Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/80vvz947

EVALUATION OF PARAPHENYLENEDIAMINE (KALA PATHAR) POISONING CASES: A PROSPECTIVE HOSPITAL-BASED STUDY AT HYDERABAD, PAKISTAN

Dr. Nadia Aslam[1], Dr. Aisha Khalid[2], Dr. Nasim Irshad[3], Dr. Waheed Ali Nahyoon[4*], Dr Muhammad Shafay[5], Dr. Ishrat Bibi[6], Dr. Marvi[7]

[1]Lecturer, Department of Forensic Medicine & Toxicology, Liaquat University of Medical and Health Sciences, Jamshoro Sindh, Pakistan. Email: drnadiaaslam77@gmail.com
[2]Assistant Professor, Department of Forensic Medicine & Toxicology, Liaquat University of Medical and Health Sciences, Jamshoro Sindh, Pakistan. Email: aeshakhalid@yahoo.com
[3]Assistant professor, Department of Forensic Medicine & Toxicology, Army Medical College, Rawalpindi, Pakistan Email: maakhanj@yahoo.com
[4*]Professor, Department of Forensic Medicine & Toxicology, Liaquat University of Medical and Health Sciences, Jamshoro Sindh, Pakistan. Email: dr_waheednahyoon@yahoo.com
[5]Assistant Professor, Department of Forensic Medicine & Toxicology, HBS Medical and Dental College, Islamabad Email: shafay_jalbani@yahoo.com
[6]Assistant Professor, Department of Forensic Medicine & Toxicology, Liaquat University of Medical and Health Sciences Jamshoro Sindh, Pakistan. Email: drishrat44@gmail.com
[7]Assistant Professor, Department of Pharmacology, Faculty of Pharmacy and Health Sciences, University of Baluchistan, Quetta, Pakistan. Email: marvibaloch56@yahoo.com

***Correspondence Author:** Dr. Waheed Ali Nahyoon,
*Professor, Department of Forensic Medicine & Toxicology, Liaquat University of Medical and Health Sciences, Jamshoro Sindh, Pakistan. Email: dr_waheednahyoon@yahoo.com

ABSTRACT

Background: In Pakistan and other Asian countries, Paraphenylene-diamine (PPD) ingestion is increasingly being used as a means of attempting suicide, according to published reports. This toxic substance can cause severe health complications, including liver damage, kidney failure, muscle breakdown and life-threatening throat swelling, which can be fatal if not promptly treated. The easy availability and affordability of PPD make it a growing concern as a means of deliberate self-harm among adults while 4.16% got referred to other facility. **Objectives:** The aim was to identify trends and causes specific to the region of medicolegal deaths, which can inform local healthcare policies and practices. This research builds on existing studies that highlight regional variations in medicolegal cases, influenced by factors such as law enforcement, socioeconomic status and cultural norms**. Study Design**: Prospective cohort study. **Study place**: Intensive Care Unit (ICU) of Liaquat University Hospital in Hyderabad. **Study duration:** 01 year from July 2023 to June 2024. **Method:** There were 24 patients diagnosed as kala Pathar poisoning during the study time period with age range of 15-35 yrs. **Results:** The results of the study showed that the majority of patients were females, accounting for 79.8 % of the cases, while males comprised 20.1%. Most patients were married, making up 75% of the sample, whereas 25% were unmarried. Notably, a significant proportion of patients, 91.66%,

belonged to low socio-economic backgrounds, with only 8.34% from middle-income groups, and none from high socio-economic groups. The outcomes showed a mortality rate of 41.66%, a recovery rate of 54.17%, and a referral rate of 4.16% to other facilities. **Conclusion:** The studied concluded that limiting access to the chemical and improving community life are necessary steps.

Key Words: Poisoning, hepatic necrosis, Suicide, Paraphenylenediamine, Kala Pathar

INTRODUCTION

Paraphenylene-diamine (PPD) locally known as "Kaala Pathar" in Urdu, a derivative of p-nitroaniline used in various chemical industries and its industrial applications are widespread. [1-2]. It has become a increasingly common cause of poisoning among individuals attempting suicide. PPD is a cheap and readily available substance often used in hair dyes. However, PPD is highly toxic, causing both local and systemic effects through oral ingestion, inhalation, or topical application [3]. The lethal dose is reported to be between 7-10 grams, with death occurring within 6-24 hours after ingestion. Once ingested, PPD is metabolized into toxic compounds, including benzoquinone diamine and Brandowaski's base, which are responsible for its toxic effects [4,5]. PPD poisoning is a significant concern not only in the Indo-Pak region but also in other parts of the world, including the Middle East, Sudan, and Morocco [6]. PPD toxicity can cause multi-organ damage, leading to complications such as renal failure, myocardial infarction, hepatic necrosis and rhabdomyolysis. Common symptoms include laryngeal edema, facial swelling, and cardiac arrhythmias, which can progress to shock. In severe cases, tracheostomy can be a lifesaving intervention, alongside supportive management [7-11]. Given the scarcity of data on PPD poisoning in this region, particularly in Hyderabad, Pakistan, this study aims to contribute to the existing knowledge and provide valuable insights for healthcare professionals and patients.

In the absence of a definitive diagnostic test for PPD poisoning, clinicians must rely on a combination of clinical evaluation, laboratory investigations and thorough patient history to make a diagnosis. Due to the lack of a specific antidote, treatment is primarily focused on supportive care. Prompt medical attention is essential to manage symptoms and prevent long-term damage. This includes administering high fluid intake to promote diuresis and performing tracheostomy to secure the airway in cases of respiratory compromise [12-15]. Patients presenting with neck edema following PPD ingestion often require emergency tracheostomy to prevent airway obstruction. Additionally, dialysis may be necessary for individuals with severe renal impairment. Patients with kidney failure may require dialysis, and early gastric lavage can play a crucial role in reducing mortality rates [16-19]. Research has shown an emerging trend of using PPD, or "black stone," as a means of self-harm. Given the limitations of conservative management in many cases, timely clinical decision-making is vital [20-21].

The primary objective of this research is to conduct a comprehensive investigation into the causes, clinical manifestations, and treatment outcomes of Paraphenylenediamine (PPD) poisoning. By doing so, the study highlighted the critical significance of timely diagnosis and intervention in managing PPD toxicity, ultimately contributing to improved patient care and outcomes.

METHODOLOGY

This study conducted on PPD poisoning was conducted at the Intensive Care Unit (ICU) of Liaquat University Hospital in Hyderabad from July 2023 to June 2024. After obtaining informed written consent from patients' attendants without any coercion, the study included patients of both genders who presented with PPD poisoning, while excluding those with other types of intoxications. A self-designed questionnaire was used to collect relevant information, including demographics such as name, gender, age, residence, and socioeconomic status. The collected data was analyzed using SPSS version 22, and the results were presented in frequencies, percentages, tables and charts.

RESULTS

Our study observed 24 patients with PPD poisoning over 1 year period. The demographic analysis showed a significant predominance of females, accounting for 79.8% of the cases, while males comprised 20.1%. The majority of patients (75%) were married, and the age distribution revealed that 80% of patients fell within the 15-25 years age range, while 20% were between 25-35 years old. In terms of socioeconomic status, the study found that the vast majority of patients (90%) belonged to the lower socioeconomic class, with only 10% coming from the middle class. No patients from upper or wealthy socioeconomic backgrounds were represented in the study. Clinically, the patients presented with a range of symptoms, including throat pain and difficulty swallowing (87%), severe breathing difficulties requiring ventilatory support (87%), and mouth opening issues with cervicofacial edema necessitating tracheostomy (87%). All patients had dark urine, indicative of potential kidney damage, with 45% developing acute renal failure. Furthermore, 95% of patients developed rhabdomyolysis, a serious condition involving muscle breakdown. The study's outcome analysis revealed a survival rate of 60% and a mortality rate of 40%. The duration of hospital stay varied from 1 day to 1 week, highlighting the need for prompt and effective treatment to improve patient outcomes.

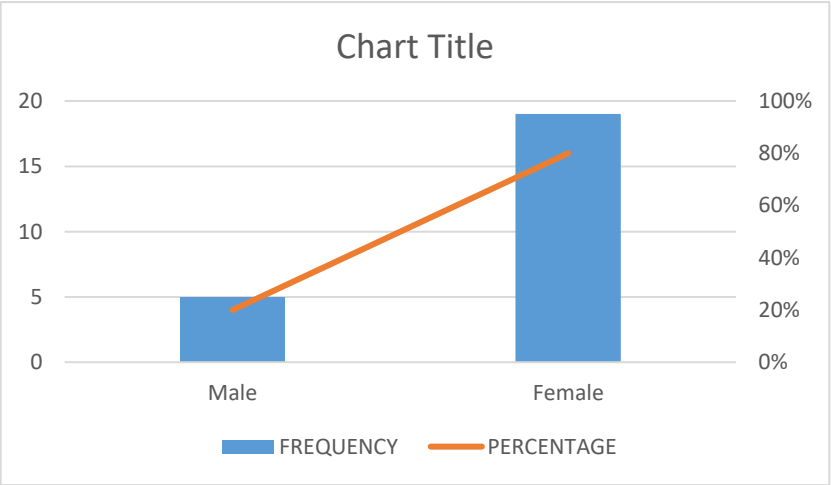

Fig-1: Chart showing frequency and percentage of male and female

Table #1. Showing demography of patients with treatment options and outcomes

1	**Sex**	
	Male 7(29.17%)	**Female** 17(70.83%)
2	**Socio-economic status**	
	Middle Income 02(8.33%)	**Low income** 22(91.66%)
3	**Marital Status**	
	Married 18(75%)	**Unmarried** 06(25%)
4	**Age ranges**	
	15 to 25 Yrs 19(79.17%)	**26 to 35 yrs** 05(20.83%)
5	**Nature of Poisoning**	
	Accidental 0(0%)	**Suicidal** 24(100%)
6	**Respiratory Support Provided**	
	Tcheostomy 07(29.17%)	**Ventilator** 17(70.83%)
7	**Out Come**	
	Survived 14(58.33%)	**Died** (41.67%)

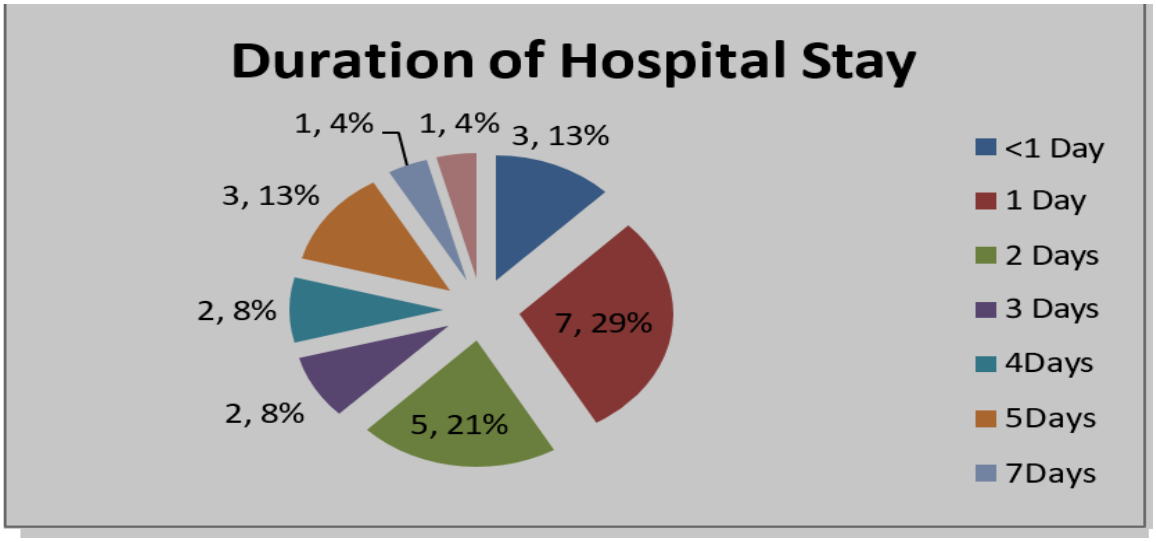

Figure # 2: Pie chart showing period of hospital stay of study population

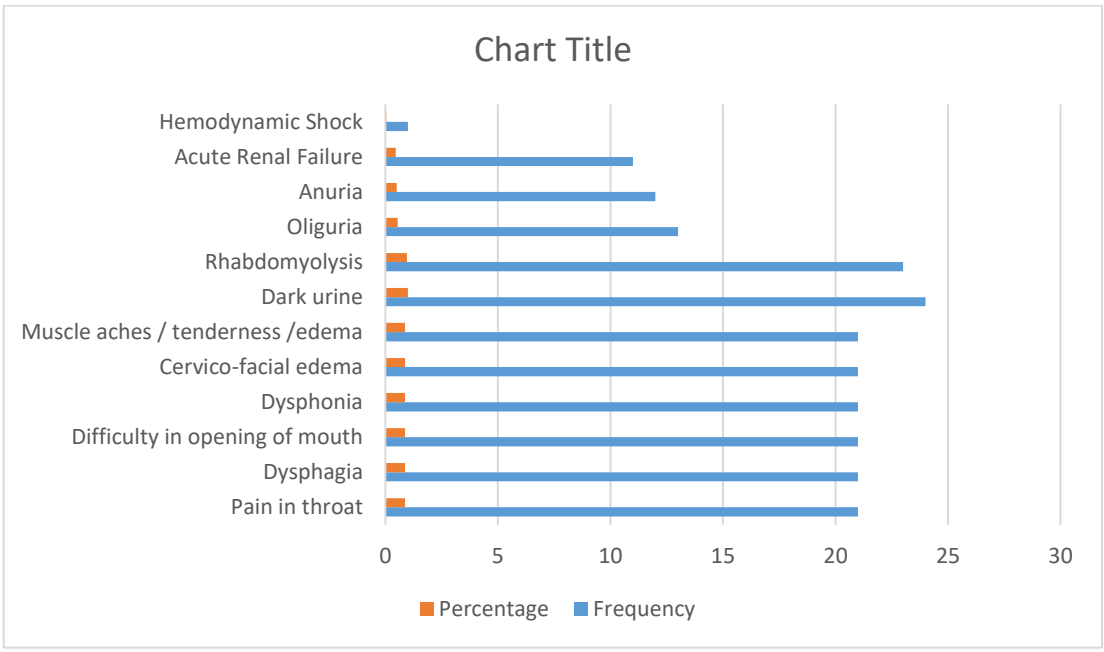

Figure # 3 Showing frequency and percentage of sign and symptoms

DISCUSSION

The study highlighted the widespread use of Paraphenylenediamine (PPD) as a hair dye in developing countries. PPD is a common component in cosmetics, particularly in combination with henna, which reduces the frequency of application. However, PPD's effects are systemic, meaning they can impact multiple body systems beyond the site of application. Unfortunately, PPD's accessibility and affordability have led to its increasing use as a poisoning agent in suicidal attempts [22]. The substance is highly toxic due to its complex chemical composition, which can cause oxidative stress and damage to various bodily tissues. The systemic effects of PPD poisoning can be severe and potentially life-threatening, emphasizing the need for prompt medical attention and effective treatment strategies [23]. A study by Qasim et al. in 2016 documented 109 cases of PPD poisoning over a three-month period, significantly higher than our findings. The study's demographic profile showed a female predominance, with 89% of cases being female and 11% male, and most patients (83.48%) were between 11-30 years old. Notably, all cases were suicidal and involved oral ingestion of PPD, consistent with our observation [24,25]. Furthermore, the majority of cases (95.41%) belonged to the

lower socioeconomic group, aligning with our study's finding [24]. A study by Khan et al. in 2018 documented a significantly larger number of PPD poisoning cases (1258) over 15 months, with a female predominance of 64.7% and a male proportion of 35.3%. The age range was broader, spanning 5-63 years, which differed from our findings. Notably, the study included children (5.2%) and reported a high number of suicidal cases (94.37%) among adults, as well as accidental poisoning cases (5.20%), which contrasts with our results. The mortality rate in adults was 24.08%, which is lower than the mortality rate observed in our study [25]. A study by Akbar et al. in 2017 identified 65 cases of PPD poisoning over a one-year period, with a female predominance of 72.31% and a male proportion of 27.69%, consistent with our findings. The mean age of patients was 24.35 years, and the majority of cases (89.23%) involved oral ingestion, which was intentional and suicidal in nature. In contrast, 10.77% of cases involved transdermal exposure, which was accidental [26]. A study by Khan et al. in 2015 documented 18 cases of PPD poisoning, with a mean age of 22.08 years. The majority of patients (71.1%) were unmarried and belonged to a low socioeconomic class, consistent with our findings. Most cases (94.74%) were suicidal, while a small proportion (5.26%) were accidental. The study reported a mortality rate of 47.4%, which is comparable to the 41.66% mortality rate observed in our study [27].

The findings of this study and previous research underscore the severity of PPD poisoning as a significant public health concern, particularly given the high mortality rates observed in a relatively young population. The incidence of PPD poisoning is notably high among low socioeconomic groups, suggesting that restricting access to this chemical could be a crucial step in mitigating the issue. Implementing regulatory measures to ban or limit the sale of PPD-containing products could potentially reduce the number of poisoning cases. Moreover, improving socioeconomic conditions, particularly in rural areas, may also play a critical role in reducing the incidence of PPD poisoning. Early management and intervention are vital in improving treatment outcomes, highlighting the need for an enhanced referral system that can efficiently handle cases from rural areas, where the majority of victims reside. By addressing these factors, it may be possible to decrease the mortality rate associated with PPD poisoning and improve overall public health outcomes.

CONCLUSION

PPD poisoning is a serious condition associated with significant morbidity and mortality. Healthcare professionals need to be well-versed in recognizing the clinical manifestations and management strategies for PPD poisoning to provide effective care. Given the substantial risks associated with PPD-containing products, regulatory measures should be taken to restrict or ban their use, particularly in hair dyes, to prevent further cases of poisoning and reduce the burden on healthcare systems.

REFERENCES

1. Ahmad E (2018) Paraphenylenediamine (PPD) Poisoning - A Case Report Do We Really Know Kala Pathar? J Anesth Crit Care Open Access 10(1): 00353. DOI: 10.15406/jaccoa.2018.10.00353
2. Bowen DAL. A case of Paraphenylene diamine poisoning. Med Sci Law. 1963;3:216-9.
3. 3.Ahmad E (2018) Paraphenylenediamine (PPD) Poisoning - A Case Report Do We Really Know Kala Pathar? J Anesth Crit Care Open Access 10(1): 00353. 10.15406/jaccoa.2018.10.003
4. 4.Bowen DAL. A case of Paraphenylene diamine poisoning. Med Sci Law. 1963;3:216-9.
5. 5. Ram R et al (2007;53:181–2.), Swarnalatha G, Prasad N, Dakshinamurty KV. Paraphenylenediamine ingestion. An uncommon cause of acute renal failure. Postgrad J Med.
6. 6. Ishaque S, Haq A, Jurair H, Siyal H (2016) Kaala Pathar (Paraphenylene Diamine) Poisoning and Angioedema in a Child: An Unusual Encounter. J Clin Toxicol 6: 294. doi:10.4172/2161-0495.1000294
7. 7. Ram R, Swarnalatha G, Prasad N, Dakshinamurty KV (2007) Paraphenylene diamine ingestion: an uncommon cause of acute renal failure. J Postgrad Med 53: 181 182.

8. 8. Akbar MA (2010) Kala pathar (paraphenylene diamine) intoxication; a study at Nishtar Hospital Multan.
9. 9. Akbar MA (2010) Kala pathar (paraphenylene diamine) intoxication; a study at Nishtar Hospital Multan. Nemeth J, Maghraby N, Kazim S. Emergency airway management: the difficult airway. Emerg Med Clin North Am 2012; 30:401-20.
10. 10. Shaik NA, Jayasundaram E. Gastric lavage in hair dye (Super-Vasmaol 33) poisoning: A friend or foe. J Emerg Trauma Shock 2012; 5:276.
11. 11. Singh N, Jatav OP, Gupta RK, Tailor MK. Myocardial damage in hair dye poisoning – An uncommon presentation. J Assoc Physicians India 2008; 56:463-4.
12. 12. Sampath kumar K, Yesudas S. Hair dye poisoning and the developing world. J Emerg Trauma Shock, 2009; 2: 129-31.
13. 13. Kallel H, Chelly H, Dammark H, Bahloul M, Ksibi H, Hamida CB, et al. Clinical manifestations of systemic paraphenylene diamine intoxication. J Nephrol, 2005; 18: 308.
14. 14.Soni SS, Nagarik AP, Dinaker M, Adikey GK, Raman A. Systemic toxicity of paraphenylenediamine. Ind J Med Sci., 2009; 63: 164-66.
15. 15.Lalila AH. Histopathological alterations in renal tubules of female rats topically treated with Paraphenylene diamine. World Appl Sci J., 2012; 16(3): 376-88.
16. 16. Sakuntala P, Khan PM, Sudarsi B, Manohar S, Siddeswari R, Swaroop K. Clinical profile and complications of hair dye poisoning. Int J Sci Res Pub. 2015;5(6):1-4.
17. 17. Jain PK, Agarwal N, Kumar P, Sengar NS, Agarwal N, Akhtar A. Hair dye poisoning in Bundel khand region (prospective analysis of hair dye poisoning cases presented in Department of Medicine, MLB Medical College, Jhansi). J Assoc Phys Ind. 2011;59:415-19.
18. 18.Ishaque S, Jurair H, Siyal H, Kaala Pathar (paraphenylene diamine) poisoning and angioedema in a child: an unusual encounter. J Clin Toxicol 2019; 6(294): 1-5.
19. 19. Tanweer S, Saeed M, Zaidi S, Aslam W. Clinical profile and outcome of paraphenylene diamine poisoning. J Coll Phys Surg Pak 2021; 28(5): 374-377.
20. 20. Ram R, Swarnalatha G, Prasad N, Dakshinamurty KV. Paraphenylene diamine ingestion: an uncommon cause of acute renal failure. J Postg Med 2007; 53(3): 181-112.
21. 21. Dorra A, Ines G, Nouioui A, Khlifi F, Salah D, Masri W, et al. Paraphenylenediamine Poisoning in Tunisia: A Case Report. Arab J Forens Sci Foren Med 2015; 230(1856): 1-5.
22. 22. Haider SA, Sultan A, Salman Z, Waris S, Bandesha Y. Paraphenylenediamine poisoning: clinical presentations and outcomes. Anaesth Pain Inten Care 2021; 22(1): 43-48.
23. 23. A-Rahman NH, Ahmed AM. Hair dye poisoning: An overview. J Sci Res. 2014; 2:31-3.11. Sampathkumar K, Yesudas S. Hair dye poisoning and the developing world. J Emerg Trauma Shock. 2009; 2(2):129-34.
24. 24,Qasim AP, Ali MA, Baig A, Moazzam MS. Emerging Trend of Self Harm by 'Kala Pathar' Hair Dye (Paraphenylene diamine) : An Epidemiological Study. APMC 2016;10(1):26 30.
25. 25.Khan MA, Akram S, Shah HBU, Hamdani SAM, Khan M. Epidemic of Kala Pathar(Paraphenylene Diamine) Poisoning: an Emerging Threat in Southern Punjab.J Coll Physicians Surg Pak. 2018 Jan;28(1):44-47. doi: 10.29271/jcpsp.2018.01.44
26. 26. Akbar K, Iqbal J, Rehman H, Iqbal R. Acute renal failure among kala pathar poisoning. JSZMC 2017;8(2): 1153-1156 16.
27. 27. Khan N, Khan H, Khan N, Ahmad I, Shah F, Rahman AU, Mahsud I. Clinical presentation and outcome of patients with paraphenylenediamine (kala-pathar) poisoning. Gomal J Med Sci 2015; 14: 3-6.