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Lessons learned from life-threatening respiratory and cardiac complications in diphtheria: A case report and literature review

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Abstract:

Diphtheria remains a serious threat and can cause life-threatening complications. We report the case of a 6-year-old girl with severe respiratory and cardiac involvement due to diphtheria. She presented with classic signs, including pseudomembrane, bull neck, lymphadenopathy, and respiratory distress. *Corynebacterium diphtheriae* var. mitis with a positive toxigenic strain was confirmed. Her condition worsened, requiring intensive care admission and high-flow nasal cannula support. She later developed ventricular tachycardia with hemodynamic instability, which was successfully treated with intravenous magnesium sulfate ($MgSO_4$). The patient recovered with antibiotics, antitoxin, and supportive care. This case highlights the potential for severe diphtheria complications, even with timely treatment. It also suggests a possible role for $MgSO_4$ in managing diphtheria-induced arrhythmias, though further research is needed. Early diagnosis, aggressive management, and continued vaccination efforts are critical to reducing diphtheria-related morbidity and mortality.

Keywords:

Cardiac complications, diphtheria, magnesium sulfate, respiratory distress, ventricular tachycardia

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Introduction

Although diphtheria cases declined significantly after the vaccine was introduced, it is still a public health concern. In regions with low immunization coverage, such as parts of Indonesia, outbreaks can occur and lead to severe complications.[1,2] Clinical manifestations vary from asymptomatic cases to severe complications, including respiratory distress, cardiac involvement, and neurological deficits.[1,3,4] Myocarditis is a serious complication of diphtheria, commonly seen in patients with severe respiratory symptoms. The presence of a bull neck, a characteristic swelling of the lymph nodes, along with a confluent pseudomembrane covering the tonsils, reflects the severity of diphtheria, and severe diphtheria is more likely to progress to myocarditis.[4] Diphtheritic myocarditis occurs in 19%–68% of cases, often presenting as electrocardiogram (ECG) changes without obvious symptoms of heart failure or shock. Mortality is highest in patients who develop complete heart block or ventricular tachyarrhythmias.[3,4] In this case report, the patient developed severe respiratory and cardiac complications, likely due to diphtheritic myocarditis, which improved with intensive management.

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Case Report

A 6-year-old girl was referred to the emergency department from a primary health center with a 1-week history of sore throat, left-sided neck swelling, fever, malaise, cough, and vomiting. She had no significant past medical history and had not received any vaccinations. On physical examination, the patient was alert with normal vital signs. She had a prominent bull neck appearance, bilateral cervical lymphadenopathy, and enlarged tonsils with a grayish pseudomembrane covering half of the left tonsil [Figure 1]. The initial chest X-ray was normal, and the ECG showed sinus tachycardia at a rate of 130 beats/min (bpm), with no additional abnormalities. The patient was diagnosed with diphtheritic tonsillitis and treated with 100,000 International Units (IUs) of intravenous antidiphtheria serum and 1,200,000 IUs of intramuscular procaine penicillin for 10 days. A throat swab culture at admission confirmed *Corynebacterium diphtheriae* var. mitis, with a positive result on the modified Elek test for toxin detection. On day 9, her condition worsened, and she was transferred to the intensive care unit (ICU) due to respiratory distress and desaturation. Radiographic evaluation revealed cardiomegaly with a cardiothoracic ratio of 62.5%, pneumonia, and right pleural effusion on the chest X-ray [Figure 2], and ECG showed sinus tachycardia at 111 bpm with multiple premature ventricular contractions. Echocardiography demonstrated dilated cardiomyopathy with a severely reduced ejection fraction (EF) of 29%, along with severe mitral and tricuspid valve regurgitation. She was started on high-flow nasal cannula oxygen at 20 L/min with 60% FiO_2 and underwent chest tube insertion, achieving 98% oxygen saturation. ECG evaluation showed sinus rhythm with a left bundle branch block morphology. The patient was hemodynamically unstable, with a heart rate of 112 bpm and blood pressure of 83/47 mmHg, necessitating the initiation of titrated inotropic and vasopressor support, guided by lithium dilution cardiac output (LiDCO) hemodynamic monitoring. Norepinephrine was titrated up to 0.1 µg/kg/min, dobutamine to 10 µg/kg/min, and dopamine to 3 µg/kg/min. Intravenous midazolam and fentanyl were given for sedation due to increasing restlessness. Ten hours later, the patient developed ventricular tachycardia at 195 bpm with blood pressure 80/46 mmHg, despite ongoing inotropic and vasopressor support. Intravenous magnesium sulfate ($MgSO_4$) (2 g over 30 min) was administered, restoring sinus tachycardia at 109 bpm and improving blood pressure to 90/50 mmHg. Over the next few days, the patient's condition steadily improved. High-flow nasal cannula, inotropes, and vasopressors were gradually withdrawn. Echocardiography showed an improved EF of 58%, moderate tricuspid regurgitation (TR), and severe mitral regurgitation (MR). After 8 days in the ICU, she was moved to low care and discharged after 22 days. One week later, follow-up showed normal vital signs and an echocardiogram with mild TR, mild MR, and EF of 69.4%.

Discussion

Epidemiology and clinical presentation

Diphtheria cases dropped sharply after vaccine introduction but remain a concern. In areas with low vaccination coverage, the toxin-producing bacterium *C. diphtheriae* can cause outbreaks and serious complications.[1] According to the World Health Organization, diphtheria cases remain high in the Southeast Asia region, with Indonesia consistently ranking second after India in recent years.[2,5] Diphtheria symptoms range from none to severe, including breathing difficulty, heart problems, and neurological issues. Diagnosis requires typical clinical signs, followed

Figure 1: Enlarged tonsils with a grayish pseudomembrane covering half of the left tonsil

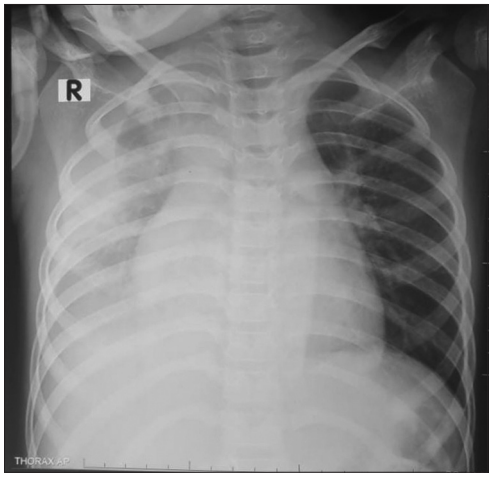

Figure 2: Chest X-ray showed cardiomegaly (cardiothoracic ratio 62.5%), pneumonia, and right pleural effusion

by microbiological confirmation through swab testing, isolation of *C. diphtheriae*, and toxin detection.[2,3,6]

Pathophysiology

Myocarditis has both infectious and noninfectious etiologies, including viral, bacterial, fungal, protozoal, and parasitic infections.[7-10] It is mainly caused by viruses (e.g., enteroviruses and severe acute respiratory syndrome coronavirus 2), bacteria (e.g., *C. diphtheriae* and *Mycobacterium tuberculosis*), and noninfectious factors such as systemic diseases, toxins, or idiopathic causes.[7-13] The disease develops through a complex process, typically progressing in triphasic model: acute, subacute, and chronic.[7-10,14] In infections, the causative agent damages cardiomyocytes by direct invasion, receptor binding to trigger immune responses, or toxin release – as seen in diphtheria, where the toxin targets heparin-binding epidermal growth factor-like growth factor precursor (pro-HB-EGF) receptor, a normal cell surface protein expressed in the heart and vascular system. The toxin binds to pro-HB-EGF to enter host cells and block protein synthesis, causing cell death; its presence in heart tissue explains diphtheria's severe cardiac complications.[7-9,11,12,14,15] Diphtheria is an increasing concern for causing myocarditis, especially in endemic areas, where it can lead to life-threatening cardiac complications.[11,16] Cardiac involvement in diphtheria shows as dysfunction and arrhythmia. It is caused by diphtheria toxin, which damages cardiomyocytes, causing inflammation that can lead to potentially fatal arrhythmias.[4,11,16] These arrhythmias, ranging from benign premature ventricular contractions to life-threatening ventricular tachycardia and fibrillation, significantly contribute to the high mortality of diphtheria-induced myocarditis.[13] Recent studies reveal that diphtheria toxin disrupts the heart's normal electrical signals, triggering arrhythmias. This effect is worsened by inflammation from myocarditis, which further increases the risk of serious heart rhythm problems.[9,11,12] Even after recovery, damaged cardiomyocytes are replaced by fibrous tissue, which can cause long-term complications.[11]

Clinical presentation and management

The patient showed typical signs of severe diphtheria, including a typical pseudomembrane on enlarged tonsils, bull neck, and swollen lymph nodes. Throat swab culture confirmed *C. diphtheriae* var. mitis with a toxigenic strain, prompting prompt antibiotic treatment and intravenous diphtheria antitoxin.[17,18] The patient's condition worsened with respiratory distress and low oxygen levels, requiring ICU admission. Supportive care included high-flow nasal cannula oxygen and inotropes and vasopressors, adjusted using LiDCO hemodynamic monitoring. Shortly after, the patient developed ventricular tachyarrhythmia with unstable hemodynamics, treated successfully with intravenous $MgSO_4$.

Role of magnesium sulfate

This case highlights severe diphtheria causing impaired heart function and life-threatening arrhythmias, likely due to myocarditis, which were effectively managed with $MgSO_4$'s antiarrhythmic and cardioprotective effects.[11,19] The potential effect of $MgSO_4$ in managing diphtheria-induced myocarditis and arrhythmias is promising, though more research is needed. It may help by stabilizing cell membranes, blocking calcium influx, and modulating ion channels.[19,20] While some studies suggest benefits, larger, well-designed clinical trials are needed to confirm the efficacy and best use of $MgSO_4$.[12] Effective management of diphtheria-induced myocarditis and arrhythmias requires a comprehensive approach, including prompt antibiotics, cardiovascular support to maintain hemodynamics, and antiarrhythmic therapy or defibrillators to prevent life-threatening arrhythmias.

Conclusion

This case report highlights the severe, life-threatening complications of diphtheria, particularly respiratory distress and cardiac involvement, even with prompt antibiotic treatment. Effective management is essential to reduce morbidity and mortality and must include not only definitive therapy but also optimal supportive care. In this case, high-flow nasal cannula oxygen and LiDCO-guided hemodynamic monitoring enabled precise titration of inotropes and vasopressors. The successful use of intravenous $MgSO_4$ also suggests potential as an adjunct treatment for diphtheria-induced myocarditis and arrhythmias, though further research is needed to confirm its safety and efficacy. This case underscores the importance of early diagnosis, comprehensive care, and sustained vigilance, along with strengthening vaccination efforts to prevent diphtheria and its complications.

Author contributions statement

TNO: Conceptualization (equal), Writing – original draft (lead), Methodology (equal), Resources (equal), Writing – review and editing (equal). SE: Writing – original draft (supporting), Visualization (lead), Methodology (equal), Resources (equal). BPS: Conceptualization (equal), Formal analysis (equal), Writing – review and editing (equal). DH: Formal analysis (equal), Writing – review and editing (equal). All authors have read and approved the submitted version (and any substantially modified version that involves the authors' contributions to the study) and have agreed to be personally accountable for their own contributions. The authors also agree to ensure that any questions related to the accuracy or integrity of any part of the work, even those in which they were not personally involved, are appropriately investigated, resolved, and that the resolution is documented in the literature.

Conflicts of interest

None Declared.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal parent has given his/her consent for the images and other clinical information to be reported in the journal. The parent understands that the names and initials will not be published and due efforts will be made to conceal the identity, but anonymity cannot be guaranteed.

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References

1. Lamichhane A, Radhakrishnan S. Diphtheria. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560911/. [Last accessed on 2024 Feb 26].
2. Husada D, Hartini Y, Nuringhati KW, Tindage SG, Mustikasari RI, Kartina L, *et al*. Eleven-year report of high number of diphtheria cases in children in East Java Province, Indonesia. Trop Med Infect Dis 2024;9:204.
3. Singh S, Gupta N, Saple P. Diphtheritic myocarditis: A case series and review of literature. J Family Med Prim Care 2020;9:5769-71.
4. Naidoo K, Msimang M, du Plessis M, Naidoo DP. Diphtheritic myocarditis: A case report, with toxinmediated complications and multi-organ involvement. Cardiovasc J Afr 2023;34:117-20.
5. WHO. Diphtheria – Number of Reported Cases. Available from: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/diphtheria---number-of-reported-cases. [Last accessed on 2025 Feb 23].
6. Diphtheria | CDC Yellow Book 2024. Available from: https://wwwnc.cdc.gov/travel/yellowbook/2024/infections-diseases/diphtheria#diagnosis. [Last accessed on 2024 Aug 03].
7. Lasica R, Djukanovic L, Savic L, Krljanac G, Zdravkovic M, Ristic M, *et al*. Update on myocarditis: From etiology and clinical picture to modern diagnostics and methods of treatment. Diagnostics (Basel) 2023;13:3073.
8. Yao Z, Liang M, Zhu S. Infectious factors in myocarditis: A comprehensive review of common and rare pathogens. Egypt Heart J 2024;76:64.
9. Brociek E, Tymińska A, Giordani AS, Caforio AL, Wojnicz R, Grabowski M, *et al*. Myocarditis: Etiology, pathogenesis, and their implications in clinical practice. Biology (Basel) 2023;12:874.
10. Heymans S, Eriksson U, Lehtonen J, Cooper LT Jr. The quest for new approaches in myocarditis and inflammatory cardiomyopathy. J Am Coll Cardiol 2016;68:2348-64.
11. Sagar S, Liu PP, Cooper LT. Myocarditis. Lancet 2012;379:738-47.
12. Cooper LT Jr. Myocarditis. N Engl J Med 2009;360:1526-38.
13. Almalki ME, Alshumrani FA, Almalki HA, Saati AA, Alzahrani SE, Khouj SM. Regional myopericarditis mimicking inferior myocardial infarction following COVID-19 vaccination: A rare adverse event. Cureus 2023;15:e41168.
14. Liu K, Han B. Role of immune cells in the pathogenesis of myocarditis. J Leukoc Biol 2024;115:253-75.
15. Mitamura T, Higashiyama S, Taniguchi N, Klagsbrun M, Mekada E. Diphtheria toxin binds to the epidermal growth factor (EGF)-like domain of human heparin-binding EGF-like growth factor/diphtheria toxin receptor and inhibits specifically its mitogenic activity. J Biol Chem 1995;270:1015-9.
16. Chanh HQ, Trieu HT, Vuong HN, Hung TK, Phan TQ, Campbell J, *et al*. Novel clinical monitoring approaches for reemergence of diphtheria myocarditis, Vietnam. Emerg Infect Dis 2022;28:282-90.
17. Eisenberg N, Panunzi I, Wolz A, Burzio C, Cilliers A, Islam MA, *et al*. Diphtheria antitoxin administration, outcomes, and safety: Response to a diphtheria outbreak in Cox's Bazar, Bangladesh. Clin Infect Dis 2021;73:e1713-8.
18. Husada D, Soegianto SD, Kurniawati IS, Hendrata AP, Irawan E, Kartina L, *et al*. First-line antibiotic susceptibility pattern of toxigenic *Corynebacterium diphtheriae* in Indonesia. BMC Infect Dis 2019;19:1049.
19. Bustos García de Castro A, Cabeza Martínez B, Ferreirós Domínguez J, García Villafañe C, Fernández-Golfín C. Miocarditis: diagnóstico y seguimiento con resonancia magnética [Myocarditis: magnetic resonance imaging diagnosis and follow-up]. Radiologia 2013;55:294-304. Spanish.
20. Ho KM. Intravenous magnesium for cardiac arrhythmias in humans: A role?. In: Watson R, Preedy V, Zibadi S. editors. Magnesium in Human Health and Disease. Nutrition and Health. Totowa, NJ: Humana Press; 2013. Available from: https://doi.org/10.1007/978-1-62703-044-1_15. [Last accessed on 2025 Sep 01].