



## HAIR DYE- AN EMERGING SUICIDAL AGENT: OUR EXPERIENCE

Mary Nirmala S\* Ganesh R \*

\*Thoothukudi Medical College

### Abstract

Hair dye poisoning has been emerging as one of the important causes of intentional deliberate self harm. To study the epidemiology of patients who consumed Super Vasmol (a commonly used commercial hair dye), profile of patients referred to the ENT department, to find the effectiveness of supportive therapy and to compare between the tracheostomy and the non tracheostomy group, a retrospective study was conducted in patients who consumed Super Vasmol admitted over a year (April 2009 – March 2010) in a teaching hospital in South India. Out of the 108 patients 38 (35.2%) were males and 70 (64.8%) were females. 42 (38.9%) were in 21-25 age group. Patients who developed cervico-facial oedema, throat pain, burning sensation in the throat, change of voice, no voice and dyspnoea with stridor were referred to the ENT Department. 74 (68.5%) patients needed an ENT opinion. Cervico-facial oedema was the main clinical manifestation in 74 patients. 33 of them underwent tracheostomy. The mortality in 108 patients was 22.2% and after tracheostomy 21.2%. Purpose of the study is to create public awareness about the lethal effects of the hair dye, because it is a major health problem and to educate the public and the medical professional about the need for aggressive and early treatment.

### Keywords

Super Vasmol, cervico-facial oedema, Dyspnoea, Stridor, Tracheostomy, Paraphenylene diamine.

### Introduction

Suicide was responsible for about 6,00,000 deaths in the 1990's [1]. It is ranked as the third leading cause of death in the age group 15-44 years. Suicide rates have increased by 60% in the past 50 years [2]. Hair dye and its constituents paraphenylene diamine have been reported as an accidental and intentional cause of poisoning from developing countries in Africa [3,4,5,6] and Asia [7,8,9,10,11]. Case series have been reported from Khartoum [12,13,14], Casablanca [15] and Morocco [16]. Numerous papers have been published from India [8,9,10,11,17,18,19,20,21]. In India it is reported from Andhra Pradesh [9,10] and from Tamil Nadu (Vellore) [8,21]. It is a cheap, freely available emulsion based hair dye used for deliberate self harm in India [22]. Super Vasmol poisoning is being reported from developing countries probably due to its easy availability and its low cost [23].

It contains potential toxins including paraphenylene diamine, resorcinol, sodium ethylene diamine tetra acetic acid (EDTA), liquid paraffin, propylene glycol cetostearyl alcohol, sodium lauryl sulphate, herbal extracts, preservatives and perfumes [21,24]. The characteristic triad of features encountered are early angioneurotic edema with stridor, rhabdomyolysis with chocolate colored urine and acute renal failure [2]. Whenever this combination occurs, hair dye poisoning is a strong suspect. The combined effects of the individual toxicants results in significant morbidity and mortality [21].

## **Methods and materials**

All patients who consumed super Vasmol admitted in our hospital from April 2009 to March 2010 were included in our study. The total number of patients were 111. Two patients more than 55 years of age and one patient who arrived late (>48 hrs) to the hospital were excluded from the study. Hence, 108 patients were included in our study. The data were collected in relation to age, sex, amount of poisoning, time to reach the hospital, time of development of cervico-facial edema and ENT manifestations. All the patients were treated symptomatically with antihistaminics, steroids, antibiotics, adrenaline nebulisation, nasal oxygen and forced alkaline diuresis. Patients who developed cervico-facial oedema, throat pain, burning sensation in the throat, change of voice and no voice were referred for an ENT opinion. Tracheostomy was done for severe tongue oedema, sublingual oedema, submandibular oedema with stridor. We have compared the profiles between alive and dead patients after the tracheostomy (Group A), alive and dead patients who have not undergone tracheostomy (Group B), and those who have and have not undergone tracheostomy (Group C).

Analysis was done with statistical package for social sciences (SPSS v.15). Chi square test was used to evaluate the level of significance and P value < 0.05 was considered as significant.

## **Results**

The total number of patients included in our study was 108. The age group ranged from 13-45 with a mean age of 24.7 (SD- standard deviation 6.51). Among them 38 were males (35.2%) and 70 were (64.8%) females, with a male female ratio of 1:1.84 (Table 1). The female patients were predominantly working in small-scale industries in nearby places (45), some were house wives (40) and some were studying in schools (23). The age group ranged from 10 -55 years with more patients in the 21-25 years group (Table 2).

85% of patients told that they have chosen Super Vasmol as a poison because it is easily available, applicable and cheaper than pesticides. 90% of the patients had ingested the dye as an act of deliberate self harm. 10% of them had ingested to threaten their relatives without knowing the seriousness of the poison. 62% of the patients told that they got the information of Super Vasmol poisoning from the neighbourhood and 38% told that they got their information from the media.

The mean amount of ingestion was 75- 100ml. There is no apparent dose-toxicity relationship. The mean time of arrival to the hospital was ranging from 1hr and 30 min to 10 hrs with mean of 4 hrs 63 min (SD 1.73). The time of development of cervico-facial oedema ranges from 1hour and 30 minutes to 9 hrs with the mean time of 4 hrs and 29 min (SD 1.75).

Among the ENT manifestations there is a high incidence of development of cervico facial oedema (74 patients) followed by throat pain (48), stridor (33), change of voice (31) and no voice (12) in various combinations (Table 3). Of all these, the earliest sign is development of submandibular oedema. 33 of them developed dyspnoea with stridor and needed emergency tracheostomy, because they did not respond to antihistamines, steroids and adrenalin nebulisation.

Among the patients who underwent tracheostomy 6 (18.2%) were males and 27 (81.8%) were females. Among the patients who underwent tracheostomy 5 (4.6%) of them had complications. Three of them had tracheo-esophageal fistula and two had wound infection around the tracheostome and all of them were treated. But none of them died. 7 patients out of the 33 died due to other complications of the dye and not due to

**Table 1** Showing sex distribution (n=108)

Sex	Total number of patients
Male	38(35.2%)
Female	70(64.8%)

tracheostomy. Among the patients who died after tracheostomy 1 patient (14.3%) was male and 6 (85.7%) were females. Out of 108 the patients 24 (22.2%) patients died. 33 (30.5%) patients needed tracheostomy.

Statistical comparison of age of patients who were alive (23.5) and died (30.4) after tracheostomy (Group A) showed a P value of 0.005, which is statistically significant (Table 4). The time of development of cervico-facial edema between alive (5hrs and 8min) and dead (2hrs and 58min) shows statistical significance (P value 0.001). There is no statistical significance between these groups in time to reach the hospital and the amount of poisoning. During the analysis of the non tracheostomy group (Group B) statistical significance is noted in age of the patients who were alive (26.03) and dead (19.8) with a P value of 0.001. There is no statistical significance in the profile of patients who have and have not undergone tracheostomy (Group C). The proportion of mortality in 108 patients was 22.2%, after tracheostomy 21.2% and in the non tracheostomy patients 22.7% (Table5).

**Table 2** :Showing age distribution (n=108)

Age group	Total number of patients
10-15 Years	5(4.6%)
16-20 Years	22(20.4%)
21-25 Years	42(38.9%)
26-30 Years	16(14.8%)
31-35 Years	15(13.9%)
36-40 Years	5(4.6%)
41-55 Years	3(2.8%)

**Table 3** Showing ENT manifestations

Symptoms	Number of patients
Cervicofacial oedema	74(68.5%)
Throat pain	48(44.4%)
Stridor	33(30.5%)
Change of voice	31(28.7%)
No voice	12(11.1%)

**Table 4** Showing comparative trends between A,B,C groups

	A			B			C		
	A1	A2	P Value	B1	B2	P Value	C1	C2	P Value
Number of patients	26	7	-	58	17	-	33	75	-
Age (Years)	23.5	30.6	0.005*	26.03	19.88	0.001*	25	24.6	0.795
Time to reach Hospital (hours)	5.27	5.1	0.735	4.37	5.16	0.999	5.21	4.55	0.469
Time of development of symptoms(hours)	5.05	2.58	0.001*	4.29	4.45	0.779	4.21	4.34	0.734
Amount of poisoning (ml)	92.5	119.2	0.172	98.17	98.18	0.843	98.18	98.18	0.999

\* P value < 0.05 statistically significant

A group : Alive (A1) and dead (A2) patients after tracheostomy

B Group: Alive (B1) and dead (B2) patients who have not undergone tracheostomy

C Group : Patient who have undergone tracheostomy (C1) and have not undergone tracheostomy(C2)

**Table: 5** Showing proportion of mortality

	Total no of patients	No of deaths	Percentage
Tracheostomy	33	7	22.70%
Non-tracheostomy	75	17	21.20%
Total	108	24	22.20%

## Discussion

The first artificial dye was synthesised in the laboratory in 1856. Permanent hair colorants have been in commercial use for over 100 years [25]. Paraphenyline diamine is a coal tar (Paranitroaniline) derivative which, on oxidation produces Bondrowski's base, which is allergenic, mutagenic and highly toxic [2] and is used to shorten the duration of applications as well as intensify the color of henna (*Lawsonia Alba*) which is traditionally used to color the palms and hair [5]. Nott first documented paraphenyline diamine poisoning in a owner of a hair salon in 1924 [4,26]. Paraphenyline diamine causes severe angioneurotic edema, muscular edema, shock, rhabdomyolysis and intravascular haemolysis with haemoglobinuria (chocolate colored urine) culminating in acute renal failure [2,11], oliguria, acute tubular [12], focal glomerular sclerosis [5] cardio toxicity resulting in myocarditis [2] and fatal arrhythmias [5] causing sudden death. It causes rhabdomyolysis by promoting leakage of calcium ions from

The smooth endoplasmic reticulum which results in prolonged muscle contraction and irreversible change in muscle structure [22]. Other features include anemia, leukocytosis, liver necrosis [27], metabolic acidosis and hyperkalemia [9].

Cetostearic alcohol, the combination of aliphatic alcohol and esters acts as a non-ionic surfactant and can produce allergic and urticarial reactions and sodium lauryl sulphate causes irritation to the skin [24]. Resorcinol a phenolic derivative, corrosive chemical used in hair dye, tanning and photography is neurotoxic, causing seizure, lethargy, coma and death [21] and is also nephrotoxic [2]. It can also cause nausea, dyspnoea,

hypotension, diaphoresis, salivation, meth haemoglobinemia, bronchospasm and in severe cases pulmonary edema [9]. EDTA produces headache, vomiting, gastritis [24]. Propylene glycol is a viscous, colorless solvent is a potent nephrotoxic. It causes hyperosmolarity, raised anion gap, metabolic acidosis, Central nervous system depression, arrhythmias and renal dysfunction [2,29] and acute haemolysis [24]. Reddy I S et al reported nephrogenic systemic fibrosis causing bilateral symmetrical thickening and induration of skin over the extremities, verrucous papules and plaques following hair dye ingestion induced acute renal failure [30].

Hair dye poisoning has been reported in 4 female patients from Casablanca [15]. Yet another two papers show this poisoning in young girls [9,24]. A study by Anugrah Chrispal et al shows (11 out of 13) female predominance [21]. In our study females contribute to 64.8% (70 out of 108) with the male female ratio of 1:1.84. The female patients were predominantly working in small-scale industries in nearby places (45), some were house wives (40) and some were studying in schools (23).

A number of children have been intoxicated in Sudan [14]. 6 year old child with paraphenyline diamine intoxication has been reported from Israel [31]. Bourquia et al has reported 4 patients in the age group between 18- 35 [15]. Another study shows the mean age as 27.75 [21]. A study of 374 patients of paraphenylene diamine poisoning from Morocco showed 54% were in 15-24 yrs and 11.5% were children [4]. In our study the age group ranged from 13-45, with the mean age as 24.75. The maximum number of patients (42) were in the 21-25 age group followed by 16-20 age group (22). Love affairs, dowry, divorce, illegitimate pregnancy, extramarital affairs and family conflicts play a critical role in this age group.

The mean amount of poisoning in Bhargava et al study was 300ml [8], in Anugrah Chrispal et al study was 150 ml [21], in Verma et al study was 100 ml [9] and in our study it is 75-100 ml. There is no apparent dose toxicity relationship noted.

The mean time to reach the hospital was 32 hrs 7 min in a study [21] 8 hrs in a case report by Dr. B.K. Barik et al [24] and 1 hr in Verma et al study [9]. In our study the mean time to reach the hospital was 5 hrs 3 min with a range from 1hr 30 min to 10 hrs. Time delay was due to the relatives not knowing immediately that the patient had consumed the poison or the distance from the hospital or transportation problem. The first clinical manifestation (usually cervicofacial edema) following ingestion of Super Vasmol occurs mostly within 6 hrs [5]. We have observed that the time to develop cervico-facial edema ranges from 1 hr 30 min to 9 hrs with a mean time 4hrs 29min (SD 1 .67).

Apart from respiratory, renal, neurological, haematological [9] and cardiac manifestations[2,5] were also noted in Super Vasmol poisoning. Respiratory syndrome following Super Vasmol ingestion is represented by asphyxia and respiratory failure secondary to inflammatory oedema involving the cricopharynx and larynx [2]. Clinical manifestations resembling ludwigs angina was noted in one patient with sorethroat, cough, severe dyspnoea caused by edema of the tongue, pharynx and neck [31]. This compound can cause angioneurotic edema with respiratory distress [8, 14]. Swollen face with asphyxia was noted by Yagi et al [12] and Bourquia A et al [15]. Gross swelling of the neck and face below the chin and mandible on both sides was noted in Dr.B.K.Barik et al study [24]. Face and neck swelling with respiratory distress and convulsions was noted in a study by Verma et al [9]. Kallel et al conducted a study in 19 patients with paraphenylene diamine intoxication in Tunisia over 6 years and found that the predominant clinical features were cervico facial edema in 79% of the patients, upper airway tract edema in 68.4%, muscular edema in 26.3% and shock in 26.3% [6]. Suliman et al who studied 150 patients with paraphenylene diamine poisoning found angioneurotic edema in 68% [6]. Anugrah Chrispal et al in their study with 13 patients with Super Vasmol poisoning found cervico-facial edema in 9 patients (69.2%), dyspnoea in 7 (53.8%) and inability to open the mouth in 6 (46.2%) [21]. In our study cervico- facial edema developed in 74 patients (68.5%), throat pain in 48 patients (44%), dyspnoea with stridor in 33 patients (30%), change of voice in 31 patients (28.7%) and aphonia ( no voice) in 12 patients (11.1%). Whether cervico facial edema is a result of angioneurotic edema [5] or a result of direct injury and inflammation is unclear [21].

Hair dye poisoning is a medical emergency. Since there is no antidote, intensive supportive care is the cornerstone of management [21]. Treatment is mainly supportive with parenteral corticosteroids and

antihistaminics have been tried. But controlled studies are needed [27]. There are no therapeutic trials as to their benefit [21]. Calcium gluconate has been used to treat symptomatic hypocalcemia causing tetany and seizures [8]. Metabolic acidosis should be corrected [2]. Early intervention with half normal saline and sodium bicarbonate infusion have been shown to have beneficial results in rhabdomyolysis and helps in avoiding dialysis [32]. Dialysis per se is supportive as the toxin is not dialyzable [7,27].

Yagi et al found intensive medical treatment along with tracheostomy as life saving [12]. In Ram et al series 4 patients had asphyxia and cervico facial edema resulting in emergency tracheostomy [18] and in Suliman et al studies it is 15.8% [5]. Ventilatory support was needed for a patient [9]. Patients should be monitored for respiratory distress and endotracheal intubation has to be performed early if laryngeal edema develops [2]. We treated our patients with parenteral Hydrocortisone, Chlorpheniramine maleate, Cefotaxime, Ranitidine, Adrenaline nebulisation, nasal oxygen and forced alkaline diuresis. Tracheostomy is done if the cervico-facial edema is severe and causes stridor and in those who developed respiratory distress. In our series 74 patients developed cervico-facial edema and 33 patients required emergency tracheostomy.

Morbidity and mortality rates are high once renal failure develops. Mortality rates vary between 0.03% - 60% [2]. High mortality within 24 hrs was noted in Sir Hashim et al study 41% (13 out of 31) [14]. In Ram et al study it is 21% [18]. In another study by Mohamed Abdelraheem et al the mortality rate is 12-42% [33]. In our study, the proportion of mortality in 108 patients is 24 (22.2%), in tracheostomy patients 7 (21.2%) and in non tracheostomy patients 17 (22.7%). There is no significant difference in mortality in these groups. When we consider the whole population the mortality of Super Vasmol is 1.38/ 100,000.





Pictures showing lingual and sublingual oedema

### **Conclusion**

There is a high incidence and rapid rise of Super Vasmol hair dye poisoning in this area. In our study age of the patient and the time to reach the hospital and time of development of cervico facial edema have an impact on mortality. Young adults (of the age group 21-25) are at the highest risk. The amount of poison ingested and tracheostomy do not have a significant impact on mortality. Many of them develop severe cervicofacial edema, dyspnoea with stridor within a few hours of consumption. So, reaching the hospital promptly and timely medical help has a major impact on mortality. Many patients also developed renal failure and cardiac arrhythmias. These alarming facts suggest the necessity to impose regulation on the free availability of Super Vasmol hair dye. Proper toxicity warning on the hair dye labels, counselling adolescent girls to withstand stress, public education regarding the potential toxicities of these compounds are imperative to reduce the mortality. It is also important for the medical fraternity to know about the manifestations, early detection and prompt treatment of the patient.

### **Key message**

Clinical outcomes rely on early recognition, prompt referral and aggressive treatment in collaboration with different specialities. Awareness programs about its toxicity should be implemented at different levels.

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**Conflict of interest** None

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