



CASE SERIES

Fatal Super Vasmol 33 Hair Dye Poisoning

Neel Sai Raju Pedada,^{1,*} Mopuri Venkateswarlu,² Venkata Ramana Rao Pedada,³
Mohit Kumar Moses Thathapudi,³ Hari Krishna Chowdary Lingampalli¹ and
Kattamreddy Ananth Rupesh³

¹Junior Resident, Department of Forensic Medicine, Andhra Medical College,
Visakhapatnam, Andhra Pradesh

²Associate Professor of Forensic Medicine, Government Medical College, Ongole.

³Associate Professor of Forensic medicine, Andhra Medical College, Visakhapatnam, Andhra Pradesh.

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Abstract

Super Vasmol 33 is a widely used hair dye in India which contains paraphenylenediamine (PPD), a coal-tar derivative known for its toxic and allergenic properties. In this article we present four fatal cases of Super Vasmol ingestion, stressing its misuse as a method of deliberate self-harm. About 10g of PPD is lethally toxic to cause death. Clinically, poisoning manifests with a characteristic triad: cervicofacial edema, rhabdomyolysis, and acute kidney injury. All four cases showed early onset of airway compromise due to laryngeal edema, requiring emergency airway management. At autopsy, histopathology showed pulmonary edema in lungs, acute tubular necrosis in the kidneys, and hepatic zone III necrosis in liver. Despite aggressive supportive care which included tracheostomy, corticosteroids, and dialysis, the mortality remained high. In Case 1, PPD was not detected in analytical toxicology likely due to metabolism and elimination as the survival period is long. The other three cases confirmed PPD presence in the chemical analysis of viscera. Immediate airway management and renal care (dialysis) remain as vital components of treatment. These cases underscore the systemic toxicity of PPD and the lack of a specific antidote. While banned in several countries, PPD remains easily accessible in India, raising concerns over its misuse. Safer alternatives like para-Toluenediamine sulfate (PTDS) may reduce hypersensitivity risks in dermatological practice. However, the toxicity of PTDS when ingested is not known. Enhanced public awareness, regulation, and substitution with less toxic compounds are essential to curb the growing incidence of hair dye poisoning in India.

Keywords: Paraphenylenediamine (PPD), Super Vasmol 33, Hair dye poisoning, Acute tubular necrosis (ATN), Rhabdomyolysis, Angioneurotic edema, Acute kidney injury (AKI).

*Corresponding Author: Neel Sai Raju Pedada
Email: sairajp027@gmail.com

Introduction

Super Vasmol 33 hair dye contains a mixture of chemical compounds, with paraphenyl-diamine (PPD) being the most significant concerning toxicity, along with other chemicals like propylene glycol, resorcinol, cetostearyl alcohol, sodium lauryl sulphate, sodium ethylenediaminetetraacetic acid, liquid paraffin, preservatives, and perfumes [1,2]. PPD is an aromatic amine derived from coal tar, widely used in hair dyes for its effective colour enhancement properties.

When pure, PPD appears as white crystals, but it rapidly turns brown upon exposure to air due to oxidation. Its molecular weight is approximately 108 Daltons, and it has a boiling point of around 267°C and a melting point of approximately 140°C. The CAS number for para-phenylenediamine (also known as 1,4-Phenylenediamine) is 106-50-3. PPD is highly soluble in organic solvents such as ethanol, ether, benzene, chloroform, and acetone, which facilitates its absorption during use. It is only partially soluble in water, especially with agitation, which can influence its absorption during oral ingestion.

The concentration of PPD in hair dyes varies significantly depending on the formulation. In stone hair dyes, PPD can constitute between 70% to 90%, whereas in branded or commercial dyes, the concentration is usually between 2% to 10%. For instance, a typical 100-milliliter bottle of Super Vasmol 33 contains approximately 12 grams of PPD, demonstrating its relatively high concentration. The toxicity of PPD is notable; ingestion of as little as 3 grams can produce systemic poisoning symptoms, and doses of 7 grams or more are potentially fatal [3]. Because of its widespread use and

toxicity, accidental or intentional oral ingestion of PPD-containing products like Super Vasmol 33 can lead to severe health consequences.

Once ingested, PPD is rapidly absorbed through the mucous membranes of the digestive tract into the bloodstream and also absorbed through skin (dermal route) and inhalation in industrial settings. It is then metabolized primarily into N-acetyl-PPD and N,N-diacetyl-PPD, which are relatively less toxic than the parent compound, yet can still cause systemic toxicity. These metabolites are subsequently eliminated through the urine. The quick absorption and metabolism of PPD are responsible for its potent toxic effects, which can include severe allergic reactions, skin and mucous membrane burns, swelling of the face and throat, and systemic complications affecting multiple organs, depending on the concentration. Given its affordability and availability, Super Vasmol 33 remains a popular choice among consumers, despite the health risks associated with PPD exposure.

Case details

Case 1

A 31-year-old female presented to the hospital with a history of consuming Super-Vasmol 33 hair dye. Her initial symptoms included a sudden onset of shortness of breath, sublingual edema, and stridor. She underwent emergency tracheostomy and supportive care, and was treated with diuretics, antibiotics, antihistamines, corticosteroids, and nebulization for 4 days during which her platelet counts, and total leucocyte counts declined, and serum creatinine, blood urea, and total bilirubin elevated (Table 1). Despite receiving treatment, her condition deteriorated rapidly and developed acute

tubular necrosis (ATN) and acute respiratory distress syndrome (ARDS), and she succumbed to the poisoning because of multi organ dysfunction syndrome. Upon autopsy, externally facial and neck swelling was noted. The brain, kidneys, and lungs along with other internal organs were congested. Laryngeal oedema was noted

(Figure 1). There were no external injuries on the body. Viscera were preserved and sent for chemical analysis, which tested negative for Paraphenylenediamine (PPD). Histopathology of lung showed pulmonary edema (Figure 2) and kidneys showed acute tubular necrosis (Figure 3).

Table 1. Clinical Parameters of Case 1 While Undergoing Treatment.

Parameters And Normal Values	Day 1	Day 2	Day 3	Day 4
Hemoglobin (11.6 to 15 g/dl)	9.4	11	8.8	7.1
Platelets (1.5 to 4.5 lakhs/microliter)	2.75L	4.48L	2.59L	1.2L
TLC (4000-11000 /microliter)	8700	25500	20500	15400
Serum creatinine (0.7-1.3mg/dL)	0.9	4.2	6.1	6.9
Blood urea (6-21 mg/dL)	20	72	117	131
Total Bilirubin (0.2-1.3 mg/dL)	0.9	0.9	1.3	1.8



Figure 1. Laryngeal oedema at autopsy in case 1

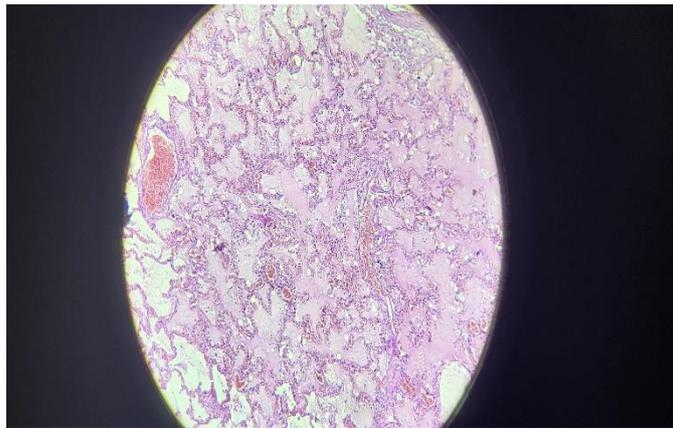


Figure 2. Pinkish exudates in alveolar spaces (H and E staining low power) in case 1.

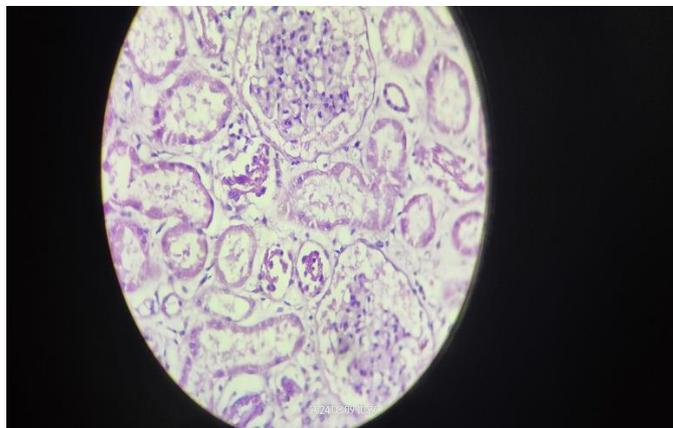


Figure 3. Separation of the basement membrane of collecting tubules and glomerulus (H and E staining low power).

Case 2

A 32-year-old female was admitted to the hospital in an unconscious state with a history of Super Vasmol 33 hair dye ingestion and died during treatment within five hours of consumption. Upon autopsy, external appearance showed congested conjunctivae, and the tongue was stained

brown. Internal examination showed laryngeal edema, the trachea was congested, 100ml of greenish brown colour fluid was noted in the stomach (Figure 4), and the mucosa of the stomach was congested. Lungs, liver, and kidneys were congested. Viscera was sent for chemical analysis, and turned positive for PPD.



Figure 4. Congested stomach mucosa and greenish brown stomach content in case 2

Histopathology of lung tissue revealed pulmonary edema (Figure 5), kidneys showed acute tubular necrosis (Figure 6), and liver showed predominant zone III necrosis, central vein dilatation, and periportal inflammation (Figure 7).

A super vasmol 33 bottle containing PPD was seized at crime scene in case 2 (Figure 8).

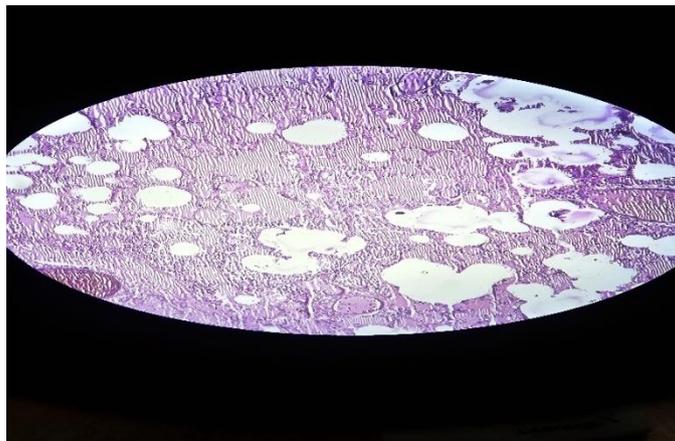


Figure 5. Pulmonary edema in case 2 (H and E staining low power).

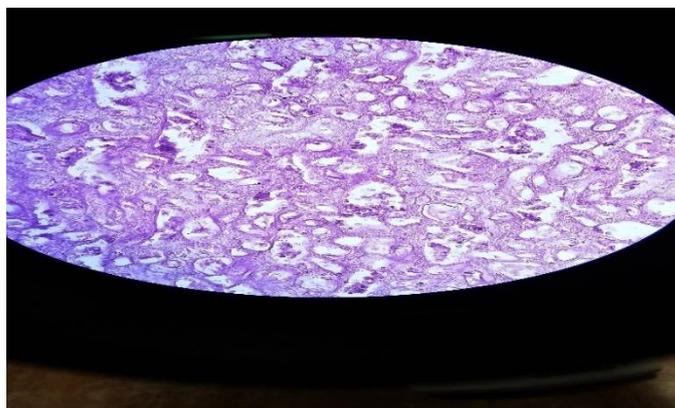


Figure 6. Tubular dilatation, cell damage and interstitial edema in case 2 (H and E staining low power).

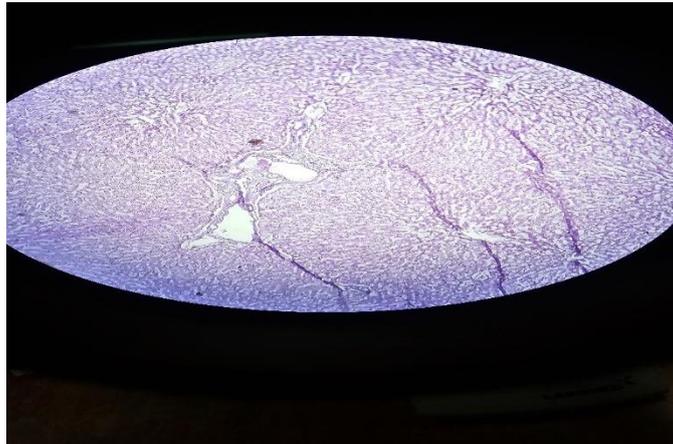


Figure 7. Liver showing central venous dilatation, periportal inflammation, zone 3 necrosis (H and E staining low power).



Figure 8. A super vasmol bottle seized at the crime scene in case 2.

Case 3

A 22-year-old female consumed Super Vasmol 33 hair dye to commit suicide and was brought to the hospital, where she received timely treatment, including an emergency tracheostomy; however, despite medical intervention, she survived only for six hours. At autopsy, faciocervical

swelling was noted (Figure 9). Internally, laryngeal edema was noted. The stomach was empty, and the mucosa showed congestion. The brain, lungs, and both kidneys were congested. Viscera was sent for chemical examination, and the result was positive for PPD.



Figure 9. Photograph showing Faciocervical swelling and surgically sutured tracheostomy wound.

Case 4

A 39-year-old male presented with a history of consuming Super-Vasmol 33 hair dye and was rushed to the hospital, and died after 2 days while undergoing treatment. The body was brought to the KGH mortuary for autopsy. Externally, Facio cervical swelling was noted. Internally, Laryngeal edema was present, about 20ml of greenish brown fluid was present in the stomach, and the mucosa was congested. The brain, Lungs, and both kidneys were congested. Laboratory investigations prior to death showed elevated serum creatinine and blood urea levels. Viscera was sent for chemical analysis and was positive for PPD.

Discussion

Super Vasmol 33 hair dye contains a mixture of chemical compounds, with paraphenyl-diamine (PPD) being the most significant concerning toxicity, along with other chemicals like propylene glycol, liquid paraffin, resorcinol, cetostearyl alcohol, sodium lauryl sulphate, sodium ethylenediaminetetraacetic acid, preservatives, and perfumes [1,2].

Paraphenylenediamine (PPD), a hazardous derivative of coal tar, undergoes oxidation to form Bandrowski's base, a trimeric compound known for its strong allergenic potential and suspected mutagenic and cytotoxic properties [4-6]. Exposure to PPD can trigger severe allergic reactions, including angioedema, muscular edema, rhabdomyolysis, and potentially life-threatening shock.

Resorcinol, another ingredient found in hair dyes, is a powerful phenolic compound (1,3-dihydroxybenzene or 3-hydroxyphenol) that is highly corrosive and can cause haemoglobinuria, resulting in urine that appears chocolate-colored. However, in the cases studied here where clinical records are available, there is no such finding of chocolate coloured urine documented.

Propylene glycol, commonly used as a solvent in hair dyes, also contributes to the toxicity of these products. Among the active ingredients in Super Vasmol, PPD, resorcinol, and propylene glycol stand out for their potential to cause systemic toxicity and life-threatening effects [7]. It is key to be informed about these dangers and

consider the implications of using such products. However, in all the cases mentioned in this case series, the manifest toxic effects appear to be due to PPD more predominantly compared to the other common ingredients mentioned herein above.

PPD (Paraphenylenediamine) poisoning follows a distinct three-stage progression. During the first three days, an inflammatory stress response is observed, characterized by relative immunosuppression. From the third to the sixth day, a proinflammatory state emerges, primarily due to rhabdomyolysis. After the sixth day, immunomodulatory effects are seen, attributed to oxidative metabolism. The poisoning induces a systemic inflammatory reaction driven by cytotoxic effects on cells. Several pathophysiological mechanisms are involved, including increased free radical formation, skeletal and cardiac muscle necrosis (scattered coagulation necrosis), the generation of quinone diamine (a highly nephrotoxic oxidative metabolite of PPD), renal tubular occlusion from myoglobin casts, and acute tubular necrosis. The clinical picture of case 1 showed a similar complex systemic toxicity due to PPD poisoning.

Clinically, PPD toxicity can present with a wide spectrum of symptoms, including hoarseness of voice, pneumothorax, hepatitis, convulsions, coma, cardiac toxicity, hypotension, and sudden cardiac death [8,9]. The fatal dose ranges from 6 to 12 grams, with 100 ml of PPD-containing solution typically containing around 12 grams. The fatal period depends on the quantity ingested and the time between ingestion and treatment initiation. Currently, there is no known antidote for PPD poisoning. A single high dose concentration is generally considered

to be more fatal because of the upper airway oedema and rhabdomyolysis induced renal failure. However, there have also been fatal outcomes in cases with low dose exposure where the treatment was delayed.

Super Vasmol poisoning presents with a characteristic triad comprising early angioneurotic edema of the face and neck, rhabdomyolysis, and acute kidney injury (AKI). The angioneurotic edema typically manifests early, with symptoms including hoarseness of voice, stridor, a swollen and hard protruding tongue, and an edematous "bull neck." These orofacial swellings are often the first clinical signs following ingestion of the dye. Rhabdomyolysis is marked by the presence of dark brown-colored urine, while AKI develops as a consequence of muscle breakdown products accumulating in the kidneys [10-12].

The management of Super Vasmol poisoning is primarily supportive and depends on the patient's clinical status. Maintaining airway patency is of utmost importance. Early or prophylactic endotracheal intubation is recommended to prevent airway compromise and reduce the need for surgical intervention. In cases of significant neck swelling, where anatomical landmarks are obscured, tracheostomy is preferred over cricothyroidotomy as an emergency surgical airway. Antihistamines and corticosteroids are commonly used to treat airway edema, possibly due to hypersensitivity to para-phenylenediamine (PPD), although there is no definitive evidence supporting their efficacy. To prevent AKI resulting from rhabdomyolysis, early initiation of alkaline diuresis with isotonic saline, sodium bicarbonate, and osmotic diuretics is crucial, along with ensuring a high urine output.

This article presents four cases: Two are fatal within hours (case 2,3) and the other two cases surviving for four days (case 1) and two days (case 4). Toxicological analysis confirmed the presence of p-phenylenediamine (PPD) in the viscera in Case 2,3,4 while Case 1 tested negative, possibly due to early treatment, metabolism, or elimination of the toxin [13-15].

Misuse of hair dye containing PPD is being increased as a means of suicidal poisoning [10] and homicidal poisoning. In Punjab, India kala pathar was used as homicidal poison to kill eleven children [17].

PPD is either fully banned or subject to strict restrictions in several countries, such as Germany, France, Sweden, and Sudan, because of its toxic and allergenic effects. In Sudan, the ban is particularly motivated by its frequent misuse in suicide attempts and the high risk of accidental paediatric poisoning. PPD is a potent skin sensitizer known to cause severe allergic contact dermatitis and Type IV hypersensitivity reactions. Additionally, it exhibits selective cytotoxicity toward skin fibroblast cells [18]. For dermatological use, para-toluenediamine sulfate (PTDS) is considered a safer and more affordable alternative to paraphenylenediamine (PPD) in hair dyes and cosmetics, as it is less likely to trigger allergic reactions [19].

Instances of accidental hair dye poisoning in children has been a source of concern [20]. Super vasmol poisoning was common in the Rayalaseema region of Andhra Pradesh for a long period of time and this trend is being now a days observed in coastal areas of Andhra Pradesh as well. It is necessary to reduce the over the counter availability of these toxic dyes and herbal

and less toxic alternatives should be explored in the interest of public safety [21].

In medico-legal cases it is important to consider sending biological samples during treatment for qualitative and quantitative analysis of PPD as the chances of detecting the same at autopsy decreases as survival period increases.

Conclusion

As hair dyes become increasingly misused as a means of poisoning either in cases of suicide or homicide, the number of related incidents has been rising in several regions across the country [10]. In all cases presented here, facial and laryngeal edema were noted similar to the earlier documented literature [10-12]. Gross findings showed congestion of the stomach mucosa and congestion of other organs. Histopathological findings showed pulmonary edema of the lungs, tubular necrosis of the kidneys, and zone 3 necrosis and periportal inflammation in the liver. There is a need for searching for safer alternatives to this toxic ingredient in hair dyes. In addition, community awareness and health education help towards early diagnosis and prevention to some extent.

Conflict of Interest

None to declare

Financial Support

Not applicable.

Ethical Considerations

Consent for conducting medicolegal autopsy was obtained from law enforcement agencies. All ethical considerations were addressed by the authors.

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