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Paradoxical Bronchospasm with Salbutamol Use: A Rare but Serious Reaction in Asthma Management

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Introduction

Salbutamol (albuterol) is a widely used Short-Acting β2-Agonist (SABA) that provides rapid bronchodilation in asthma and other obstructive airway diseases. While it is generally considered safe and effective, paradoxical bronchospasm an acute worsening of bronchoconstriction following inhalation has been reported in rare cases. This reaction may be life-threatening, especially when it delays or interferes with appropriate therapy. The pathogenesis remains unclear but may involve hypersensitivity to excipients, temperature of the aerosol, or direct airway irritation. Clinicians often overlook this adverse effect, leading to repeated dosing and worsening of symptoms. This report details a case of paradoxical bronchospasm following salbutamol use and emphasizes the importance of clinical awareness in such scenarios. Recognition of paradoxical bronchospasm is critical, particularly in patients who exhibit sudden deterioration after administration of inhaled bronchodilators. Misinterpreting this response as worsening asthma may lead to repeated doses of salbutamol, further exacerbating the bronchospasm and potentially resulting in respiratory failure. Differential diagnosis should include evaluating for alternative causes such as poor inhaler technique, vocal cord dysfunction, or foreign body aspiration, but paradoxical response to the drug itself must remain a consideration. Switching to a different bronchodilator formulation or delivery method, such as a nebulized solution without specific excipients or a dry powder inhaler, may be necessary. Early identification and prompt modification of treatment can prevent serious complications and guide safer long-term asthma management [1].

Description

Paradoxical bronchospasm is a rare but potentially life-threatening adverse reaction associated with β2-agonist therapy, particularly salbutamol. It is characterized by an acute worsening of bronchoconstriction immediately following drug administration, often presenting with increased dyspnea, wheezing and chest tightness. While salbutamol is generally safe and effective, paradoxical responses may be misinterpreted as treatment failure, leading to repeated dosing that exacerbates the condition. Prompt recognition and discontinuation of the offending agent are essential to patient safety. The precise pathophysiology remains unclear, but several contributing factors have been identified. These include hypersensitivity to excipients such as benzalkonium chloride or disodium edetate, local irritation from aerosol propellants and thermal effects from cold inhaled aerosols. Neurogenic reflex mechanisms involving airway irritant receptors have also been proposed. Diagnosis is largely clinical and should be considered in patients who deteriorate after bronchodilator use, particularly when symptoms improve after switching to alternative treatments such as anticholinergics or corticosteroids. Paradoxical bronchospasm remains a diagnostic challenge due to its rarity and resemblance to worsening asthma. It is often underdiagnosed or mistaken for poor disease control, leading to inappropriate intensification of therapy. Clinical suspicion, close monitoring after inhaled therapy and awareness of atypical responses are essential for timely diagnosis [2].

Objective assessment through pulmonary function testing before and after inhaler use may help identify a paradoxical decline in lung function. Importantly, patient education on recognizing unusual symptom patterns and when to seek immediate medical care plays a critical role in preventing severe outcomes. Management strategies should include avoiding formulations that contain potential irritants, ensuring proper inhaler technique and selecting alternative bronchodilators when necessary. Inhaled anticholinergics, leukotriene receptor antagonists, or corticosteroids may offer effective alternatives without triggering paradoxical responses. In some cases, switching to dry powder inhalers or preservative-free nebulized solutions can mitigate the risk. Ongoing documentation and reporting of such adverse events are necessary to inform prescribing practices and guide future therapeutic formulations. Looking ahead, the development of inhaler formulations without known sensitizing excipients such as benzalkonium chloride may reduce the incidence of paradoxical bronchospasm. Pharmaceutical innovation should prioritize patient safety by minimizing additives that have been implicated in airway irritation. Future drug trials may benefit from incorporating bronchial reactivity assessments to screen for early signs of paradoxical responses, especially in populations with heightened airway sensitivity [3].

Furthermore, predictive tools such as clinical risk scores or biomarkers could be developed to identify individuals at higher risk for paradoxical bronchospasm prior to initiating β2-agonist therapy. Integration of pharmacogenomic research may uncover genetic predispositions that influence airway reactivity to inhaled agents. Additionally, expanding the use of smart inhaler technology, capable of detecting changes in respiratory patterns post-inhalation, could offer real-time alerts for adverse reactions. Education campaigns targeting both healthcare providers and patients about this rare but serious phenomenon will be crucial in improving early recognition, promoting safer prescribing habits and ultimately enhancing asthma care outcomes. In clinical practice, integrating standardized screening protocols before initiating inhaled β2-agonists may enhance early detection of at-risk individuals. Pre-treatment evaluation tools could include a structured checklist encompassing prior reactions to inhaled medications, atopic history and coexisting respiratory conditions such as eosinophilic bronchitis or hyperresponsive airways. These tools can help clinicians make more informed decisions on selecting initial bronchodilator therapy, avoiding unnecessary exposure to formulations that may provoke adverse reactions. Embedding such checklists into electronic medical records could also facilitate automated alerts, improving clinical vigilance in emergency and outpatient settings [4].

There is also a growing need for post-marketing surveillance studies and real-world data collection focusing specifically on adverse respiratory reactions to inhaled therapies. Although clinical trials often report a favourable safety profile for salbutamol, rare events like paradoxical bronchospasm may be underrepresented. Establishing dedicated pharmacovigilance databases or registries that capture detailed information about inhaler formulations, excipients, delivery methods and patient

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outcomes could help better quantify the incidence and risk factors associated with this phenomenon. These data can then guide updates to clinical guidelines and inform regulatory bodies about necessary labelling changes or product modifications. Finally, multidisciplinary collaboration will be essential in optimizing both prevention and management strategies for paradoxical bronchospasm. Pulmonologists, allergists, pharmacists and respiratory therapists must work together to design patient-specific asthma action plans that account for rare but serious adverse effects. Public health initiatives can support this effort by promoting inhaler literacy and improving access to alternative bronchodilators for patients with known sensitivities. As research continues to clarify the mechanisms underlying paradoxical bronchospasm, personalized medicine approaches tailoring therapy based on individual airway reactivity and treatment response may become a key element in preventing this complication and enhancing safety in respiratory care [5].

Conclusion

Paradoxical bronchospasm is an uncommon but serious reaction to salbutamol that can complicate asthma management. Clinicians must consider this diagnosis in patients who worsen after β2-agonist use, especially when standard interventions fail. Early recognition, drug discontinuation and alternative bronchodilators are key to successful management. Increased awareness and post-marketing surveillance can help reduce morbidity associated with this under-recognized adverse drug reaction. Prompt reporting of suspected cases to pharmacovigilance programs is essential for improving drug safety data and guiding regulatory decisions. Research into formulation components and patient-specific risk factors may lead to the development of safer inhaler options. Ultimately, a combination of clinician awareness, patient education and evidence-based prescribing can mitigate risks and improve asthma care outcomes.

Acknowledgment

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Conflict of Interest

None.

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