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FROM CHIPS TO CYANOSIS: A CASE REPORT OF BLACK STONE (PARAPHENYLENEDIAMINE) POISONING WITH CRITICAL CARE AND PHYSIOTHERAPY REHABILITATION

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Abstract

Background: Black stone poisoning is a serious medical emergency that is common in South Asian countries. It can quickly cause swelling of the face and throat, breathing problems, kidney injury, muscle damage, and failure of multiple organs. There is limited information about the role of physiotherapy in the recovery of these patients.

Case Presentation: A 15-year-old girl was admitted with severe breathing difficulty after her family initially reported that she had choked while eating potato chips. She rapidly developed swelling of the face, tongue, and throat, requiring an emergency tracheostomy. Further investigation confirmed intentional ingestion of black stone . She later developed respiratory failure, rhabdomyolysis, acute

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

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Bhatti et al - 2026

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kidney injury, and multiorgan dysfunction, requiring mechanical ventilation and intensive care treatment.

Intervention: After her condition became stable, physiotherapy was started in the intensive care unit. Treatment included proper positioning, airway clearance, breathing exercises, passive and active-assisted limb exercises, inspiratory muscle training, early mobilization, muscle strengthening, balance training, walking practice, and activities of daily living. Rehabilitation was progressed according to the patient's condition.

Outcome: The patient showed improvement in breathing, muscle strength, mobility, and overall function. She was successfully weaned from the ventilator, maintained normal oxygen levels on room air, walked with minimal assistance, and was able to perform basic daily activities before discharge. Functional outcome measures also showed significant improvement.

Conclusion: This case shows that early diagnosis, timely airway management, intensive care, and structured physiotherapy rehabilitation are important for the recovery of patients with severe black stone poisoning. Early rehabilitation can improve breathing, reduce muscle weakness, restore mobility, and help patients regain independence. More studies are needed to develop standard physiotherapy guidelines for patients recovering from this poisoning.

INTRODUCTION

Self-poisoning remains a major global public health challenge and is responsible for a substantial proportion of suicide-related morbidity and mortality, particularly in low- and middle-income countries (1) The World Health Organization estimates that more than 700,000 people die by suicide annually, with self-poisoning representing one of the most frequently employed methods in many developing nations where highly toxic substances are easy to access (2). Access to inexpensive toxic agents, limited mental health services, social stigma, and delayed healthcare presentation collectively contribute to poor outcomes following deliberate self-poisoning (3). Recent epidemiological studies have demonstrated a continuing rise in intentional poisoning among

Vol. 5 No. 2 (2026)

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https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127214

adolescents and young adults, emphasizing the need for effective preventive strategies and multidisciplinary management approaches. (4)

Among the numerous toxic agents implicated in deliberate self-harm, paraphenylenediamine, commonly marketed as "Kala Pathar" or "Black Stone," has emerged as an important cause of poisoning in South Asia, the Middle East, and several African countries (5). Originally introduced as an ingredient in permanent hair dyes because of its strong coloring properties, IT has increasingly become a preferred suicidal agent because it is inexpensive, easily available, and largely unregulated in many developing countries (6). Unlike poisoning patterns observed in high-income countries, ingestion of it is now recognized as a unique regional toxicological emergency associated with rapid clinical deterioration and high mortality (7).

Pakistan represents one of the countries with the highest reported burden of black stone poisoning. Multiple hospital-based studies have demonstrated that most affected patients are young females from rural and socioeconomically disadvantaged backgrounds who ingest black stone with suicidal intent (8). Mortality rates ranging from approximately 20% to over 30% have been reported depending on disease severity, timing of presentation, and availability of intensive care resources (9). The National Poison Control Center in Karachi has identified black stone poisoning as one of the leading causes of intentional poisoning requiring critical care admission, with Sindh and southern Punjab contributing a substantial proportion of reported cases (6). Seasonal variation, particularly during the spring and summer months, has also been described. (7,9)

Chemically, paraphenylenediamine is an aromatic amine that undergoes rapid oxidation following ingestion, producing highly reactive quinone diamine intermediates capable of inducing extensive oxidative stress, lipid peroxidation, and direct cellular injury (10). These toxic metabolites trigger widespread skeletal muscle necrosis, myocardial injury, hepatic dysfunction, and acute tubular necrosis while simultaneously provoking an intense inflammatory response (11). The characteristic cervicofacial and laryngeal angioedema observed shortly after ingestion frequently progresses to life-

Vol. 5 No. 2 (2026)
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Online ISSN 3007-2387
Print ISSN 3007-2379
Bhatti et al - 2026
DOI: http://doi.org/10.5281/zenodo.21127214

threatening airway obstruction, making early airway protection the cornerstone of successful management (12)

Following ingestion, paraphenylenediamine undergoes rapid oxidation by cytochrome-mediated enzymatic pathways to form highly reactive quinone diamine intermediates and Bandrowski's base, resulting in extensive oxidative stress, lipid peroxidation, mitochondrial dysfunction, and direct cellular necrosis (13). These toxic metabolites primarily affect skeletal muscle, cardiac muscle, renal tubular epithelium, hepatic tissue, and the upper respiratory tract, accounting for the multisystem manifestations observed in severe poisoning(14).

The earliest and most characteristic clinical manifestation is rapidly progressive cervicofacial and laryngeal angioedema, which usually develops within the first few hours after ingestion and presents with dysphagia, odynophagia, hoarseness, stridor, tongue swelling, and impending airway obstruction (15). Because edema progresses rapidly and is frequently refractory to corticosteroids and antihistamines alone (16), definitive airway management through early endotracheal intubation or emergency tracheostomy is often lifesaving. Several Pakistani studies have reported tracheostomy requirements exceeding 80–90% among critically ill patients with severe poisoning (17).

In addition to airway compromise, extensive rhabdomyolysis develops secondary to direct myocyte toxicity, producing marked elevations in serum creatine kinase, lactate dehydrogenase, myoglobinuria, and electrolyte abnormalities (18). Myoglobin-induced tubular obstruction together with renal vasoconstriction contributes to acute tubular necrosis and acute kidney injury (AKI), which remain among the leading causes of mortality in affected patients(19). Hyperkalemia, metabolic acidosis, hypocalcemia, and hyperphosphatemia further increase the risk of malignant cardiac arrhythmias and sudden cardiac death (20).

Cardiovascular toxicity is increasingly recognized in severe black stone poisoning and includes myocarditis, ventricular arrhythmias, cardiogenic shock, myocardial depression, and sudden cardiac arrest (21). Hepatic injury characterized by markedly elevated transaminases frequently accompanies skeletal muscle necrosis, while prolonged tissue hypoxia and systemic inflammatory activation may

Vol. 5 No. 2 (2026)

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Print ISSN 3007-2379

Bhatti et al - 2026

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precipitate multiorgan dysfunction syndrome (22). Neurological manifestations including agitation, seizures, altered consciousness, and coma have also been described in critically ill patients (23).

Since no specific antidote currently exists, management remains entirely supportive and requires a multidisciplinary intensive care approach (24). Immediate airway protection, intravenous fluid resuscitation, urine alkalinization where appropriate and early recognition and prompt transfer to intensive care have consistently been associated with improved survival (25).

Critically ill survivors frequently experience prolonged mechanical ventilation, ICU-acquired weakness, profound deconditioning, respiratory muscle dysfunction, impaired mobility, reduced exercise tolerance, dysphagia, and psychological sequelae following extended hospitalization. Early multidisciplinary rehabilitation, including physiotherapy plays important role in managing such symptoms but data is limited (26).

The published literature describing the complete continuum of care from emergency stabilization and intensive care management to structured physiotherapy rehabilitation represents an important knowledge gap, particularly in low-resource settings where this poisoning remains highly prevalent (27,28). Most available publications emphasize toxicological manifestations and mortality while providing little information regarding rehabilitation interventions, functional recovery, and long-term patient outcome (29).An additional challenge in the diagnosis and management of paraphenylenediamine poisoning is the frequent provision of false, incomplete, or misleading histories by patients or accompanying relatives because of social stigma, fear of legal consequences, family pressure, or intentional concealment of suicidal intent (30).

Therefore, this case report describes the comprehensive clinical course of an adolescent female with severe black stone (paraphenylenediamine) poisoning requiring multidisciplinary critical care management followed by physiotherapy rehabilitation. By highlighting the progression from acute toxic exposure to functional recovery, this report aims to increase awareness among intensivists, emergency physicians, toxicologists, rehabilitation specialists, and physiotherapists regarding the

Vol. 5 No. 2 (2026)
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Bhatti et al - 2026
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importance of early recognition, aggressive critical care management, and timely rehabilitation interventions to promote better clinical and functional outcomes.

CASE REPORT

15-year-old female was initially admitted to a peripheral hospital after suspected poisoning. According to her family, she had consumed potato chips before developing sudden shortness of breath. Based on this history, food aspiration was initially suspected. However, within a short time, she developed rapidly progressive swelling of the face, neck, tongue, and larynx, leading to severe airway obstruction. An emergency tracheostomy was performed to secure the airway.

Subsequent toxicological evaluation confirmed ingestion of black stone (paraphenylenediamine-containing hair dye). After further questioning, the family disclosed that the ingestion was intentional following family conflicts. The initial false history delayed the diagnosis of paraphenylenediamine poisoning and appropriate management.

Despite emergency airway stabilization, the patient's respiratory status continued to deteriorate. On 13 March 2025, she required endotracheal intubation because of worsening respiratory failure and was placed on invasive mechanical ventilation. She remained ventilator-dependent until 18 March 2025, after which she was transferred to the Medical Intensive Care Unit (MICU) for advanced critical care because of severe rhabdomyolysis and multiorgan dysfunction syndrome.

On admission to the MICU, the patient was sedated and mechanically ventilated using pressure-control ventilation (pressure control 16 cmH_2O, tidal volume 350 mL, respiratory rate 16 breaths/min, FiO_2 30%, and PEEP 5 cmH_2O). Arterial blood gas analysis demonstrated mixed metabolic acidosis, while blood-stained respiratory secretions were noted secondary to airway trauma. Her APACHE II score was 26 and SOFA score was 7, indicating severe critical illness.

Attempts to reduce sedation were unsuccessful because the patient developed marked tachypnea and tachycardia. By 22 March 2025, she was weaned to oxygen therapy (5 L/min) through a T-piece and tolerated an overnight spontaneous breathing trial despite a mild febrile episode. Chest radiography

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127214

demonstrated bilateral pleural effusions, with a PaO_2/FiO_2 ratio of 103, consistent with moderate hypoxemia. She remained fluid overloaded with a positive fluid balance (+1154 mL) and oliguria (10 mL/hour).

By 23 March 2025, the patient was switched to spontaneous pressure-support ventilation and successfully completed a 12-hour T-piece trial. Arterial blood gases improved, although metabolic alkalosis developed. Chest examination revealed improved bilateral air entry. Ultrafiltration removed 2.5 L of fluid; however, urine output remained absent, indicating persistent acute kidney injury.

On the 25th hospital day, the patient's respiratory condition deteriorated with tachypnea (35 breaths/min) and reduced tidal volumes (approximately 250 mL), requiring a return to pressure-control ventilation. Sedation was intensified using propofol, fentanyl, and neuromuscular blockade to improve ventilator synchrony. Chest radiography demonstrated mild bilateral pulmonary infiltrates suggestive of early pulmonary infection.

By 27 March 2025, the patient had improved clinically and was stable on a T-piece with 2 L/min oxygen while maintaining an oxygen saturation of 98%. Chest imaging demonstrated persistent bilateral lung volume loss. Respiratory cultures isolated *Pseudomonas aeruginosa* and *Candida tropicalis*, and targeted antimicrobial therapy was initiated.

Successful extubation was achieved on 29 March 2025. The patient maintained an oxygen saturation of 95% while breathing room air. Respiratory secretions had significantly decreased, and chest radiography showed only mild residual bilateral lung volume loss. Ultrafiltration continued with removal of an additional 2.5 L of fluid.

By 31 March 2025, the patient remained clinically stable on room air with an oxygen saturation of 99%. Gastrointestinal bleeding had resolved, blood cultures were negative, and urine cultures grew *Candida* and *Enterococcus* species. Arterial blood gases had normalized, respiratory secretions were minimal, and urine output gradually improved to 5–10 mL/hour, indicating recovery of renal function.

Vol. 5 No. 2 (2026)

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https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127214

laboratory investigations were performed throughout the patient's ICU stay to monitor the progression of systemic illness and response to treatment. Trends in hematological parameters, inflammatory markers, renal function, and biochemical indices were used to guide ongoing clinical management (Figures 1–4).

Investigations

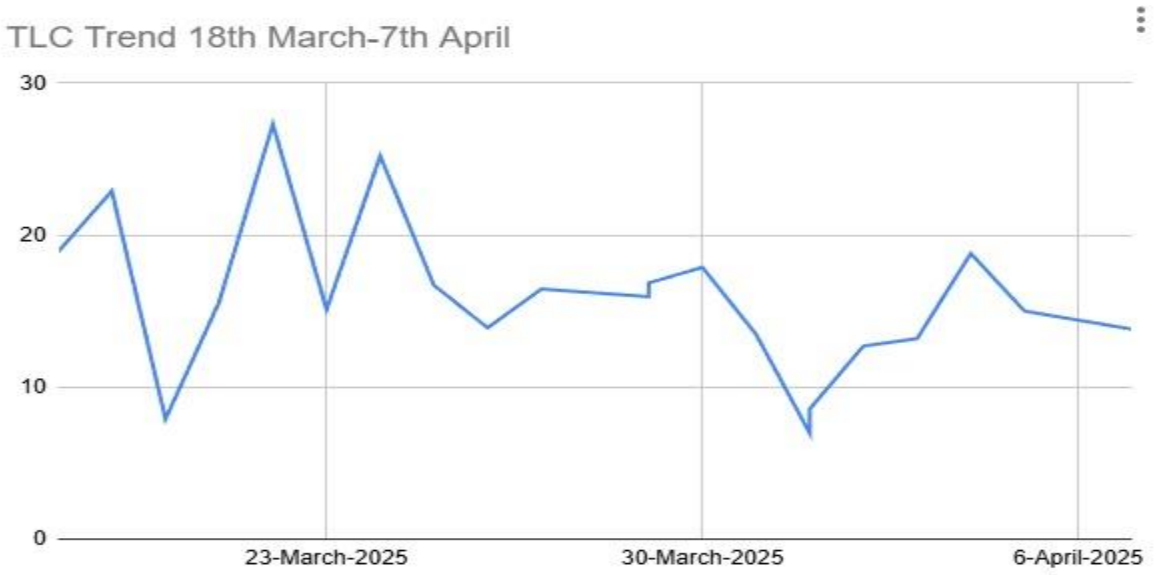

Figure 1. ***Trend of Total Leukocyte Count (TLC) TLC from 18 March to 7 April 2025 demonstrating marked fluctuations during the acute phase of illness, with an initial leukocytosis with systemic inflammatory response and infection, followed by gradual stabilization after targeted antimicrobial therapy and clinical improvement.***

The total leukocyte count remained elevated during the early ICU course, reflecting systemic inflammation and secondary infection. Following initiation of targeted antimicrobial therapy and improvement in the patient's clinical condition, the leukocyte count gradually decreased and approached normal values before discharge.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127214

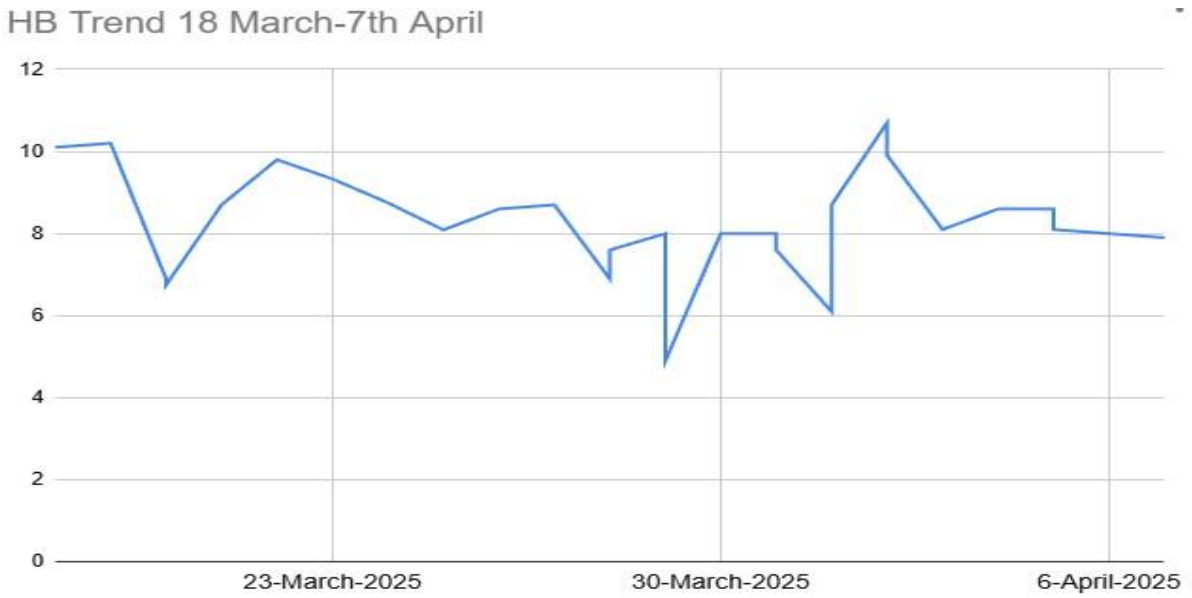

Figure 2. ***Hemoglobin Trend measurements from 18 March to 7 April 2025 demonstrating fluctuations during the ICU stay related to critical illness, repeated blood sampling, gastrointestinal bleeding, renal dysfunction, and subsequent stabilization following supportive management.***

Hemoglobin levels gradually declined during the acute phase of illness and were further affected by gastrointestinal bleeding and critical illness. Following supportive management and stabilization, hemoglobin levels remained stable without further significant decline.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

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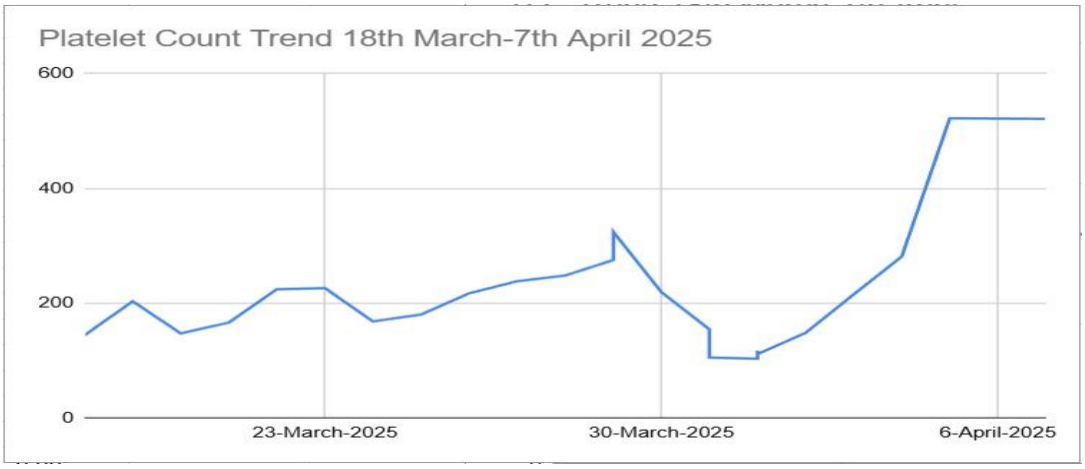

Figure 3. ***platelet count from 18 March to 7 April 2025 demonstrating thrombocytopenia during the acute phase of critical illness followed by gradual recovery and normalization with clinical improvement.***

Platelet counts remained within the low-to-normal range during the early ICU stay but declined during the acute phase of illness, likely reflecting systemic inflammation, sepsis, and multiorgan dysfunction. Following clinical stabilization, treatment of infection, and recovery from critical illness, platelet counts progressively increased and eventually normalized before discharge, indicating hematological recovery.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127214

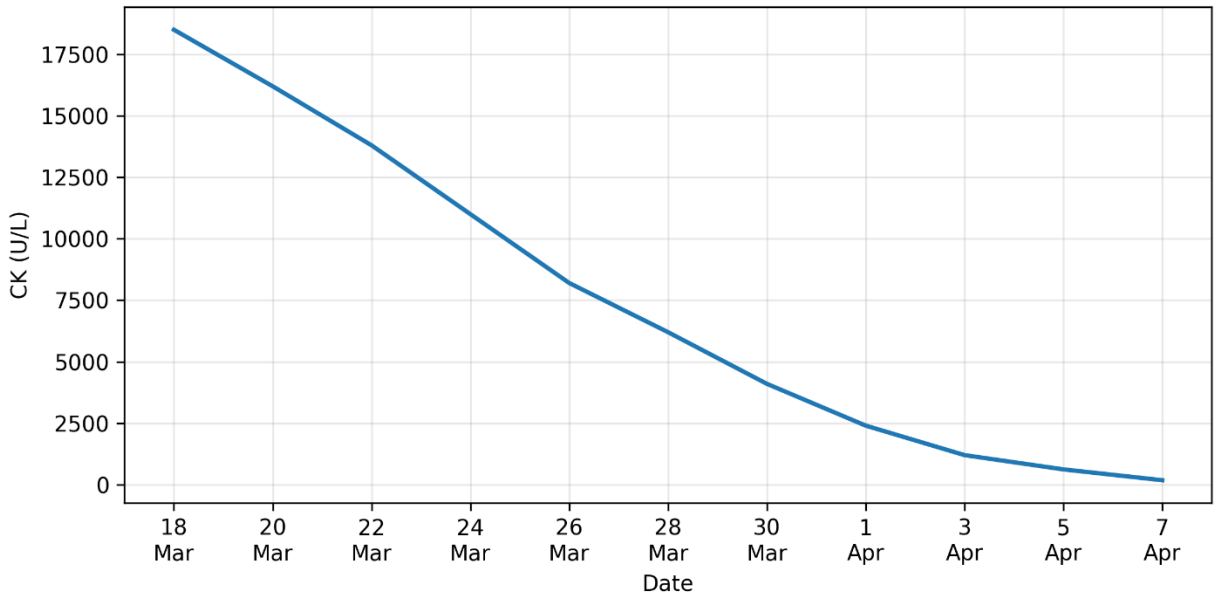

Figure 4. ***Creatine kinase trend from 18 March to 7 April 2025 demonstrating markedly elevated CK levels during the acute phase of paraphenylenediamine poisoning followed by a progressive decline with clinical recovery.***

Creatine kinase levels were markedly elevated during the early ICU stay, reflecting severe rhabdomyolysis caused by paraphenylenediamine toxicity

Physiotherapy Assessment and Rehabilitation

Physiotherapy was initiated immediately after medical stabilization in the Medical Intensive Care Unit. Initial assessment revealed severe ICU-acquired weakness, generalized muscle wasting, poor chest expansion, ineffective cough, retained airway secretions, impaired sitting balance, complete dependence for bed mobility and transfers, and inability to perform activities of daily living. The patient was closely monitored throughout treatment using heart rate, blood pressure, respiratory rate, oxygen saturation, ventilator parameters, and level of consciousness to ensure safe progression of rehabilitation.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127214

Phase I – Mechanical Ventilation

While mechanically ventilated, physiotherapy focused on preventing pulmonary and musculoskeletal complications. Respiratory management included the **Lotorp method**, ventilator hyperinflation, manual hyperinflation when clinically appropriate, endotracheal suctioning, manual chest techniques, airway clearance, positioning every two hours, diaphragmatic facilitation, thoracic expansion techniques, and optimization of ventilation–perfusion matching. Musculoskeletal interventions included passive range-of-motion exercises for all limbs, stretching, pressure area care, positioning to prevent contractures, and early neuromuscular stimulation through frequent movement and postural changes.

Phase II – Ventilator Weaning

As sedation was reduced and spontaneous breathing trials were introduced, rehabilitation progressed to breathing control exercises, diaphragmatic breathing, inspiratory muscle training, thoracic expansion exercises, active-assisted range-of-motion exercises, bed mobility, rolling, sitting at the edge of the bed, trunk control exercises, and transfer training. Therapy intensity was increased gradually according to the patient's cardiopulmonary stability and tolerance.

Phase III – Post-Extubation Rehabilitation

Following successful extubation, respiratory physiotherapy focused on improving lung expansion and secretion clearance through diaphragmatic breathing, incentive spirometry, thoracic expansion exercises, huffing and effective coughing techniques, airway clearance, and inspiratory muscle training. Functional rehabilitation progressed to sit-to-stand practice, standing balance, progressive ambulation, lower- and upper-limb strengthening, gait training, endurance exercises, stair practice as tolerated, and retraining of activities of daily living.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127214

Phase IV – Functional Recovery and Discharge Planning

As the patient's condition improved, physiotherapy emphasized restoration of functional independence through progressive resistance exercises, balance and coordination training, endurance conditioning, postural correction, and functional mobility practice. The patient gradually progressed from assisted sitting to independent walking with supervision. Education was provided to the patient and family regarding breathing exercises, airway clearance techniques, home exercise progression, energy conservation, safe mobility, and the importance of continuing outpatient physiotherapy after discharge.

Outcome

At discharge, the patient demonstrated marked improvement in respiratory function, muscle strength, mobility, and functional independence. She was able to maintain normal oxygen saturation on room air, ambulate with minimal assistance, perform basic activities of daily living, and continue rehabilitation through a structured outpatient physiotherapy program with regular follow-up.

Table 1. Timeline of Clinical Events and Physiotherapy Rehabilitation

Date / Hospital Day	Clinical Events	Medical Management	Physiotherapy Rehabilitation
Initial Presentation	Presented with acute shortness of breath after reported 'chip ingestion.' Rapid facial, tongue, and laryngeal edema developed.	Emergency tracheostomy performed. Toxicology later confirmed black stone ingestion.	No physiotherapy due to unstable airway and emergency management.
13 March 2025	Worsening respiratory failure.	Endotracheal intubation and	Initial physiotherapy assessment.

Vol. 5 No. 2 (2026)

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Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127214

		invasive mechanical ventilation initiated.	Positioning, passive ROM, pressure injury prevention, secretion assessment.
18 March 2025	Developed rhabdomyolysis and multiorgan dysfunction syndrome.	Transferred to MICU for advanced critical care.	Continued passive mobilization and respiratory assessment.
MICU Admission	Sedated on pressure-control ventilation (PC 16 cmH_2O, TV 350 mL, RR 16, FiO_2 30%, PEEP 5). Mixed metabolic acidosis. APACHE II = 26, SOFA = 7.	Mechanical ventilation, sedation, organ support, monitoring.	Lotorp method, ventilator hyperinflation, manual hyperinflation when indicated, endotracheal suctioning, Counter rotation, passive ROM, positioning every 2 hours, chest expansion therapy, prevention of ICU-acquired weakness.
22 March 2025	Weaned to T-piece (5 L/min). Bilateral pleural effusions, P/F ratio 103, oliguria.	Oxygen therapy, fluid management, nephrology review.	Continued Lotorp positioning, breathing control, thoracic expansion, active-assisted ROM, upright

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127214

			sitting, airway clearance.
23 March 2025	Pressure-support ventilation. Completed 12-hour T-piece trial. Persistent anuria despite ultrafiltration.	Ultrafiltration (2.5 L), continued supportive care.	Bed mobility, sitting edge of bed, trunk control, inspiratory muscle training, diaphragmatic breathing, progressive mobilization.
Hospital Day 25	Respiratory deterioration with tachypnea and low tidal volumes.	Returned to pressure-control ventilation. Sedation increased.	Modified physiotherapy with Lotorp method, VHI/MHI, airway clearance, passive ROM, positioning, secretion management.
27 March 2025	Stable on T-piece. Respiratory cultures positive for Pseudomonas aeruginosa and Candida tropicalis.	Targeted antimicrobial therapy initiated.	Chair sitting, transfer training, standing, incentive spirometry, diaphragmatic breathing, strengthening, assisted ambulation.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127214

29 March 2025	Successfully extubated. Minimal secretions.	Continued stabilization and ultrafiltration.	Inspiratory muscle training, airway clearance, huffing/coughing, gait training, balance, strengthening, ADL retraining.
31 March 2025	Stable on room air. GI bleeding resolved. Urine output improved.	Continued monitoring and discharge planning.	Out of bed mobilization tolerated, resistance exercises, functional mobility, home exercise program, family education.

Table 2 Physiotherapy Outcome Measures During Hospitalization

Outcome Measure	ICU Admission	Post-Extubation	Hospital Discharge	Clinical Interpretation
ICU Mobility Scale (IMS) (0–10)	0	5	9	Progressed from bed-bound to independent ambulation with supervision.
Behavioral Pain Scale (BPS) (3–12)	8	5	3	Pain progressively reduced during

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Bhatti et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127214

				recovery.
Modified Medical Research Council Dyspnea Scale (mMRC) (0–4)	4	2	1	Dyspnea improved from severe breathlessness to mild breathlessness with exertion.
Functional Mobility Scale (FMS)	Level 1 (Dependent)	Level 3 (Minimal Assistance)	Level 5 (Independent Ambulation)	Functional mobility improved to independent walking.

Conclusion

Black stone (paraphenylenediamine) poisoning is a serious medical emergency that can rapidly lead to airway obstruction, respiratory failure, rhabdomyolysis, acute kidney injury, and multiorgan dysfunction. This case highlights the importance of early recognition, prompt airway management, and aggressive intensive care treatment to improve survival. It also demonstrates the important role of physiotherapy throughout the ICU stay. Early respiratory physiotherapy, proper positioning, airway clearance techniques, ventilator-based interventions, breathing exercises, and early mobilization helped prevent ICU-related complications, improve lung function, reduce muscle weakness, and restore functional mobility. A multidisciplinary approach involving intensivists, nurses, physiotherapists, nephrologists, respiratory therapists, and mental health professionals is

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Print ISSN 3007-2379
Bhatti et al - 2026
DOI: http://doi.org/10.5281/zenodo.21127214

essential for achieving the best clinical and functional outcomes. This case also emphasizes the need for public awareness, better regulation of black stone products, and further research to develop standardized physiotherapy rehabilitation protocols for patients recovering from severe this poisoning.

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Bhatti et al - 2026
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