

Airway Obstruction: Clinical Analysis of Cases in a Tertiary Hospital

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Abstract

Background: Acute upper airway obstruction is a life-threatening emergency that requires urgent evaluation and precise action to save life. It is the most crucial and dramatic emergency faced in otorhinolaryngology (ORL) practice, and occurs in both the old and young, male and female. **Purpose:** The study was aimed to analyze cases of acute upper airway obstruction seen in our tertiary Hospital over a decade and half, to ascertain the number of patients, their ages and sexes, causes and interventions. **Methods:** It was a retrospective study conducted in the Department of Otorhinolaryngology, Head & Neck Surgery, University of Nigeria Teaching Hospital, Ituku/Ozalla, Enugu, Nigeria from January 2007 to December 2021. The charts and records of the patients were reviewed to extract the required data which were analyzed with descriptive statistics. **Results:** Two hundred and ninety one (291) cases of acute upper airway obstruction were studied. There were 200 (68.73%) males and 91 (31.27%) females, ratio 2.20:1.00. Their ages ranged from 1 day (0.002739 years) to 88 years, with a mean of 30.61 ± 26.56 , 95% confidence interval (CI) 27.53 to 33.68 and median of 29. Children were 132 (45.36%) and adults 159 (54.64%). Causes of obstruction were many and varied, and included: congenital, trauma, infection, inflammation, neoplasm and others. Tracheostomy was the main surgical airway intervention. **Conclusion:** Incidence of acute upper airway obstruction was common and involved both the old and young, male and female, with varied causes. Vigilance and caution need be taken for early presentation and precise intervention offered to mitigate morbidity and mortality.

Keywords

Airway, Obstruction, Acute, Clinical, Analysis

1. Introduction

The airway is the pathway through which oxygen reaches the lungs. When ob-

structed, is jeopardized and no more available for its function. This presents a serious clinical scenario. When acute is a life-threatening emergency and requires immediate assessment and intervention with little margin for error, making it a constant challenge for clinicians [1] [2]. In acute upper airway obstruction, severe hypoxemia can lead to cardiac arrest. Chronic obstructive sleep apnoea is associated with major cardiac events, hypertension, arrhythmias, congestive heart failure, and stroke [3] [4].

Airway obstruction is the most crucial and dramatic emergencies faced in Otorhinolaryngology (ORL) practice. It can occur in all ages with no significant sex difference. A mild airway obstruction that has existed for months in a patient may suddenly deteriorate to severe airway obstruction and become a very acute emergency. Thus, it is important to obtain a detailed history, even in patients with an acute presentation, to delineate the cause. Causes are protean and vary with age, and social activities. Congenital causes are more common in children, and neoplastic causes more common in adults, particularly in patients with a long-standing history of smoking or alcohol abuse. Infection and inflammation are apparently the most common causes of acute upper airway obstruction with trauma advancing rapidly to take the lead.

This study sort to retrospectively conduct a clinical analysis of cases of upper airway obstruction seen in our tertiary hospital over a decade and half with the aim of delineating the number of patients involved, their ages, sex, the variety of causes and the immediate interventions offered to relieve the acute airway challenge. The outcome of the study is expected to impact positively on future cases and give direction to planning and preparation of protocols for handling them.

2. Material and Methods

2.1. Search Strategy, Information Sources and Study Selection

It was a retrospective study carried out in the Department of Otorhinolaryngology, Head & Neck Surgery of the hospital from January 2007 to December 2021 to analyze cases of acute upper airway obstruction seen in our tertiary Hospital over a decade and half, to ascertain the number of patients, their ages and sexes, causes and interventions.

2.2. Data Extraction and Data Analysis

The case notes and clinical records of all the patients irrespective of gender or age with acute upper airway obstruction who presented or were referred to the hospital and managed by the Otorhinolaryngology, Head & Neck Surgery Department within the period of the study were retrieved from the ward, clinic, theatre, Accident & Emergency (A&E) and Intensive Care Unit (ICU). Excluded were cases of airway challenge that did not require active airway management and those whose case notes were not available or had incomplete data. Cases that had alternative airway or adjunctive airway intervention for other surgeries such as oral and maxillofacial surgeries were also excluded.

The variables studied were patients' age and gender, area of obstruction, state/condition of patients at presentation, and resuscitative measures/intervention to relieve the obstruction. The variables were extracted from the clinical records and case notes of the patients obtained from the various locations.

The data generated were analyzed using descriptive statistics and presented in both tables and descriptive forms as appropriate. Data analysis was carried out using SPSS version 20 (SPSS, Chicago, IL, USA). The t-test was used to compare the means. The study protocol was reviewed and approved by the hospital's medical records department.

3. Results

3.1. Study Characteristics

A total of two hundred and ninety one (291) patients with acute upper airway obstruction who met the inclusion criteria treated during the study period on an emergency basis requiring urgent airway intervention were included in the study. There were 200 (68.73%) males and 91 (31.27%) females, ratio 2.20:1.00 with ages ranging from 1 day (0.002739 years) to 88 years, mean 30.61 ± 26.56 , 95% CI of 27.53 to 33.68 and median of 29. The age grouping of the patients segregating male and female and their percentages is shown in **Table 1**. Children constituted 132 (45.36%), range 1 day to 18 years with 84 (28.87%) males and 48 (16.49%) females, ratio 1.75:1.00, mean 4.48 ± 4.44 , 95% CI of 3.71 to 5.25 and median 3. Children aged ≤ 10 years accounted for 115 (39.52%) of the patients. 93 (31.96%) of them were aged ≤ 5 years and made up of 53 males and 40 female, ratio 1.33:1.00. Among them patients less than 1 year accounted for 14 (4.81%) comprising 7 males and 7 females, ratio is 1:1. Their ages and causes of upper airway obstruction were displayed in **Table 2**. Adults in the study were 159 (54.64%) made up of 116 (39.86%) males and 43 (14.78%) females ratio 2.70:1.00. Their ages span from 20 to 88 years, with a mean of 52.19 ± 4.44 , 95% CI of 49.79 to 54.58, median 53 (**Table 3**). The oldest male in the study was aged 88 years, female 75 years while the youngest male was aged 2 days (0.005479

Table 1. Age grouping of patients with upper airway obstruction.

Age group (years)	Male	Female	Total	Percentage %
<1 - 10	73	42	115	39.52
11 - 20	11	7	18	6.19
21 - 30	11	4	15	5.15
31 - 40	12	12	24	8.25
41 - 50	18	9	27	9.28
51 - 60	35	13	48	16.49
61 - 70	24	2	26	8.93
71 - 80	14	2	16	5.50
81 - 90	2	-	2	0.68

Table 2. Summary of the categories of patients studied.

Gender	Number	Percentage (%)
Male	200	68.73
Female	91	31.27
Children	132	45.36
Adults	159	54.64
Male children	84	28.87
Female children	48	16.49
Male adults	116	39.86
Female adults	43	14.78

Table 3. Distribution of the pathologies of patients less than 1 year.

0.5 (6 months)	Female	FB aspiration
0.17 (2 months)	Female	FB aspiration
0.83 (10 months)	Female	FB aspiration
0.75 (9 months)	Female	FB aspiration
0.005479 (2 days)	Female	Teratoma
0.42 (5 months)	Female	Caustic soda ingestion
0.005479 (2 days)	Male	Bilateral choanal atresia
0.67 (8 months)	Male	FB (hypopharynx)
0.83 (10 months)	Male	FB aspiration
0.58 (7 months)	Male	FB aspiration (larynx)
0.92 (11 months)	Male	FB aspiration
0.67 (8 months)	Male	FB aspiration (hypopharynx)
<u>0.002740 (1 day)</u>	Female	Bilateral choanal atresia

Note: FB = Foreign body.

years), female 1 day (0.002739 years). Young adults ($\geq 18 - 50$) years in the study were 66 (22.68%) and the elderly (51 - 90 years) were 92 (31.61%). Adult males were 116, aged 20 to 88 years with a mean of 54.83 ± 15.35 , 95% CI of 52.00 to 57.65 and median of 55. Adult females constituted 43, with their ages ranging from 20 to 75 years, mean 45.49 ± 13.17 , 95% CI of 41.44 to 49.54 and median age of 48. Male children in the study were 84 with ages ranging from 2 days (0.005479 years) to 17 years, mean of 4.69 ± 3.94 years, 95% CI of 3.84 to 5.55 and median of 3. Female children were 48 with ages spanning from 1 day (0.002739 years) to 18 years, mean 4.10 ± 5.25 , 95% CI of 2.56 to 5.64 and median of 2.

3.2. Comparison of the Gender and Age of the Study Subjects

The means of the ages were compared and the results shown below.

1) Children versus adults: $P < 0.0001$. By conventional criteria this difference is considered to be extremely statistically significant.

2) Males versus females: $P = 0.0028$. This is considered to be very statistically significant.

3) Male children versus female children: $P = 0.4680$. By conventional criteria, this difference is considered to be not statistically significant.

4) Male adults versus female adults: $P = 0.0005$. This difference is considered to be extremely statistically significant.

5) Male children versus male adults: $P < 0.0001$. This is considered to be extremely statistically significant.

6) Female children versus female adults: $P < 0.0001$. Again this is considered to be extremely statistically significant.

A myriad of causes were responsible for the airway obstruction in the patients studied ranging from congenital, trauma, infection, inflammatory to tumours and others (**Table 4**). The intervention given constituted mainly securing the airway where necessary and stabilizing the patient prior to definitive treatment of the pathology that resulted to the airway challenge. The main surgical airway given was tracheotomy seen mainly in patients with tumours majority of which were laryngeal carcinoma. Other methods used to stabilize the airway included oropharyngeal or nasopharyngeal airways and endotracheal intubation. Patients were taken to areas or units for the definitive treatment and follow up of the primary pathologies after stabilizing their airway. The airway management outcomes were adequate and favourable.

4. Discussion

Management of acute upper airway obstruction in a hospital setting is complicated, tasking and may require handling sometimes erratic environment, recognizing the potentially several causes of diseases that may lead to airway challenge such as infection, inflammation, trauma, mechanical, and iatrogenic; and having requisite expertise to quickly secure the airway. The attending physician has to be abreast of several factors such as the patient's age, co-morbidities, ability of the patient to remain in the supine position, level and severity of obstruction, stability of the cervical spine, ability to ventilate, and level of anxiety. Two hundred and ninety one (291) patients were studied, made up of 68.73% males and 31.27% females. Children constituted 45.36% and adults 54.46%. Of these, 4.81% were less than 1 year and 31.61% were elderly (51 - 90 years). This indicates that cases of acute upper airway obstruction is fairly common, cuts across all ages and gender. Several causes were responsible for the acute upper airway obstruction in our study (**Table 4**) with foreign body aspiration (35.74%) forming the majority. This occurred majorly in children. Inhalation of foreign bodies especially in children is not uncommon but it is preventable. Infants and young

Table 4. The causes of acute upper airway obstruction in the study.

Pathology	Number	Percentage (%)
Foreign body	104	35.74
Laryngeal cancer	93	32.00
Recurrent Respiratory Papillomatosis	17	5.84
Recurrent laryngeal nerve paralysis	16	5.50
Nasopharyngeal carcinoma (NPC)	7	2.41
Laryngeal stenosis	4	1.37
Oropharyngeal tumour	4	1.37
Non-Hodgkin's lymphoma	4	1.37
Vocal cord nodule	3	1.03
Blunt laryngeal trauma	3	1.03
Cut throat injury	3	1.03
Thyroid tumour	3	1.03
Retropharyngeal abscess	3	1.03
Obstructive airway disease	3	1.03
Hypopharyngeal tumour	2	0.69
Adenotonsillar hypertrophy	2	0.69
Subglottic stenosis	2	0.69
Rhabdomyosarcoma	2	0.69
Bilateral choanal atresia	2	0.69
Bulbar palsy	2	0.69
Tongue carcinoma	1	0.34
Oropharyngeal trauma	1	0.34
Laryngeal polyp	1	0.34
Laryngeal granuloma in HIV infection	1	0.34
Tracheal trauma	1	0.34
Caustic soda ingestion	1	0.34
Advanced maxillary carcinoma	1	0.34
Mid-facial trauma	1	0.34
Head injury from RTA	1	0.34
Ludwig's angina	1	0.34
Lymphoproliferative disease	1	0.34
Teratoma	1	0.34

children tend to explore and place objects in their mouths with attendant risk of foreign body aspiration owing to their immature protective mechanisms. It is not as common in adults. Inhalation of foreign bodies in adults is generally found in those with underlying disease. Adults may also inhale foreign bodies

when asleep, drunk or under general anaesthesia for dental extraction. Inhalation of foreign bodies have also been reported in healthy adults [5] [6]. Foreign body inhalation leads to significant morbidity and mortality in any age group. In children it is an acute emergency [7] [8] and the presentation could be alarming in some cases. Delay in diagnosis is associated with increased morbidity and mortality [9] [10] [11] warranting vigilance and caution. Rigid bronchoscopy was the main stay of intervention done. It is often performed for both definitive diagnosis and treatment because of the risks of over looked foreign body aspiration, even when there is little suspicion or doubtful history [9] [11] [12] [13] [14]. Laryngeal cancer (32.00%) was the leading neoplasm in the study associated with upper airway obstruction and was seen typically in adults. The airway compromise was relieved with tracheostomy. Patients who require a tracheostomy before management of their laryngeal cancer have worse outcomes than those who have the procedure after management [15] [16]. Various other tumours were encountered, of note were two cases (0.69%) of adenotonsillar hypertrophy. Enlarged adenoids and tonsils can cause chronic upper airway obstruction that may result in a spectrum of clinical findings ranging from sleep apnoea syndrome to cor-pulmonale and heart failure. The clinical findings associated with this entity are reversible if the condition is identified early and the removal of the obstructing tissue is performed before life-threatening changes occur. When the obstruction becomes acute death may occur if not attended to urgently. Retropharyngeal abscess (1.03%) and Ludwig's angina (0.34%) were among the infective causes in the series. Patients with Ludwig's angina have bilateral infection of the sublingual and submandibular spaces and present with submental and submandibular induration, cellulitis, and swollen and tender floor of the mouth, resulting in a posteriorly displaced tongue. This displacement ultimately leads to obstruction at the level of the oropharynx and supraglottis which can be life threatening. The most common causes of Ludwig's angina are dental infections, sialadenitis, peritonsillar abscess, parapharyngeal abscess, traumatic injuries to the oral cavity, and mandibular fractures in that order. The standard treatment involves securing the airway followed by formal incision and drainage of the sublingual and submandibular spaces. Conservative management with intravenous antibiotics as practiced in some quarters is associated with a risk of airway compromise almost 10 times as high as that in patients who received early surgical drainage (26.3% vs 2.9%) [17]. Vocal cord paralysis constituted 5.50% of the causes of acute upper airway obstruction in the study. In paralysis of the vocal cord, the vocal cords fail to adequately abduct. Bilateral vocal cord paralysis can result from tumour infiltration of the larynx or both recurrent laryngeal nerves, prolonged intubation or placement of nasogastric tube, and infections and pathologic conditions affecting the brain stem. Vocal cord paralysis can also result from complications during thoracic and anterior neck surgeries. Patients can cope with a narrowed airway for some time, but further diminution of the airway caliber, with inflammatory insults such as

viral infection, may lead to airway compromise. For this circumstance, a tracheostomy should be considered while the assessment for recovery is pending. Laryngeal 1.37% and subglottic 0.69% stenosis were also encountered in the study. Cases of subglottic or glottic stenosis are rare and challenging; they most often result from prolonged or traumatic intubation but may also be congenital or idiopathic. Patients with granulomatosis polyangiitis and relapsing polychondritis may also present with subglottic stenosis [18] [19]. Mucosal inflammation and localized fibrosis are the main pathological features of the disease. Diagnosis is confirmed by means of laryngoscopy and bronchoscopy. Standard treatment involves dilation of the airway; use of lasers to radially incise the stenosis or pressure-controlled balloons to dilate the stenosis are commonly used as adjunct. Some surgeons consider injection of glucocorticoids or the topical application of mitomycin. Neither the surgical technique used nor the grade of stenosis alters the surgical intervals; however, mitomycin application is associated with extension of the periods between subsequent endoscopic treatment [20]. Although in-office glucocorticoid injections have been studied, long-term outcomes have not yet been reported [21] [22]. Thyroid tumour was not left out; constituted 1.03%. Benign tumours of the thyroid, particularly when they extend substernally, can lead to substantial subglottic and tracheal deviation and compression. In rare instances, thyroid cancers invade the airway, leading to both an extrinsic compression effect and an intrinsic narrowing related to intraluminal disease. Trauma such as blunt laryngeal trauma 1.03%, tracheal trauma 0.34% and cut throat injury 1.03% were encountered. Traumatic injury to the airway can be open (penetrating) or closed (blunt). Classic signs of and symptoms of a major injury after open or closed neck trauma include a sucking or bubbling neck wound, pharyngeal bleeding, a large or expanding haematoma, subcutaneous emphysema, dysphagia, dysphonia, and stridor. Vascular, pharyngeal, and laryngotracheal injuries are managed simultaneously and require the expertise of a multidisciplinary team, preferably in a specialized trauma center [23]. Interestingly, cases in the series were effectively stabilized and properly positioned for the definitive management of the pathologies that led to their airway compromise.

5. Conclusion

Cases of acute upper airway obstruction are fairly common in our facility. All age groups and gender were involved. A variety of aetiologies were responsible with foreign body aspiration or inhalation topping the list and closely followed by laryngeal carcinoma. Patients with aerodigestive neoplasms especially laryngeal carcinoma had tracheostomy to relieve their airway compromise prior to definitive treatment. It is advocated that parents and care givers closely monitor children and regulate the objects made available to them to reduce cases of foreign body aspiration among them. Adults with airway complaints or symptoms no matter how trivial should present early to the appropriate personnel for proper

evaluation and diagnosis to reduce the morbidity and mortality that accompany late presentation. Clinicians should brace up and be ready to tackle a variety of causes of airway obstruction.

Conflicts of Interest

The authors declare that there are no conflicts of interests.

References

- [1] Golzari, S.E., Khan, Z.H., Ghabili, K., Hamzeh, H.Z., Hassen, S., Rasoul, A., Ata, M., *et al.* (2013) Contributions of Medieval Islamic Physicians to the History of Tracheostomy. *Anesthesia & Analgesia*, **116**, 1123-1132. <https://doi.org/10.1213/ANE.0b013e3182884313>
- [2] Szmuk, P., Ezri, T., Evron, S., Roth, Y. and Katz, J. (2008) A Brief History of Tracheostomy and Tracheal Intubation, from the Bronze Age to the Space Age. *Intensive Care Medicine*, **34**, 222-228. <https://doi.org/10.1007/s00134-007-0931-5>
- [3] Mattila, T., Vasankari, T., Rissanen, H., Knekt, P., Puukka, P. and Heliövaara, M. (2018) Airway Obstruction and the Risk of Myocardial Infarction and Death from Coronary Heart Disease: A National Health Examination Survey with a 33-Year Follow-Up Period. *European Journal of Epidemiology*, **33**, 89-98. <https://doi.org/10.1007/s10654-017-0278-3>
- [4] Lévy, P., Kohler, M., McNicholas, W.T., McEvoy, R.D., Somers, V.K., Lavie, L., *et al.* (2015) Obstructive Sleep Apnoea Syndrome. *Nature Reviews Disease Primers*, **1**, Article No. 15015. <https://doi.org/10.1038/nrdp.2015.15>
- [5] Limper, A.H. and Prakash, M.B.S. (1990) Tracheobronchial Foreign Bodies in Adults. *Annals of Internal Medicine*, **112**, 604-609. <https://doi.org/10.7326/0003-4819-112-8-604>
- [6] Matsuse, H., Shimoda, T., Kawano, T., Fukushima, C., Mitsuta, K., Obase, Y., Toman, S., *et al.* (2001) Airway Foreign Body with Clinical Features Mimicking Bronchial Asthma. *Respiration*, **68**, 103-105. <https://doi.org/10.1159/000050473>
- [7] Banerjee, A., Subba Rao, K.S.V.K., Khanna, S.K., Narayanan, P.S., Gupta, B.K., Sekar, J.C., *et al.* (1988) Laryngotracheobronchial Foreign Bodies in Children. *The Journal of Laryngology & Otology*, **102**, 1029-1032. <https://doi.org/10.1017/S0022215100107170>
- [8] Anyanwu, C.H. (1985) Foreign Body Airway Obstruction in Nigerian Children. *Journal of Tropical Pediatrics*, **31**, 170-173. <https://doi.org/10.1093/tropej/31.3.170>
- [9] Sersar, S.L., Rizk, W.H., Bila, M., El Daisty, M.M., Eltantawy, T.A., Abdelhakam, B.B., *et al.* (2006) Inhaled Foreign Bodies: Presentation, Management and Value of History and Plain Chest Radiography in Delayed Presentation. *Otolaryngology-Head and Neck Surgery*, **134**, 92-99. <https://doi.org/10.1016/j.otohns.2005.08.019>
- [10] Reilly, J., Thompson, J., MacArthur, C., Pransky, S., Besk, D., Smith, M., *et al.* (1997) Pediatric Aerodigestive Foreign Body Injuries Are Complications Related to Timeliness of Diagnosis. *The Laryngoscope*, **107**, 17-20. <https://doi.org/10.1097/00005537-199701000-00006>
- [11] Mu, L., He, P. and Sun, D. (1991) The Causes and Complications of Late Diagnosis of Foreign Body Aspiration in Children Report of 210 Cases. *Arch Otolaryngology-Head and Neck Surgery*, **117**, 876-879. <https://doi.org/10.1001/archotol.1991.01870200070010>
- [12] Karakoc, F., Karadağ, B., Akbenlioğlu, C., *et al.* (2002) Foreign Body Aspiration:

- What Is the Outcome? *Pediatric Pulmonology*, **34**, 30-36.
<https://doi.org/10.1002/ppul.10094>
- [13] Pinzoni, F., Boniotti, C., Molinaro, S.M., Baraldi, A. and Berlucchi, M. (2007) Inhaled Foreign Bodies in Pediatric Patients: Review of Personal Experience. *International Journal of Pediatric Otorhinolaryngology*, **71**, 1897-1903.
<https://doi.org/10.1016/j.ijporl.2007.09.002>
- [14] Heyer, C.M., Bollmeier, M.E., Rossler, L., Nuessleir, T.G., Stephan, V., Bauer, T.T., et al. (2006) Evaluation of Clinical, Radiologic, and Laboratory Prebronchoscopy Findings in Children with Suspected Foreign Body Aspiration. *Journal of Pediatric Surgery*, **41**, 1882-1888. <https://doi.org/10.1016/j.jpedsurg.2006.06.016>
- [15] Semdaie, D., Haron, F., Casiraghi, O., Bidaull, F., Temam, S., Janot, F., et al. (2018) Laser Debulking or Tracheostomy in Airway Management Prior to Total Laryngectomy for T4a Laryngeal Cancer. *European Archives of Oto-Rhino-Laryngology*, **275**, 1869-1875. <https://doi.org/10.1007/s00405-018-4994-4>
- [16] Du, E., Smith, R.V., Ow, J.J., Tassler, A.B. and Schiff, B.A. (2016) Tumor Debulking in the Management of Laryngeal Cancer Airway Obstruction. *Otolaryngology-Head and Neck Surgery*, **155**, 805-807. <https://doi.org/10.1177/0194599816661326>
- [17] Edetanlen, B.E. and Saheeb, B.D. (2018) Comparison of Outcomes in Conservative versus Surgical Treatments for Ludwig's Angina. *Medical Principles and Practice*, **27**, 362-366. <https://doi.org/10.1159/000490740>
- [18] Ugan, Y., Dođru, A., Aynali, G., Sahim, M. and Tunç, Ş.E. (2018) A Clinical Threat in Patients with Granulomatosis Polyangiitis in Remission: Subglottic Stenosis. *European Journal of Rheumatology*, **5**, 69-71.
<https://doi.org/10.5152/eurjrheum.2017.16025>
- [19] Childs, L.F., Rickert, S., Wengerman, O.C., Lebovics, R. and Blitzer, A. (2012) Laryngeal Manifestations of Relapsing Polychondritis and a Novel Treatment Option. *Journal of Voice*, **26**, 587-589. <https://doi.org/10.1016/j.jvoice.2011.07.012>
- [20] Feinstein, A.J., Goel, A., Raghavan, G., Long, J., Chhetri, D.K., Berke, G.S. and Mendelsohn, A.H. (2017) Endoscopic Management of Subglottic Stenosis. *JAMA Otolaryngology-Head and Neck Surgery*, **143**, 500-505.
<https://doi.org/10.1001/jamaoto.2016.4131>
- [21] Hoffman, M.R., Coughlin, A.R. and Dailey, S.H. (2017) Serial Office-Based Steroid Injections for Treatment of Idiopathic Subglottic Stenosis. *The Laryngoscope*, **127**, 2471-2481. <https://doi.org/10.1002/lary.26682>
- [22] Franco Jr., R.A., Husan, I., Reder, L. and Padle, P. (2018) Awake Serial Intralesional Steroid Injection without Surgery as a Novel Targeted Treatment for Idiopathic Subglottic Stenosis. *Laryngoscope*, **128**, 610-617. <https://doi.org/10.1002/lary.26874>
- [23] Jain, U., McCunn, M., Smith, C.E. and Pitt, J.F. (2016) Management of Traumatized Airway. *Anesthesiology*, **124**, 199-206.
<https://doi.org/10.1097/ALN.0000000000000903>