Afr. J. Trad. CAM (2006) **3 (1):** 142 - 149

Research Paper

Afr. J. Traditional,
Complementary and Alternative Medicines
www.africanethnomedicines.net

ISSN 0189-6016©2006

A RESTROSPECTIVE STUDY OF ACUTE SYSTEMIC POISONING OF PARAPHENYLENEDIAMINE (OCCIDENTAL TAKAWT) IN MOROCCO

Ayoub Filali[1*], Ilham Semlali[2], Valeria Ottaviano[3], Carmelo Furnari[3], Danillo Corradini [4], Rachida Soulaymani[2]

[1]Institut de Formation aux Carrières de Santé, Rabat, Morocco, [2]Centre Anti Poison du Maroc. Rabat, Morocco, [3]Laboratorio di Tossicologia forense, Università degli Studi "Tor Vergata". Roma, Italy, [4]Istituto di Metodologie Chimiche, Roma Montelibretti. Roma, Italy.
E-mail: afilaliz@yahoo.fr **,** Tel: + 212 37 6919 38 / 68, Fax: +212 37 69 27 96

Abstract

Paraphenylenediamine (PPD) is commonly used in several industries (dyeing furs, photochemical processes, tyre vulcanisation industries, oxidisable hair dye, etc.). Its allergic effect is well established and many studies are devoted to the subject, but PPD systemic poisoning is not understood. Several acute PPD poisoning cases (accidental or intentional) had been reported, in particular, from Africa and Asia where it is traditionally used mixed with Henna to colour palms of hands and soles of feet and to dye hair. We examine here an eleven-year (1992-2002) retrospective of PPD poisoning reported to the Poison Control Centre of Morocco. It revealed 374 cases with a female predominance (77%). The majority of poisoning was intentional (78.1%) and the group most prone to PPD poisoning were the young population (15.1-25 and 25.1-35 years-old-age groups) accounting for 54.3% and 15.2%, respectively. 21.1% of poisoning cases were fatal, and the source/route of poisoning was by ingestion in the largest number of cases (93%). 50% of poisoning were from the south of Morocco, where phytotherapy knowledge is very developed. The largest number of cases was recorded in 2001 (20.1%). The prevention and treatment of PPD poisoning by public enlightenment is mandatory in the effort to reduce poisoning by this agent.

Key words: Paraphenylenediamine, Acute poisoning, Takawt, *Tamarix aphyla*, Morocco.

Introduction

Though uncommon in the west, ingestion of paraphenylenediamine (PPD) is frequently reported from Africa and Asia (Chugh et al., 1982; Hashim et al., 1992; Ashraf et al., 1994; Zeggwagh et al., 2003) where it is most often mixed with “Henna” (leaves of *Lawsonia alba*) and applied to colour palms of hands and soles of feet and to dye hair a dark red shade. PPD accelerates the dyeing process. Acute poisoning, accidental or intentional, by

Afr. J. Trad. CAM (2006) **3 (1):**142 - 149

ingestion of PPD causes severe oedema of the face and neck frequently requiring emergency tracheotomy. This is followed by rhabdomyolysis and acute renal failure, culminating in death if not treated aggressively (Ashraf et al., 1994).

PPD poisoning in Morocco is closely linked to socio-cultural factors. In fact, Moroccan women use "Henna" mixed with a vegetable product, scab of *Tamarix aphyla* (Tamaricaceae) locally called "Takawt" to dye hair. This is a non toxic product also employed in traditional medicine but it has been reported that "Takawt" was used in Morocco also as an abortive agent in mixtures with other plants (Bellakhdar, 1997).

In Morocco PPD otherwise known as Occidental Takawt; is ignorantly thought to be the same substance as the local "Takawt" and therefore is being used for the same purposes as the local "Takawt" for its dyeing property or for its alledged abortive effect. It is also used for suicidal intent. Recently, it has been established that PPD can cause systemic toxicity in Morocco, where availability and low price make it an attractive poisoning agent. In one fatal poisoning, total intake of PPD was about 3g (63mg/kg) (Saito and al., 1990). In fact, it is possible to buy 10g of PPD for only about 0.3 $ US now in Morocco.

The early acute PPD intoxication cases in Morocco occurred in the seventies and were reported by Arditti (Arditti et al., 1980), and since this date reports of intoxication have been sporadic (Bourquia et al., 1988; Squali et al., 1991; Zeggwagh et al., 1996; Kerkeb et al., 1998;). Over the last several years the number of PPD poisoning has increased continuously and significantly. It was the second reason for hospitalisation in the intensive care unit of the Casablanca University hospital in 1999 and the first reason for admission in the emergency unit (Portes Médicales) of Rabat University hospital in 2003. Acute poisoning by PPD ingestion is ranked amongst the most frequent causes of suicidal poisoning requiring hospitalisation in Morocco.

The first documented systemic poisoning with PPD where toxicity occurred from handling dye was described in 1924 (Nott, 1924) concerning the owner of a hairdressing salon. Contact with PPD which led to systemic toxicity had been reported (Kamil and Davidson 1996; Lava and Dollar, 1996). It should be observed that presently tattoos are very popular in Western countries especially among young people. In particular, temporary tattoo techniques come directly from that practised in Morocco, where a mixture of Henna and PPD is used. A common theory is that PPD is able to reduce the time necessary for the absorption of colours through the skin. The aim of this work is to stimulate the awareness among scientists in general about this problem, and in particular the Moroccan people who confuse PPD with *Tamarix aphyla.*

Methodology

Data for this study were extracted from the medical records of the Toxicovigilance Department of the Moroccan Poison Control Centre. This department collects reports concerning poisoning cases from different regions of the country. A retrospective review of all reports received from 1992 to 2002, concerning acute PPD poisoning is shown. PPD poisoning cases for 2003 were not completely recorded. The data extracted from the above source included circumstances of poisoning, sex, age distribution, the outcome, region and poisoning according to the year.

Statistics: Data were analysed using Epi Info 6.04b version program, 2000. (from Center for Disease Control, Epidemiology Program Office, Atlanta, USA).

Afr. J. Trad. CAM (2006) **3 (1):** 142 - 149

Results

Three-hundred and seventy-four (374) cases of acute paraphenylenediamine poisoning were recorded. These accounted for 288 (77%) females and 86 (23%) males. The majority of the PPD poisoning cases were intentional; it was ingested with suicidal intent, or for its claimed abortive effect, in 292 cases (78.1%) as illustrated in table 1. The clinical outcome of the poisoning is shown in table 2; the intoxication culminated to death in 79 cases (21.1%). The intake of the poison was mainly by oral ingestion: 348 cases (93%) as reported in table 3. As shown in table 4 the young population between 15.1 and 25 years old is the most affected by this intoxication with 203 cases (54.3%), 43 cases (11.5%) concerned children less than 15 years old, 57 cases (15.2%) were between 25.1 and 35 years.

Table1: Circumstances of PPD poisoning.

Circumstances	**Number of PPD poisoning**	**Percentage of PPD poisoning (%)**
Suicidal	292	78.1
Accidental	50	13.4
Criminal	9	2.4
Unspecified	23	6.1

Concerning the poisoning according to the year (table 5), the majority of the cases were recorded from 1999 to 2002 with 49 (13.1%), 65 (17.4%), 75 (20.1%), and 59 (15.8%) cases for 1999, 2000, 2001 and 2002 respectively. The largest number of cases was recorded on 2001.

Table 2: Outcome of PPD poisoning.

Outcome	Number of PPD poisoning	Percentage of PPD poisoning (%)
Complication (hospitalisation)	101	27
Death	79	21.1
Favourable	105	28.1
Unspecified	89	23.8

Afr. J. Trad. CAM (2006) **3 (1):** 142 - 149

Table 6 shows PPD acute poisoning as distributed in different Moroccan regions. The south of Morocco seems to be the most affected with 187 cases (50%) followed by the centre 132 cases (35.3%).

Table 3: The route of PPD poisoning.

Tract of poisoning	Number of PPD poisoning	Percentage of PPD poisoning (%)
Oral	348	93
Inhalation	10	2.7
Percutaneous	2	0.5
Unspecified	14	3.7

Discussion

The acute toxicity of PPD by ingestion, especially, is not well documented; some clinical studies have been devoted to the subject (El Ansary et al., 1983; Fathi et al., 1995; Kamil and Davidson 1996; Yagi et al., 1996; Ababou et al., 2000). The socio-cultural factors led to the high number of poisoning. A total of 374 intoxications were reported from 1992 to 2002. Studies have shown that the female population (77%) is more affected than the male population (23%) because, on the one hand PPD is a product used in traditional cosmetology so females know it better, and on the other hand because of its deemed abortive effect. This female predominance ranged from 72% to 92% found in other reports with 72% for Kerkeb et al. (1998), Yagi et al. (1991), 77% and Motaouakil et al. (1999), 92%.

Three circumstances of poisoning are reported; suicide predominates (78.1%), followed by accidental poisoning (13.4 %). Yagi et al. (1991) report 70% of suicidal cases. Accidental ingestion of PPD seems to be more frequently observed among the younger population (children), as reported by Hashim et al. (1992).

About the clinical outcome of the poisoning, in our study, PPD poisoning resulted in death in 79 cases (21.1%); a similar percentage of the negative prognosis has been found by other authors, 33% and 22% for El Ansary et al. (1983) and Kerkeb et al. (1998) respectively. In the majority of the cases (93%) PPD was taken intentionally, with suicidal intent or for its claimed abortive effect, by ingestion. It is not easy to explain the 10 cases (2.7%) of intoxication through inhalation; this is the first time that PPD poisoning has been reported in this way. For the cases involving the younger population, it may be attributed to the fact that children had sniffed the powder in order to know what it was.

Two cases (0.5%) of PPD poisoning by percutaneous absorption were recorded at the Moroccan Poison Control Centre. Lava and Dollar (1996) and Kamil and Davidson (1996) reported PPD systemic poisoning by contact. Acute PPD poisoning by age group shows that the group most prone to PPD poisoning in this study was the 15.1 to 25 year-old-age group

Afr. J. Trad. CAM (2006) **3 (1):** 142 - 149

accounting for 203 cases (54.3%). This can be explained not only by the fact that young people are the most affected by intentional poisoning in general, but because, on top of that, young females (especially unmarried) use PPD for its claimed abortive effect but do not admit using it for terminating an unwanted pregnancy. Paediatric poisoning, in the age groups from

Table 4: Acute PPD poisoning by age groups.

Age group years	Number of PPD poisoning	Percentage of PPD Poisoning (%)
2 - 9	13	3.5
9.1 - 15	30	8
15.1 - 25	203	54.3
25.1 - 35	57	15.2
35.1 - 45	29	7.8
45.1 - 55	18	4.8
55.1 - 63	6	1.6
63.1 - 75	4	1.1
> 75	1	0.3
Unspecified	13	3.5
Total	374	

2 to 15 years old, was reported in 43 cases (11.3%). A case study from Sudan referred 31 cases of paediatric PPD poisoning between 1984 and 1989 (Hashim et al., 1992).

Concerning PPD poisoning distribution in different regions of Morocco, there were 187 cases (50%) from the south. The south is the sparsely populated region and it is considered the region of Morocco in which phytotherapy is the most developed (Eddouks et al. 2002). In fact, the local “Takawt” cited above is a plant from the Saharan region (the south of Morocco) and it is more commonly used there than in the northern region. An increased use of traditional practice in the south, and availability of PPD lead to a higher number of PPD poisoning. One hundred thirty two cases (35.3%) of poisoning were recorded in the centre, mainly from Casablanca, a big metropolis with a great number of shantytowns and a lot of socio-economic problems that lead to a high number of suicides and undesirable pregnancies. The north of Morocco seems to be less affected.

Afr. J. Trad. CAM (2006) **3 (1):** 142 -149

Conclusion

The systemic toxicity of PPD has serious consequences which may eventually lead to death. This study showed that PPD poisoning was fatal in 21.1% of cases; this mortality rate remains a cause of great concern. A program of public education and stricter controls over the sale and distribution of PPD in Morocco should go along towards alleviating this problem.

Table 5: Acute PPD poisoning according to the year.

Year	Number of PPD poisoning	Percentage of PPD poisoning (%)
1992	7	1.9
1993	25	6.7
1994	8	2.1
1995	26	7
1996	22	5.9
1997	23	6.2
1998	15	4
1999	49	13.1
2000	65	17.4
2001	75	20.1
2002	59	15.8
Total	374	

Table 6: Acute PPD poisoning as distributed in different region.

Moroccan region	**Poisoning number**	**Percentage of poisoning (%)**
North region	55	14.7
Centre region	132	35.3
South region	187	50

Afr. J. Trad. CAM (2006) **3 (1):** 142 - 149

Awareness of the clinical features of this intoxication is required in western Countries where, though not yet a common problem, increasing migration of relevant ethnic groups, may lead to more cases due to cross cultural activities.

Acknowledgments

Our gratitude goes to Mr.Mohammed Badri, statistician at the Poison Control Centre of Morocco, for the data input and statistic evaluations and to Mr. Mark T. Stickevers for revising the English language. We are also grateful to acknowledge that this paper originates amongst the cooperation project between the Moroccan National Scientific and Technologic Research Centre (C.N.R.S.T.) and the Italian National Research Centre (C.N.R.I.).

References

1. Ababou, A., Ababou, K., Mosadik, A., Lazreq, C., Sbihi, A., (2000). Rhabdomyolyse du myocarde après intoxication à la paraphénylène diamine. Ann Fr Anesth Reanim **19 :** 105-107.
2. Arditti, J., David, J.M., Chiglione, C., Jouglard, J., (1980). Takaout, teinture capillaire naturelle ? Bull Med Leg et Toxicol **22:** 153-155.
3. Ashraf, W., Dawling, S., Farrow, L.J., (1994). Systemic paraphenylenediamine poisoning: A case report and review. Hum ExpToxicol **13 :** 167-170.
4. Bellakhdar, J., (1997). Médecine arabe ancienne et savoir populaires. Pharmacopée traditionnelle marocaine, Ibis Press 510-512 and 614.
5. Bourquia, A., Jabrane, A.J., Ramdani, B., Zaid, D., (1988). Toxicité Systémique de la paraphenylène diamine. Presse Med **17 :** 798-800.
6. Chugh, K.S., Malik, G.H., Singhal, P.C., (1982). Acute renal failure following paraphenylenediamine (hair dye) poisoning : report of two cases. J. Med. **13:** 131-137.
7. Eddouks, M., Maghrani, M., Lemhadri, A., Ouahidi, M.L., Jouad, H., (2002). Ethnopharmacological survey of medicinal plants used for the treatment of diabetes mellitus, hypertension and cardiac diseases in the south region of Morocco (Thafilalet). J. Ethnopharmacol. **82:** 97-103
8. El Ansary, E.H., Ahmed, M.K., Clague, H.W., (1983). Systemic toxicity of paraphenylenediamine. Lancet, I, 1341.
9. Fatihi, E., Laraki, M., Zaïd, D., Benaguida, M., (1995). Toxicité systémique de la paraphénylène diamine à propos de 13 cas. Rea Urg 4, 671-373.
10. Hashim, M., Hamza, Y.O., Yahia, B., Khogali, F.M., Suleman, G.I., (1992). Poisoning from Henna dye and paraphenylenediamine mixtures in children in Kartoum. Ann Trop Paediatr **12:** 3-6.
11. Kamil. A.A., Davidson, N.M., (1996). A woman who collapsed after painting her soles. Lancet B: 658.
12. Kerkeb, O., Zeggwagh, A.A., Aboukal, R., Madadi, R., Zerkaoui, A., (1998). Myocardite toxique secondaire à l'intoxication aiguë par la paraphénylène diamine. Ann Fr Anesth Reanim **17 :** 1059.
13. Lava, N.S., Dollar, J., (1996). Hair dye induced rhabdomyolysis. Electroencephalogr Clin Neurophysiol **98(3):** 18P.

14. Motaouakil, S., El Mouknia M., Benslama, A., Chara, M., Menbhi, L., Ramdani, B., Benghalem, M., 1999. Intoxication à la paraphénylène diamine. Cah Med **22 :** 10-13.
15. Nott, H. W., (1924). Systemic poisoning by hair dye. Br. Med. J. **1:** 421-422.
16. Saito, K., Murai, T., Yabe, K., Hara, M., (1990). Rhabdomyolysis due to paraphenylenediamine (hair dye)-report of an atopsy case. Nippon Hiogaku Zasshi **44 :** 469-474.
17. Squali, J., Drissi, R., Maazouzi, K., (1991). Toxicité systémique de la ppd. Cah Anesthésiol **3:** 559-560.
18. Yagi, H.I., El Hindi, A.M., Khalil, S.I., (1991). Acute poisoning from hair dye. East Afr. Med. J. **68:** 404-411.
19. Yagi, H.I., El Hindi, A.M., Diab, A., Elshikh, A.A., (1996). Paraphenylenediamine induced optic atrophy following hair dye poisoning. Hum exp Toxicol **15:** 617-618.
20. Zeggwagh, A.A., Aboukal, R., Madani, R., Zerkaoui, A., Hamafi, M., Kerkeb, O., (1996). Myocardite toxique due à la paraphénylène diamine, à propos de deux cas. Rea Urg **5 :** 699-703.
21. Zeggwagh, A.A., Aboukal, R., Madani, R., Zerkaoui, A., Hamafi, M., Kerkeb, O., (2003). Thrombus ventriculaire gauche et myocardite toxique induite par la paraphénylène diamine. Ann Fr Anesth Reanim 19 **(7) :** 639-641.