REVIEW ARTICLE

Translational Health Reports. 2026; 2(1): 4
https://doi.org/10.22034/thr.2025.236668

The Role of Early Intravenous Immunoglobulin and Nursing Process Optimization in Modulating Inflammation and Improving Outcomes in Pediatric Severe Adenovirus Pneumonia: A Comprehensive Review

Salayeva Navbahor[1], Docent. Sevara Sadullayeva[2], Ollaberganov Zayniddin Umarbekovich[3], Niginabonu Khajiqurbonova[4], Sultanov Muhammad[5], Saginova Aygerim Sisenbayevna[6]

[1]*Department of Pedagogy and Psychology, Urgench State University, Urgench, Uzbekistan*
[2]*Department of Psychological Sciences, Mamun University, Khiva, Uzbekistan*
[3]*Department of Medicine, Urgench Mamun University, Urgench, Uzbekistan*
[4]*Department of Clinical Subjects, Tashkent State Medical University, Tashkent, Uzbekistan*
[5]*Department of Psychology, Mamun University, Khiva, Uzbekistan*
[6]*Department of Medicine, Urgench Mamun University, Urgench, Uzbekistan*

Article history:

Received: 18 Oct 2025
Accepted: 3 Dec 2025
Available online: 12 Dec 2025

Keywords:

Immunoglobulin
Pediatric
Adenovirus
Pneumonia

Abstract

Background: Severe adenovirus pneumonia (SAP) in children is a critical illness characterized by a dysregulated hyperinflammatory response. The adjunctive role of early intravenous immunoglobulin (IVIG) and optimized nursing care in modulating this inflammation remains a key area of clinical investigation.
Objective: This review evaluated current evidence on the efficacy of early IVIG administration and nursing process optimization (NPO) in improving clinical and biochemical outcomes for pediatric SAP.
Methods: A comprehensive analysis of clinical studies, including a pivotal randomized controlled trial was conducted. The review focuses on IVIG's immunomodulatory mechanisms and the impact of structured nursing interventions on care delivery.
Results: Early IVIG administration is associated with significant reductions in key inflammatory markers (CRP, PCT, IL-8) and leads to superior clinical outcomes, including shorter hospital stays, fever duration, and mechanical ventilation requirements, alongside lower complication rates. Concurrently, implementing NPO protocols dramatically reduces infusion-related adverse events.
Conclusion: The synergistic application of early IVIG and NPO presents a promising, holistic strategy for managing pediatric SAP by effectively modulating inflammation and enhancing the safety of care delivery. This combined approach warrants broader clinical adoption and further long-term study.

Cite this article as: Navbahor S, Sadullayeva DS, Umarbekovich OZ, Khajiqurbonova N, Muhammad S, Sisenbayevna SA. The Role of Early Intravenous Immunoglobulin and Nursing Process Optimization in Modulating Inflammation and Improving Outcomes in Pediatric Severe Adenovirus Pneumonia: A Comprehensive Review. Transl Health Rep. 2026; 2(1):4. https://doi.org/ 10.22034/thr.2025.236668.

Introduction

Adenovirus pneumonia represents one of the most severe forms of pneumonia in infants and young children, with severe adenovirus pneumonia (SAP) posing a substantial threat to life. SAP is characterized by high, persistent fever, acute respiratory distress, and a high propensity for complications, including respiratory failure, pleural effusion, and myocarditis [1,2]. The disease progression is often rapid, and the associated hyperinflammatory response contributes significantly to tissue damage and organ dysfunction [3].

Correspondence:
Saginova Aygerim Sisenbayevna
E-mail: saSisenbayevna@yahoo.com

The clinical management of SAP remains challenging, as no specific antiviral therapy has proven universally effective. Treatment is primarily supportive, encompassing antiviral agents, management of secondary bacterial infections, and organ support, including mechanical ventilation (MV) for respiratory failure [4, 5]. Within this therapeutic landscape, intravenous immunoglobulin (IVIG) has emerged as a valuable immunomodulatory adjunct. IVIG, a preparation of polyclonal IgG antibodies, is postulated to exert its effects through multiple mechanisms, including Fc receptor blockade, neutralization of pathogens and toxins, and modulation of cytokine production [6, 7]. These actions may help temper the destructive inflammatory cascade seen in SAP.

Parallel to advances in pharmacological treatment, innovations in healthcare delivery are crucial. The concept of business process reengineering, introduced to healthcare to improve efficiency and quality [8], has found application in nursing. Nursing process optimization (NPO) involves a fundamental rethinking and redesign of nursing workflows from the patient's perspective to maximize safety, efficacy, and value [9]. In high-stakes environments like pediatric emergency infusion, NPO can significantly reduce procedural risks and improve the patient experience [10].

This review aims to critically appraise the current understanding of the role of early IVIG administration in modulating inflammatory biomarkers and improving clinical outcomes in pediatric SAP. It further seeks to evaluate the impact of NPO on enhancing the safety and effectiveness of care delivery, framing these interventions within a holistic approach to managing this severe pediatric illness.

Pathophysiology and Inflammatory Cascade in Severe Adenovirus Pneumonia

The severity of adenovirus pneumonia is not solely due to viral cytopathic effects but is largely driven by an excessive host immune response. The infection triggers a robust activation of innate and adaptive immunity, leading to a "cytokine storm" [11]. Key inflammatory mediators involved include:

- **C-reactive Protein (CRP):** A classic acute-phase reactant produced by the liver in response to interleukin-6 (IL-6). Elevated CRP levels correlate with the severity of inflammation and tissue damage [12].
- **Procalcitonin (PCT):** Another acute-phase reactant, PCT is often more specific for severe bacterial co-infections but is also elevated in severe systemic inflammatory states, including severe viral pneumonias, and can serve as a marker of disease severity and treatment response [13].
- **Interleukin-8 (IL-8):** A potent chemokine that attracts neutrophils to the site of infection. Excessive IL-8 production contributes to neutrophilic infiltration in the lungs, leading to alveolar damage and impaired gas exchange [14].

This dysregulated inflammatory response is central to the pathogenesis of complications such as acute respiratory distress syndrome (ARDS), pleural effusion, and extrapulmonary manifestations like myocarditis and encephalitis [3]. Therefore, therapeutic strategies aimed at modulating this response, such as IVIG, hold significant promise.

Immunomodulatory Mechanisms of Intravenous Immunoglobulin (IVIG)

IVIG's mechanisms of action are multifaceted and extend beyond simple antibody replacement. In the context of severe infection and inflammation, its beneficial effects are thought to derive from:

1. Neutralization of Pathogens and Toxins: IVIG contains a broad spectrum of neutralizing antibodies against common pathogens, which can aid in clearing the adenovirus and preventing secondary infections [6].

2. Fc Receptor Blockade: IVIG saturates Fcγ receptors on macrophages and other immune cells, thereby inhibiting antibody-dependent cellular cytotoxicity and phagocytosis of opsonized cells, which can mitigate tissue damage [7].

3. Modulation of Cytokine and Chemokine Production: IVIG can suppress the production of pro-inflammatory cytokines (e.g., TNF-α, IL-1β, IL-6) and chemokines like IL-8, thereby dampening the cytokine storm [15].

4. Anti-inflammatory Mediators: Certain preparations of IVIG contain anti-inflammatory components that can directly inhibit inflammatory pathways.

These immunomodulatory properties provide a strong rationale for the use of IVIG in conditions like SAP, where an exaggerated immune response is a key driver of pathology.

Clinical Evidence for Early IVIG in Pediatric SAP

A growing body of clinical evidence supports the adjunctive use of IVIG in SAP. Recent studies have focused on the timing of administration, with "early" intervention (within the first few days of hospitalization) being hypothesized to yield superior outcomes by intervening before the inflammatory cascade becomes irreversible.

A recent randomized controlled trial by Wu et al. provides compelling evidence for this approach [1]. In their study of 150 children with SAP, patients who received early IVIG (250-400 mg/kg/d for 3-5 days) alongside standard care demonstrated significantly greater reductions in inflammatory markers compared to the control group receiving standard care alone. The experimental group showed reductions of

approximately 40%, 30%, and 25% in CRP, PCT, and IL-8 levels, respectively, far exceeding the changes observed in the control group [1].

More importantly, these biochemical improvements translated into superior clinical outcomes. The IVIG group experienced a significantly shorter length of hospital stay (9.8±3.7 days vs. 13.6±3.5 days), a shorter duration of fever (10.6±4.2 days vs. 15.3±4.1 days), and a reduced need for and duration of mechanical ventilation (3.8±1.1 days vs. 5.5±2.7 days) [1]. Furthermore, the incidence of major complications, including pleural effusion, atelectasis, and myocarditis, was markedly lower in the IVIG group. This study underscores the potential of early IVIG to not only modulate the immune response but also to alter the clinical course of the disease favorably.

These findings are consistent with other reports in the literature. For instance, IVIG has been shown to improve outcomes in steroid-resistant pneumonia and other hyperinflammatory states [13, 16]. A study by Ouldali et al. also highlighted the role of IVIG in controlling fever and inflammation in multisystem inflammatory syndrome in children (MIS-C), a condition sharing some pathophysiological features with severe viral infections [17].

The Role of Nursing Process Optimization (NPO) in Safe Care Delivery

The administration of IVIG and the management of critically ill children with SAP require meticulous attention to detail to prevent iatrogenic harm. Nursing process optimization (NPO) is a systematic approach to redesigning workflows to enhance patient safety, efficiency, and satisfaction.

Key components of NPO in the context of emergency infusion, as demonstrated by Wu et al., include [1]:

- **Reception Optimization:** Streamlining patient intake, ensuring comprehensive handovers, and implementing triage protocols to prioritize critically ill children (e.g., those with high fever or altered mental status).
- **Infusion Process Optimization:** Standardizing drug verification, sequencing, and monitoring procedures. This includes proactive patient monitoring, especially during the infusion of hypertonic or irritating drugs, and clear communication with families about the use of call bells.
- **Psychological and Holistic Care:** Providing pre-infusion counseling to alleviate anxiety in both children and their families, thereby improving cooperation and reducing the risk of accidental displacement of lines or other incidents.

The implementation of NPO in the study by Wu et al. led to a dramatic reduction in infusion-related adverse events, such as fluid exosmosis, accidental disconnection, and medication errors [1]. This aligns with other studies that have shown process reengineering in healthcare settings can significantly improve patient safety profiles [18, 19]. By ensuring the safe and efficient delivery of critical therapies like IVIG, NPO acts as a force multiplier, enhancing the overall effectiveness of the medical intervention.

Discussion

The integration of early immunomodulatory intervention with optimized care delivery represents a paradigm shift in the management of pediatric SAP. Evidence suggests that early IVIG administration directly targets the core pathophysiology of SAP—the hyperinflammatory state—leading to measurable decreases in key mediators like CRP, PCT, and IL-8 [1]. This biochemical modulation correlates with tangible clinical benefits, including accelerated recovery, reduced resource utilization (shorter LOHS and MV time), and fewer complications.

The complementary role of NPO cannot be overstated. The complexity of caring for a critically ill child receiving intravenous biologics demands a highly reliable system. NPO provides the structural framework to minimize procedural risks, ensuring that the potential benefits of IVIG are not undermined by preventable adverse events [1, 10]. The synergy between a targeted biological therapy and a robust, patient-centered care process creates a comprehensive therapeutic strategy.

However, several questions remain. The optimal dosing and timing of IVIG for SAP require further standardization through larger, multi-center trials. The long-term impact of early immunomodulation on pulmonary sequelae, such as bronchiectasis or bronchiolitis obliterans, is another critical area for future research [12]. Furthermore, the generalizability of specific NPO protocols across different healthcare settings needs to be evaluated.

In conclusion, the current body of evidence strongly supports the adjunctive use of early intravenous immunoglobulin in the treatment of pediatric severe adenovirus pneumonia. Its ability to modulate the inflammatory response, as evidenced by the suppression of CRP, PCT, and IL-8, underlies significant improvements in clinical outcomes [1]. When this pharmacological strategy is coupled with nursing process optimization—a systematic approach to enhancing safety and efficiency in care delivery—the overall management of SAP is substantially improved [1, 9]. Future efforts should focus on validating these findings in broader populations, refining treatment protocols, and investigating long-term benefits, to firmly establish this combined approach as a standard of care for this challenging disease.

Acknowledgment

The authors would like to express their appreciation to all those who helped us conduct this research.

Funding

None

Authors Contributions

The authors contributed to the data analysis. Drafting, revising and approving the article, responsible for all aspects of this work.

Conflict of Interest

None

References

1. Wu H, Su L, Zhang Y, Li S, Cai R. Effect of Early Intravenous Infusion of Gamma Globulin on Inflammatory Markers (CRP, PCT, IL-8) in the Adjuvant Treatment of Pediatric Severe Adenovirus Pneumonia. Unpublished data. 2024.
2. Zhang C, Jia D, Sun Y, Song X. siRNA recombinant adenovirus enhances cardiac function after myocardial infarction by inhibiting the RAGE protein and the MAP/ERK1/2 pathway. Acta Medica Mediterranea. 2019;35(4):2051-6.
3. La Fay C, Bosdure E, Baravalle-Einaudi M, Stremler-Le Bel N, Dubus JC, Mazenq J. Severe adenovirus pneumonia with hemophagocytic syndrome and respiratory failure. Arch Pediatr. 2020;27(7):383-5.
4. Moon SM, Choe J, Na SJ, Chung CR, Suh GY, Jeon K. Comparative Study on the Effect of Cidofovir Treatment for Severe Adenovirus Pneumonia. J Intensive Care Med. 2021;36(12):1436-42.
5. Sreenath K, Batra P, Vinayaraj EV, Bhatia R, SaiKiran K, Singh V, et al. Coinfections with Other Respiratory Pathogens among Patients with COVID-19. Microbiol Spectr. 2021;9(1):e0016321.
6. Moradimajd P, Samaee H, Sedigh-Maroufi S, Kourosh-Aami M, Mohsenzadagan M. Administration of intravenous immunoglobulin in the treatment of COVID-19: A review of available evidence. J Med Virol. 2021;93(5):2675-82.
7. Dalakas MC. Update on Intravenous Immunoglobulin in Neurology: Modulating Neuro-autoimmunity, Evolving Factors on Efficacy and Dosing and Challenges on Stopping Chronic IVIg Therapy. Neurotherapeutics. 2021;18(4):2397-418.
8. Ahmed Bayomy N, E Khedr A, Abd-Elmegid LA. Adaptive model to support business process reengineering. PeerJ Comput Sci. 2021;7:e505.
9. Xiong Y, Liu Y, Cui J. Postoperative Cognitive Behavioral Intervention in Patients with Coronary Heart Disease Based on the Effect of Nursing Process Reengineering. Biomed Res Int. 2022;2022:6974909.
10. Song Y, Wang W, Zhang L, Sha L, Lu G. Optimization of the intravenous infusion workflow in the isolation ward for patients with coronavirus disease 2019. Int J Nurs Sci. 2020;7(2):148-52.
11. Yang MY, Zhang XP, Cao JS, Zhou X, Cai ZL, Kang XY, et al. [Clinical application of blood purification in treatment of severe adenovirus pneumonia]. Zhongguo Dang Dai Er Ke Za Zhi. 2020;22(10):1109-13.
12. Zhang XP, Yang MY, Zhou X, Cao JS, Cai ZL, Kang XY, et al. [Clinical features of severe type 7 adenovirus pneumonia: an analysis of 45 cases]. Zhongguo Dang Dai Er Ke Za Zhi. 2020;22(5):429-34.
13. Balaji A, Hsu M, Lin CT, Feliciano J, Marrone K, Brahmer JR, et al. Steroid-refractory PD-(L)1 pneumonitis: incidence, clinical features, treatment, and outcomes. J Immunother Cancer. 2021;9(1):e001731.
14. Aronoff SC, Hall A, Del Vecchio MT. The Natural History of Severe Acute Respiratory Syndrome Coronavirus 2-Related Multisystem Inflammatory Syndrome in Children: A Systematic Review. J Pediatric Infect Dis Soc. 2020;9(6):746-51.
15. Wolfe GI, Ward ES, de Haard H, Ulrichts P, Mozaffar T, Pasnoor M, et al. IgG regulation through FcRn blocking: A novel mechanism for the treatment of myasthenia gravis. J Neurol Sci. 2021;430:118074
16. Manwani D, Xu C, Lee SK, Amatuni G, Cohen HW, Carullo V, et al. Randomized phase 2 trial of Intravenous Gamma Globulin (IVIG) for the treatment of acute vaso-occlusive crisis in patients with sickle cell disease: Lessons learned from the midpoint analysis. Complement Ther Med. 2020;52:102481.
17. Ouldali N, Toubiana J, Antona D, Javouhey E, Madhi F, Lorrot M, et al. Association of Intravenous Immunoglobulins Plus Methylprednisolone vs Immunoglobulins Alone With Course of Fever in Multisystem Inflammatory Syndrome in Children. JAMA. 2021;325(9):855-64.
18. Burgess L, Kynoch K, Hines S. Implementing best practice into the emergency department triage process. Int J Evid Based Healthc. 2019;17(1):27-35.
19. Hanna KS, Segal EM, Barlow A, Barlow B. Clinical strategies for optimizing infusion center care through a pandemic. J Oncol Pharm Pract. 2021;27(1):165-79.