SURABAYA MEDICAL JOURNAL
(SMJ IDI SURABAYA)

Volume 3, Issue 2, 2025, p. 10-18

e-ISSN: 2986-7584
p-ISSN: 2986-2469

Erawati, (2026)

OPEN ACCESS

CASE REPORT

Diagnostic Challenges in Identifying Ludwig's Angina with Complicated Comorbidities in a Diabetic and Tuberculosis Patient in Emergency Settings: A Case Report

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Article Info

Article history:
Received: 07-05-2025
Revised: 10-01-2026
Accepted: 04-02-2026
Published: 13-08-2026

Keywords:
Airway obstruction;
Diabetes mellitus;
Ludwig's angina;
SOFA Score;
Tuberculosis

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ABSTRACT

Background: Ludwig's angina (LA) is a rapidly spreading infection of the submandibular, sublingual, and submental spaces that involves the floor of the mouth and may lead to airway compromise and sepsis. Predisposing factors such as dental infections, diabetes mellitus (DM), and immunocompromised conditions (e.g., tuberculosis) increase the risk and complicate management. **Objective:** To present a rare and severe manifestation of Ludwig's angina in a patient with uncontrolled DM and active TB, highlighting the synergistic effects of these comorbidities and underscoring the importance of early diagnosis, multidisciplinary care, and evidence-based intervention. **Case:** A 43-year-old male with a history of uncontrolled DM and tuberculosis presented with a 4–5 months progressive swelling and pain in the right submandibular area, worsening in the last week. Physical examination showed an indurated, warm, erythematous mass, limited neck movement, and poor dental hygiene. **Discussion:** Laboratory results revealed leucocytosis, elevated liver enzymes, hyperglycaemia, and chest X-ray suggesting pulmonary TB. SOFA score was calculated to assess the severity of systemic involvement. The patient received oxygen, IV antibiotics, insulin, and was referred for surgical debridement. Due to hemodynamic instability and complex comorbidities, the patient required referral to a tertiary care centre for definitive airway and surgical management. **Conclusion:** Ludwig's angina in patients with DM and TB requires rapid multidisciplinary management. Delay increases morbidity and risk of airway obstruction or sepsis.

Citation:
Erawati, A. (2026). Diagnostic Challenges in Identifying Ludwig's Angina with Complicated Comorbidities in a Diabetic and Tuberculosis Patient in Emergency Settings: A Case Report. Surabaya Medical Journal, 3(2): 1-10. DOI: https://doi.org/10.59747/smjidisurabaya.v3i2.103

Surabaya Medical Journal (SMJ IDI SBY)
eISSN: 2986-7584; pISSN: 2986-2469; DOI: https://doi.org/10.59747/smjidisurabaya.v3i2.103

Highlights

1. LA is a rapidly progressing soft tissue infection. Its greatest threat lies in the potential for airway obstruction and sepsis, making early recognition and urgent intervention absolutely critical to patient survival.
2. Synergistic impact of diabetes and tuberculosis. DM impairs immune cell function and microvascular circulation, while TB contributes to chronic immune suppression. Together, they create a perfect storm for aggressive infection and poor treatment response.
3. Multidisciplinary management is essential. Effective treatment involves a combination of airway stabilization, broad-spectrum intravenous antibiotics (such as ceftriaxone and metronidazole), tight glycemic control with insulin, and surgical drainage when needed.
4. Importance of early diagnosis. The use of scoring systems like SOFA helps clinicians gauge the severity of organ dysfunction. Early signs, such as neck swelling and pain, should never be overlooked. Intensive care monitoring and timely referral to higher-level facilities are often necessary to prevent life-threatening complications.

BACKGROUND

Ludwig's angina is a rapidly and frequently fatal progressive gangrenous cellulitis and edema of the soft tissues of the neck and floor of the mouth (Candamourty et al., 2012; Miah & Ali, 2020; Vallée et al., 2020). The infections caused by Streptococci and/or anaerobic bacteria spreading to submandibular, sublingual, submental regions, and possibly mediastinum (Gunawan & Ferriastuti, 2022), so that this disease requires an urgent recognition due to their potential for rapid deterioration, as the diseases causing a complication in the form of airway obstruction (Candamourty et al., 2012) due to the spreading of cellulitis and oedema (Banerjee & Pathan, 2022). This condition is categorized as emergency and life-threatening (Owobu et al., 2020). Clinical features commonly include neck swelling, pain, trismus, dysphagia, odynophagia, and elevation of the tongue, all of which may precede airway obstruction (Sonar et al., 2023). Early diagnosis is needed to prevent mortality and morbidity (Banerjee & Pathan, 2022).

The disease burden increases markedly in immunocompromised patients (Fatma Zeynep et al., 2017). Diabetes mellitus (DM) is a known risk factor for severe soft tissue infections (Cheng et al., 2024) due to impaired neutrophil function, microvascular disease (Dryden et al., 2015), and poor wound healing (Jurado & Walker., 1990). In patients with pulmonary tuberculosis (TB), chronic inflammation and immune dysregulation further weaken the host's defenses. Coincidence of both conditions can lead to fulminant progression of Ludwig's angina, poor response to therapy, and increased risk of complications (Miah & Ali, 2020; Sonar et al., 2023). Prior to the development of antibiotics, mortality for Ludwig's angina exceeded 50% (Vallée et al., 2020). As a result of intravenous antibiotic therapy, along with improved imaging modalities and surgical techniques, mortality currently averages approximately 8% (Miah & Ali, 2020). The medical management includes airway control, antibiotic therapy, surgical incision and drainage (Bhuiyan et al., 2022).

OBJECTIVE

This case report presents a rare and severe manifestation of Ludwig's angina in a patient with uncontrolled DM and active TB, highlighting the synergistic effects of these comorbidities and underscores the importance of early diagnosis, multidisciplinary care, and evidence-based intervention.

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CASE

A 43-year-old male presented to the emergency department with a 4–5 months history of progressive right neck swelling, worsening in the last week. The patient had fever, difficulty moving his neck, and vision loss in the right eye. The visual disturbance was suspected to be unrelated to Ludwig's angina and more likely a side effect of ongoing anti-tuberculosis therapy, possibly ethambutol-induced optic neuropathy, and thus was not addressed during the acute management.

Figure 1. Male, 43 years old, revealing bilateral involvement of the mandibular, sublingual, and submental space showing brawny induration of the swelling in the emergency

Past medical history included uncontrolled DM, ongoing anti-tuberculosis FDC 4 tablet therapy and poor dental hygiene with carious molars. Physical examination revealed a 6x8 cm indurated, erythematous, and tender swelling in the right submandibular region.

Vital signs on admission showed temperature 39.4°C, heart rate 135 bpm strong peripheral pulses, and BP 111/52 mmHg. Labs revealed leukocytosis (29.26 x 10^3/µL), neutrophilia (95.1%), hyperglycemia (GDA up to 471 mg/dL), and elevated liver enzymes. Arterial blood gas analysis showed a pH of 7.556, indicating respiratory alkalosis, with PCO_2 of 29.5 mmHg, PO_2 of 110.4 mmHg, and oxygen saturation of 97.9%. HCO_3^- was 22.5 mEq/L, which is within the normal range, suggesting that compensation had not yet occurred. The patient's body temperature increased up to 40.2°C. These findings support a hypermetabolic state possibly related to systemic infection or sepsis. The Sequential Organ Failure Assessment (SOFA) score was calculated to assess the severity of systemic involvement. The patient had a SOFA score of 4, derived from hypotension (MAP < 70 mmHg), respiratory alkalosis, and elevated temperature, which reflected moderate risk of organ dysfunction and aligned with the clinical suspicion of early sepsis.

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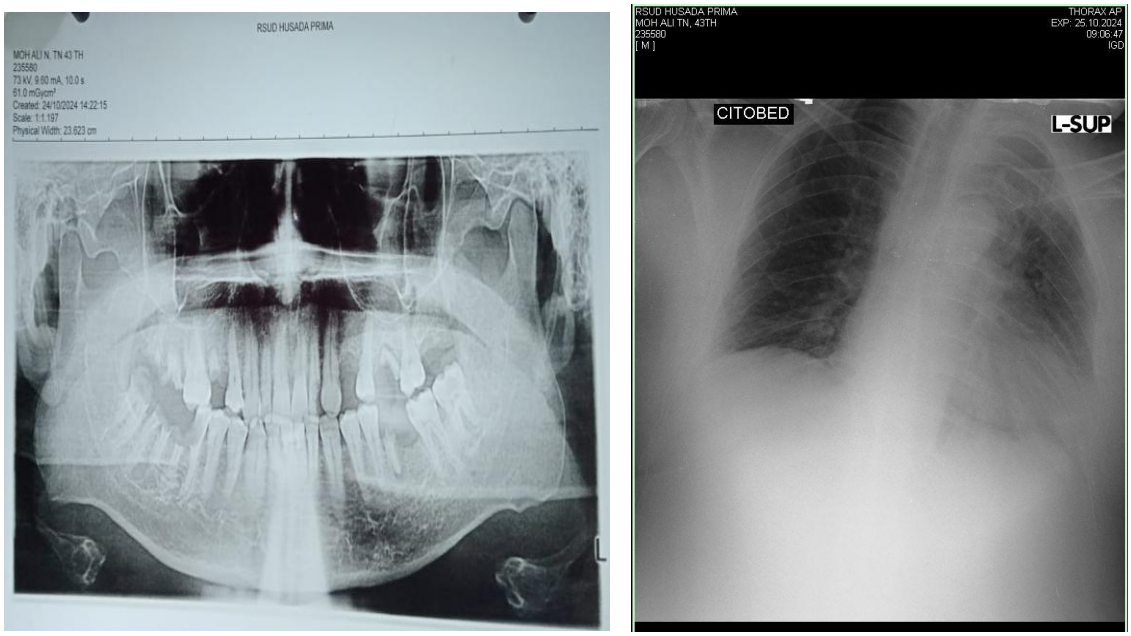

Figure 2 Left: Panoramic dental X-ray (OPG) revealed extensive caries and periapical pathology involving the lower second and third molars, supporting an odontogenic source of infection. **Figure 2 Right:** Chest radiograph showed bilateral infiltrates consistent with active pulmonary tuberculosis, particularly in the upper lobes, correlating with the patient's TB history

Chest X-ray suggested pulmonary TB. Panoramic dental X-ray (OPG) revealed extensive caries and periapical pathology involving the lower second and third molars, supporting an odontogenic source of infection. Blood cultures later revealed growth of *Streptococcus* species, confirming a typical polymicrobial pattern often seen in Ludwig's angina.

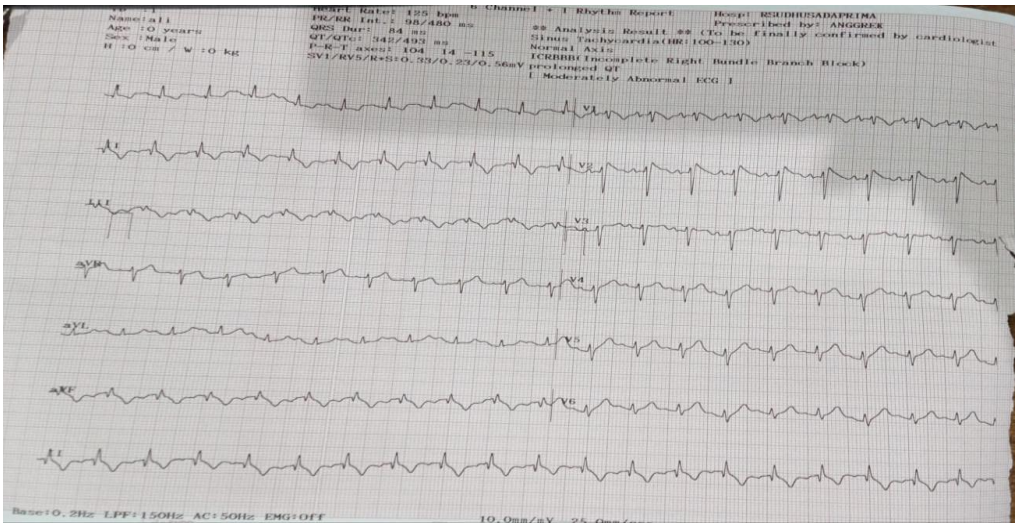

Figure 3. ECG: Heart Rate: 125 bpm. Rhythm: Sinus tachycardia. Findings: Incomplete Right Bundle Branch Block (ICRBBB), Moderately prolonged QT interval

The patient received empirical antibiotics (ceftriaxone 1 g administered intravenously (IV) every 12 hours and metronidazole 500 mg IV every 8 hours), insulin therapy, and was prepared for surgical debridement. Antibiotics were administered in the emergency department within six hours of arrival, in accordance with early sepsis protocols and before culture results were available, as early initiation of

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antimicrobial therapy, which is essential in severe infections such as Ludwig's angina (Banerje., 2022) Multidisciplinary consultations were obtained and the patient was referred for definitive care.

DISCUSSION

Ludwig's angina presentation is often insidious, beginning with dental infection and advancing to submandibular involvement (Gunawan & Ferriastuti, 2022). It forms a recognizing swelling in submandibular space (looks like "double chin"), or the "double tongue" appearance in the floor of the mouth (Silva et al., 2020). The most common etiology was dental caries or odontogenic infection of the lower 2nd and 3rd molars 92% of the causes were odontogenic infections (Balakrishnan & Thenmozhi, 2014; Candamourty et al., 2012; Rowe & Ollapallil, 2011). The lack of lymphatic barriers in the submandibular and sublingual spaces allows rapid progression, which can compress the airway and lead to respiratory distress (Miah & Ali, 2020; Sonar et al., 2023). The spreading of cellulitis is mostly due to immunocompromised individuals (Balakrishnan & Thenmozhi, 2014), such as T2DM. T2DM causes many destruction in the body, including decreased leukocytic function and microvascular repercussions (Silva et al., 2020), making Ludwig's angina developing more aggressively, especially in maxillofacial area (Gordon & Connelly, 2003; Solano et al., 2022). A case report found that Ludwig's angina and ketoacidosis is the first manifestation of DM (Infante-Cossío et al., 2010), and common in DM patients (Bridwell et al., 2021).

Diabetes mellitus impairs neutrophil chemotaxis and phagocytosis, disrupts microvascular circulation and resulting in ineffective immune response to infections. This explains the prolonged ICU stays, often requiring mechanical ventilation and worsening course of infection in this patient. Additionally, hyperglycemia contributes to delayed wound healing, increasing the risk of complications (Sonar et al., 2023). Microbiological analysis in Ludwig's angina commonly reveals polymicrobial flora, with the most prevalent organisms include *Streptococcus viridans*, *Staphylococcus aureus*, and anaerobes bacteria such as *Bacteroides*, *Fusobacterium*, and occasionally *Klebsiella* spp. (Solano et al., 2022; Yadav et al., 2019). In a rare case, *Bacillus* spp. in diabetic patients can cause Ludwig's angina with severe infection due to necrotizing exotoxins with the consequences of systemic inflammation leading on organ failure (Solano et al., 2022). In the presented case, while culture did not isolate *Mycobacterium tuberculosis* from the cervical swelling, its role in immune dysregulation and overall debilitation is critical. TB acts as an indirect but significant factor that contributes to the severity and poor prognosis of LA. Broad-spectrum coverage is essential due to the polymicrobial nature of the infection, with anaerobic and aerobic organisms commonly involved (Bridwell et al., 2021; Sonar et al., 2023).

In patients with active tuberculosis undergoing first-line anti-tuberculosis therapy, visual impairment should not be attributed solely to systemic illness or unrelated comorbidities. Ethambutol-induced optic neuropathy (EON) is a well-recognized adverse effect, typically presenting as progressive, painless visual blurring accompanied by reduced visual acuity and color vision disturbances, and may significantly exacerbate pre-existing visual symptoms. Ophthalmologic examination typically demonstrates bilateral reduction of visual acuity, red–green color discrimination impairment, optic disc hyperemia, and blurred disc margins on funduscopic evaluation, reflecting early optic nerve involvement. Although EON is classically described as bilateral and dose- or duration-dependent, cases with variable onset and severity have been reported, including irreversible visual loss despite prompt drug discontinuation. The pathophysiology of ethambutol toxicity is thought to involve mitochondrial dysfunction and chelation of essential metal ions, particularly zinc and copper, resulting in retinal ganglion cell injury and subsequent optic nerve damage (Patel et al., 2024). In this case, the patient had already experienced visual loss prior to admission, and ongoing fixed-dose combination (FDC) anti-tuberculosis therapy containing ethambutol may have contributed to or exacerbated the visual disturbance. This highlights the importance of baseline and periodic visual acuity assessment prior to

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eISSN: 2986-7584; pISSN: 2986-2469; DOI: https://doi.org/10.59747/smjidisurabaya.v3i2.103

and during ethambutol-containing therapy, particularly in patients with additional risk factors such as diabetes mellitus, prolonged treatment duration, or poor nutritional status.

Empirical antimicrobial therapy should begin immediately upon diagnosis. Bridwell et al. (2020) recommend empiric coverage using third-generation cephalosporins (e.g., ceftriaxone) in combination with metronidazole or clindamycin to ensure anaerobic coverage (Bridwell et al., 2021). In more resistant settings or in patients with severe systemic compromise, carbapenems or beta-lactam/beta-lactamase inhibitors (e.g., piperacillin-tazobactam) may be required. The use of metronidazole in this case ensured adequate anaerobic coverage and was aligned with current best practices.

Initial treatment of Ludwig's angina involves securing the airway, administering empirical IV antibiotics, and supportive care. Airway protection is a priority in Ludwig's angina management (Bridwell et al., 2021; Lin et al., 2020). Early tracheostomy is indicated in patients with signs of airway compromise, such as dyspnea, stridor, or inability to tolerate supine positioning. While this patient maintained a stable airway during presentation, close airway monitoring and early preparation for intervention are critical. Fiberoptic intubation or surgical tracheostomy should be considered in settings of progressive swelling or altered mental status. Surgical intervention is indicated in cases of cellulitis or failure of conservative management (Lin et al., 2020; Vallée et al., 2020).

Early detection of Ludwig's angina may be improved through heightened clinical suspicion in patients with chronic odontogenic infection and immunocompromised states, prompt dental evaluation, and early imaging when progressive cervical swelling persists beyond the expected course of localized infection.

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eISSN: 2986-7584; pISSN: 2986-2469; DOI: https://doi.org/10.59747/smjidisurabaya.v3i2.103

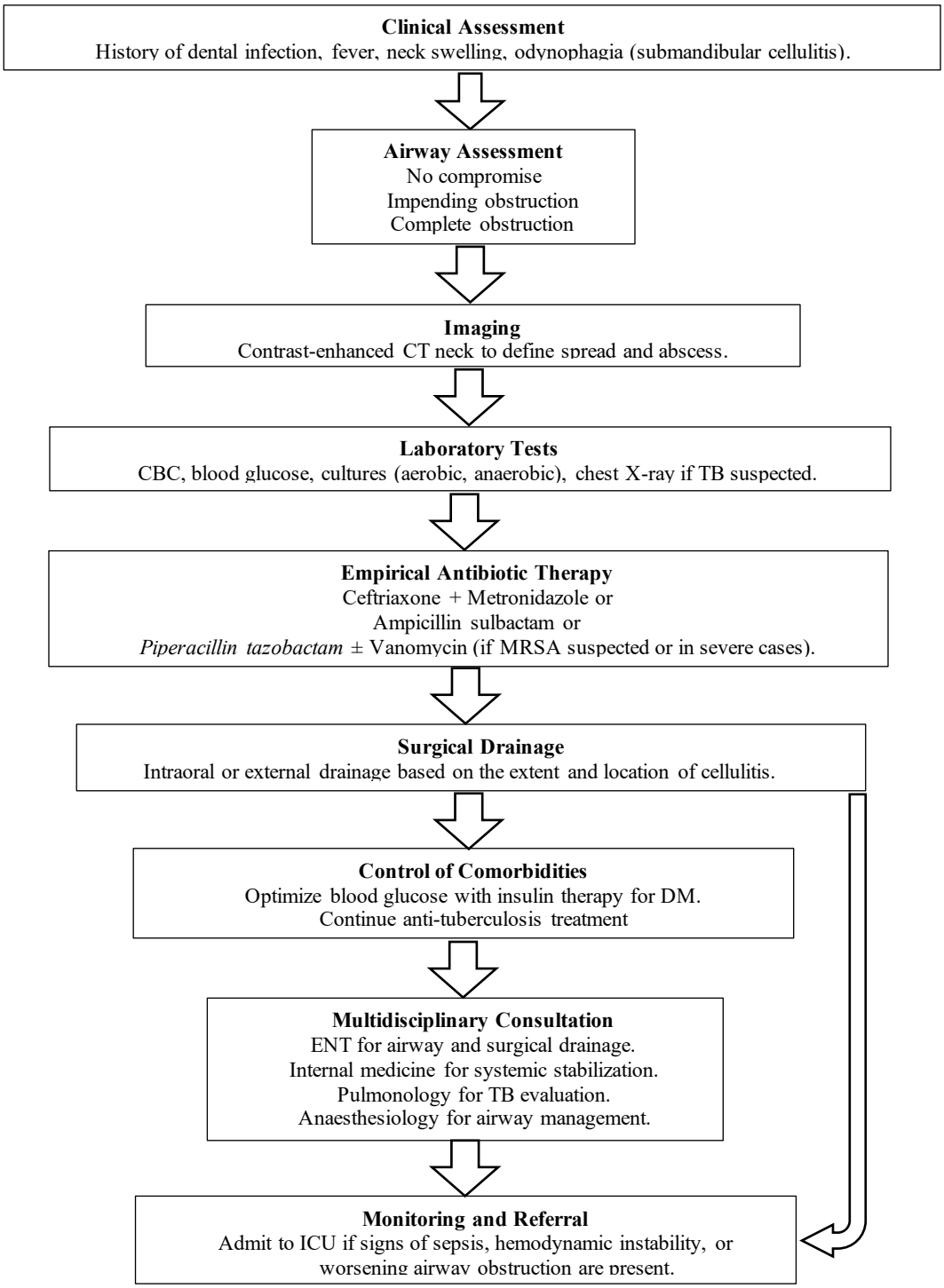

Figure 4. Flowchart for Ludwig's angina management

Based on literature and current guidelines, a structured flowchart for Ludwig's angina management is outlined in Figure 4 (Bridwell et al., 2021; Lin et al., 2020; Vallée et al., 2020). Multidisciplinary collaboration is crucial, especially in patients with comorbidities. Control of blood glucose, continuation of tuberculosis therapy, and close monitoring of respiratory function must be addressed simultaneously. In ENT or maxillofacial facilities, surgeons perform drainage or ICU support, in which timely referral is necessary to prevent fatal outcomes.

eISSN: 2986-7584; pISSN: 2986-2469; DOI: https://doi.org/10.59747/smjidisurabaya.v3i2.103

CONCLUSION

Ludwig's angina is a life-threatening condition requiring urgent and comprehensive management. The presence of comorbid conditions such as diabetes mellitus and tuberculosis significantly increases the risk of complications. Early diagnosis, airway management, appropriate antibiotic use, surgical drainage, and coordinated care significantly improve patient's outcomes. Multidisciplinary collaboration is paramount to improving patient's outcomes, especially in resource-limited settings.

Acknowledgment

None.

Conflict of Interest

The author declares no conflict of interest.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

Patient concern for publication

The consent has been taken.

Author contribution

MENCP: patient's care, conception, collecting and interpreting the data, drafting the manuscript, and conducting the literature review; EI: drafting, conducting the literature review, and revising.

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