CASE REPORT

Pediatrics Sciences Journal (*PedScij*) 2026, Volume 7, Number 1: 29-33
P-ISSN: 2722-0427, E-ISSN: 2722-1474

Pediatric Sciences Journal

Published by
Pediatrics Sciences Journal

Pneumonia as a viral complication or secondary bacterial infection in a pediatric measles? A case report

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Received: 2026-01-22
Accepted: 2026-04-04
Published: 2026-05-05

ABSTRACT

Background: Measles is a highly contagious acute viral infection worldwide. Pneumonia is one of the major respiratory complications associated with measles and remains a leading cause of mortality. Pneumonia in measles may occur because of primary viral complications or secondary bacterial infection.

Case Presentation: A three-year-old girl presented with fever, generalized erythematous rash, conjunctival injection, cough, coryza, and shortness of breath. Physical examination revealed erythematous papules across the body, bilateral lung rhonchi, Koplik spots, and hyperemic conjunctivae. Complete blood count showed a normal white blood cell count with neutrophilia. The patient was diagnosed with measles-associated pneumonia and treated with vitamin A supplementation, antibiotics, and supportive care. She was hospitalized for five days with progressive improvement in respiratory problems and skin rash. Pneumonia in measles may develop from initial viral complications or measles-induced immunosuppression, predisposing individuals to secondary bacterial infection. In this case, an increased neutrophil-to-lymphocyte ratio was observed, which may reflect an inflammatory response and raise the suspicion of possible secondary bacterial infection. However, neutrophil to lymphocyte ratio is a non-specific marker that can also be elevated in severe viral infections, systemic inflammation, physiological stress, and corticosteroid exposure. Therefore, its interpretation should be made cautiously and in conjunction with other clinical findings.

Conclusion: The neutrophil to lymphocyte ratio is a simple and accessible laboratory parameter that may support clinical assessment but cannot independently confirm bacterial infection. Comprehensive assessment involving clinical, laboratory, and radiological findings is essential to support therapeutic decision-making in pediatric patients with measles-associated pneumonia.

Keywords: *Measles, Pneumonia, Neutrophil to Lymphocyte Ratio, Pediatric.*
Cite This Article: Putri, K.A., Yusuf, R. 2026. Pneumonia as a viral complication or secondary bacterial infection in a pediatric measles? A case report. *Pediatrics Sciences Journal* 7(1): 29-33. DOI: 10.51559/pedscij.v7i1.158

INTRODUCTION

Measles is a highly contagious viral infection that remains a significant cause of morbidity and mortality in children, particularly in developing countries. It is caused by the measles virus, a member of the genus Morbillivirus, and is transmitted through respiratory droplets and aerosols.[1] Although immunization programs have been proven effective in reducing the global incidence of measles, cases continue to occur, particularly among children with incomplete vaccination status.[2] Measles can cause not only acute symptoms such as fever and rash but also a range of complications that contribute to increased morbidity and mortality in children. Nationally, the Ministry of Health, Republic of Indonesia, reported measles outbreaks in 42 districts and cities across 14 provinces in 2025, with a total of 2,139 suspected cases, 205 confirmed cases, and 17 deaths.[3]: In recent months, reported measles cases have increased. This rise is suspected to be associated with communities with incomplete vaccination coverage. These conditions heighten the risk of complications, especially in children, infants, and individuals with poor nutritional or immune status.

Measles infection leads to a reduction in cellular immunity, increasing a child's susceptibility to secondary infections, particularly lower respiratory tract infections.[4] Pneumonia is the most common complication in children with measles. It can result either from a direct viral complication of the lungs by the measles virus or from a secondary bacterial infection that develops following the immunosuppression caused by the measles infection.[5] Clinically distinguishing pneumonia as a direct complication of measles from pneumonia due to a secondary infection can be challenging. This complicates both diagnosis and management decisions, particularly regarding the appropriate use of antibiotics. A simple laboratory parameter that can assist in this differentiation is the neutrophil-to-lymphocyte ratio (NLR), which is derived from a routine complete blood count (CBC). From a pathophysiological perspective, bacterial infections typically provoke an acute inflammatory response marked by neutrophilia and relative lymphopenia, leading to an elevated NLR. In contrast, viral infections are usually associated with relative lymphocytosis or a non-dominant

neutrophil response, resulting in a lower NLR compared to bacterial infections.[6,7]

This case report aims to provide an overview of pneumonia in a child with measles and to discuss whether the pneumonia represents a direct complication of the measles infection or a secondary infection. It is intended to offer clinical insights and to raise clinician awareness of respiratory complications in pediatric measles patients, facilitating timely and effective management.

CASE PRESENTATION

A three-year-old girl presented to the emergency department on the third day of fever. The fever temporarily subsided with antipyretics and warm compresses but recurred shortly thereafter. Associated symptoms included a generalized rash, conjunctival redness, cough, coryza, and shortness of breath.

The rash first appeared on the second day of fever, when her temperature reached 39°C. It initially developed on the neck and subsequently spread to the head, trunk, and extremities. Conjunctival redness occurred concurrently with the rash and was accompanied by yellowish ocular discharge. The patient had experienced a productive cough and coryza for three days prior to admission. Shortness of breath developed approximately two hours before presentation. She had not received the measles–rubella (MR) vaccination at 9 and 18 months of age. There was no history of similar symptoms, previous illnesses, hospitalizations, or surgical procedures. Her growth and development were age-appropriate, and her nutritional intake was adequate.

On arrival, the patient was febrile (39.1°C), with a heart rate of 132 beats per minute (strong and bounding), a respiratory rate of 36 breaths per minute, and an oxygen saturation of 95% on room air. She appeared moderately ill and had good nutritional status. Physical examination revealed bilateral conjunctivitis and Koplik spots on the buccal mucosa. Lung auscultation revealed rhonchi in both lung fields. Dermatologic examination demonstrated multiple erythematous macules and papules with well-defined borders, measuring 0.5–2 cm in diameter, some exhibiting a geographic pattern, distributed diffusely across the entire body.

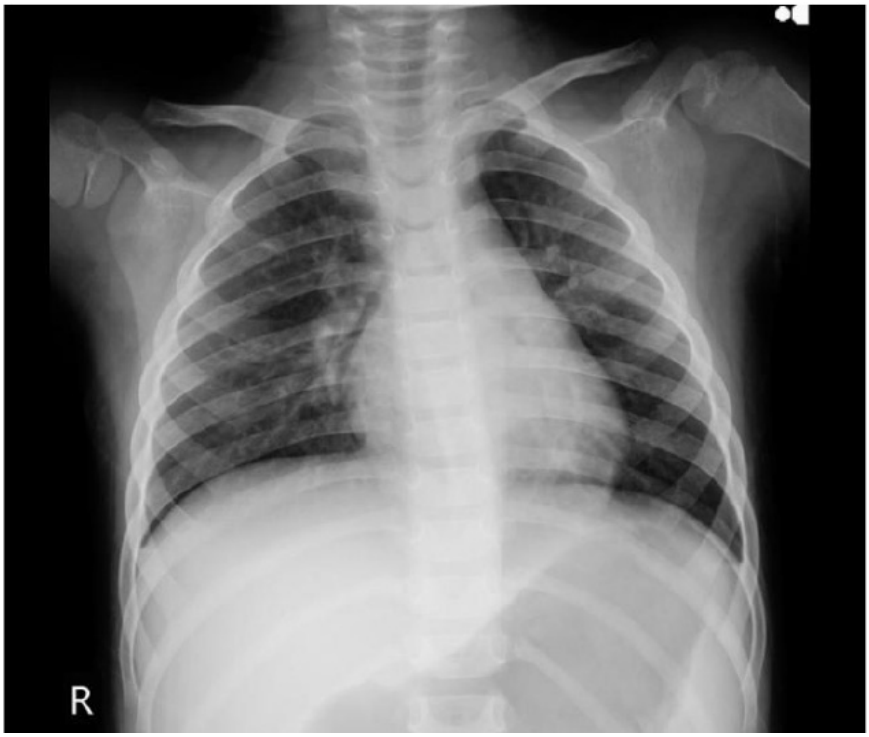


Figure 1. Chest x-ray performed on the first day of hospitalization, revealing radiographic features suggestive of pneumonia.

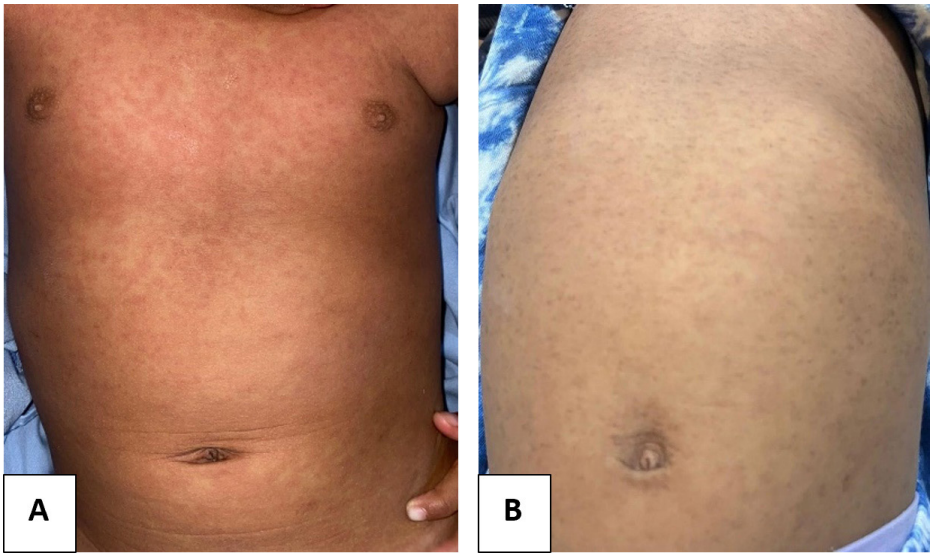


Figure 2. Comparison of maculopapular rash appearance on day 2 (A) and day 5 (B) of hospitalization.

The CBC was obtained on the third day of fever, corresponding to the early eruptive stage. CBC revealed a normal white blood cell (WBC) count (10.02 × 10^3/μL), with neutrophilia (8.97 × 10^3/μL; 89.55%) and lymphopenia (0.68 × 10^3/μL; 6.83%). The platelet count was within normal limits (235.9 × 10^3/μL). The NLR was elevated at 13.2. Prior to blood sampling, the patient had received antipyretic therapy and a compounded medication of unknown composition. Therefore, the potential impact of prior medications on leukocyte parameters and NLR could not be fully evaluated. Chest radiography demonstrated a reticular pattern with infiltrates in the right and left suprahilar, parahilar, and paracardial

Table 1. Clinical course of the patient during hospitalization

Hospital Day	Presenting Complaints	Vital Sign				
		GCS	HR	RR	Temp	SpO2
Day-1	Fever, shortness of breath, cough, coryza, generalized rash	E4V5M6	132	36	39.1	95%
Day-2	Fever and dyspnea improved, cough and coryza persisted, with generalized rash	E4V5M6	120	28	37.9	98%
Day-3	Persistent cough and coryza, with fading erythematous rash on the extremities	E4V5M6	110	24	36.6	98%
Day-4	Persistent cough and coryza, with fading erythematous rash on the body	E4V5M6	110	24	36.8	98%
Day-5	Generalized erythematous rash gradually fading.	E4V5M6	100	24	36.0	98%

regions, consistent with pneumonia (Figure 1).

The patient received oral vitamin A at a dose of 200,000 IU daily for two days. Intravenous ceftriaxone 800 mg (50–75 mg/kg per dose) was administered once every 24 hours. Supportive care included oxygen therapy, intravenous fluids, antipyretics, and intravenous corticosteroids. Nebulized short-acting beta-2 agonists were also provided, along with routine oral antihistamines and multivitamins for symptomatic treatment.

The patient was admitted to a standard inpatient ward for further management. After five days of treatment, the patient's clinical condition stabilized and returned close to baseline (Table 1). The erythematous maculopapular rash evolved into a hyperpigmented maculopapular rash by the third day of hospitalization (Figure 2). Intravenous antibiotics were discontinued on day five. The patient was subsequently discharged in stable condition with a course of oral antibiotics for continued therapy.

DISCUSSION

Measles is a viral infection caused by the *Morbillivirus* genus of the *Paramyxoviridae* family.[1] It predominantly affects children under five years who are unvaccinated or incompletely immunized. It is estimated that approximately 95.000 deaths due to measles occurred worldwide in 2024.[8] This case describes a three-year-old girl who presented with fever that had developed three days prior to hospital admission. Other symptoms included the appearance of a rash, hyperemic conjunctivae, cough, coryza, and shortness of breath. This patient's clinical features were all in line with clinical signs and symptoms of measles. The prodromal, eruptive, and convalescent phases are the three clinical phases that measles typically goes through. Fever, cough, coryza, conjunctivitis, with the appearance of a maculopapular rash are the characteristics of the prodromal phase. The presence of shortness of breath may suggest the development of respiratory complications in patients with measles.[9]

The patient has no history of receiving the MR vaccine. According to the national immunization program of the Ministry of Health, Republic of Indonesia, and the recommendations of the Indonesian Pediatric Society, the patient's routine immunization status was incomplete for her age. Based on the national immunization schedule for children aged 0–18, the MR vaccine is administered subcutaneously starting at 9 months of age, followed by a second dose at 15–18 months and a third dose at 5–7 years of age. If the MR vaccine has not been delivered by 12 months of age, MR or MMR immunization may be given, with the second dose administered at an interval of six months.[10] Vaccination status is one of the key contributing factors to the occurrence of measles. A very strong positive correlation has been identified between children under five years of age who have not received measles vaccination and the incidence of measles in the Province of DKI Jakarta.[11]

Based on the physical examination findings, the combination of fever, maculopapular rash, hyperpigmentation, cough, coryza, and the presence of Koplik spots may serve as an early screening tool to establish clinical suspicion of measles infection, particularly during outbreak situations.[12] Measles symptoms usually appear after an incubation period of 8–12 days following infection, with the infectious phase occurring from four days before to four days after the onset of the rash.[9] The rash in measles is characterized by an erythematous maculopapular eruption that usually appears around 3–4 days after the onset of fever. It initially begins on the face and neck and then spreads progressively to the rest of the body over a period of 2–3 days.[13] Prior to the appearance of the skin rash, enanthem may be detected on the buccal mucosa opposite the molar teeth. This enanthem, known as Koplik spots, is present in approximately 60–70% of patients and is temporary, often lasting 12–72 hours.[14] The most common complication of measles is pneumonia. Pneumonia may develop from primary viral complication or secondary bacterial infection. The risk increases in children under five years and in adults older than 20 years.[15]

Laboratory examination of the CBC revealed a normal total WBC count with lymphopenia. Chest radiography demonstrated infiltrates with a reticular pattern in the right and left suprahilar, parahilar, and paracardiac regions, suggesting pneumonia. Lower total leukocyte and lymphocyte counts tend to occur in measles patients. In a retrospective cross-sectional study involving 140 febrile children with maculopapular rash, leukopenia was identified in one-third of patients, while lymphopenia was present in around 40% of cases.[16] Similar findings were reported in a study of 249 hospitalized pediatric

patients with measles, in which leukopenia and lymphopenia were identified in 40.6% and 38.5% of patients, respectively.[17] Another observational study with 117 subjects also indicated lymphopenia in 40.5% of measles cases, which was significantly lower compared with the control group.[18] Leukopenia in measles is generated by measles virus-induced lymphocyte apoptosis during the viremic phase. This is subsequently followed by a rapid rebound in lymphocyte counts due to immunological activation, cellular proliferation, and enhanced lymphocyte production from the thymus.[19] In a study of 114 patients with measles complicated by pneumonia, bronchial wall thickening was observed in the majority of patients (88.5%), minimal radiological findings were reported in 25% of cases, and normal radiographic findings were identified in nine patients despite a clinical diagnosis of pneumonia.[20] Pneumonia in measles is associated with the development of multinucleated giant cells inside the alveolar spaces, bronchiolar epithelium, and tracheobronchial tree. Epithelial hyperplasia and diffuse alveolar damage result in alveolar fluid accumulation and inflammatory cellular infiltrates, which are represented in radiological findings.[15]

Complete blood count (CBC) examination may serve as an initial investigation to support the diagnosis of measles. The NLR is an affordable and widely obtainable laboratory marker that represents acute and chronic inflammatory reactions as well as adaptive immunological status.[21] In this case, an increased NLR value of 13.2 was reported. A rise in NLR occurs as a result of greater neutrophil activity in response to inflammation, accompanied by a reduction in lymphocyte count due to redistribution and apoptosis.[22,23] Since relative neutrophilia and lymphopenia are established laboratory markers of bacterial infection, a higher NLR might suggest an increased likelihood of bacterial involvement.[23,24] A study conducted by Hussain et al. demonstrated that NLR was considerably higher in pneumonia with bacterial involvement, particularly among patients with positive culture results. It may be considered in guiding antibiotic therapy when microbiological testing is unavailable.[24,25] Neutrophilia with concurrent lymphopenia is commonly observed in bacterial infections but remains non-specific and may also occur in severe viral infections, systemic inflammation, physiological stress, and corticosteroid exposure.[21,26–28] Due to costs and practical limitations, neither polymerase chain reaction (PCR) nor serological testing were carried out in this case.

Management of measles is essentially supportive, focusing on prevention of dehydration and the treatment of any complications that occur. Routine antibiotic therapy is not recommended; however, antibiotics should be considered in cases of secondary bacterial infections such as pneumonia, otitis media, sepsis, or septic shock.[29] Vitamin A supplementation has been recommended for all cases of measles, as it has been shown to reduce mortality and morbidity and acts as an immunomodulator that enhances antibody responses to the measles virus.[30] In this case, the patient received oral vitamin A at a dose of 200,000 IU every 24 hours for two days, along with intravenous ceftriaxone 800 mg (50–75 mg/kg/dose) given once daily. Nebulized salbutamol thins secretions and lessens breathing effort in patients with pneumonia, which may aid in improving airway clearance.[31] Corticosteroids are not routinely recommended in measles and have not been shown to enhance outcomes; however, available research does not suggest a significant increase in immunosuppression or adverse effects.[32] Steroids may be considered as adjunctive therapy because of their ability to suppress excessive inflammatory responses in the airways.[33] In this case, systemic corticosteroids were administered as adjunctive therapy based on clinical judgment, considering significant lower respiratory tract involvement and a suspected exaggerated inflammatory response. Although their use in measles-associated pneumonia remains controversial and is not routinely recommended, treatment was individualized according to clinical severity. While some studies suggest potential benefits in adults, evidence in pediatric populations remains limited and inconclusive.[34] The patient showed clinical improvement after five days of hospitalization.

CONCLUSION

Pneumonia is the most common complication and the leading cause of mortality in pediatric measles infection. This case report demonstrates a three-year-old girl child presenting with clinical manifestations of measles-associated pneumonia, accompanied by an elevated NLR on CBC. This finding may suggest a possible contribution of secondary bacterial infection to pneumonia alongside viral complications, although microbiological confirmation was not available. The NLR may support clinical assessment but cannot independently confirm bacterial infection. The simultaneous administration of vitamin A and antibiotics resulted in a good clinical response, as shown by progressive symptom improvement during hospitalization. Comprehensive assessment, including patient history, physical examination, laboratory investigations, and radiological findings, plays a crucial role in evaluating the likelihood of secondary bacterial infection and supports clinical decision-making regarding antibiotic therapy in patients with measles-associated pneumonia.

DISCLOSURES

FUNDING

This case report did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST

None declared.

ETHICS CONSIDERATION

The case has been reported in accordance with institutional ethical standards. The patient's identity has been anonymized to protect confidentiality.

AUTHOR CONTRIBUTION

All authors contributed equally to the conception, design, data collection, analysis, drafting, and critical revision

of the manuscript. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

ACKNOWLEDGMENTS

None.

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