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STRUCTURED AIRWAY MANAGEMENT AND EVIDENCE-BASED EXTUBATION STRATEGY FOR LUDWIG'S ANGINA

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ABSTRACT

Ludwig's angina is a rapidly advancing infection affecting the submandibular, sublingual, and submental spaces, posing a significant risk of airway obstruction. Prompt airway management and an appropriate extubation strategy are essential to prevent life-threatening complications. We report on a 20-year-old male patient who developed worsening neck swelling, swallowing difficulties, and respiratory issues as a result of untreated dental cavities. Upon examination, submandibular cellulitis and posterior tongue displacement were observed. Laboratory results showed leukocytosis, thrombocytopenia, and hypoalbuminemia, indicating a systemic inflammatory response. Based on the clinical and laboratory evidence, a diagnosis of Ludwig's angina complicated by sepsis was established. To ensure airway patency, awake fiber-optic intubation was conducted, followed by the commencement of mechanical ventilation. Intravenous administration of ceftriaxone and metronidazole was employed as empirical therapy to address both aerobic and anaerobic bacterial infections. The patient received care in the intensive care unit (ICU), where continuous monitoring and sedation were maintained. On the eighth day, extubation was successfully performed after confirming a positive cuff leak test, the absence of further edema, and stable respiratory function. The patient achieved full recovery without necessitating a tracheostomy or additional corticosteroid treatment. This case study demonstrates the successful conservative management of Ludwig's angina in a young adult, facilitated by prompt airway intervention, comprehensive multidisciplinary care in the intensive care unit (ICU), and a carefully planned extubation strategy. It emphasizes the critical role of personalized, evidence-based protocols in addressing complex airway infections and supports the application of non-surgical methods when guided by objective criteria.

***Keywords*:** Ludwig's angina, airway management, fiber-optic intubation, extubation strategy, sepsis

1. INTRODUCTION

Ludwig's angina is a swiftly advancing, potentially fatal infection that affects the sublingual, submental, and submandibular regions, often stemming from dental infections. This condition leads to widespread cellulitis and swelling in the neck and the floor of the mouth, significantly increasing the risk of airway obstruction due to tongue displacement and edema.[1] Despite progress in medical treatments, the condition continues to have a high mortality rate, mainly due to airway compromise or the spread of infection to the mediastinum.[2]

Effective management of the airway is vital to prevent respiratory distress and death. However, the presence of extensive edema and altered anatomy complicates standard intubation procedures, often necessitating advanced methods such as fiber-optic intubation or tracheostomy for securing the airway.[3] In such cases, extubation requires meticulous evaluation to prevent complications like reintubation or respiratory failure.[4]

This report presents the case of a young adult with Ludwig's angina resulting from untreated dental caries. It underscores a systematic approach to postoperative airway management and extubation, highlighting the importance of criteria-based protocols to ensure patient safety. Through this case, we aim to demonstrate the essential role of timely, evidence-based interventions in enhancing outcomes for patients facing complex airway challenges.[5]

2.CASE PRESENTATION

A 20-year-old male with untreated dental caries in the right lower molar presented with progressive neck swelling, dysphagia, and respiratory distress over ten days. He developed fever and purulent neck discharge a day before admission.

On examination, he was febrile and tachypneic with oxygen saturation of 98% on nasal cannula. He had bilateral swelling, erythema, and tenderness extending to the clavicle, accompanied by posterior tongue displacement due to sublingual edema, indicating imminent airway obstruction. Figure 2 illustrates the patient's preoperative condition with severe submandibular swelling and erythema and postoperative improvement following therapy.

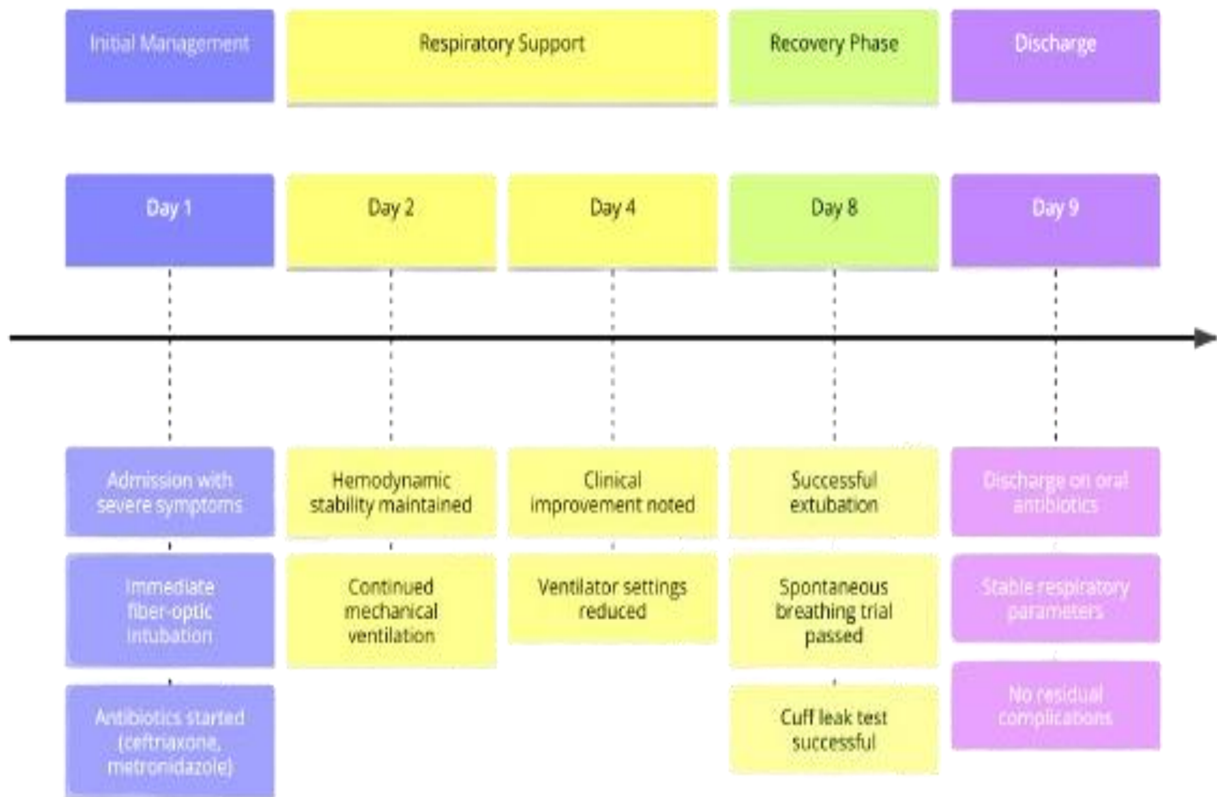

Figure 1. Case Report Timeline

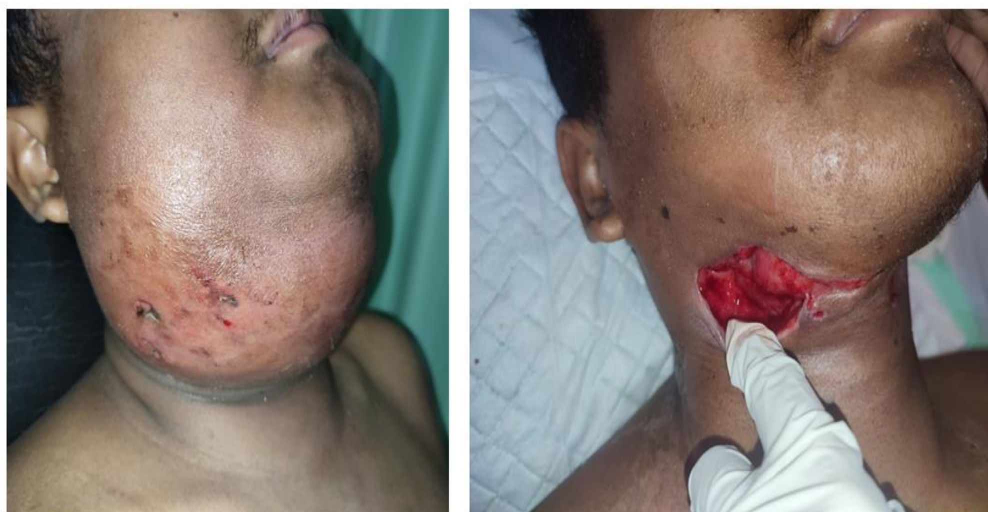

Figure 2. Preoperative (Left) and Postoperative (Right) Images of a Patient with Ludwig's Angina

Clinically, increased respiration rate >22 breaths/minute alone cannot fulfil sepsis suspicion as it scored 1 on qSOFA score. But laboratory result revealed leukocytosis, thrombocytopenia, reduced p/f ratio of 300, and elevated level of both creatinine and bilirubin level. This finding supported the diagnosis of sepsis as it scored 5 in Sequential Organ Failure Assessment (SOFA) along with clear site of infection. The patient was diagnosed with Ludwig's angina complicated by sepsis. Preoperative neck radiographs (see Figure 3) confirmed submandibular swelling and airway narrowing, while chest radiographs excluded mediastinal spread or pulmonary involvement.

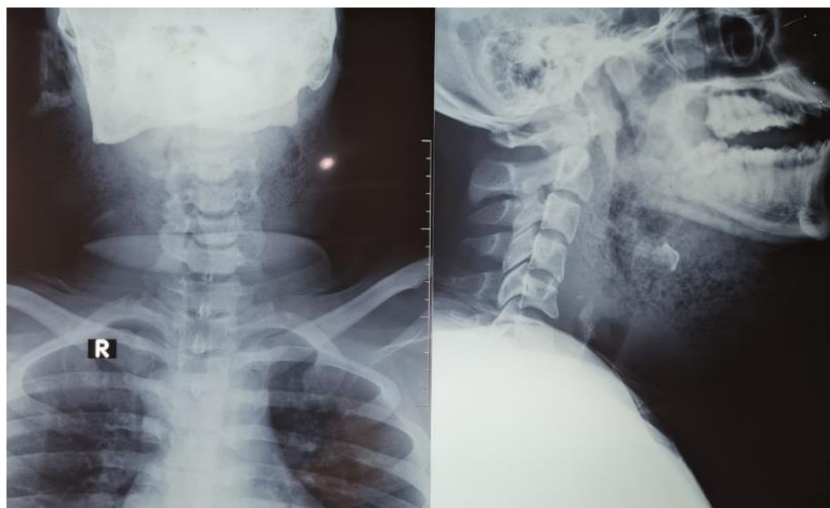

Figure 3. Preoperative Lateral and Anteroposterior Radiographs Showing Submandibular Soft Tissue Swelling in Ludwig's Angina

Patient then planned to have urgent surgical incision and abscess drainage. Airway management was initiated using awake fiber-optic intubation, deemed safest due to extensive edema and anatomical distortion. The patient was placed on mechanical ventilation and started on intravenous ceftriaxone and metronidazole to target both aerobic and anaerobic pathogens. Empirical antibiotic selection was based on literature showing high efficacy against Streptococcus viridans, Staphylococcus aureus, and anaerobic oral flora, which are commonly involved in Ludwig's angina. Streptococcus constellatus and Porphyromonas asaccharolytica were identified from abscess's tissue culture, and both were sensitive to ceftriaxone and metronidazole, which then continued for the next seven days.
Continuous intensive care unit monitoring was performed, including invasive blood pressure measurement, electrocardiography, pulse oximetry, and serial arterial blood gas analyses. Hemodynamic status, urine output, and neurological function (via GCS) were monitored every 2–4 hours. Ventilator parameters, including tidal volume, PEEP, FiO_2, and peak airway pressure, were adjusted daily.
Sedation was maintained using intravenous midazolam (2–5 mg/hour) and fentanyl infusion (30-50 mcg/hour) with Richmond Agitation Sedation Scale (RASS) targets of -1 to -3 to ensure patient-ventilator synchrony while avoiding oversedation. Opioids were given for the first 24 hours then continued with intravenous ibuprofen and paracetamol. Daily sedation interruption was performed to assess neurological recovery.
On the second day of admission, the patient remained hemodynamically stable. Although neck swelling persisted, it showed no progression. The patient was managed with intravenous fluids and head elevation to reduce airway edema. No diagnostic or logistical challenges were encountered.

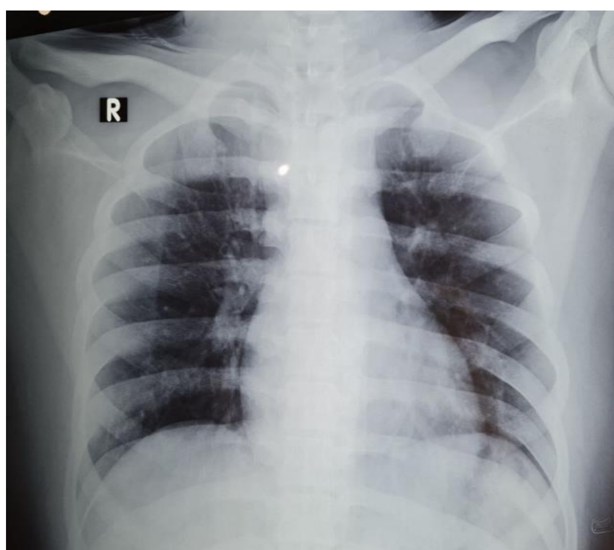

Figure 4. Chest Radiograph Showing Normal Lung Fields and Mediastinum in a Patient with Ludwig's Angina

By the fourth day, infection signs improved, allowing gradual reduction of ventilatory support with oxygen saturation stable at 97%. Daily airway and ventilatory assessments guided a smooth weaning process without complications.

On the eighth day, a successful cuff leak test confirmed minimal airway edema, supporting extubation readiness. The extubation strategy was based on a multi-criteria protocol including: improvement in inflammatory markers, adequate mental status (GCS 15), ability to tolerate spontaneous breathing trials for more than 2 hours with minimal ventilator support ($FiO_2 \leq 0.4$, PEEP $\leq$ 5 cmH_2O), and absence of stridor or neck swelling progression.

The procedure was conducted in a semi-upright position under close ICU supervision, with difficult airway cart and reintubation equipment prepared at the bedside.

Extubation was performed in a controlled setting with supplemental oxygen. Post-extubation monitoring included continuous pulse oximetry, respiratory rate, and voice quality assessment to detect early signs of airway compromise. Post-extubation, the patient's respiratory parameters remained stable, with an oxygen saturation of 97% on room air.

By the ninth day, neck swelling had resolved, and the patient resumed normal oral intake. He was discharged on oral antibiotics with otolaryngology follow-up. Complete recovery was achieved with no residual symptoms, emphasizing the importance of timely airway management and structured extubation protocols in complex infections like Ludwig's angina. Post-extubation photographs were not obtained due to the rapid improvement in the patient's condition and early discharge, which limited the opportunity for standardized postoperative documentation.

3. DISCUSSION

This case highlights the critical importance of timely airway management and structured extubation criteria in Ludwig's angina, a rapidly progressing and potentially fatal infection involving diffuse cellulitis of the mouth floor.[3] In this patient, an untreated molar infection spread to the sublingual, submandibular, and submental spaces, leading to airway compromise, dysphagia, and respiratory distress. The ability of Ludwig's angina to infiltrate fascial planes and potentially cause asphyxia or mediastinal spread underscores its high mortality risk.[6]

Awake fiber-optic intubation was employed in this case, adhering to guidelines for managing anticipated difficult airways. This approach allowed visualization of the airway while maintaining spontaneous breathing, thus minimizing the risk of exacerbating edema associated with general anesthesia.[5] Evidence consistently supports fiber-optic intubation in Ludwig's angina, as it reduces complications by avoiding excessive airway manipulation and provides clear anatomical guidance.[7,8] Although technically demanding, its benefits in high-risk cases, as demonstrated here, underscore its value in improving outcomes.

The decision to forgo steroid use in this case reflects ongoing debate in Ludwig's angina management. While steroids have been suggested to reduce inflammatory edema and improve airway patency, evidence supporting their efficacy remains limited. A narrative review analyzing 31 cases noted that dexamethasone was often used without significant adverse effects, yet concerns persist that steroids may mask infection progression.[9,10] Given this uncertainty and the favorable clinical progress achieved without steroids in this patient, a conservative management strategy relying on antibiotics and mechanical ventilation was deemed appropriate.

Broad-spectrum antibiotic therapy is a cornerstone of Ludwig's angina treatment, targeting the mixed aerobic and anaerobic pathogens typically involved. Ceftriaxone and metronidazole were selected for their efficacy against common causative organisms, including Streptococcus viridans and Staphylococcus aureus.[11] Early initiation of antibiotics is essential to controlling infection, mitigating systemic inflammation, and preventing complications such as mediastinal spread. The literature underscores the importance of aggressive antibiotic regimens, as inadequate treatment can escalate the condition and necessitate invasive interventions like tracheostomy.[6] In this case, timely antibiotic therapy effectively controlled the infection without additional surgical drainage.

Extubation in Ludwig's angina presents unique challenges due to the risk of residual airway edema and potential complications such as stridor or obstruction. The cuff leak test, which assesses airway patency by evaluating air escape around the deflated endotracheal tube cuff, was instrumental in determining extubation readiness in this patient.[12] Studies suggest that a cuff leak volume below 110–130 mL indicates a higher risk of post-extubation stridor.[11] The positive cuff leak test in this case provided objective confirmation of minimal edema, supporting the decision to proceed with extubation. In addition to the cuff leak test, the extubation protocol in this case followed the recommendations by the Society of Critical Care Medicine (SCCM) and the Difficult Airway Society (DAS), which emphasize readiness criteria such as stable hemodynamics, absence of stridor, sufficient spontaneous breathing capacity, and access to reintubation tools. Structured extubation protocols, as applied here, align with evidence-based recommendations for reducing post-extubation complications in high-risk patients.[13]

Balancing timely extubation with ensuring airway stability is critical. Prolonged intubation increases risks such as ventilator-associated pneumonia, whereas premature extubation can lead to respiratory failure.[14,15] In this case, extubation was delayed until the eighth day to allow sufficient resolution of edema and infection. This decision, coupled with gradual weaning and daily spontaneous breathing trials, facilitated a smooth transition from mechanical ventilation to spontaneous breathing.[1,16] Protocolized weaning processes have been shown to improve outcomes in patients with difficult airways, providing a controlled environment for assessing respiratory function and stability.

This case demonstrates the benefits of a comprehensive, criteria-based approach to airway management and extubation in Ludwig's angina. The combination of fiber-optic intubation and objective extubation readiness testing minimized risks and contributed to a favorable outcome. Close monitoring of hemodynamic and respiratory parameters allowed timely adjustments in ventilatory support, ensuring patient safety throughout the recovery process.[17]

Despite these strengths, certain limitations are acknowledged. Fiber-optic intubation, while recommended, requires specialized equipment and trained personnel, which may not be readily available in all settings.[5] In such cases, alternative techniques like tracheostomy might be necessary, potentially increasing morbidity. Additionally, although the cuff leak test provided valuable insights into airway patency, it is not infallible; undetected edema could still pose risks for post-extubation complications, emphasizing the need for clinical judgment alongside objective measures.[18]

Compared to similar reports, this case is notable for the patient's young age, the successful avoidance of tracheostomy, and the complete resolution of infection without corticosteroid use. While most published cases of Ludwig's angina requiring ICU care involved older adults or tracheostomy interventions, this case offers a rare example of full recovery through structured, non-surgical, protocol-driven critical care.[19]

Moreover, our management was consistent with the Infectious Diseases Society of America (IDSA) guidelines for severe soft tissue infections, which advocate for early airway control, appropriate empiric antibiotics, and close monitoring in ICU settings. Our extubation strategy followed SCCM and DAS principles, reaffirming the value of multidisciplinary, guideline-based care in complex airway infections.[20]

This case not only reinforces existing knowledge but adds practical insight for ICU clinicians managing high-risk airway scenarios. The structured protocol applied in this young adult resulted in complete recovery, suggesting that when appropriate resources and training are available, non-invasive strategies can yield excellent outcomes.[21]

4.CONCLUSION

This case highlights the successful management of Ludwig's angina using a structured airway strategy, including awake fiber-optic intubation and objective extubation criteria. Full recovery was achieved without tracheostomy or corticosteroids, emphasizing the value of guideline-based, non-invasive ICU care in complex airway infections.

5.DECLARATIONS

Ethics approval and consent to participate

This case report was conducted in accordance with institutional ethical standards. Written informed consent was obtained from the patient for the publication of this case and accompanying clinical data. Ethical approval was not required, as the report describes a single clinical case without experimental intervention.

Consent for publication

All relevant clinical data are included within the article. Additional information is available from the corresponding author upon reasonable request.

Competing interests

The authors declare no competing interests.

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