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Frequency of Hyperkalemia in Patients with Paraphenylenediamine Poisoning at a Tertiary Care Hospital

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ABSTRACT

Introduction: Paraphenylenediamine is a low-cost and readily available hair dye in Pakistan. It is highly toxic and lethal substance when ingested. This study was conducted to determine the frequency of hyperkalemia in patients with PPD poisoning.

Objective: To determine the frequency of hyperkalemia in patients with PPD-poisoning at a tertiary care hospital.

Material and Methods: A descriptive case series study was conducted at Teaching Hospital Dera Ghazi Khan, from 1st January, 2019 to 30th June, 2020. A total of 87 patients fulfilling the inclusion criteria were enrolled. After the approval from hospital ethical Committee, informed consent was obtained from all the patients. Once registered, 3 ml venous blood sample was drawn and sent to the hospital laboratory (after every 12 hours) for serum potassium levels to diagnose hyperkalemia. Data was entered and analyzed using SPSS-23.

Results: Out of 87 cases, 20 (23.0 %) were male while 67 (77.0 %) were female patients. Mean age was 25.69 ± 7.43 years with age range of 18-45 years. 65 patients (74.7 %) belonged to rural areas and 22 (25.3 %) to urban areas. Poor socioeconomic status was noted in 71 (81.6%) while 16 (18.4%) were of middle income. Out of 87 cases, 52 (58.9%) were illiterate and 35 (40.2%) were literate. Reason for intake was homicidal in 22 (25.3%) and suicidal in 65 (74.7%). Mean hospital stay was 6.23 ± 3.39 days and 54 (62.1 %) had hospital stay for more than 3 days. Mean serum potassium level was 5.10 ± 0.45 mmol/L and hyperkalemia was noted in 23 cases (26.4%).

Conclusion: High frequency of hyperkalemia was noted in our study among patients with Paraphenylenediamine poisoning and resulted in prolong duration of hospitalization.

Key Words: Paraphenylenediamine poisoning, Hyperkalemia, Serum Potassium, Tertiary care Hospital, Hair dye, Suicidal

INTRODUCTION

Poisoning is one of the common ways of suicide and deliberate self-harm.¹ In underdeveloped countries including Pakistan where poverty is common due to unemployment and literacy rate is low, use of Paraphenylenediamine has become a common method of poisoning as it is readily available and cheap in the market. PPD ingestion causes different signs and symptoms due to involvement of multiple organs. It is brown or black colored solid substance, derivative of para-phenylamine and easily soluble in H₂O.^{2,3,4} PPD is metabolized by electron oxidation with cytochrome P450 peroxidase to form a

reactive compound called benzoquinone diamine. This can be further oxidized to a substance known as Brandowaski's base, reported to cause anaphylaxis.

The first case of PPD poisoning was reported in 1924⁵, when a barber accidentally developed toxicity while handling the dye. Hair Dye Poisoning is highly uncommon in developed countries due to strict formulary regulations; however in developing world like Asia and Africa, it is emerging as a common means of suicide. In South East Asia especially in India, use of hair dye as a suicidal tool is reported to have mortality rate reaching up to 24 percent even with treatment⁴. As there

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is no antidote available for PPD poisoning, only early recognition of symptoms and timely management is the key treatment option to avoid adverse effects. Paraphenylenediamine is a major toxic substance in hair dye which can cause life threatening neck and facial edema, laryngeal edema that may need emergency tracheostomy or endotracheal intubation to secure airway and muscle damage that may cause rhabdomyolysis and lead to acute renal failure.⁶

PPD poisoning is associated with significant increase in morbidities and mortalities and is more common in females as compared to males and is more prevalent in lower social classes. In Pakistan, most incidents are reported from Sindh and Punjab related to hair dye poisoning.^{7,8} Hair dye powder is readily available and its excessive use in this area has led to clinical implications of its toxicity that may be accidental or suicidal. A study conducted by Haider et al.,⁹ has reported 34.4 % hyperkalemia in patients presenting with PPD poisoning.

This study has been proposed to document hyperkalemia in patients with PPD poisoning as we commonly treat such patients in our daily practice but no such study has been done in our local population (Dera Ghazi Khan). The results of this study will generate baseline database of our local population and help clinicians to anticipate such adverse events in early stages which will lead to the proper management of such cases.

OBJECTIVE: To determine the frequency of hyperkalemia in patients with PPD-poisoning at a tertiary care hospital

MATERIAL AND METHODS

A descriptive case series study was conducted at Department of Medicine, Teaching Hospital Dera Ghazi Khan from 1st January, 2019 to 30th June, 2020. A total of 87 cases were enrolled through a non-probability, consecutive sampling. All the patients with PPD poisoning with either gender; between 15 – 60 years were included and patients with past history of kidney and chronic liver disease were excluded. After the approval from hospital ethical review committee (NO.7925/ Teach: Hosp:D.G.Khan/ Dated 16/12/2018), informed consent was taken for each patient. A pre-designed proforma (ANNEXURE-1) was used to collect information regarding reason for intake (suicidal, homicidal, accidental), level of education, location (urban, rural), duration of hospital stay, gender, age and family income. Once registered, 3 ml venous blood sample was drawn and sent to the hospital laboratory (after every 12 hours) for serum potassium levels to diagnose hyperkalemia. Data was entered and analyzed by consultant physician with 10 year post fellowship experience using SPSS-23. Descriptive statistics was applied to calculate mean and standard deviation for the age, hospital stay and Serum potassium level. Frequencies and percentages were

calculated for categorical variables like gender, age groups, reason for intake, residential status, family income, level of education and hyperkalemia. Effect modifiers like age, residential status, family income, level of education, duration of hospital stay, gender and reason for intake were controlled by stratification. Post stratification chi-square test was applied to see their effect on hyperkalemia. P-value equal or less than 0.05 was considered as significant.

RESULTS

A total of 87 patients were included in study. Out of these, 20 (23.0 %) were male patients while 67 (77.0 %) were female patients. Mean age was 25.69 ± 7.43 years with age range in 18-45 years. Majority of our study cases i.e. 74 (85.1 %) were aged up to 35 years. Out of these 87 cases, 65 (74.7 %) belonged to rural areas and 22 (25.3 %) belonged to urban areas. Poor socioeconomic status was noted in 71 (81.6%) while 16 (18.4%) were of middle income. 52 patients (58.9%) were illiterate and 35 (40.2%) were literate. Reason for intake was homicidal in 22 (25.3%) and suicidal in 65 (74.7%). Mean hospital stay of our study cases was 6.23 ± 3.39 days and 54 (62.1 %) had hospital stay for more than 3 days. Mean serum potassium level was 5.10 ± 0.45 mmol/L and hyperkalemia was noted in 23 (26.4%) (Table No.1). Hyperkalemia was stratified with regards to gender, age, residential status, socioeconomic status, literacy, reason for intake and hospital stay. Length of hospital stay showed a significant relationship with hyperkalemia (Table No. 2)

DISCUSSION

A poison is chemical agent that produces adverse effects when enter the human body. Intoxication by hair dye is very common in Pakistan and this is usually attributed to the active ingredient Paraphenylenediamine (PPD). Some other hair dyes exist where the active ingredient is different from PPD e.g. NTD and other aromatic amine compounds. Intoxication can be either topical or oral or inhalational route. Cutaneous absorption and ingestion produce severe local reactions and systemic effects. There were significant biochemical and histopathological changes noted in cases admitted to hospital. Death may occur following ingestion or absorption of small amount although the lethal dose reported in the literature is ten gram. The usual patterns of intoxication are Suicidal about (84percent), Accidental especially in children due to ingestion (eight %), Homicidal about (6percent) or through the skin absorption when used for cosmetic purpose (two %). In mild cases, allergic reaction caused by use of hair dye usually involve the upper eyelids and ear, while in more advance cases there may be complete closure of eyelids and allergic contact dermatitis reaction may become wide spread¹⁰.

In our study, 20 (23.0 %) were male patients while 67 (77.0 %) were female patients. Similar results have been reported in many different studies showing PPD ingestion being more common in young female population. A study conducted by Tanweer et al.¹¹ has reported around 78 percent female gender predominance and the study by Elgamel et al.¹⁰ has also reported about 80percent females in PPD Poisoning which is comparable with our study results. A study conducted by Ishtiaq et al.¹² has also reported that seventy one % female were involved in this poisoning. A study conducted by Kondle et al.¹³ has also reported eighty two percent female gender involved. Another study by Sakuntala et al.¹⁴ and Khan et al.¹⁵ has reported about 81 percent and sixty five percent female preponderance respectively which are in compliance with our study results.

Mean age of our study cases was 25.69 ± 7.43 years with age range of 18-45 years. Majority of our study cases i.e. 74 (85.1 %) were aged up to 35 years. A study conducted by Tanweer et al.¹¹ has reported 23.21 ± 8.2 years mean age of the patients which is close to our study results. A study conducted by Ishtiaq et al.¹² and Kondle et al.¹³ has also reported mean age 22 ± 3.4 years and 23.8 ± 7.8 years respectively and Khan et al.¹⁵ has also reported 21 years mean age, similar to that of our study results.

Out of 87 study cases, 65 (74.7 %) belonged to rural areas and 22 (25.3 %) to urban areas. Poor socioeconomic status was noted in 71 (81.6%) while 16 (18.4%) were of middle income. A study conducted by Ishtiaq et al.¹² has reported 72 percent patients from lower socio-economic status and 74 percent from rural areas which are comparable with our study results. Another study by Khan et al.¹⁵ has also reported sixty five % PPD poisoning cases belonged to poor families and 64.30 percent were illiterate. Reason for intake was homicidal in 22 (25.3%) and suicidal in 65 (74.7%). A study conducted by Tanweer et al.¹¹ has also reported 82 percent suicidal intension which is close to our study results. Mean hospital stay of our study cases was 6.23 ± 3.39 days and 54 (62.1 %) had hospital stay for more than 3 days. A study conducted by Tanweer et al.¹¹ has also reported 9.5 days mean duration of hospitalization which is in compliance with our study results.

Mean serum potassium level was 5.10 ± 0.45 mmol/L and hyperkalemia was noted in 23 (26.4%). A study conducted by Haider et al.⁹ has reported 34.4 % hyperkalemia in patients presenting with PPD poisoning.

CONCLUSION

High frequency of hyperkalemia was noted in our study among patients with Paraphenylenediamine poisoning and resulted in prolonged duration of hospitalization. There is dire need for proper legislation and implementation of law

enforcement regarding readily availability of the PPD on counter for its control and prevention as it is associated with significant increase in adverse events after ingestion.

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Authors Contribution

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Table 1: Socio-demographic and clinical characteristics of subjects' n=87

Variables	Frequency	Percentage
Gender		
Male	20	23.0
Female	67	77.0
Age		
≤ 35 Years	74	85.1
≥ 35 Years	13	14.9
Residential status		
Rural	65	74.7
Urban	22	25.3
Socioeconomic status		
Low income	71	81.6
Middle Income	16	18.4
Educational status		
Illiterate	52	59.8
Literate	35	40.2
reason for intake		
Homicidal	22	25.3
Suicidal	65	74.7
hospital stay		
Up to 3 days	33	37.9
More than 3 days	54	62.1
Hyperkalemia		
Yes	23	26.4
No	64	73.6

Table 2: Stratification of hyperkalemia and independent variables among the groups.

Variables		Hyperkalemia Frequency (%age)		P-value
		Yes	No	
Age	<35 Years	21(28.4)	53 (71.6)	0.500
	> 35 Years	2 (15.4)	11 (84.6)	
Gender	Male	03 (15.0)	17 (85.0)	0.253
	Female	20 (28.9)	47 (71.1)	
Residential status	Rural	15 (23.1)	50 (76.9)	0.267
	Urban	08 (36.4)	14 (63.6)	
Socioeconomic status	Low income	17 (24.0)	54 (76.0)	
	Middle Income	06 (37.5)	10 (62.5)	
Reason for intake	Homicide	07 (31.8)	15 (68.2)	0.579
	Suicidal	16 (24.5)	49 (75.4)	
Hospital stay	< 3 days	02 (6.1)	31 (93.9)	.001
	> 3 days	21 38.9()	33 (61.1)	