Control (n=71)	P value (not corrected for multiple comparisons)	Odds ratio	95% CI
No NMBD for airway when BMI < 30	86 (n=7)	38 (n=32)	0.035	10.0	1.0 to 482
NMBD for airway management	38	65	0.053	0.3	0.1 to 1.0
Potential difficult airway(MP III)	19	4	0.063	5.7	1.0 to 31.5
Heparin reversal at the end of procedure	69	85	0.161	0.4	0.1 to 1.4
Cardioversion with energy 300 Joules	38	21	0.200	2.2	0.7 to 7.2
Jet ventilation used	69	83	0.292	0.4	0.1 to 1.5
Cardioversion twice or more	38	46	0.586	0.7	0.2 to 2.1
Soft bite block usage documented	19	14	0.691	1.5	0.4 to 6.4
Oral anticoagulation held before procedure	19	15	0.704	1.4	0.3 to 5.6
Esophageal temperature probe inserted	69	62	0.776	1.4	0.4 to 4.3
CPAP or BiPAP before procedure	19	21	1.000	0.9	0.2 to 3.7
Glidescope used	19	24	1.000	0.8	0.2 to 3.1
Heparin before intubation	63	62	1.000	1.0	0.3 to 3.1

NMBD, neuromuscular blocking drug; BMI, body mass index; CPAP, Continuous positive airway pressure; BiPAP, bilevel positive airway pressure; MP, Mallampati; CI, confidence interval. P values are for Fisher's exact test; the CIs are for the odds ratio. Note that Fisher's exact test appears to be inconsistent with the confidence interval for the odds ratio for the risk factor related to NMBD administration when BMI is less than 30; this discrepancy could be expected under known conditions(<http://www.stata.com/support/faqs/statistics/fishers-exact-test/>; data accessed on July 17, 2012).