



A Review on Hair Colorants and their Adverse Effects

Suneethi M S ^a, Anju George ^b

^{a,b} Student, 8th Semester Bpharm, Chemists College of Pharmaceutical Sciences and Research, Ernakulam Kerala, India

ABSTRACT

In hair dyeing, there is urgent need to understand the toxicities and risks associated with the exposure to chemicals found in hair dye formulations. Hair dyes are classified as oxidative and nonoxidative based on the chemical composition and ingredients. We review the safety of the various chemicals in oxidative and nonoxidative hair dyes, toxicities associated with the hair dyeing, and the carcinogenic risks related to hair dyeing. The use of chemicals as raw materials in hair dyes may cause synthesis of other contaminants with potential toxicities and risk of cancer. A chemical and mechanistic basis of the reported toxicities of hair dye mixtures and individual hair dye ingredients is needed. Hair dye poisoning has been one of the most important cause of intentional self harm in the developing world. Hair dyes contain PPD and other chemicals, can cause laryngeal edema, severe metabolic acidosis and acute renal failure and so on.

Keywords: Hair colorants, Ingredients, Adverse effects, Treatment

1. INTRODUCTION

Hair is an indicator of attractiveness, femininity, masculinity, health, and beauty. Now a days, hair dyeing has become popular among both men and women pursuing such value or fashion trends. Globally, hair colorants are a rapidly growing industry. It involves treatment of the hair with natural and chemical compounds mainly for cosmetic purposes. Hair dyes come in two forms: (i) oxidative (permanent) and (ii) nonoxidative (semi-permanent and temporary) Permanent dyes consist of primary intermediates (e.g., p-phenylenediamines) and couplers (e.g., m-hydroxy phenols) in the presence of peroxide. Nonoxidative hair dyes include colored compounds that stain hair. Some of the chemicals used in hair dye ingredients are reported as carcinogenic in animals.

Hair Dye Ingredients and their health effects

Ingredient	Health effects
Para-phenylenediamine (PPD)	Pharyngeal, laryngeal irritation; bronchial asthma; sensitization dermatitis
Para-aminophenol	Asthma, irritation of the skin and eyes, dermatitis and methemoglobinemia with cyanosis
4,5-Diaminopyrazole	Causes serious eye damage, may cause an allergic skin reaction
Pyrimidine	Eye irritation; dermatitis
Resorcinol	Irritation of eyes, skin, nose, throat, upper respiratory system; bluish skin, dizziness, drowsiness
Meta-aminophenol	Skin sensitization
Meta-phenylenediamine	Irritating to the eyes and skin, may cause effects on the kidneys and blood resulting in renal failure and formation of methemoglobin
Pyridine	Irritation of eyes, skin, respiratory tract; headache, dizziness, insomnia; redness; burning sensation; weakness

2. Hair Dye-Induced Toxicities and Adverse Health Effects

2.1 Contact Allergy and Hair Loss

The contact allergies occur frequently, may lead to the occurrence of ACD and urticarial contact. ACD commonly occurs on the scalp, face, and hands of hair dye users, which reduces quality of life in the affected individuals and can have negative socioeconomic impacts by using permanent hair dyes containing PPD at concentrations $\leq 0.67\%$ is unlikely to induce skin sensitization.

As hairdressers are exposed in all steps of the dyeing process, they face a significantly higher skin sensitization risk than personal hair dye users. The use of protective gloves during hair coloring and warnings on the product labels, a sensitivity test is needed before application have decreased the incidence of hair dye-induced allergies. With sufficient protection against local and systemic exposure to the oxidative hair dyes and hair coloring is unlikely to pose a serious risk to the human health. Along with the increasing popularity of hair dye use, growing complaints about hair dye-induced hair loss have been a concern of dermatologists.

2.2 Respiratory Sensitization, Allergies, And Other Diseases

Asthma and allergic rhinitis are main diseases that results in negative socioeconomic impacts. Hairdressers are at a high risk of occupational rhinitis and asthma because, in daily work, as they are frequently exposed to irritants and allergens. A case-control study showed that hairdressers over 40 years of age were more likely to suffer asthma-like symptoms than nonhairdressers due to their long occupational exposure to hair dye ingredients. The hairdressers should undergo continuous medical surveillance to monitor the risk factors and reduce the chance of respiratory diseases linked to occupational exposure.

2.3 Hair Dye Poisoning

Due to the easy availability and high toxicity of PPD, people who want to commit suicide may attempt it by consuming this agent. Hair dye poisoning may trigger the occurrence of some urgent and fatal outcomes, like acute kidney injury, pneumothorax and rhabdomyolysis. Orally ingesting PPD causes severe trauma to the airway and may lead to several respiratory symptoms. Individuals with AKI are at a 9-fold risk of developing chronic kidney disease that can give rise to other organ dysfunctions. The characterized pathological manifestations of AKI include acute tubular necrosis, glomerular hyperaemia, intratubular casts, and tubulointerstitial hemorrhages as well as mesangial hyperplasia. Hair dye-induced AKI occurs in a dose-dependent manner, but even with no intervention, the injured kidney may recover over time.

2.4 Reproductive Toxicity and Disruption of Thyroid Hormone Synthesis

The Zebrafish embryos are the animal models for studying how hair dyes can affect embryonic growth. The studies demonstrated that exposure to hair dyes induced morphological and physiological abnormalities in zebrafish embryos, provoked interest in determining whether hair dyes could affect human embryo development. Abnormal birth weight in humans reflects the poor health of the foetus and mother, which contributes to the occurrence of obesity, malnutrition and so on in the child in the future. In terms of hair dyeing, the risk of infantile abnormal birth weight is elevated when mothers have irregular menstruation or have used hair dyes before pregnancy.

3. TREATMENT

Hair dye ingestion is a medical emergency. Emergency measures should include gastric lavage. Patients should be monitored for respiratory distress and endotracheal intubation has to be performed early if laryngeal edema develops. Metabolic acidosis has to be corrected. With half normal saline and soda bicarbonate infusion has been shown to be beneficial. Hemodialysis, peritoneal dialysis and continuous renal replacement therapy have been tried and useful in acute renal failure. Mortality rates vary between 0.03% and 60%.

CONCLUSIONS

Hair dyeing formulations are categorized into oxidative and nonoxidative types. Exposures to the hair dyes may cause several kinds of toxicity and side effects. Although evidence has not shown a consistent conclusion about the correlation between hair dye use and risk of carcinogenesis. Moreover, maternal hair dyeing during the month before pregnancy, during pregnancy, or during breastfeeding is a risk factor for the occurrence of leukemia, brain tumors in the offspring. The toxicology studies are needed to better understand the risks associated with exposure to hair dyes and to address this important public health concern. The current and emerging methods in toxicology can allow for a significantly superior assessment of complex mixtures such as hair dyes and therefore further support data-driven and fact-based evaluation of this public health concern.

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