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A CASE REPORT ON OPTIMIZING PREHOSPITAL MANAGEMENT OF PEDIATRIC BRONCHIAL ASTHMA EXACERBATIONS

Sebastian Marek Ossowski[1], Przemysław Żuratyński[2]✉, Michał Borowczyk[2]

[1]Wladyslaw Bieganski Poviat Hospital in Ilawa, Medical Rescue Team in Ilawa, Poland
[2]Nicolaus Copernicus University in Torun, Collegium Medicum in Bydgoszcz, Faculty of Health Sciences, Department of Emergency Medical Services

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✉ ***przemyslaw.zuratynski@cm.umk.pl***

ABSTRACT

This case report presents the prehospital management of an 8-year-old boy experiencing a severe bronchial asthma exacerbation. The aim of the study was to assess the effectiveness of emergency interventions performed by a specialist emergency medical team, based on current international and national guidelines. The patient received nebulized salbutamol, oxygen therapy with a non-rebreather mask, and intramuscular methylprednisolone. Vital signs were monitored throughout the intervention. The applied treatment resulted in stabilization of the patient's condition and improved respiratory function prior to hospital admission. This case emphasizes the importance of rapid, guideline-based prehospital treatment in pediatric asthma and highlights the critical role of trained emergency personnel in ensuring positive patient outcomes.

Keywords: Bronchial asthma, pediatric patient, emergency medical team, airway obstruction,

INTRODUCTION

Bronchial asthma is a chronic inflammatory disease of the respiratory system, classified by the World Health Organization (WHO) as one of the major noncommunicable Chronic Respiratory Diseases (CRDs) [1]. According to the Global Initiative for Asthma (GINA), asthma is a heterogeneous condition with various phenotypes and degrees of severity. It is characterized by bronchial hyperresponsiveness and persistent inflammation, which clinically manifests as episodes of wheezing, dyspnea, chest tightness, and cough—symptoms that typically worsen at night or in the early morning [2].

In pediatric patients, the most common triggers of asthma exacerbations are environmental allergens such as pollen or dust mites, while in adults, internal factors often dominate. Although asthma symptoms may remit with age, the underlying airway inflammation tends to persist and may recur later in life. Importantly, the clinical presentation in children is not significantly different from that in adults. Exacerbations are characterized by airway narrowing, mucus hypersecretion, and bronchial wall inflammation. In children, such episodes can rapidly lead to life-threatening respiratory failure and require immediate medical intervention. Genetic predisposition also plays a key role in disease onset [3–6].

Bronchial asthma remains one of the most common chronic conditions in children and presents a significant challenge not only for hospital-based care but especially for emergency medical teams operating in prehospital settings. According to WHO data, approximately 262 million people worldwide suffer from asthma, with over 455,000 asthma-related deaths recorded in 2019—many of them among children and adolescents [1].

In Poland, as of 2023, approximately 2.067 million individuals were living with asthma. Notably, the highest

prevalence per 100,000 population was observed among boys aged 6–10 years, highlighting the significant burden of asthma in the pediatric population [7].

Despite the high prevalence and potentially life-threatening nature of severe exacerbations, there is still a lack of standardized and clearly defined protocols for prehospital management of pediatric asthma attacks [7]. The literature is predominantly focused on in-hospital treatment, leaving the prehospital phase poorly documented. As a result, emergency medical services (EMS) must often rely on general guidelines that do not always consider the unique characteristics of pediatric asthma cases.

Another challenge is the lack of uniform tools for assessing the severity of exacerbations and the considerable variability in clinical practices across EMS teams. This inconsistency can negatively impact the effectiveness of treatment and patient safety [6].

THE AIM OF STUDY

The aim of the study was to assess the effectiveness of emergency interventions performed by a specialist emergency medical team, based on current international and national guidelines.

METHODS

The study was conducted on the premises of the Medical College in Bydgoszcz, Nicolaus Copernicus University in Torun, Poland. Patient records needed for the individual case study were made available electronically on May 7, 2024 by the Dr. Antoni Jurasz University Hospital No. 1 in Bydgoszcz. For the purposes of the study, approval was obtained from the Bioethics Committee at the Nicolaus Copernicus University in Torun, Collegium Medicum in Bydgoszcz (KB 204/2024)

The subject of the study was the documentation of 17.06.2020 established at 11:47 a.m. in the pediatric emergency room of the Dr. Antoni Jurasz University Hospital No. 1 in Bydgoszcz. The documentation provided also included the pre-hospital management of the patient recorded on the medical emergency action card provided by the primary team of the state emergency medical service.

This case was selected due to its clinical relevance and illustrative value for prehospital management of pediatric bronchial asthma exacerbation. The patient presented with an acute, first-time severe exacerbation requiring immediate life-saving interventions. Despite the use of standard emergency protocols, the patient's condition demonstrated delayed response to first-line bronchodilators, which raised practical concerns regarding the adequacy of current prehospital procedures in pediatric settings. The case thus serves as an example of challenges encountered when typical therapeutic algorithms prove insufficient or delayed in effect.

This presentation, although not rare in terms of diagnosis, is significant due to the combination of:

- early onset and sudden progression in a previously undiagnosed child,
- limited parental knowledge of symptoms,
- and the necessity for critical decision-making in a home-based intervention by EMS personnel with no prior asthma documentation.

The patient was selected using the following criteria:

- pediatric age group (under 18),
- acute exacerbation of asthma requiring prehospital intervention,
- full documentation from the EMS intervention,
- availability of parental consent and ethics committee approval.

To evaluate the prehospital response, the following criteria were applied:

- timeliness of intervention (time from dispatch to treatment),
- adherence to existing national EMS protocols and international guidelines (GINA),
- appropriateness of pharmacological measures (type, dosage, route),
- clinical outcome and patient stabilization prior to hospital arrival,
- communication and education provided to caregivers during intervention.

CASE DESCRIPTION

PRE-HOSPITAL TREATMENT

On June 17, 2020, at 10:36 a.m., the medical dispatcher called an emergency medical services (EMS) team for an 8-year-old boy experiencing increasing dyspnea and persistent cough. The EMS team was dispatched in code one, and the call was received at 10:36 a.m.

Upon arrival at the scene, the child's basic vital signs were measured, and a medical history was obtained from both the patient and his guardian. The child weighed 26 kg. A physical examination was conducted based on the SAMPLE acronym commonly used in emergency medicine. The collected medical history was as follows:

- S (Symptoms): shortness of breath, cough, weakness, chest pain
- A (Allergies): no previously diagnosed allergies
- M (Medications): no medications taken
- P (Past medical history): none
- L (Last meal): breakfast at approximately 9:00 a.m., consisting of milk with cornflakes
- E (Events): child vaccinated in accordance with the immunization schedule, Apgar score 10/10, dyspnea occurred after going outside to the garden, no insect bites observed.

Due to the rapidly progressing dyspnea associated with an asthma exacerbation, the assessment focused on the patient's vital signs. Given the isolated nature of the incident, the examination was limited to internal medicine without the need for trauma assessment. No psychiatric evaluation was included. The child's social conditions were assessed as very good—well cared for, with both parents present and favorable developmental environment. Vital signs assessed during the ABCDE examination performed by the EMS team are presented in Table 1.

Table 1. Patient's vital parameters at various stages of the intervention

	Preliminary examination	**After administration of drugs**	**After administration of drugs - after 20 min**
A (airway assessment)	airway clear	airway clear	airway clear
B (respiratory assessment)			
o Respiratory rate	29/min	26/min	25/min
o Respiratory effort	present	present	present
o Thoracic and ribcage respiratory trajectory	yes	yes	yes
o Chest elevation symmetrical	without pathology	without pathology	without pathology
o Auscultation bilaterally present expiratory wheezes	yes	yes	yes
o Blood saturation	90%	93%	94%
C (cardiovascular assessment)			
o Heart rate	118 bpm, steady, symmetric	115 bpm, steady, symmetric	110 bpm, steady, symmetric
o Capillary return	< 2s	< 2s	< 2s
o Blood pressure	97/61 mmHg	100/68 mmHg	101/69 mmHg
o Color, moisture, skin warming	without pathology	without pathology	without pathology

o Superficial body temperature	36.8°C	36.7°C	36.7°C
o ECG	sinus rhythm, no pathology	sinus rhythm, no pathology	sinus rhythm, no pathology
D (assessment of disturbance of consciousness)			
o On AVPU consciousness assessment scale	A - patient conscious (alert)	A - patient conscious (alert)	A - patient conscious (alert)
o GCS	15 points	15 points	15 points
o Glucose level	95 mg%	-	-
o Neurological assessment	without pathological changes	without pathological changes	without pathological changes
o Reactive pupils	without pathological deviations	without pathological deviations	without pathological deviations
E (injury assessment)	no signs of trauma	no signs of trauma	no signs of trauma

Following initial assessment, the team leader ordered the administration of 2.5 mg of salbutamol via nebulization and the preparation of 5 mg of dexamethasone for intravenous administration. While preparing the medications, a peripheral IV line was established in the left antecubital fossa. To improve oxygen saturation, passive oxygen therapy was provided—initially via a nebulization mask with a flow rate of 12 L/min along with salbutamol, then via nasal cannulas with a flow rate of 5 L/min. After medication administration, the patient's vital signs were reassessed (Table 1).

Due to continued dyspnea, 20 minutes after the first dose, a second nebulized dose of salbutamol (2.5 mg) was administered. Following this, the patient's condition improved (Table 1).

Because this was the child's first episode of bronchial asthma exacerbation, the team leader recommended hospital transport for further diagnosis. The child's legal guardian consented to transport. The patient was transferred to the ambulance and transported to the hospital. Passive oxygen therapy was continued during transport. Upon arrival, the child was handed over to the on-duty nurse at the pediatric emergency department.

During the operation, the EMS team documented the diagnoses and interventions listed in Table 2.

Table 2. Diagnoses and interventions performed by the EMS team

DIAGNOSIS	Hypoxia due to asthma exacerbation	Ineffective ventilation due to ongoing inflammation in the airways due to bronchial asthma exacerbation, with expiratory wheezing present	Risk of fungal lesions in the mouth and face after nebulization	Risk of infection of the site of the IV infusion	Risk of deterioration of the victim's condition

OBJECTIVE	Obtain optimal oxygen concentration SpO2 94-98%	Obtain effective ventilation without expiratory wheezing	No occurrence of fungal lesions after nebulization performed	No occurrence of infection at the site of the performed IV insertion	Counteract deterioration of the victim's condition
INTERVENTIONS	Use of passive oxygen therapy with the use of a partially returnable mask with a reservoir. Setting the flow of medical oxygen on the regulator to a value of 12l/min. Monitoring of SpO2 values.	Use of a nebulization mask . Setting the oxygen flow rate on the regulator. Nebulization of Salbutamolum 2.5 mg. Repeat nebulization after 20min with Salbutamolum 2.5 mg. Performing an unobstructed peripheral venipuncture. Administration of Dexamethasoni 5mg intravenously.	Informing the patient and parent of the possibility of fungal lesions. Informing the patient and parent to rinse the mouth and wash the face every time after the nebulization is applied. Observing the patient. Washing the patient's face.	Inspecting the site of the IV infusion performed. Rinsing the cannula after each drug delivery with saline. Securing the site of the performed insertion with a veneer. Maintaining antisepsis and aseptics each time the cannula is used. Proper administration and preparation of drugs administered by intravenous route.	Monitoring the patient's basic vital signs. Maintaining psychological comfort. Transporting the patient to the hospital
RESULT	Obtaining adequate saturation	Obtaining satisfactory ventilation of the patient	No fungal lesions after the nebulization used	No infection at the site of the insertion performed	No deterioration of the patient's condition

HOSPITAL TREATMENT

The patient, an 8-year-old male, was urgently admitted to the pediatric emergency department of Dr. Antoni Jurasz University Hospital No. 1 in Bydgoszcz on June 17, 2020, at 11:47 a.m. According to information provided by the EMS team, the child’s guardian had noticed worsening condition with accompanying dyspnea.

At the time of hospital admission, improvement in the patient’s condition was noted—breathing remained rapid with expiratory wheezing, oxygen saturation was 96%, and heart rate was 90 bpm.

In the hospital, necessary laboratory tests were performed, and the medical history was taken again. After consultation with an internist, the child received instructions regarding asthma prevention and was prescribed appropriate medications for potential recurrence of symptoms. The patient was discharged home after completing treatment.

DISCUSSION

Acute asthma exacerbation in the pediatric population remains one of the key challenges for emergency medical services (EMS), both due to its high prevalence and potentially rapid clinical deterioration. The case of the 8-year-old patient presented here fits the typical pattern of a first-time asthma episode, with symptoms including shortness of breath, persistent cough, and weakness. Thanks to the caregiver’s prompt reaction and the rapid dispatch of the EMS team, timely treatment was initiated and symptoms were successfully managed. Although the intervention was carried out according to current medical knowledge and clinical guidelines, this case also reveals important limitations and areas for improvement within the pediatric prehospital care system.

Numerous case reports in the literature describe first asthma exacerbations in children with no prior diagnosis of the

condition. In a study by Olin et al., up to 30% of children hospitalized for asthma exacerbation had no prior asthma diagnosis, which increases the risk of diagnostic delays and treatment errors [8]. Similar to our case, symptoms appeared suddenly, and the lack of medical history required a rapid clinical assessment under time and resource constraints. The EMS team administered standard pharmacological treatment: 2.5 mg of salbutamol via nebulization, consistent with the GINA 2023 guidelines [2]. Partial clinical improvement following the first dose justified administration of a second dose after 20 minutes. The importance of early beta2-agonist use via nebulization as a critical component of asthma management has been emphasized in studies such as that by Bacharier et al., which found that early administration of salbutamol within the first 60 minutes reduced the risk of hospitalization in children [9].

Intravenous dexamethasone was administered at a dose of 5 mg, which was appropriate in principle, although slightly below the recommended minimum for a child weighing 26 kg (5.2–7.8 mg, based on the 0.2–0.3 mg/kg dosing guideline) [10]. In prehospital settings, such dosing discrepancies may result from limitations in available vial sizes or the need for rapid administration. Nevertheless, insufficient corticosteroid dosing can lead to incomplete resolution of airway inflammation, increasing the risk of relapse and repeat hospitalization. An effective alternative, widely accepted in international guidelines, is prednisolone; in Poland, however, dexamethasone is often used as a substitute due to availability issues [2,10].

Oxygen therapy was initiated with nebulization at a flow rate of 12 L/min, followed by nasal cannula oxygen at 5 L/min. While this approach falls within current guidelines for mild-to-moderate exacerbations, some sources such as Travers et al. suggest that continuing oxygen delivery via mask provides higher oxygen concentration and may yield better outcomes in moderate-to-severe cases [11]. For a patient with significant bronchospasm, this could have supported more stable saturation post-nebulization.

This case also highlighted organizational limitations, particularly the insufficient information contained in the dispatcher’s call note. It lacked essential details on the patient’s medical history, symptom onset, and possible triggers—information that is vital for EMS teams to prepare equipment, calculate doses, and mentally rehearse treatment plans en route. Studies on prehospital communication emphasize that the quality of dispatcher-to-EMS information significantly impacts both treatment effectiveness and response time. Despite the limited data in this case, the EMS team demonstrated sound preparation and effective initial clinical assessment, aligning well with the European Resuscitation Council (ERC) guidelines for pediatric emergencies. The ERC emphasizes early recognition and rapid, structured intervention in cases of asthma exacerbation. According to the 2021 ERC First Aid Guidelines, asthma is explicitly identified as a condition requiring prompt treatment with inhaled bronchodilators—preferably via spacer or nebulizer—and supplemental oxygen when oxygen saturation drops below 94% [12]. The guidelines also stress the importance of positioning the child upright to ease breathing, calming them to reduce oxygen consumption, and urgently seeking further medical support in all moderate or severe cases. Furthermore, ERC guidance recommends intramuscular or intravenous corticosteroids and hospital referral in children with recurrent exacerbations or inadequate response to initial therapy. These recommendations were largely reflected in the management of the case presented and serve as a valuable framework for EMS teams working in dynamic prehospital environments.

From a process improvement perspective, it would be highly beneficial to introduce standardized clinical severity assessment tools—such as the Pediatric Respiratory Assessment Measure (PRAM)—into prehospital practice. PRAM is a validated, age-appropriate scoring tool designed to objectively assess the severity of asthma exacerbations based on parameters like respiratory rate, oxygen saturation, use of accessory muscles, and degree of wheezing [13]. Although underutilized in many EMS systems due to time pressure, lack of familiarity, or inadequate training, the implementation of PRAM could significantly improve the consistency and quality of clinical assessments in the field. It would also support more appropriate triage decisions, better documentation, and enhanced communication with receiving facilities. Furthermore, structured use of such tools could serve as a foundation for future research, quality assurance, and protocol development in pediatric prehospital asthma care.

In cases of inadequate response to standard pharmacotherapy, the use of intravenous magnesium sulfate ($MgSO_4$) should be considered as a second-line agent. Its effectiveness has been demonstrated in numerous studies, including the Cochrane review by Cheuk et al., which found that $MgSO_4$ shortened hospital stays and improved clinical outcomes [14]. The recommended dose is 25–50 mg/kg IV, yet access to this medication in EMS kits across Poland remains limited.

Finally, patient handover at the pediatric emergency department is a crucial step. In this case, the handover was conducted thoroughly and in accordance with professional standards, which is essential for ensuring continuity of care. Incomplete information transfer from EMS to hospital staff can result in misinformed treatment decisions. This case demonstrates the importance of structured communication and the paramedic’s ability to summarize the prehospital intervention clearly and concisely.

In conclusion, this case illustrates the effectiveness and appropriateness of the EMS team's actions, while also highlighting systemic limitations related to pharmacotherapy, oxygen delivery, and communication. Further improvements in the quality of pediatric prehospital asthma care will require the development of standardized protocols, enhanced pediatric training, and better equipping of EMS teams with child-specific tools and medications.

LIMITATIONS

As with all case reports, the findings and interpretations are limited by the nature of single-patient observation. This case may not represent the full spectrum of asthma exacerbations in the pediatric population, particularly in chronic or previously diagnosed patients. Furthermore, the absence of long-term follow-up data limits conclusions about continuity of care and outcomes beyond the prehospital phase.

CONCLUSION

Based on the described case, the following conclusions can be drawn:

1. Taking a medical history is a crucial step in diagnosing the cause of a bronchial asthma exacerbation.
2. Developing an action strategy before the arrival of the emergency medical team enables faster implementation of procedures.
3. Rapid identification of the asthmatic condition significantly increases the chances of halting its progression.
4. Continuous patient monitoring allows for early detection of clinical deterioration.
5. Prompt initiation of pharmacotherapy during an asthma exacerbation effectively inhibits the escalation of the condition.

RECOMMENDATIONS

In light of the conclusions drawn from this case, the following recommendations are proposed to improve prehospital management of pediatric bronchial asthma exacerbations:

1. **Ensure** thorough medical history taking as an integral part of initial patient assessment, to support accurate diagnosis and tailored intervention.
2. **Implement** pre-arrival planning protocols for emergency teams, including prehospital action strategies based on initial dispatch information.
3. **Provide** training for rapid recognition of asthmatic symptoms among emergency personnel to enable swift diagnosis and initiation of treatment.
4. **Standardize** continuous patient monitoring throughout the intervention to detect early signs of deterioration and adjust treatment accordingly.
5. **Emphasize** the importance of immediate pharmacological intervention, including bronchodilators and corticosteroids, in all cases of asthma exacerbation to prevent escalation and improve outcomes.

DISCLOSURES

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

ETHICAL APPROVAL

For the purposes of the study, approval was obtained from the Bioethics Committee at the Nicolaus Copernicus University in Toruń, Collegium Medicum in Bydgoszcz (KB 204/2024).

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COMPETING INTERESTS

The authors declare that they have no competing interests

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back