Abstract

Ludwig’s angina, although uncommon, remains a potentially life-threatening condition because of the risk of impending airway obstruction. Effective treatment is based on early recognition of the clinical process, with the appropriate use of parenteral antibiotics, securing the airway, and formal surgical drainage of the infection. Awake fiberoptic intubation under topical anesthesia may be the preferred method to secure the airway. Flexible nasotracheal intubation requires skill and experience. When fiberoptic bronchoscopy is not feasible, not available, or has failed, an elective awake cricothyrotomy and tracheostomy are the options. Furthermore, the introduction of newer advanced airway techniques, such as video-assisted laryngoscopy, may allow the clinician additional flexibility in nonsurgical airway management. We present a recent case of a patient with Ludwig’s angina, successfully managed at our hospital, with a brief review of airway management options.

Keywords: Ludwig’s angina, complications, airway management.
Introduction

LA is a known, yet an uncommon surgical emergency that is potentially life threatening unless early recognized and aggressively treated, requiring immediate interventions. Potentially life-threatening complications have been reported to occur at a rate of 10-20%, even in recent literature on LA cases. Despite a reduction in mortality rates that exceeded 50% prior to the development of antibiotics, LA remains a potentially lethal entity primarily because of rapidly progressive airway obstruction. As a result of antibiotic therapy, along with improved imaging modalities and surgical techniques, mortality currently averages approximately 8-10%.

Airway management in patients with Ludwig’s angina is of the utmost importance and remains challenging. The choice of the safest technique is not yet determined and should be based on clinical signs and stage of LA, technical conditions available and mainly on clinical experience. We present a recent case of a patient with advanced stage Ludwig’s angina, successfully managed at our hospital, with a brief review with emphasis on airway management options.

Case Report

A 35 years old male (73 Kg, 179 cm, BMI 23 kg/m²), presented to the emergency department of our tertiary university hospital complaining of inability to open the mouth, mouth pain, neck pain and inability to swallow. From history he reported that he was symptomatic for three days prior to admission with progressive swelling in the neck, mouth pain especially with tongue movement and reduced mouth opening. He was on treatment with oral antibiotics (amoxicillin 500 mg orally 3 times a day) taken the first two days. He was able to swallow only small quantity of water but no solid food for the last two days due to progressive increased difficulty and eventually inability in swallowing. For this reason on the third day no antibiotic was received.

On physical examination, the patient was anxious and uncomfortable because he could not tolerate at all the supine position. He had hoarse voice with moderate degree of stridor and respiratory distress. His body temperature was 38.9°C with a pulse rate of 120 beats per minute, blood pressure of 135/85 mmHg, oxyhemoglobin saturation 94% on room air and respiratory rate of 26 breaths per minute. There was a diffuse, indurated, nonfluctuant, large neck swelling with bilateral involvement of the submental and particularly the submandibular area, elevating his tongue upwards and buckwards. On airway examination, there was trismus and severely restricted mouth-opening, with an interincisor gap of 1 cm. Neck extension was painful and limited. Both the nares were patent and the trachea was palpable in the lower part of the neck. A blood sample was sent for culture and neck CT scan was ordered. However, preoperative CT scan was not possible since the patient could not remain in the supine position. From the laboratory findings white blood count was 26,800/mm³. Except for being smoker, otherwise the patient was not known to have any medical illness and was classified as ASA physical status IIIIE. A clinical diagnosis of Ludwig’s angina was made and he was scheduled for emergency surgical decompression.

A nasotracheal awake fiberoptic intubation (AFOI) was planned, with tracheostomy as a backup. This procedure was explained to the patient and written informed consent was obtained for AFOI and possible tracheostomy. Both nasal passages were inspected and clinically examined by asking the patient to expire through each nostril separated and the best was selected for intubation.

In the operating theater, the patient could not tolerate at all the supine position because it precipitated to complete airway obstruction. For this reason he was put in semisitting (Fowler’s) position at 60° and the anesthetist with the fiberscope (FB) standing on the right side of the patient. Patient was advised to be cooperative as possible. Electrocardiography, noninvasive blood pressure, and pulse oximetry were monitored. Intravenous (IV) access was obtained and an infusion of Ringer’s Lactate started. An antisialagogue (glycopyrrolate 200mcq) and dexamethasone 16mg were administered IV, to reduce upper airway edema and improve the view. Antibiotic treatment started and included IV penicillin and clindamycin. No sedative or opioid agent was administered. The surgical team was
in the operating room ready and gowned for emergency cricothyrotomy in case of acute airway loss.

For the nasotracheal intubation, the selected nostril was prepared with 0.1% xylometazoline drops for nasal decongestion prior to topical anesthesia of the airway. Additionally, using a thin forceps a small wet gauze soaked with phenylephrine solution 0.5% was pushed into the selected nostril as far as possible and remained for almost 4-5min. Then the gauze was removed and the nostril was anesthetized with puffs of 10% lidocaine spray. Patient was asked to take slow regular deep breaths through nose to facilitate distribution of local anesthetic spray. The posterior pharynx airway was topically treated with 4% lignocaine gargle and 10% lignocaine spray puffs applied to the base of the tongue and the oropharyngeal mucosa. A transtracheal cricothyroid puncture performed with 2 ml 2% lignocaine, to anesthetize the infraglottic stuctures. Thorough suctioning of the posterior pharynx was performed before starting the AFOI.

For nasal intubation, the tube-first technique was used. A straight reinforced tracheal tube 6.5mmID, was placed in a warm fluid (normal saline 0.9%) to make it more pliable. Then it was lubricated and was gently passed through the prepared nostril into the pharynx. The FB was passed through the endotracheal tube to the posterior pharynx. Thick copious and purulent secretions were suctioned. The trachea was identified on the second attempt, with the vocal cords surrounded by soft tissue edema and the FB was further advanced until carina was visualized. The endotracheal tube was then advanced into the trachea. After confirmation of tracheal intubation by fiberoptic viewing of tube tip inside the trachea and end-tidal carbon dioxide in capnography, anesthesia was induced with fentanyl 100 mcg, propofol 120 mg and cisatracurium 12 mg. Anesthesia was maintained with nitrous oxide in oxygen and sevoflurane and was subsequently uneventful. The patient was dehydrated and received 2 l of crystalloids.

After the surgery and due to the periglottic edema, the patient remained intubated and transferred mechanically ventilated to the intensive care unit. The next morning the patient was comfortable, with a pulse rate of 74 beats per minute, blood pressure of 120/70 mmHg and oxyhemoglobin saturation of 98%. The neck swelling had subsided. A thorough oral examination was performed with the fibrescope. There was no periglottic edema and the trachea was extubated. Post-extubation recovery was uneventful.

![Fig. 1](image)

*Fig. 1*
Right-sided postoperative CT scan. Submental surgical incision. Note the existing sublingual edema.
The same day it was possible to get a CT scan from the neck (fig. 1, 2). The patient was discharged 4 days later.

**Discussion**

Ludwig’s angina (LA) is a rapidly progressive bilateral infection of the floor of the mouth which starts in either the submaxillary or the sublingual spaces and then involves the loose connective tissue filling the areas between the three layers of deep cervical fascia and disseminates to entire submandibular space. It begins as a cellulitis, then turns into fasciitis, and finally becomes a true abscess. The infection can also spread contiguously to involve the pharyngomaxillary and retropharyngeal spaces, thereby encircling the airway.

The symptoms of Ludwig’s angina vary depending on the patient and the degree of infection. Most common symptoms on admission are, neck pain followed by neck swelling, throat pain, fever, dysphagia and respiratory distress. Since this entity is uncommon, unnecessary delay in diagnosis and management may occur and may result in serious complications. If left untreated and depending on the virulence of the causative pathogen as with any bacterial infection, sepsis may occur. Without immediate treatment, the submandibular infection may also rapidly spread to the mediastinal or pharyngomaxillary spaces. An unsuspecting physician may underestimate an initially localized infection, which could rapidly present as airway collapse or descending mediastinitis.

The most life-threatening complication of LA is the complete airway obstruction and asphyxia, caused by expanding edema of soft tissues of the neck along with the enlargement, elevation and posterior displacement of the tongue. Cases of hypoxic cardiac arrest have been reported as a result of acute airway compromise, hypoxic obtundation, with resultant

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**Fig. 2**

*Left-sided postoperative CT scan. Sublingual and submandibular surgical incisions.*
inability to secure an airway\(^1,38\). Another common cause of death is the acute loss of airway during airway management interventions\(^1,13,14,38\). In a recent study the rate of death related to acute airway compromise or infection-related consequences was 11.8\%\(^1\).

Diagnostic sensitivity of clinical examination alone is 55\%\(^15\). In less urgent cases, contrast CT may increase this to 95\%\(^14\). A contrast computed tomography scan is the most appropriate imaging tool, not only for the diagnosis of deep neck space infections, but also to show the extent of disease\(^1-5\). However, this was not possible in our case due to inability of the patient to lie supine. In cases of significant airway compromise where an immediate decision regarding the need of a definitive airway is required, clinical experience and judgment are superior to imaging.

In the early stages the disease begins as a mild infection and in selected patients, a trial of intravenous targeted or broad-spectrum empiric antibiotic therapy, associated with an intensive contrast computed tomography scan-based wait-and-watch policy, may avoid an unnecessary surgical procedure\(^16-18\). However, widespread diffusion of empirical broad-spectrum oral antibiotic and anti-inflammatory treatments may cause masked presentations of deep neck infections without swelling, fever, or leukocytosis\(^19\). It is important to remember, that when dealing with LA antibiotic coverage alone will rarely manage the infection, and the prognosis only improves with combined surgical and pharmacological management\(^1,4,21-23\). Therefore, surgical intervention is required in the majority of LA cases (80\%-100\%)\(^2,4,19,21\).

Moreover, about 25\% of patients present significant comorbidities, which may negatively affect the course of the infection\(^14\). In these cases and in patients in advance stage with large or multiple spaces infections, a more aggressive surgical strategy is mandatory. The aggressive surgical intervention, the antibiotic introduction along with improved imaging modalities and the improvement of dental care, have determined a significant reduction of the mortality rate from 50\% to currently averages approximately 8\%-23\%-25\%. However, in a recent study deaths related to acute airway compromise or infection-related consequences were at a rate of 11.8\%\(^1\).

Airway compromise due to LA usually originates from parapharyngeal or retropharyngeal edema giving rise to supraglottic obstruction\(^1,4,5\). In advanced stage, like in our case, the patient can’t tolerate the supine position because it precipitates complete airway obstruction. The patient presented with severe dysphagia, trismus, hoarse voice, stridor and sitting posture, which are late signs of impending airway obstruction and indicate the need for an immediate airway management\(^1,4,5\).

Therefore, airway management is crucial and the primary therapeutic concern\(^1,4,6,9,13\). The maintenance of a secure airway is a challenging task both for the anesthesiologist and surgeon. Various techniques are available to secure the airway. However, crucial factors in the decision making for specific airway management techniques are the stage of the infection, degree of distorted anatomy, and the experience of the practitioner. The success and safety of these techniques in patients with LA have not yet been established. Sound clinical judgment is critical for timing and for selecting the appropriate method for airway intervention.

Classically, elective awake tracheostomy has been suggested as the standard of care for establishment of a definitive airway for all patients with LA, in order to avoid the dangers of emergency tracheostomy in a severely compromised airway\(^13,26,27\). In the recent literature elective awake tracheostomy was performed in more than 50\% of LA cases, while the range varies between 5\%-65.6\%, depending on the stage of the disease\(^1-5,9,13,14\).

However, others have advocated that tracheostomy should be avoided where possible, due to a connection between the fascial spaces which may lead to the pretracheal space being involved, with possible spread of infection further inferiorly into the chest\(^14,28\). Additionally, others have challenged the value of surgical airway\(^16-18\). Moreover, tracheostomy may be technically difficult or impossible in advanced cases of infection, because of the position needed for tracheostomy or because of anatomical distortion of the anterior neck or patient’s inability to lie supine, like in our case\(^13,25,28\). In several studies, there has been a trend toward decreased need for immediate airway control by endotracheal intubation or tracheostomy\(^16,17,30\). However, large retrospective series have underlined the catastrophic outcome of the progressive nature
of the LA that may lead to sudden oropharyngeal obstruction\textsuperscript{1,2,4,13,21}.

Awake fiberoptic intubation (AFOI) using topical anesthesia has now been recommended as the first choice for airway control in adult patients with deep neck infections including Ludwig’s angina\textsuperscript{6}. Otorrhagin AFOI, has been reported successfully in patients with LA\textsuperscript{6,16}. The nasal AFOI seems to be more suitable in those patients with trismus and restricted mouth opening or those with inability to lie supine\textsuperscript{6,16,31}. The flexibility and versatility of fiberoptic endoscopy allows dynamic assessment of the airway anatomy in the supraglottic and subglottic region in an atraumatic fashion. Adequate preparation and application of local anesthesia enables the patient to tolerate the procedure with greater comfort. Tissue edema and immobility, the distorted airway, copious and purulent secretions, common in patients with LA, may contribute to the difficulty of fiberoptic intubation\textsuperscript{6,31}. Although AFOI is associated with low success rate\textsuperscript{32-34}, more often the failure to intubate is caused by inadequate preparation of the patient, use of a poor-quality fiberscope, and inadequate experience with the procedure\textsuperscript{6,54}. The necessary equipment may not be fully understood, or it may not be available when needed. National incident reporting systems show that unavailability of equipment and user error, were common reasons for reporting critical equipment-related incidents\textsuperscript{35-37}. However, in skilled and experienced hands, awake nasal fiberoptic intubation is the preferred method of airway management in patients with LA, associated with high success rate\textsuperscript{6}.

In one LA case, a supraglottic airway device was used as a guide for AFOI\textsuperscript{38}. However, the use of supraglottic airway devices is not indicated in patients with upper airway obstruction. Alternatively, fiberoptic intubation following general anesthesia induction and muscle paralysis is not recommended in patients with LA, since it can cause the collapse of the airway and inability to mask ventilate due to anatomical distortion.

In our case, no sedative or opioid was given during the awake nasal fiberoptic intubation. It is our strong belief, based on adequate evidence along with experience, that even minimal doses of sedatives or opioids, may contribute in losing the fragile balance in the critical muscle tone in upper airway and may precipitate complete airway closure and make mask ventilation and intubation impossible\textsuperscript{39,41}. Securing the airway in the fully awake state is therefore the safest option.

Conventional orotracheal intubation under general anesthesia in patients with LA is challenging\textsuperscript{1,2,4,16}. The distorted airway anatomy, tissue immobility, and limited access to the mouth make orotracheal intubation with conventional laryngoscopy difficult or impossible\textsuperscript{13,14,23,42}. The edema of the tongue and mouth and trismus are the most common obstacles for an oral intubation. In the early stages of the disease, general anesthesia and muscle relaxants may overcome trismus and allow the mouth to be opened for successful conventional laryngoscopy\textsuperscript{1,16,42,43}. However, in advanced cases, the induction of general anesthesia is very dangerous, because it may precipitate to complete airway closure and make face mask ventilation and tracheal intubation impossible (“Can’t intubate, can’t ventilate” situation), thus necessitating emergency tracheostomy\textsuperscript{13,14,23}. The reported failure rate in a large retrospective review was disappointingly high (55%)\textsuperscript{2}. Rupture of an abscess and aspiration of pus have been reported during an attempted orotracheal intubation under general anesthesia\textsuperscript{19,23}.

Inhalational induction in patients with LA has been reported\textsuperscript{42,43}. However, this technique is not recommended since it may result in complete airway obstruction, as a result of relaxation and collapse of pharyngeal muscles or coughing in the light stages of anesthesia.

Moreover, blind nasal intubation has been reported in patients with LA\textsuperscript{6}. However, this technique is to be avoided as, besides having a high failure rate, it could cause catastrophic bleeding, laryngospasm, airway edema, rupture of pus into the oral cavity, and aspiration\textsuperscript{2,13,20}. Complete airway obstruction could be precipitated, potentially necessitating an emergency cricothyrotomy\textsuperscript{2,13,20}.

Depending on the life-saving time required and the emergency situation, transtracheal access and subsequent jet ventilation are among the last options in a ‘cannot intubate-cannot ventilate’ scenario\textsuperscript{44}.

All studies, regardless of the approach to airway management recommended, reinforce the importance of careful airway management through
good clinical judgment and adequate experience. The introduction of newer advanced airway techniques, such as video-assisted laryngoscopy, may allow the clinician additional flexibility in nonsurgical airway management. Video-assisted laryngoscopy has an upgraded role during the recent airway management guidelines and has used successfully in patients with anticipated and unanticipated difficult airway. Additionally, it has been used successfully in one patient with LA. When compared with the AFOI, it has been reported that the videolaryngoscopy technique is an acceptable alternative and has a comparable success rate. Furthermore, video-assisted laryngoscopy is becoming widely used and thus is gaining the advantage of familiarity and experience, where the stress of using unfamiliar equipment is more keenly felt. Videolaryngoscopes are also easier available especially in an emergency situation, cheaper and more versatile, allowing use in a greater number and wider variety of patients.

In conclusion, Ludwig’s angina, although uncommon, remains a potentially life-threatening condition because of the risk of impending airway obstruction. Effective treatment is based on early recognition of the clinical process, with the appropriate use of parenteral antibiotics, airway management, and formal surgical drainage of the infection. In advanced cases, securing the airway is of the utmost importance and remains challenging. Awake fiberoptic nasotracheal intubation under topical anesthesia may be the preferred method to secure the airway. However, it requires skill and experience. When fiberoptic bronchoscopy is not feasible, not available, or has failed, an elective awake cricothyrotomy and tracheostomy are the options. Furthermore, the introduction of newer advanced airway techniques, such as video-assisted laryngoscopy, may allow the clinician additional flexibility in nonsurgical airway management.
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1. BRIDION Summary of Product Characteristics (SPC).

Please see summary of product characteristics for full prescribing information.

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