

# Review Paper: Thallium Intoxication in Relation to Drug Abuse and Cigarette Smoking in Iran



Hamid Reza Banafshe<sup>1</sup>, Amir Ghaderi<sup>1\*</sup>

1. Department of Addiction Studies, School of Medicine, Kashan University of Medical Sciences, Kashan, Iran.



**Citation:** Banafshe HR, Ghaderi A. Thallium Intoxication in Relation to Drug Abuse and Cigarette Smoking in Iran. International Journal of Medical Toxicology and Forensic Medicine. 2018; 8(2):41-44. <http://dx.doi.org/10.22037/ijmtfm.v0i0.22090>

**doi:** <http://dx.doi.org/10.22037/ijmtfm.v0i0.22090>

**Funding:** See Page 43

**Copyright:** The Author(s)

## Article info:

**Received:** 19 Dec 2017

**First Revision:** 28 Dec 2017

**Accepted:** 28 Feb 2018

**Published:** 01 Apr 2018

## Keywords:

Thallium, Intoxication, Drug abuse, Cigarette smoking

## ABSTRACT

Thallium (Tl) is a highly toxic heavy metal with atomic number 81. It is a soft, bluish-white or gray water-insoluble metal but the salt forms are colorless, tasteless, and odorless. Tl is readily absorbed via ingestion, inhalation, and dermal contact. Any amount of Tl in the body is abnormal. The clinical manifestation of thallotoxicosis has a wide spectrum but painful ascending peripheral neuropathy, gastrointestinal, and dermatologic manifestations are major characteristics in Tl toxicity. Tl intoxication has been identified in drug abuse and cigarette smoking leading to various signs and symptoms. Substance abuse and cigarette smoke are a major public health hazard across the world.

## 1. Introduction

Heavy metals are regarded as one of the major threats to human health [1]. Thallium (Tl) is one of the heavy metals with atomic number 81, It is a highly toxic metal, which was discovered by William Crookes in 1861 [2]. The toxicity of Tl is worse than lead, cadmium, and mercury [3]. Tl is odorless, colorless, and tasteless. It has affinity with sulphhydryl groups in cells, K-dependent systems, essential enzymes of Krebs cycle and sodium-potassium ATPase [4-6].

The clinical symptoms of thallotoxicosis such as hair loss, neuropathy (sensory or motor), encephalopathy,

gastrointestinal, and visual problems are the characteristic manifestations following Tl long-term exposure [7, 8]. The presence of Tl in the hair or urine can indicate exposure to thallium. The normal levels of Tl in body human urine and hair amount to less than 1 ppm and 5-10 ppb, respectively.

Also, thallium level can be assessed in blood, however, this tissue is not a good indicator of exposure since Tl stays there too short [9]. Tl intoxication has been identified in drug abuse and cigarette smoking [10-13] leading to various signs and symptoms. Substance abuse and cigarette smoke are a major public health hazard across the world. Thus, the aim of this review was to

\* Corresponding Author:

Amir Ghaderi, PhD

Address: Department of Addiction Studies, School of Medicine, Kashan University of Medical Sciences, Kashan, Iran.

Tel: +98 (31) 55463378

E-mail: [gaderiam@yahoo.com](mailto:gaderiam@yahoo.com)

integrate the conclusion of previous studies considering the contents of Tl in illicit drug and cigarette smokers.

## 2. Drug Abuse

The World Health Organization (WHO) reported the prevalence of drug abuse in the world population was between 0.6% and 0.8% in 2013; that was nearly three times higher in Iran in 2010, i.e. 2.275% [14]. There is a high prevalence of illicit drugs use in Iran. Opioids constitute common drugs abuse in Iran, including opioid (82%), opium residues (28%), methadone (16.6%), heroin/crack (16%) and morphine (2.6%) [15]. In this regard, the main focus has been placed upon the treatment of illicit drug abuse in Iran, so around 5000 outpatient buprenorphine or Methadone Maintenance Treatment (MMT) clinics render services in Iran.

Also, about 500000 addicts are under maintenance treatment [16, 17]. Opioid is still the most abused drug. Informal, and often illegal laboratories refine opium into a sticky, brown paste, which is pressed into bricks and sun dried [18]. Salesmen and smugglers might add various heavy metals to illicit drugs to increase their weight and potential effects for more profit [19, 20]. Subsequently, illicit drug dependent patients complain from clinical symptoms which are not related to the abused substance, the most frequency complained clinical findings are neurological, gastrointestinal, and dermal problems [10, 13, 21, 22]. Adulteration of abuse drug is common and the most prevalent additives are lead [23-25], Tl [10, 11, 13] as well as different combinations including steroids [26, 27]. So the consequences may be extensively variant problems [28, 29].

The amount of thallium in illicit drug is usually small, when taken in large amounts, opium adulterated with Tl can produce clinical toxicity in addict patient. A few studies describe unusual and exotic causes of chronic Tl intoxication as an adulterant to street drugs [9, 19, 20]. Afshari et al. [20] reported three patients of suspected thallotoxicosis after heroin using. Also, Questel et al. [19] reported two patients of thallotoxicosis in heroin abuse. The first case-control study on opium users was reported by Ghaderi et al. [10].

The study was conducted on 100 opioid poisoned patients and 50 non-opioid abusers as the control group. According to this report, the urinary Tl level in opioid abusers was higher than in the healthy control. Also, the long-term opioid abuse might lead to Tl poisoning. The most frequent clinical manifestation Tl thallotoxicosis were ataxia, sweating, and constipation. Therefore, it is

essential for the first-line health respondents and clinicians who manage the admitted thallotoxicosis patients to understand the importance of early and accurate diagnosis of these patients.

## 3. Cigarette Smokers

The World Health Organization (WHO) has reported 15.1 billion smokers in the world, and 8% of cigarette abuse is reported from developing countries. Also, WHO reported that cigarette consumption will reach up to 19% among men and 10% among women in Iran by 2025 and 9% of the total population in Iran was predicted to be cigarette smokers in 2025 [30, 31]. Furthermore, WHO estimated that cigarette consumption is currently responsible for the death of 6 million people around world; this rate includes 600000 people who are also reported to die from the effects of passive smokers [32, 33].

Tobacco contains toxic metals, including cadmium, thallium, and lead. These metals can produce prolonged contact causes such as heart disease, kidney, respiratory, skin problems and hair loss [32, 34-39]. The Agency of Toxic Substances and Disease Registry (ATSDR) reported that smoking (cigarette and smoke) is one of the thallium sources and they estimated that the amount of thallium in cigarette consumption is significantly enhanced as compared to healthy people [9].

The first case-control study on cigarette smoking was reported by Ghaderi et al. [12]. The study was conducted on 56 cigarette smokers who were smoking continuously at least one year before the study and 53 non-smokers as control group. According to this report, the urinary Tl level in the smokers was higher than in the healthy control. Duration of cigarette smoking was significantly associated with Tl level. Also, there was not a correlation between water pipe smokers, COPD and thallium level. In the report, Tl level in smokers with clinical symptoms of depression, memory deficits, insomnia, and sweating were higher than those of cigarette consumption without these symptoms.

## 4. Conclusion

In Iran, cigarette smoke and substance abuse are known to be hazardous to public health, and considered the main cause of death worldwide. Tl and other toxic metals including lead and arsenic accumulate in the body. Therefore, increased biological level of these metals is the main cause of toxic and carcinogenic effects. Because of the importance of this issue, implementing tobacco and substance abuse control policies as the main

and common source of heavy metals intoxication can reduce the prevalence of nicotine and illicit drugs consumed in Iran. Also, the first-line health respondents and clinicians who treat the admitted thallotoxicosis patients should understand the importance of early and accurate diagnosis of these patients.

## Ethical Considerations

### Funding

The present study was supported by a grant from the Vice-chancellor for Research and Kashan University of Medical Sciences in Iran.

### Conflict of interest

The authors declared no conflict of interest.

## References

- [1] Karbowska B. Presence of thallium in the environment: Sources of contaminations, distribution and monitoring methods. *Environmental Monitoring and Assessment*. 2016; 188(11):640. [DOI:10.1007/s10661-016-5647-y] [PMID] [PMO CID]
- [2] Galván-Arzate S, Santamaría A. Thallium toxicity. *Toxicology Letters*. 1998; 99(1):1-3. [DOI:10.1016/S0378-4274(98)00126-X]
- [3] Peter AJ, Viraraghavan T. Thallium: A review of public health and environmental concerns. *Environment International*. 2005; 31(4):493-501. [DOI:10.1016/j.envint.2004.09.003] [PMID]
- [4] Mulkey JP, Oehme FW. A review of thallium toxicity. *Veterinary and human toxicology*. 1993; 35(5):445-53. [PMID]
- [5] Misra UK, Kalita J, Yadav RK, Ranjan P. Thallium poisoning: emphasis on early diagnosis and response to haemodialysis. *Postgraduate Medical Journal*. 2003; 79(928):103-5. [DOI:10.1136/pmj.79.928.103] [PMID] [PMCID]
- [6] Hasan M, Chandra SV, Dua PR, Raghbir R, Ali SF. Biochemical and electrophysiologic effects of thallium poisoning on the rat corpus striatum. *Toxicology and Applied Pharmacology*. 1977; 41(2):353-9. [DOI:10.1016/0041-008X(77)90036-9]
- [7] Hirata M, Taoda K, Ono-Ogasawara M, Takaya M, Hisanaga N. A probable case of chronic occupational thallium poisoning in a glass factory. *Industrial Health*. 1998; 36(3): 300-3. [DOI:10.2486/indhealth.36.300] [PMID]
- [8] Schaller KH, Manke G, Raithel HJ, Bühlmeier G, Schmidt M, Valentin H. Investigations of thallium-exposed workers in cement factories. *International Archives of Occupational and Environmental Health*. 1980; 47(3):223-31. [DOI:10.1007/BF00381680] [PMID]
- [9] Agency for Toxic Substances and Disease Registry. Public health statement thallium. Washington, D.C.: Agency for Toxic Substances and Disease Registry; 1992.
- [10] Ghaderi A, Vahdati-Mashhadian N, Oghabian Z, Moradi V, Afshari R, Mehrpour O. Thallium exists in opioid poisoned patients. *DARU Journal of Pharmaceutical Sciences*. 2015; 23:39. [DOI:10.1186/s40199-015-0121-x] [PMID] [PMO CID]
- [11] Ghaderi A, Banafshe HR, Khodabandehlo S, Mehrzad F, Mehrpour O, Afshari R. Qualitative thallium urinary assays are almost as valuable as quantitative tests: Implication for outpatient settings in low and middle income countries. *Electronic Physician*. 2017; 9(4):4190. [DOI:10.19082/4190] [PMID] [PMCID]
- [12] Ghaderi A, NasehGhafoori P, Rasouli-Azad M, Sehat M, Mehrzad F, Nekuei M, et al. Examining of Thallium in cigarette smokers. *Biological Trace Element Research*. 2018; 182(2):224-30. [DOI:10.1007/s12011-017-1107-y]
- [13] Ghaderi A, Afshari R. Alteration of abused drugs should be added to the medical curricula. *Future of Medical Education Journal*. 2016; 6(1):3-4. [DOI:10.22038/fmej.2016.6773]
- [14] United Nations Office on Drugs and Crime. World drug report 2016. Vienna: United Nations Office on Drugs and Crime; 2016.
- [15] Eskandarieh S, Hajebi A, Noroozi A, Haghdoost AA, Baneshi MR. Epidemiology of alcohol abuse in Iran. *Asia Pacific Journal of Medical Toxicology*. 2014; 3(1):22. [DOI:10.22038/apjmt.2014.2905]
- [16] Lankarani KB, Alavian SM, Peymani P. Health in the Islamic Republic of Iran, challenges and progresses. *Medical Journal of the Islamic Republic of Iran*. 2013; 27(1):42-9. [PMO CID] [PMID]
- [17] Lankarani KB, Afshari R. Alcohol consumption in Iran. *Lancet*. 2014; 384(9958): 1927-8. [DOI:10.1016/S0140-6736(14)62279-0]
- [18] Jalili M, Azizkhani R. Lead toxicity resulting from chronic ingestion of opium. *The Western Journal of Emergency Medicine*. 2009; 10(4):244-146. [PMID] [PMCID]
- [19] Questel F, Dugarin J, Dally S. Thallium-contaminated heroin. *Annals of Internal Medicine*. 1996; 124(6):616. [DOI:10.7326/0003-4819-124-6-199603150-00024] [PMID]
- [20] Afshari R, Mégarbane B, Zavar A. Thallium poisoning: One additional and unexpected risk of heroin abuse. *Clinical Toxicology*. 2012; 50(8):791-2. [DOI:10.3109/15563650.2012.713110] [PMID]
- [21] Salehi H, Sayadi A, Tashakori M, Yazdandoost R, Soltanpoor N, Sadeghi H, et al. Comparison of serum lead level in oral opium addicts with healthy control group. *Archives of Iranian Medicine*. 2009; 12(6): 555-8. [PMID]
- [22] Afshari R, Shafaeyan H, Afshari R. An epidemiologic study of opioid dependent subjects who were volunteered for opioid detoxification in Iran, 2005. *Clinical Toxicology*. 2006; 44(4):581-2.
- [23] Afshari R, Emadzadeh A. Case report on adulterated opium-induced severe lead toxicity. *Drug and Chemical Toxicology*. 2010; 33(1):48-9. [DOI:10.3109/01480540903127340] [PMID]

- [24] Khatibi-Moghadam H, Khadem-Rezaiyan M, Afshari R. Comparison of serum and urine lead levels in opium addicts with healthy control group. *Human & Experimental Toxicology*. 2016; 35(8):861-5. [DOI:10.1177/0960327115607947] [PMID]
- [25] Mostafazadeh B, Shadnia S, Tavakkoli MA, Vishteh HR. Evaluation of blood lead level in methamphetamine users in Tehran. *Substance Abuse Treatment, Prevention, and Policy*. 2017; 12(1):2. [DOI:10.1186/s13011-017-0088-3] [PMID] [PMCID]
- [26] Afshari R. Non-medical use of medications in middle and low income countries. *Asia Pacific Journal of Medical Toxicology*. 2014; 3(2):49.
- [27] Koushesh HR, Afshari R, Afshari R. A new illicit opioid dependence outbreak, evidence for a combination of opioids and steroids. *Drug and Chemical Toxicology*. 2009; 32(2):114-9. [DOI:10.1080/01480540802588485] [PMID]
- [28] Mokhtarifar A, Mozaffari H, Afshari R, Goshayeshi L, AkavanRezayat K, Ghaffar zadegan K, et al. Cholestasis and seizure due to lead toxicity: A case report. *Hepatitis Monthly*. 2013; 13(11):e12427. [DOI:10.5812/hepatmon.12427] [PMID] [PMCID]
- [29] Khosrojerdi H, Monzavi SM, Afshari R. Blood products used in exchange transfusion should also be screened for opioids. *Journal of the Pakistan Medical Association*. 2014; 64(3):363. [PMID]
- [30] Petersen PE. Tobacco and oral health-the role of the World Health Organization. *Oral Health and Preventive Dentistry*. 2003; 1(4):309-16. [PMID]
- [31] World Health Organization. WHO global report on trends in prevalence of tobacco smoking 2015. Geneva: World Health Organization; 2015.
- [32] Funck-Brentano C, Raphaël M, Lafontaine M, Arnould JP, Verstuyft C, Lebot M, et al. Effects of type of smoking (pipe, cigars or cigarettes) on biological indices of tobacco exposure and toxicity. *Lung Cancer*. 2006; 54(1):11-8. [DOI:10.1016/j.lungcan.2006.06.016] [PMID]
- [33] Sawa T, Ohshima H. Nitrate DNA damage in inflammation and its possible role in carcinogenesis. *Nitric Oxide*. 2006; 14(2):91-100. [DOI:10.1016/j.niox.2005.06.005] [PMID]
- [34] Pappas RS, Polzin GM, Zhang L, Watson CH, Paschal DC, Ashley DL. Cadmium, lead, and thallium in mainstream tobacco smoke particulate. *Food and Chemical Toxicology*. 2006; 44(5):714-23. [DOI:10.1016/j.fct.2005.10.004] [PMID]
- [35] Xiao T, Guha J, Boyle D, Liu CQ, Chen J. Environmental concerns related to high thallium levels in soils and thallium uptake by plants in southwest Guizhou, China. *Science of the Total Environment*. 2004; 318(1-3):223-44. [DOI:10.1016/S0048-9697(03)00448-0]
- [36] Navas-Acien A, Silbergeld EK, Sharrett AR, Calderon-Aranda E, Selvin E, Guallar E. Metals in urine and peripheral arterial disease. *Environmental Health Perspectives*. 2005; 113(2):164-9. [DOI:10.1289/ehp.7329] [PMID] [PMCID]
- [37] Skalnaya MG, Tinkov AA, Demidov VA, Serebryansky EP, Nikonorov AA, Skalny AV. Hair ultra-trace elements in relation to age and body mass index in adult women. *Journal of Elementology*. 2016; 21(1). [DOI:10.5601/jelem.2015.20.3.924]
- [38] Pourkhabbaz A, Pourkhabbaz H. Investigation of toxic metals in the tobacco of different Iranian cigarette brands and related health issues. *Iranian Journal of Basic Medical Sciences*. 2012; 15(1):636-644. [PMID] [PMCID]
- [39] Stolerman IP, Naylor CG, Mesdaghinia A, Morris HV. The duration of nicotine-induced attentional enhancement in the five-choice serial reaction time task: Lack of long-lasting cognitive improvement. *Behavioural Pharmacology*. 2009; 20(8):742-54. [DOI:10.1097/FBP.0b013e328333b290] [PMID]