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Critical, anesthetic, and surgical management of Ludwig's angina complicated by descending mediastinitis

Manejo crítico, anestésico y quirúrgico de la angina de Ludwig complicada con mediastinitis descendente

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Abstract

Ludwig's angina is a rapidly progressive cervicofacial infection involving the submandibular, sublingual, and submental spaces, with a high risk of acute airway obstruction and extension into the deep cervical spaces and mediastinum. It constitutes a medical and surgical emergency associated with high morbidity and mortality when diagnosis and treatment are delayed. We present the case of a 30-year-old man with no significant past medical history who developed fever, odynophagia, dysphagia, neck pain, mucopurulent sputum, and progressively worsening respiratory distress following the extraction of the right mandibular third molar. Neck computed tomography (CT) demonstrated gas within the cervical soft tissues and edema involving the submandibular and parapharyngeal spaces, while chest CT confirmed extension of the infection into the mediastinum, revealing a mediastinal collection consistent with descending necrotizing mediastinitis. During hospitalization, the patient developed acute respiratory failure requiring orotracheal intubation, invasive mechanical ventilation, and admission to the intensive care unit. He underwent emergency thoracotomy with mediastinal abscess drainage, exploratory cervicectomy, and multiple surgical debridement's. Cultures obtained from the cervical and mediastinal abscesses yielded *Streptococcus anginosus*. During his clinical course, he developed ventilator-associated pneumonia caused by multidrug-resistant *Acinetobacter baumannii*, prompting adjustment of antimicrobial therapy. After 25 days of intensive care, the patient showed favorable clinical improvement and was discharged in stable condition. This case highlights the importance of early recognition of Ludwig's angina and the timely use of computed tomography to identify cervicomediastinal spread of the infection. Early airway protection, prompt administration of broad-spectrum antibiotics, timely surgical drainage, and multidisciplinary intensive care management were critical in achieving a favorable outcome despite the severity of the disease.

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Resumen

La angina de Ludwig es una infección cervicofacial de rápida progresión que compromete los espacios submandibular, sublingual y submentoniano, con riesgo de obstrucción aguda de la vía aérea y extensión hacia los espacios

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rvicales profundos y el mediastino. Constituye una urgencia médico-quirúrgica asociada con elevada morbimor-idad cuando el diagnóstico y el tratamiento son tardíos. Se presenta el caso de un paciente masculino de 30 años, antecedentes patológicos de importancia, que desarrolló fiebre, odinofagia, disfagia, cervicalgia, expectoración ıcopurulenta y dificultad respiratoria progresiva tras la extracción de un tercer molar mandibular derecho. La nografía computarizada de cuello evidenció gas en los tejidos blandos cervicales y edema de los espacios sub-ndibular y parafaríngeo, mientras que la tomografía de tórax confirmó extensión de la infección hacia el me-ıstino, con colección mediastínica y hallazgos compatibles con mediastinitis necrotizante descendente. Durante hospitalización presentó insuficiencia respiratoria aguda que requirió intubación orotraqueal, ventilación mecá-a invasiva e ingreso a la unidad de cuidados intensivos. Fue sometido a toracotomía de urgencia con drenaje de sceso mediastínico, cervicotomía exploradora y múltiples limpiezas quirúrgicas. Los cultivos del absceso cervi-y mediastínico aislaron *Streptococcus anginosus*. Durante la evolución desarrolló neumonía asociada a venti-ión mecánica por *Acinetobacter baumannii* multirresistente, por lo que se ajustó el tratamiento antimicrobiano. as 25 días de cuidados intensivos, el paciente presentó evolución clínica favorable y fue dado de alta en condi-nes estables. Este caso resalta la importancia del reconocimiento temprano de la angina de Ludwig y de la lización oportuna de tomografía computarizada para identificar la extensión cervicomediastínica de la infección. aseguramiento precoz de la vía aérea, la antibioticoterapia de amplio espectro, el drenaje quirúrgico oportuno y manejo multidisciplinario intensivo fueron determinantes para lograr una evolución favorable pese a la gravedad cuadro clínico.

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Introduction

Ludwig's angina is a rapidly progressive necrotizing cellulitis of the floor of the mouth that involves the submandibular, sublingual and submental spaces, with potential extension to the deep cervical spaces and the mediastinum. It is considered a medical-surgical emergency due to the high risk of acute airway obstruction, sepsis, and descending necrotizing mediastinitis; complications that significantly increase morbidity and mortality when diagnosis and treatment are delayed[1].

Described by Wilhelm Frederick von Ludwig in 1836, this entity continues to represent a challenge for emergency departments, anesthesiology, surgery, and critical care medicine, despite advances in antibiotic therapy, imaging techniques, and intensive support. The reduction in mortality observed in recent decades is mainly attributed to early recognition, timely airway assurance, and early surgical control of the infectious focus[2,3].

Odontogenic infections constitute approximately 70 % of cases, with the second and third mandibular molars being the main gateways due to their close anatomical relationship with the submandibular spaces. Other predisposing factors include diabetes mellitus, alcoholism, malnutrition, immunosuppression, human immunodeficiency virus infection, chronic kidney disease, and poor oral hygiene[4-6].

The infection is usually polymicrobial and involves aerobic and anaerobic bacteria of the oral microbiota, with a predominance of *Streptococcus*, *Streptococcus anginosus*, *Bacteroides*, *Fusobacterium* and *Staphylococcus* species. The rapid spread of the infection through the cervical fascial planes can cause massive edema of the floor of the mouth, posterior displacement of the tongue, obstruction of the airway and extension to the mediastinum, causing descending necrotizing mediastinitis, one of the complications with the worst prognosis[7-11].

Clinical manifestations include fever, sore throat, dysphagia, neck pain, trismus, enlarged submandibular volume, and progressive respiratory distress. In

the event of clinical suspicion, computed tomography with contrast is the study of choice to determine the extent of the infection, identify the presence of gas in the soft tissues, deep collections, and involvement of the cervical and mediastinal spaces, which are essential information for planning surgical treatment[12-16].

Treatment should be initiated immediately and includes early airway insurance, broad-spectrum intravenous antibiotic therapy, timely surgical drainage, and intensive management. The coordinated participation of anesthesiology, general surgery, thoracic surgery, otolaryngology, and critical care medicine is essential in patients with advanced disease, due to the high frequency of difficult airway and the need for complex surgical procedures to control septic focus[10,17-21].

Although most cases respond favorably when treatment is timely, progression to descending mediastinitis continues to be associated with high morbidity and mortality and usually requires mechanical ventilation, multiple surgical interventions, and prolonged stay in intensive care units[22,23].

This report describes the critical, anesthetic and surgical management of a young patient with complicated odontogenic angina with descending necrotizing mediastinitis, highlighting the role of computed tomography in diagnosis, early surgical control of the infectious focus and multidisciplinary approach as determining factors for a favorable clinical outcome.

Case Presentation

A 30-year-old male patient, with no significant pathological history, consulted for a seven-day clinical picture initially characterized by asthenia, fever, odynophagia, malaise, and hyporexia. Three days before admission, he presented exacerbation of symptoms with progressive dysphagia, mucopurulent expectoration, vomiting, intense pain in the right cervical region, chest pain, and respiratory distress, which is why he was referred to a tertiary hospital.

As a relevant history, the patient reported extraction of the right mandibular third molar 24 days before admission. Subsequently, he presented halitosis and persistent gingival pain, for which he received unspecified outpatient antibiotic treatment and later ceftriaxone, without evidence of clinical improvement.

Upon admission, he was evaluated by the Otorhinolaryngology Service, which indicated hospitalization for observation, maxillofacial and neck computed tomography, in addition to laboratory studies. Blood count showed leukocytosis of 20,000 cells/μL. He initially received dexamethasone, clindamycin, and ceftriaxone intravenously while diagnostic evaluation was completed.

He was subsequently evaluated by the General Surgery Service. On physical examination, he was conscious and oriented, with a score of 15/15 on the Glasgow scale. He had a temperature of 38.1° C, a heart rate of 120 beats per minute, blood pressure of 144/78 mmHg, a respiratory rate of 28 breaths per minute, and 88 % SpO_2 breathing ambient air. Oropharyngeal examination showed intense hyperemia with abundant purulent secretion, while the neck presented painful volume increase in the submandibular and submental region. Pulmonary auscultation revealed hypoventilation at the right lung base and retrosternal pain on palpation. The rest of the physical examination showed no relevant alterations.

Neck computed tomography showed multiple gas bubbles in the soft tissues adjacent to the right mandibular third molar, associated with diffuse edema of the submandibular, sublingual, and parapharyngeal spaces, with extension to the deep cervical spaces (Figure 1A and 1B). Due to these findings, a chest

computed tomography was performed, which exposed the spread of the infectious process to the upper mediastinum, with the presence of gas, mediastinal collection, and inflammatory changes compatible with descending necrotizing mediastinitis (Figure 1C and 1D). Based on clinical and radiological evaluation, the diagnosis of complicated Ludwig's angina with descending mediastinitis and mediastinal abscess was established.

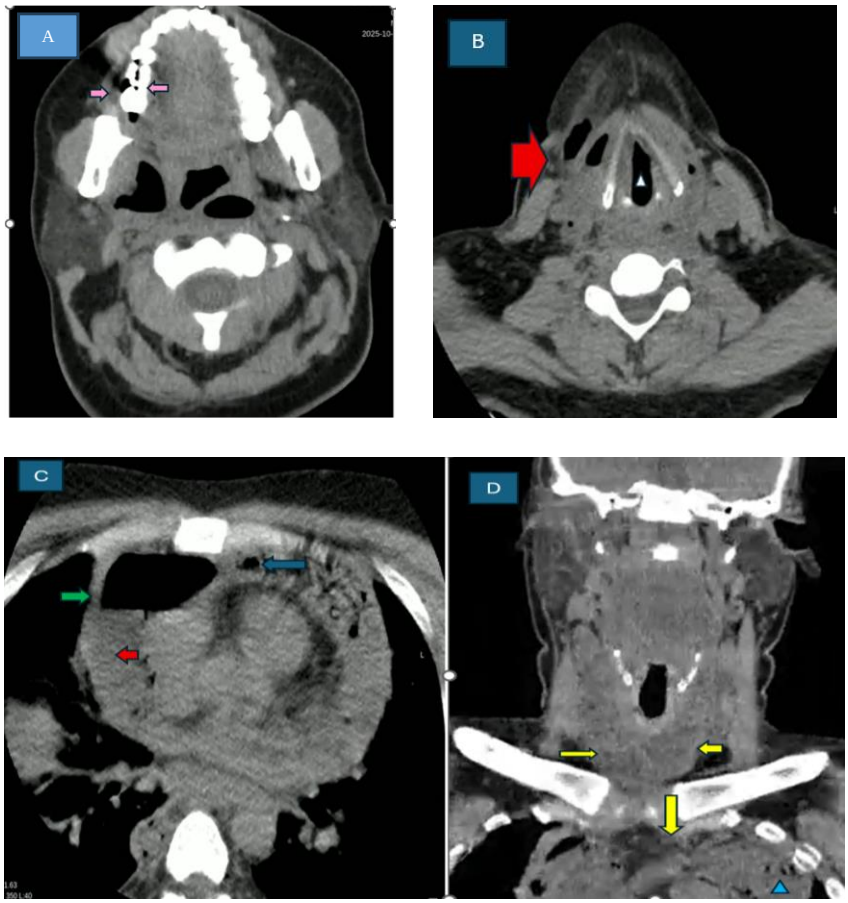


Figure 1 Computed tomography of the neck and chest in a patient with complicated Ludwig's angina with descending necrotizing mediastinitis. (A) Axial neck section showing gas collection in the region of the right mandibular third molar (pink arrows), compatible with odontogenic focus, associated with diffuse edema of the soft tissues of the floor of the mouth. (B) Cervical axial section showing significant edema of the right submandibular and parapharyngeal spaces with multiple gas bubbles (red arrow), findings compatible with necrotizing cellulitis, and extension to the deep cervical spaces. (C) Axial section of the thorax showing descending mediastinitis with extensive aerial collection and inflammatory material in the anterior mediastinum (green arrow), mediastinal purulent collection (red arrow) and inflammatory changes with pleuromediastinal involvement (blue arrow). (D) Coronal CT reconstruction showing spread of infection from the deep cervical spaces to the upper mediastinum (yellow arrows), consistent with descending necrotizing mediastinitis secondary to Ludwig's angina

Given the severity of the clinical picture, support measures were instituted that included absolute fasting, continuous monitoring, nasal cannula oxygen therapy, thromboprophylaxis, and empirical broad-spectrum antibiotic therapy with meropenem and vancomycin.

During the first 24 hours of hospitalization, the patient presented progressive respiratory deterioration, with increased work of breathing and use of accessory muscles, for which he required orotracheal intubation by means of a rapid induction sequence. During laryngoscopy, significant edema of the supraglottic structures with abundant purulent secretion was

observed, which made it difficult to manage the airway and forced the use of an endotracheal tube with an internal diameter of 6.5 mm. He was later connected to invasive mechanical ventilation and immediately transferred to the operating room.

Under general anesthesia, a right thoracotomy was performed with exploration and drainage of the mediastinal abscess. During the procedure, multiple pleuromediastinal adhesions, abundant fibrinopurulent material, and a tension-encapsulated mediastinal abscess containing approximately 500 mL of chocolatey fetid secretion were evidenced, associated with necrosis of the mediastinal pleura and inflammatory involvement of the aortic arch, supra-aortic trunks, and superior vena cava. Simultaneously, an exploratory cervicotomy was performed, obtaining approximately 120 mL of purulent material from a paratracheal collection with extension towards the mediastinum and the submandibular region. Intraoperative findings were consistent with the extent of disease previously confirmed on computed tomography scan. Samples were taken for microbiological study.

In the immediate postoperative period, he was admitted to the Intensive Care Unit under invasive mechanical ventilation, continuous sedation-analgesia, and transient vasopressor support with norepinephrine. The severity scores were APACHE II of 14 points and SOFA of 1 point. Echocardiogram showed preserved biventricular systolic function and acute non-constrictive pericarditis.

During his evolution, he developed sepsis, acute respiratory failure, and acute renal failure AKIN I stage. Ludwig's angina on the fourth day of hospitalization, he underwent a second surgery due to the persistence of the infectious process, which was reopened in the cervicotomy, drainage of approximately 50 mL of purulent secretion, and re-cleaned surgery.

Culture of the cervical abscess and mediastinal abscess isolated *Streptococcus anginosus*, confirming the odontogenic origin of the infection. Subsequently, he developed pneumonia associated with mechanical ventilation due to *multidrug-resistant Acinetobacter baumannii*, identified in the tracheal aspirate, so the antimicrobial treatment was adjusted to ampicillin/sulbactam and tigecycline according to the antibiogram.

The clinical evolution was progressively favorable. Resolution of the septic process, recovery of renal and respiratory function, removal of vasopressor support, and successful weaning from mechanical ventilation after tracheostomy were achieved. The chest drains were progressively removed and the surgical wounds evolved satisfactorily with serial dressings.

After 25 days of stay in the Intensive Care Unit, the patient was transferred to the General Surgery Service in good clinical condition. He was subsequently discharged from the hospital conscious, oriented, hemodynamically stable, without requiring supplemental oxygen therapy, with adequate healing of surgical wounds and outpatient follow-up by the general surgery, thoracic surgery, otorhinolaryngology and dentistry services.

Discussion

Ludwig's angina is a rapidly progressing cervicofacial infection that can involve the submandibular, sublingual, and submental spaces, with extension to the deep cervical spaces and the mediastinum through the fascial planes of the neck. However, mortality has now decreased thanks to early diagnosis and multidisciplinary treatment; Descending necrotizing mediastinitis continues to be one of its most serious complications, with mortality rates ranging from 20-40 % when diagnosis or surgical drainage is late[24].

In the present case, the history of extraction of the right mandibular third molar, followed by odynophagia, dysphagia, neck pain, and progressive respiratory distress, was highly suggestive of a complicated odontogenic infection. Computed tomography made it possible to identify early the presence of gas in the soft tissues of the floor of the mouth and deep cervical spaces, in addition to indicating the extension of the infection to the upper mediastinum, characteristic findings of descending necrotizing mediastinitis (Figure 1). The presence of cervical emphysema was a radiological sign of great importance, as it indicates infection by gas-producing bacteria and is usually associated with greater anatomical extension and the need for urgent surgical treatment[15,16,24].

Computed tomography is considered the imaging method of choice to assess the extent of Ludwig's angina, due to its high sensitivity to detect deep collections, soft tissue gas, and mediastinal involvement. In our patient, this study modified the therapeutic behavior by indicating mediastinitis and mediastinal abscess, allowing immediate planning of thoracotomy and exploratory cervicotomy. Several authors agree that delay in performing computed tomography scans or surgical drainage is one of the main factors associated with mortality[15,16].

Airway management represents the main anesthetic challenge in this disease. Diffuse edema of the floor of the mouth and supraglottic structures conditioned a difficult airway that required urgent orotracheal intubation by rapid induction sequence. During laryngoscopy, abundant purulent secretions and significant edema of the epiglottis and adjacent structures were observed, findings consistent with what has been described in the literature, where difficulty in intubation is one of the main causes of morbidity and mortality. The coordinated action of the anesthesiology team made it possible to secure the airway before the development of a complete obstruction.

Another noteworthy aspect was the anatomical extent of the infectious process observed during surgery. Thoracotomy showed approximately 500 mL of foul-smelling material encapsulated in the mediastinum, associated with pleuromediastinal necrosis and inflammatory involvement of the aortic arch, supra-aortic trunks, and superior vena cava, while cervicotomy allowed drainage of a paratracheal purulent collection with communication to the mediastinum. These findings confirm the aggressiveness of the infection and justify the need for early surgical control of septic foci, currently considered the main determinant of survival in patients with descending mediastinitis.

From the microbiological point of view, the isolation of *Streptococcus anginosus* in the cultures of the cervical and mediastinal abscess was consistent with the odontogenic origin of the infection. This microorganism belongs to the *Streptococcus anginosus* group (formerly *Streptococcus milleri* group), recognized for its high capacity to produce deep abscesses and facilitate dissemination to cervical and thoracic spaces. During the evolution, the patient developed pneumonia associated with mechanical ventilation due to *multidrug-resistant Acinetobacter baumannii*, which motivated the adjustment of antimicrobial treatment according to the microbiological results. This finding highlights the importance of obtaining cultures before the start of antibiotic therapy and of performing a therapeutic de-escalation based on microbiology.

In accordance with current recommendations, initial antibiotic treatment included meropenem and vancomycin, due to the unfavorable clinical course, recent exposure to ceftriaxone, and extensive cervicomediastinal involvement. This scheme provided coverage against aerobic and anaerobic microorganisms, Gram-negative bacilli and methicillin-resistant *Staphylococcus aureus*, until the microbiological results were available, allowing the treatment to be individualized.

The literature describes variable outcomes depending on the time of diagnosis and the extent of the disease. Yamaguchi et al.[10], reported the death of a patient with Ludwig's angina secondary to odontogenic infection that rapidly evolved into complete airway obstruction, with massive edema of the floor of the mouth and larynx on autopsy. On the contrary, Romero et al.[11], described a patient with limited neck involvement who responded satisfactorily to antibiotic treatment without the need for mediastinal drainage. Likewise, Kovalev[17] reported a patient with a late diagnosis who required multiple surgical procedures and a prolonged hospital stay. In comparison with these reports, the present case stands out for the rapid identification of mediastinal extension by computed tomography and for the early establishment of a multidisciplinary approach, factors that probably conditioned the favorable evolution.

Finally, this case reaffirms that Ludwig's angina should be considered a true medical-surgical emergency. Early clinical suspicion, immediate tomographic evaluation, timely airway assurance, aggressive surgical drainage, and multidisciplinary management are the fundamental pillars to reduce morbidity and mortality, especially when there is progression to descending necrotizing mediastinitis.

Conclusion

Ludwig's angina complicated with descending necrotizing mediastinitis is a potentially lethal medical-surgical emergency, the prognosis of which depends on early recognition and the immediate initiation of comprehensive treatment. The present case shows that an apparently localized odontogenic infection can progress rapidly to the deep cervical spaces and the mediastinum, causing acute respiratory failure, sepsis, and multiorgan involvement.

Computed tomography played a key role in identifying the cervicomediastinal extent of the infectious process and guiding surgical treatment planning. Likewise, timely control of septic focus by cervicotomy and thoracotomy with mediastinal drainage, early airway insurance, empirical broad-spectrum antibiotic therapy with subsequent adjustment according to microbiological results, and intensive support were decisive in achieving a favorable clinical outcome.

This case highlights the importance of a coordinated multidisciplinary approach between emergency medicine, anesthesiology, general surgery, thoracic surgery, otorhinolaryngology and critical care medicine, especially in patients with respiratory compromise and suspected spread to the mediastinum.

In conclusion, early clinical suspicion, timely computed tomography scans, early surgical control of the infectious focus, and multidisciplinary management are the fundamental pillars to reduce morbidity and mortality associated with Ludwig's angina complicated by descending mediastinitis.

In summary, in patients with a recent history of infection or dental procedure who present with odynophagia, dysphagia, neck pain, and progressive respiratory distress, Ludwig's angina should be suspected. Computed tomography will make it possible to establish the anatomical extent of the infection and guide timely surgical treatment, while early securing of the airway and drainage of the septic focus are decisive in improving survival.

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Conflicts of interest

The authors declare that they have no conflicts of interest in this research.

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Ethical considerations

This article complies with the principles of beneficence, non-maleficence and autonomy, focusing on the well-being of the patient, institutional informed consent was obtained with protection of confidentiality and proper handling of sensitive information.

Limitations in research

As it is a clinical case, it has a low capacity for generalization to larger populations and the limitations of an observational case due to lack of control of the variables.

Publishing permissions

Institutional consent was obtained for the publication of images and review of the medical record.

Identification of the responsibility and contribution of the authors in the article

Hidalgo Javier, conceptualization and resources, *Vanessa Holguín*, methodology. *José Intriago*, data curation. *Cinthya Giler*, writing the original draft. *Giannina Chiriboga*, revision and editing of the original draft. *Ana Ydrovo*, visualization. *Meyline Chala*, research. *Lady Estrada*, supervision. *Dagna Vecilla*, project management. *Vanessa Holguín*, *Michael Orellana*, writing the final draft. *Cinthya Giler*, final acceptance of the chapter. *Giannina Chiriboga*, acquisition of funds and translation.

Use of artificial intelligence

No artificial intelligence was used in any phase of the development of this clinical case.

Data Access

The data that have been generated as part of the development, treatment and control of the patient under study are available through the author for correspondence.

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