Original Article

The Potential Toxicological Effects of Hair Dye on Human Liver, Renal and Blood Parameters

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ABSTRACT

Introduction: Suicidal attempts with hair dye have steadily increased over the last few decades. It contains paraphenylenediamine (PPD) (highly toxic component) and a mixture of other chemicals that can damage the respiratory, muscular, blood, renal and hepatic systems. **Objectives**: This study aimed to analyze the laboratory findings following hair dye intoxication in Aswan University hospital. **Methods:** The current study was conducted in the internal medicine care unit of Aswan University Hospital involving fifty patients with acute hair dye poisoning in the period from September 2019 to March 2020 then continued from September 2020 till July 2021 due to Covid- 19. The demographic data, manner of toxicity, clinical manifestations and outcome were noted. Some laboratory investigations as alanine transaminase (ALT), aspartate transaminase (AST), Urea, Creatinine and complete blood count (CBC) were recorded. **Results:** Among the study population the majority were females 42 (84%). The main presenting symptom was face and neck swelling which was encountered in 92% of the studied cases. Liver function tests showed significant elevation of serum levels of ALT and AST. Renal function tests showed increase in serum urea and creatinine on third day onwards. CBC changes occurred in form of increased TLC while the hemoglobin, RBCs and platelets count were normal. **Conclusions:** PPD-containing hair dye has emerged as a potential suicidal poison. It demonstrated a strong influence of laboratory markers indicating injury to vital organs of the body system.

Keywords: Hair dye, Suicidal attempts, Paraphenylenediamine (PPD).

I. INTRODUCTION

Poisoning is a serious health hazard and one of the leading causes of morbidity and mortality around the world. The pattern of poisoning changes with time and varies from country to country (Kakkar et al., 2016). It is one of the major problems encountered in emergency departments of hospitals (Sakuntala et al., 2015).

In many developing countries of Asia, Africa and Middle East, poisoning using hair dye containing paraphenylenediamine (PPD) is emerging as a method of intentional self-poisoning and it is associated with high death rates (Balasubramanian et al., 2014).

PPD has harmful effects on multiple organs, including the heart, liver, kidney, blood, and muscles (Rawat et al., 2016).

PPD ingestion can be complicated by rhabdomyolysis, acute hepatitis, acute renal failure, myocarditis, arrhythmias, metabolic abnormalities, seizures, shock, and eventually death (Umair et al., 2018).

Liver was found to be the target organ in PPD intoxication where it is metabolized. The underlying mechanism of PPD-induced hepatic affection is not fully understood. It might be explained by the hepatocytes' direct toxic response to PPD or its metabolite (Abdel-Moneim., 2017).

PPD renal involvement ranges from transient proteinuria to acute kidney injury (AKI). AKI usually appears within few days after PPD exposure. Renal injury is due to direct toxic effect of PPD to renal tubules, hematologic disruption, hypovolemia and rhabdomyolysis (Shigidi et al., 2014). Organ damage may be assessed by appropriate tests for rhabdomyolysis and hepato-renal involvement. PPD poisoning causes variety of biochemical changes like total leucocytic count (TLC) in hematology, alanine transaminase (ALT) and aspartate transaminase (AST) with liver injury, urea, creatinine, myoglobinuria and hematuria for AKI. This abnormal profile can help in determining the PPD intoxication and the extent of tissue damage (Solangi et al., 2015).

So, the current study was carried out to analyze some laboratory findings as ALT, AST, Urea, Creatinine and complete blood count (CBC) following hair dye ingestion in Aswan University hospital.

I. PATIENTS AND METHODS

II.1. Patients:

This prospective, descriptive analytical study was conducted in the internal medicine care unit of Aswan University hospital during the period from September 2019 to March 2020 then continued from September 2020 till July 2021 due to Covid-19. Institutional ethics committee approved this study under the number of 19/9/415.

In this period, a total number of fifty patients with hair dye poisoning were admitted to the hospital. The demographic details like age, gender and residence were recorded. Also the manner of toxicity, clinical manifestations, laboratory investigations and outcome were noted.

Laboratory data which were collected from the patient file records including liver function tests (AST, ALT), kidney function tests (serum urea and creatinine) and CBC (hemoglobin, red blood cells (RBCs), total leucocytic count (TLC) and platelets), were recorded and analyzed.

II.2. Materials and instruments:

- Kits for measurement of ALT and AST by Cobas Integra 400 plus chemistry analyzer from Roche Company.
- Kits for measurement of urea and creatinine by Cobas Integra 400 plus chemistry analyzer from Roche Company.
- Kits for measurement of CBC parameters by XN-330 analyzer from Sysmex Egypt LLC Company.

II. STATISTICAL ANALYSIS:

Numerical data were expressed as mean ± SD. Comparison of data was done using wilcoxon signed ranks test after check of data for normality. Data were analyzed using SPSS (statistical Package for the Social Sciences) statistics version 26. P value < 0.05 is considered statistically significant.

III. RESULTS

Fifty patients with a history of hair dye poisoning were observed in the internal medicine care unit of Aswan University Hospital in the period from September 2019 to March 2020 then continued from September 2020 till July 2021 due to covid-19.

Their age ranged from 15-53 years with the mean age of 26.56±10.86. Among these, 42 cases (84%) were females and 8 (16%) were males.The majority of patients 27 (54%) were between 15 to 25 years, 12 (24%) patients were >25 to 35 years, 7 (14%) patients were >35-45 and only 4 (8%) were >45 years of age. Twenty seven cases (54%) were from rural areas while 23 cases (46%) were from urban areas. (**Figures 1, 2 and 3)**

Suicidal poisoning was identified in fourty-one cases (82%) and nine cases (18%) were due to accidental poisoning. (**Figure 4**)

Face and neck swelling was presented in (92%) patients, change urine color in (62%), dysphagia in (58%), dysnea in (68%), vomiting in (52%), convulsions in (18%) and leg swelling in (12%) patients. **(Table 1**)

Outcome of the studied cases showed that fourty cases (80%) survived while ten cases (20%) died. (**Figure 5)**

Liver function tests showed increase in the mean ALT level from normal reference value (41 IU/l), where it was 285.31 IU/l on admission to 458 IU/l after 3 days to 157 IU/l on discharge. The mean AST level also showed increased level from normal reference value (37 IU/l) to 667.56 IU/l on admission to 997.64 IU/l after 3 days to 149.65 IU/l on discharge. Regarding the renal function, the mean serum urea level increased gradually from 30 mg/dl on admission to 52.47 mg/dl after 3 days and became 39.2 mg/dl on discharge. The mean serum creatinine level increased gradually from 0.99 mg/dl on admission to 1.16 mg/dl after 3 days and became 1.1 mg/dl on discharge as documented in **(Table 2), (Figures 6, 7 and 8).**

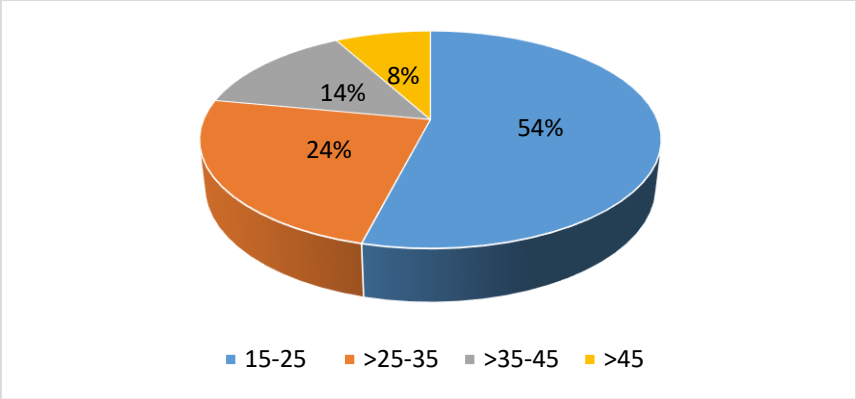

Figure (1): Age distribution of the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

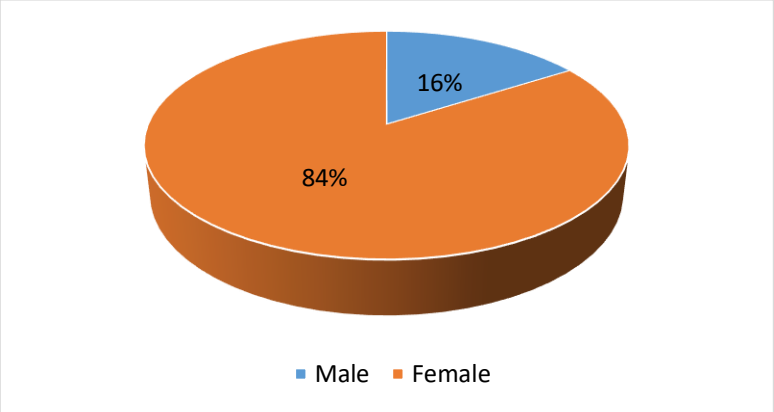

Figure (2): Sex distribution of the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

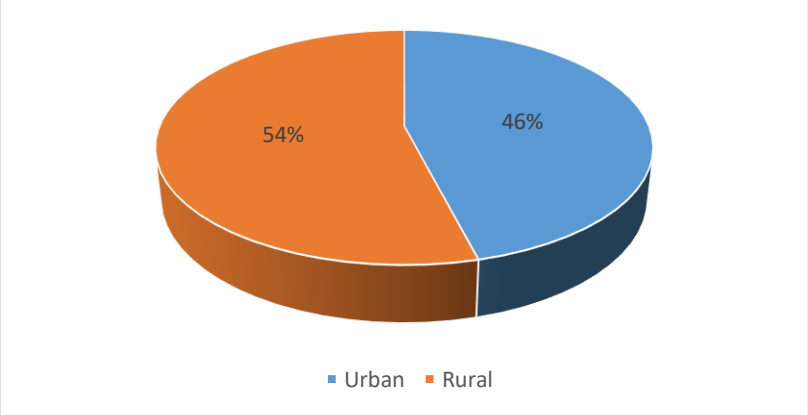

Figure (3): Residence distribution of the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

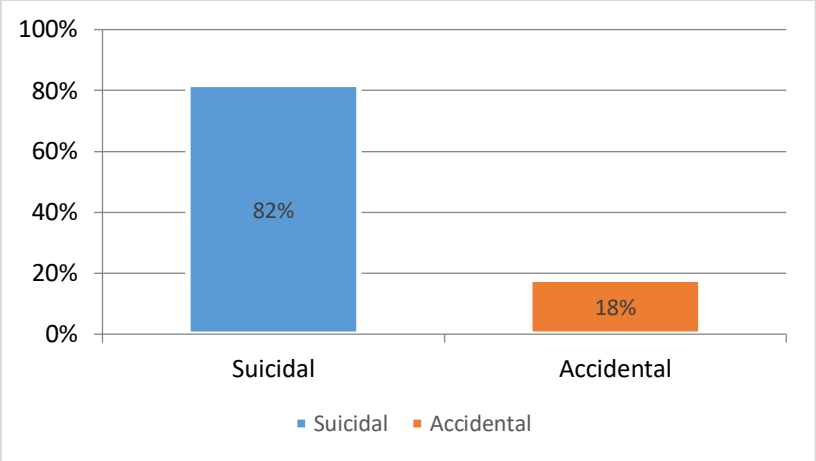

Figure (4): Manner of toxicity of the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

Table 1: Clinical presentation of the the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

Symptoms	Number of patients (N=50)	Percentage (%)
Face and neck swelling		
Yes	46	92.0
No	4	8.0
Change urine color		
Yes	31	62.0
No	19	38.0
Dysphagia		
Yes	29	58.0
No	21	42.0
Dyspnea		
Yes	28	56.0
No	22	44.0
Vomiting		
Yes	26	52.0
No	24	48.0
Convulsions		
Yes	9	18.0
No	41	82.0
Leg swelling		
Yes	6	12.0
No	44	88.0

N= Number of patients.

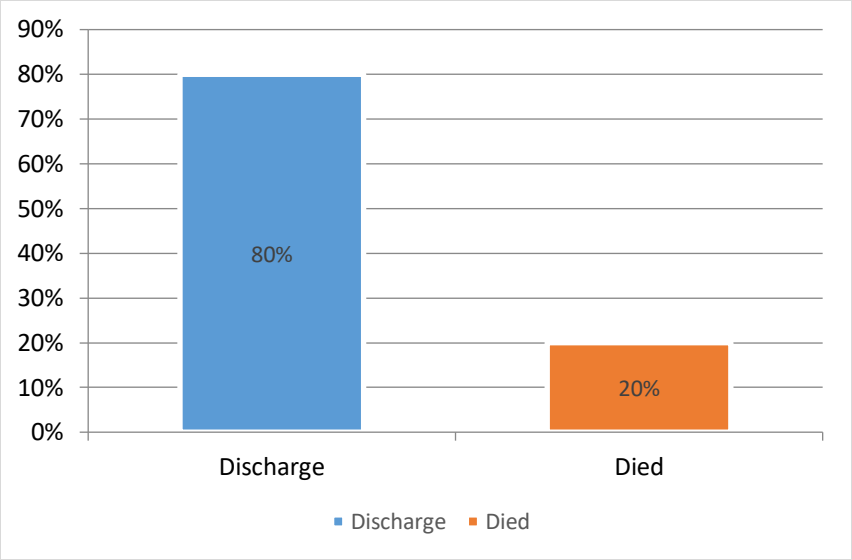

Figure (5): Outcome of the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

Table (2): Hepatic and renal function parameters of the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

Parameters / **Patients (N=50)**	**ALT (IU/l)** Mean± SD	**AST (IU/l)** Mean± SD	**Serum urea (mg/dl)** Mean± SD	**Serum creatinine (mg/dl)** Mean± SD
Normal Reference Value	41	37	10-50	0.6-1.5
On admission	285.31±379.29	667.56±990.21	30.01±19.6	0.99±0.74
After 3 days	458.08±555.84	997.64±1088.72	52.47±35.19	1.16±1.08
On discharge	157.01±183.92	149.65±215.18	39.2±34.36	1.1±1.36

ALT=Alanine transaminase.
AST=Aspartate transaminase.
SD=Standard deviation.
N= Number of patients.

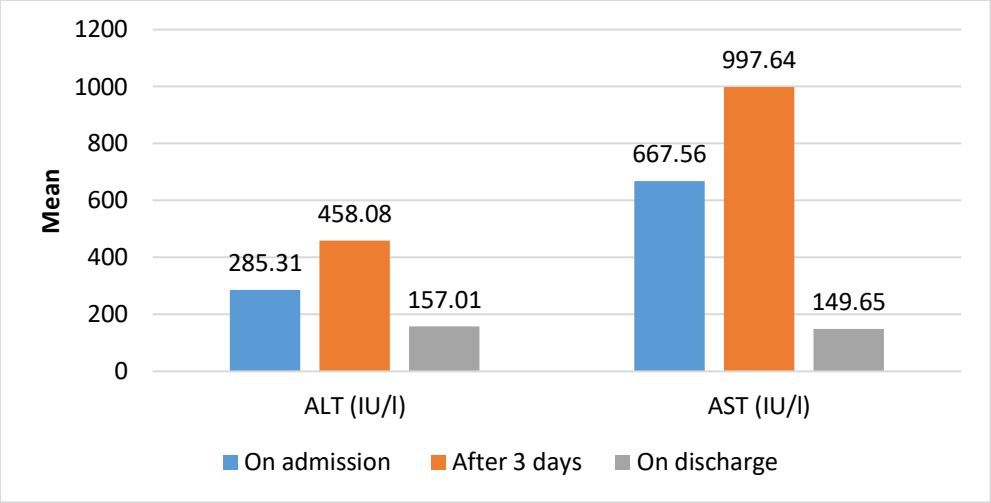

Figure (6): Hepatic parameters of the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

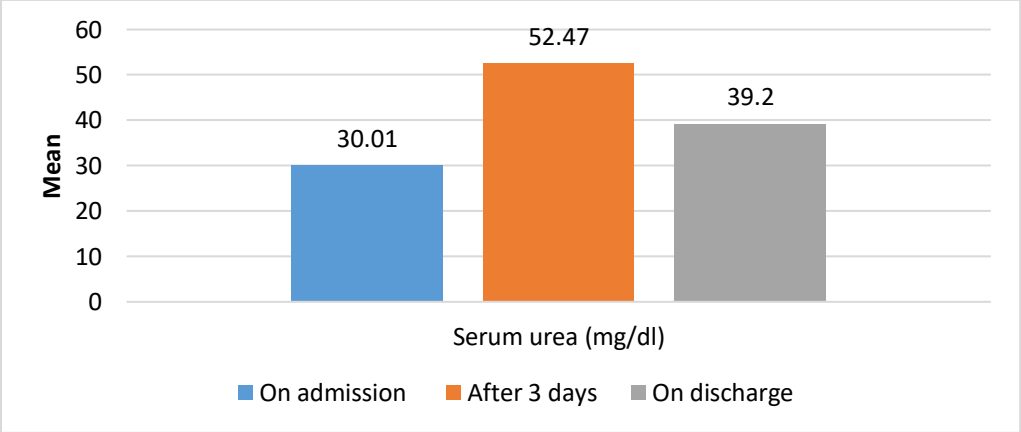

Figure (7): Serum urea among the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

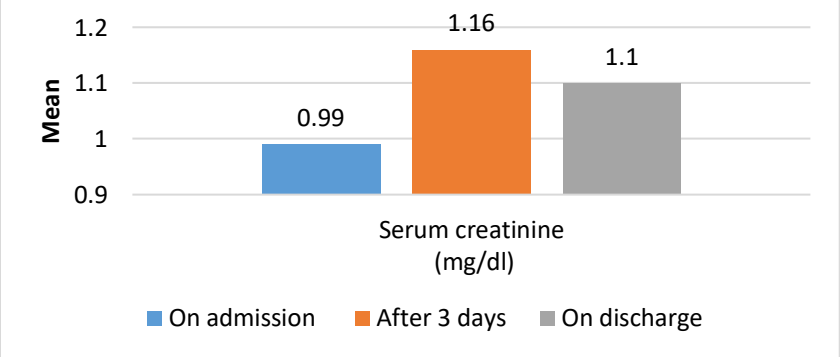

Figure (8): Serum creatinine among the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

Comparison between ALT, AST, Urea and Creatinine among the studied cases on admission, after 3 days and on discharge was illustrated in **Table (3)** and showed that: There was a highly statistically significant difference in the mean values of ALT level between patients on admission in comparison with normal reference value, on admission and on discharge, between patients after 3 days and on discharge and between patients on discharge as compared with normal reference value (p <0.001 respectively) and statistically significant difference between patients on admission and after 3 days (p=0.043). There was highly statistically significant difference in the mean values of AST level between patients on admission as compared with normal reference value, on admission and on discharge, between patients after 3 days and on discharge and between patients on discharge in comparison with normal reference value (p <0.001 respectively) while there was statistically significant difference between patients on admission and after 3 days (p=0.048).

Regarding the renal function tests, there was a highly statistically significant difference in the mean values of serum urea between patients on admission and value of patients after 3 days (p <0.001) and statistically significant difference between patients after 3 days and on discharge (p=0.032). There was no statistically significant difference between patients on admission as compared with normal reference value, on admission and on discharge and between patients on discharge in comparison with normal reference value (p= 0.996, 0.085 and 0.070 respectively).

There was no statistically significant difference in the mean values of serum creatinine between patients on admission in comparison with normal reference value, on admission and after 3 days, on admission and on discharge, between patients after 3 days and on discharge and between patients on discharge as compared with normal reference value (p= 0.915, 0.187, 0.605, 0.854 and 0.601 respectively).

Table (3): Comparative analysis of hepatic and renal function parameters among the the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

Parameters / Patients (N=50)		ALT (IU/l)	AST (IU/l)	Serum urea (mg/dl)	Serum creatinine (mg/dl)
On admission *VS* normal level	P value	**<0.001****	**<0.001****	0.996	0.915
On admission *VS* after 3 days	P value	**0.043***	**0.048***	**<0.001****	0.187
On admission *VS* on discharge	P value	**<0.001****	**<0.001****	0.085	0.605
After 3 days *VS* on discharge	P value	**<0.001****	**<0.001****	**0.032***	0.854
On discharge *VS* normal level	P value	**<0.001****	**<0.001****	0.070	0.601

Wilcoxon signed ranks test was used.
*Statistically significant difference (p≤0.05).
** Highly statistically significant difference (p≤0.01).
N=Number of patients.

The mean value of Hemoglobin was 13.08 g/dl on admission, 12.14 g/dl after 3 days of admission and 11.71 g/dl on discharge. The mean value of RBCs was 4.68 $x10^{12}$/L on admission, 4.3 $x10^{12}$/L after 3 days and 4.1$x10^{12}$/L on discharge. Mean total leucocytic count was 15.67 $x10^{9}$/L on admission, 15.58 $x10^{9}$/L after 3 days and 12.9 $x10^{9}$/L on discharge. The mean value of platelets was 287.54 $x10^{9}$/L on admission, 254.97 $x10^{9}$/L after 3 days of admission and 250.8 $x10^{9}$/L on discharge (**Table 4), (Figures 9 and 10).** .

Table (4): Hematological parameters among the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

Parameters / Patients (N=50)	Hemoglobin (g/dl) Mean± SD	RBCs ($x10^{12}$/L) Mean± SD	TLC ($x10^{9}$/L) Mean± SD	Platelets ($x10^{9}$/L) Mean± SD
Normal reference value	12-16 (females) 13-17 (males)	3.8-6.5	4-11	150-500
On admission	13.08±1.71	4.68±0.76	15.67±7.37	287.54±89.02
After 3 days	12.14±1.59	4.3±0.73	15.58±7.58	254.97±68.54
On discharge	11.71±1.34	4.1±0.55	12.9±7.49	250.8±68.77

SD=Standard deviation.
RBCs=Red blood cells.
TLC=Total leucocytic count.
N= Number of patients.

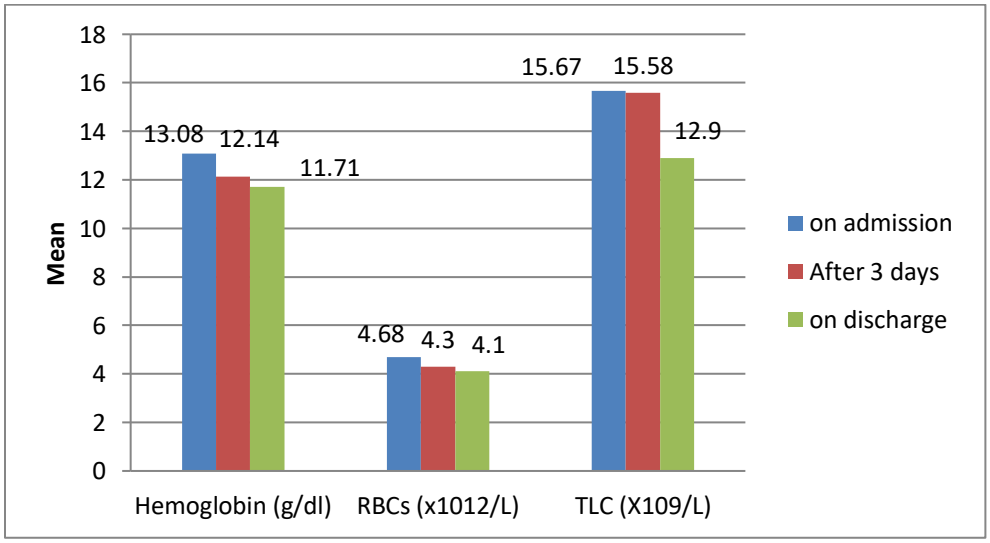

Figure (9): Hemoglobin, RBCs and TLC among the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

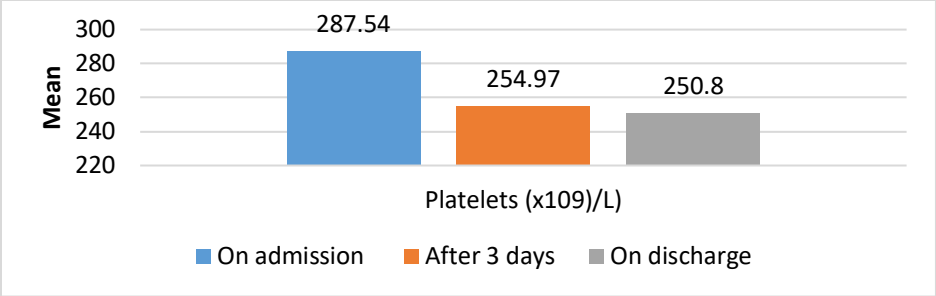

Figure (10): Platelets among the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

Comparative analysis of hair dye toxicity effects on hematological parameters among the studied cases were illustrated in **Table (5)**:

There was highly statistically significant difference in the mean values of hemoglobin level between patients on admission and after 3 days, on admission and on discharge, between patients after 3 days and on discharge and between patients on discharge in comparison with normal reference value (p <0.001, <0.001, 0.007 and <0.001 respectively). However, there was no statistically significant difference between patients on admission as compared with normal reference value (p= 0.755).

The current study founded a highly statistically significant difference in the mean values of RBCs level between patients on admission and after 3 days and on admission and on discharge (p<0.001 respectively) and statistically significant difference between patients after 3 days and on discharge (p=0.016). However, there was no statistically significant difference between patients on admission and on discharge in comparison with normal reference value (p= 0.098 and 0.220 respectively)

Highly statistically significant difference was present in the mean values of platelets between patients on admission and after 3 days and between patients on admission and on discharge (p =0.002 and 0.007 respectively), but there was no statistically significant difference between patients on admission in comparison with normal reference value, between patients after 3 days and on discharge and between patients on discharge in comparison with normal reference value (p= 0.080, 0.754 and 0.159 respectively).

There was a highly statistically significant difference in the mean values of total leucocytic count between patients on admission as compared with normal reference value, on admission and on discharge and between patients after 3 days and on discharge (p<0.001 respectively). There was statistically significant difference between patients on discharge as compared with normal reference value (p=0.010), but there was no statistically significant difference between patients on admission and after 3 days (p =0.677).

Table (5): Comparative analysis of hair dye toxicity effects on hematological parameters among the fifty hair dye poisoned cases admitted to the internal medicine care unit of Aswan University Hospital in the period from September 2019 to July 2021.

Parameters / Patients (N=50)		Hemoglobin (g/dl)	RBCs ($x10^{12}$/L)	Platelets ($x10^{9}$/L)	TLC ($x10^{9}$/L)
On admission *VS* normal level	P value	0.755	0.098	0.080	**<0.001****
On admission *VS* after 3 days	P value	**<0.001****	**<0.001****	**0.002****	0.677
On admission *VS* on discharge	P value	**<0.001****	**<0.001****	**0.007****	**<0.001****
After 3 days *VS* on discharge	P value	**0.007****	**0.016***	0.754	**<0.001****
On discharge *VS* normal level	P value	**<0.001****	0.220	0.159	**0.010***

Wilcoxon signed ranks test was used.
*Statistically significant difference ($p \leq 0.05$).
** Highly statistically significant difference ($p \leq 0.01$).
N= Number of patients.

IV. DISCUSSION

Poisoning by ingestion of PPD containing hair dyes is increasing at an alarming rate over last decade. It is becoming a prominent apparent cause for committing suicide in developing countries. This may be due to the oral and media propaganda within the public, its low cost and easily availability in almost local general stores (Ramulu et al., 2016).

PPD exposure has harmful effect on both liver and kidney structure and function, confirmed by increased levels of ALT, AST, urea and creatinine which indicate decreased of the liver ability to detoxify toxic agents and decrease kidney ability to excrete the toxic metabolites (Bharali et al., 2012).

In this current study, most of the cases were in the age group of 15-25 years old and the mean age of 26.56±10.86 years (Abdel-Hady et al., 2023). This was agreed with Zagla et al., (2019) who reported that the majority of cases in the age group of 18- 28 years old and the mean age of the studied patients was 25±11years, but the present results were higher than Khan et al., (2016) who stated that the amean age of their studied cases was 22.08±6.42 years.

It was observed that the female gender was primarily affected by this poisoning which represented 84% of studied cases in comparison with male cases (16%) (Abdel-Hady et al., 2023), and this was agreed with Ramulu et al., (2016) who founded a female preponderance with 80.64% as compared to males 18.75%, but our results were in contradiction with Shalaby et al., (2010) who reported that 72% were males and 28% were females among 25 cases of PPD intoxication studied over a 7-year period (October 2001 - November 2008).

Regarding the residence, most of the patients were from rural areas (54%) (Abdel-Hady et al., 2023). This agreed with Mohamed et al., (2014) who founded that the number of toxic cases was significantly higher in rural areas than urban areas, but different from Khuhro et al., (2019) who reported that all their patients were from rural backgrounds.

The manner of death in most of patients in this study was suicidal and represents 82%, (Abdel-Hady et al., 2023). This was consistent with Shigidi et al., (2014) who founded that the suicidal cases were 86.7%, but these results were quite different from Khan et al., (2016) who noted that a high proportion of PPD intoxication (94.74%) was based on suicidal intention.

Upper airway obstruction due to cervico-facial edema was the most serious and common manifestation which occurs in 92% of cases (Abdel-Hady et al., 2023). This finding was agreed to Zaghla et al., who reported that the primary manifestation of PPD poisoning was facial and neck swelling and occur in 90% patients, but Rawat et al., (2016) reported cervico- facial edema in 70.76% of their patients.

Black colored urine due to the presence of myoglobin and hemoglobinuria was observed in 62% of the studied cases (Abdel-Hady et al., 2023). It was quite similar to Ali et al., (2020) who founded dark urine in 50% of cases.

In this study, 58% of patients had dysphagia owing to severe edema of the face, neck, and tongue, as well as inflammation of the mucosa of the mouth, lip, and throat (Abdel-Hady et al., 2023). This was different from Khuhro et al., (2019) who observed dysphagia in 100% of their patients.

Twenty-eight cases (56%) developed dyspnea (Abdel-Hady et al., 2023). This was quite similar with Zaghla et al., (2019) who founded dyspnea in 67.5 %, but disagreed with Khan et al., (2016) who noted dyspnea in 94.7% of their studied cases.

Vomiting due to local GIT irritation with inflammation and burning pain was occurred in the present results in 52% of the studied cases. This was consistent with Ramulu et al., (2016) who noted vomiting in 80.6% of thei patients.

The present results showed convulsions in 18% of the studied cases (Abdel-Hady et al., 2023).This was quite with Ramulu et al., (2016) who founded seizures in 12.9% patients, but Ali et al., (2020) noted seizures in 2.2% of their patients.

According to the outcome, mortality was 20% (Abdel-Hady et al., 2023). This was in agreement with Qasim et al., (2016) who reported that mortality was 21.10% of their patients while disagreed with Khan et al., (2016) who noted that the mortality occurred in 47.4% of their patients.

As regard the laboratory investigations**,** we recorded significant elevation of serum levels of hepatic enzymes (ALT and AST) and AST was higher than ALT. This agreed with Tiwari et al., (2016) who noted impaired liver function tests (LFT) where one patient showed deranged LFT between 24 and 48 Hrs, three patients between 48–72 h, three patients between 72–96 h, while 2 patients exhibited it after 96 h of admission, Rawat et al., (2016) who reported serum ALT, AST levels were raised in approximately 50% cases and Zaghla et al., (2019) who showed 82.5% patients with increased serum ALT and AST and explained this elevation in AST was not only because of liver necrosis but also inflict of muscle injury.

On the present study, there was also increase in serum urea and creatinine on third day onwards. These results were in accordance with Tiwari et al., (2016) who reported blood urea and serum creatinine levels were significantly increased in hair dye poisoning patients and Zaghla et al., (2019) who recorded elevated serum urea in 62.5% of patients and serum creatinine in 20% of patients.

The present results showed CBC changes in the form of increased total leucocytic count (TLC) while hemoglobin (Hb), red blood cells (RBCs) and platelets count were normal. This agreed with Ramulu et al., (2016) who reported that increased TLC count in 41.93% and Zaghla et al., (2019) who reported twenty eight cases (70%) had CBC changes in the form of leukocytosis, but disagreed with Punjani ., (2014) who showed decreased hemoglobin in their case report in Pakistan that was 8.5 gm/dL, El-Amin et al., (2014) who recorded that the hematological parameters showed significant decrease in Hemoglobin, RBCs and TLC count and Zaghla et al., (2019) who reported anemia in 57.5% and thrombocytopenia in 22.5% patients.

V. CONCLUSION AND RECOMMENDATIONS

Hair dye poisoning had emerged as a potential trend for committing suicide as it contains PPD (highly toxic component). PPD presents in high concenteration in the commercial hair dyes and its ingestion results in damage in the liver and kidney. This appears in the form of significant elevation in liver and renal function tests. So, recommendations of this study are replacement of the current hair dye materials with less hazardous or natural ones. Regulations and restrictions of the use and sale of hair dye containing PPD. Hair dye ingredients must be wrote on the label. Medical physicians should be aware of this poison with early recognition of the complications and prompt treatment.

Conflict of interest

The authors declared that there was no conflict of interest.

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التأثيرات السمية المحتملة لصبغة الشعر على الكبد و الكلى والدم

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مقدمة: ازدادت محاولات الانتحار باستخدام صبغات الشعر المحتوية على مادة البارافينيلين دايمين بشكل ملحوظ خلال العقود القليلة الماضية. تحتوي صبغات الشعرعلى مادة البارافينيلين دايمين (مكون شديد السمية) ومزيج من المواد الكيميائية الأخرى التي يمكن أن تلحق الضرر بالجهاز التنفسي والعضلي والكلى والكبد.**الأهداف:** هدفت الدراسة إلى تحليل النتائج المعملية بعد التسمم بمادة البارافينيلين دايمين بمستشفى أسوان الجامعى. **الطريقة:** أجريت الدراسة الحالية في مستشفى أسوان الجامعى على 50 مريضاً يعانون من تسمم حاد بصبغة الشعر في الفترة من سبتمبر 2019 إلى مارس 2020 ثم استمرت من سبتمبر 2020 حتى يوليو 2021 بسبب كوفيد-19. تمت ملاحظة البيانات الديموغرافية وطريقة السمية والاعراض والنتائج. و تم تسجيل النتائج المعملية الاتية (ناقلة أمين الأسبرتات , ناقلة أمين الألانين ، اليوريا ، الكرياتينين و صورة الدم). **النتائج:** كانت غالبية الحالات من الإناث 42 حالة (84٪). وكان العرض الرئيسي هو تورم الوجه والرقبة والذي ظهر في 92٪ من الحالات المدروسة. أظهرت اختبارات وظائف الكبد ارتفاعًا ملحوظًا في مستويات ناقلة أمين الأسبرتات و ناقلة أمين الألانين في الدم. أظهرت اختبارات وظائف الكلى زيادة في مستوى اليوريا والكرياتينين في الدم في اليوم الثالث وما بعده. وكانت التغييرات فى صورة الدم في شكل زيادة عدد كرات الدم البيضاء بينما كانت نسبة الهيموجلوبين وعدد كرات الدم الحمراء والصفائح الدموية طبيعيًا. **الاستنتاج:** ظهرت صبغات الشعر المحتوية على مادة البارافينيلين دايمين كسم انتحاري محتمل و أظهرت النتائج المعملية تأثيرًا قويًا للاشارة إلى إصابة الأعضاء الحيوية في الجسم. **التوصيات**: يجب رفع مستوى الوعي العام بالمخاطر المرتبطة بمادة البارافينيلين دايمين, واستبدال مواد صبغات الشعر الحالية بمواد أقل خطورة أو طبيعية, و يجب كتابة مكونات صبغة الشعر على الملصق ووضع لوائح وقيود لاستخدام وبيع صبغات الشعر المحتوية على مادة البارافينيلين دايمين. يجب أن يكون الأطباء على دراية بهذا السم مع التعرف المبكر على المضاعفات والعلاج الفورى.

كلمات البحث: صبغات الشعر, محاولات انتحارية, بارافينيلين دايمين.