

# THALLIUM POISONING :CLINICAL OBSERVATIONS THROUGH TWO OUTBREAKS IN BASRAH.

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## ABSTRACT

**Background:** Thallium is the most suitable agent for criminal poisoning of human being as it is tasteless and odorless. It usually associated with typical clinical features mainly dermatological and neurological manifestations.

**Objective:** To report an two outbreaks of thallium poisoning in Basrah.

**Patients and Methods:** This case descriptive study that was conducted in the Department of Dermatology -Basrah Teaching Hospital from January 2009 to February 2010 ,where a total of thirty two patients with thallium poisoning were enrolled in this study. At the first outbreak, 17 patients were seen at January 2009 due to ingestion of cake while 15 patients were seen at the second outbreak at February 2010 who were accidental ingestion of rat poisons. A detailed history was taken from all patients regarding all demographics points related to this poisoning. Full clinical examination was performed looking for skin manifestations in addition to other systemic involvement. Thallium in urine has been measured using the colorimetric method and was positive in all of them.

**Results:** Thirty two patients with thallium poisoning were evaluated. The first outbreak including 17 patients ,with 13 males and 4 females, their ages ranged from 11-33 years with a mean of 24 years , all those patients gave history of eating cakes laced with thallium. Whereas the second outbreak that including 15 patients , 8 males and 7 females, their ages ranged from 5-30 years with a mean 15 years ,all those patients gave history of accidental ingestion of rat poisons . Among both out breaks the dermatological findings were mainly anagen hair loss in diffuse and patchy pattern affected the scalp and limbs. Also dusky ecchymotic red dermatitis like rash was observed on the face especially perioral region and dorsum of hands and legs. Neurologic manifestations, mainly of peripheral neuropathy, reported in 50% patients of the second group while no one of the first group showed any of these finding.

**Conclusion:** Outbreak of thallium poisoning is now occurring in recurrent rate which may be lethal to human being as a result of accidental ingestion or for criminal purposes. It gives characteristic cutaneous, neurological and psychological features that can lead to the right diagnosis.

**Keywords:** Thallium poisoning ,Basrah patients, south of Iraq.

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## INTRODUCTION

Thallium is a heavy metal that has qualities of a perfect criminal poison. Its salts are tasteless, colorless and odorless, that dissolve completely in liquids, which are rapidly absorbed, and defy detection on routine toxicological screens. Thallium has been the agent of choice in several criminal poisonings<sup>(1-3)</sup>. According to Mulkey and Oehme (1993), thallium levels in normal human and animals are <1 ppb in blood and urine, and <10 ppb in tissues. Elimination half-life of thallium is long, due to its large distribution volume. The estimated half-life in humans is reported between 1-3 days after low doses and between 1-1.7 days under clinical therapy after ingestion or exposure by a possible lethal dose. Other groups have reported an elimination half-life between 8-30 days. Minimum lethal dose (LDL0) of thallium in humans is also highly variable. Average lethal dose for thallium sulfate has been reported to range from 10 -15 mg/kg<sup>(4)</sup>. Thallium poisonings are generally due to ingestion of the salts, but cases of inhalation of dusts or fumes from smelting, skin absorption and even from sniffing contaminated cocaine have been reported<sup>(5,6)</sup>. It is used in the manufacture of electronic components, optical lenses, semiconductor materials, alloys, gamma radiation detection equipment, imitation jewelry, artist's paints, low temperature thermometers, and green fireworks<sup>(5)</sup>. In some parts of the world it is still used for killing rodents and this may lead to inadvertent ingestion by humans<sup>(7)</sup>. Thallium poisoning is rare in Western societies. It has occasionally been the tool for murder<sup>(8)</sup>. In October 1988, five of seven members of a Florida family were poisoned with thallium, constituting the largest outbreak of acute thallium

poisoning in the United States since thallium was banned as a rodenticide in 1972<sup>(2)</sup>. An outbreak of thallium poisoning was reported in Baghdad in February 2008 where members of Iraqi Air Force Club and some of their children were poisoned by cake laced with thallium. Two of the children died<sup>(9)</sup>. Its toxic effect is due to its ability to inhibit a number of intracellular potassium-mediated processes and legends formation with protein sulfhydryl groups, inhibition of cellular respiration, interaction with riboflavin and riboflavin-based cofactors, and distribution of calcium homeostasis<sup>(1,4)</sup>. The diagnosis of thallium poisoning is not very easy and requires chemical analysis to confirm it. Emsley (1978) mentioned that a person in the UK poisoned eight people and two of them died<sup>(1)</sup>. Demonstration of the presence of thallium in urine is the best diagnostic procedure available<sup>(4)</sup>. Thallium remains a means of criminal poisoning and should be considered in any patient with a rapidly progressing peripheral neuropathy with or without alopecia<sup>(8)</sup>. Short-term exposure to thallium may induce hair loss, skin lesions, and damage to the nervous system<sup>(4,10,12,13)</sup>. The clinical features of short-term thallium intoxication include gastrointestinal symptoms of nausea, vomiting, stomatitis, and diarrhea, followed by severe painful dysesthesia and paraesthesia in the distal limbs, erythematous rashes in the cheeks and perioral region, and hyperkeratosis with loss of hair in sub acute stage<sup>(2,3)</sup>. In the long-term, complete hair loss and severe polyneuropathy have been noted. The severity of dermatological pictures is supposed to be related to the severity of thallium intoxication<sup>(13)</sup>. The combination of rapid, diffuse alopecia, with neurologic and gastrointestinal disturbance is pathognomonic for thallium toxicity. The

hair mount, showing a tapered or bayonet anagen hair with black pigmentation at the base, which may be highly diagnostic before the onset of alopecia<sup>(11)</sup>. The present work is designed to reporting two outbreaks of thallium poisoning in Basrah / south of Iraq.

## PATIENTS & METHODS

This case descriptive study that was conducted at the Department of Dermatology -Basrah Teaching Hospital from January 2009 to February 2010 ,where a total of thirty two patients with thallium poisoning were seen during two outbreaks, the first outbreak included 17 patients out of 32 who were seen at January 2009 while the second outbreak included 15 patients out of 32 who were seen at February 2010 . A detailed history was done regarding the following points : age , sex , mode of intake , patient's presenting complaints and time of onset. Full dermatological examination was performed looking for skin manifestation and other systemic involvement. Thallium in urine has been measured in the poisoning consultation center using the colorimetric method and was positive in all of patients. The ethical approval of the scientific committee of the local Scientific Council of Dermatology & Venereology-Iraqi Board for Medical Specializations, was taken.

## RESULTS

Thirty two patients with thallium poisoning were evaluated in two outbreaks. The first outbreak(group1) including 17 patients , 13 males and 4 females, their ages ranged from 11-33 years with a mean of 24 years , all those patients gave history of eating cakes laced with thallium. Whereas the second outbreak(group2) including 15

patients , 8 males and 7 females, whose ages ranged from 5-30 years with a mean of 15 years ,all those patients gave history of accidental ingestion of rat poison (Fig. 1) . All patients of the first outbreak were presented after the ingestion of cakes that laced with thallium where developed immediate onset sign and symptoms of thallium intoxication including: nausea , vomiting and diarrhea and within two weeks they developed skin manifestations mainly severe hair loss in diffuse and patchy forms of anagen type, affecting mainly scalp and body hair but with out any neurological manifestations. while in the second group all patients presented after accidental ingestion of rat poison where they developed sign and symptoms of thallium intoxication including :nausea , vomiting and diarrhea , followed in 50% of them by mental and peripheral neurological complaints and within two weeks all patient of this group developed skin manifestations mainly severe hair loss in diffuse and patchy forms of anagen type , affecting mainly scalp and body hair. Clinical findings including dermatological data were as follow :

Anagen hair loss that was obvious in all the patients of both groups (Fig 2), it was started in the second and third week , as diffuse or patchy hair loss involving mainly the scalp and the lower limbs. The affected hair was either broken at the surface of the skin in black dots like patterns or diffusely lost, presenting as diffuse hair thinning or as a remarkable total alopecia .The remaining hairs at the affected area were easily plucked and they were in typical anagen phase. Microscopically the roots were pigmented having anagen features. While erythematous lesions appeared in all patients in the first week, presenting as a dermatitis-like picture with ecchymotic

dusky red color that covered the face especially around the mouth and the limbs mainly the dorsa of both hands simulating horse shoe appearance and that of zinc deficiency or pellagra like (Fig.3,4) . Acneiform rash of the face was also presented in two patients. The neurological findings were observed in 50% of patients of the second group as peripheral neuropathy with marked leg and foot tenderness and paraesthesia which developed within 2 to 4 days of thallium intoxication. Muscular weakness was noted in most of those patients especially of the lower limbs , with variable severity. Psychiatric findings were seen in 10% of patients of the second group mainly in a form of personality changes, depression and apathy while others presented with anxiety and acute agitation. All patients were given 5mg/kg(t.d.s) oral zinc sulfate as they were considered cases of zinc deficiency before the definite diagnosis of thallium poisoning was established. Surprisingly 30 out of 32 cases improved markedly within few days especially regarding the horse shoe like rash on the dorsa of their hands, alopecia and neuromuscular involvement .The patients were kept on this treatment for two weeks with no relapse was reported after that, whereas the remaining two cases of the second group who presented later with severe neurological symptoms and in spite of the dramatic response to the oral zinc sulfate regarding their dermatological symptoms , and after establishing the diagnosis they received adjuvant activated charcoal and Prussian blue, those two patients deteriorated and died due to respiratory failure.

## DISCUSSION

The International Program on Chemical Safety (IPCS) of the World Health

Organization (1996) has produced a detailed Environmental Health Criteria Monograph on thallium. The monograph concluded that in the general population, the total intake of thallium has been estimated to be less than 5 microgram per day, mostly from foodstuffs, and that this does not constitute a threat to health<sup>(1)</sup> Thallium is commonly used in Iraq as rat poison but the medical literatures was lacking of any recording of sporadic cases or outbreak poisoning. Most recently as a result of occupation and war , thallium was used as a chemical poison for mass killing mainly for political reasons as in February 2008 outbreak of thallium poisoning occurred mainly among members of Iraqi air force club where some of their children were poisoned by cake laced with thallium and two of the children died<sup>(9)</sup> Thereafter followed by a sequences of twenty two cases who were seen by the poisoning consultation center, medical city teaching hospital where five cases were evaluated by *Sharquie et al*(outbreak of Thallium poisoning Among Iraqi Patients ,unpublished paper ) , the skin and neurological finding were the dominant pictures<sup>(14)</sup>. In our study two outbreaks of the poisoning were reported at 2009 and 2010 showed that the skin manifestations were very characteristic of thallium poisoning, especially the severe anagen alopecia and dermatitis like pictures .These features had been similarly reported by other studies<sup>(14)</sup> and are so characteristic that can lead into right diagnosis. Other diagnoses that might be mistaken with thallium poisoning are acquired zinc deficiency, pellagra and erythema multiforme<sup>(14)</sup>. The similarities of skin and hair manifestations between thallium poisoning and that of pellagra and/or zinc deficiency, with dramatic improvement of all cases after treatment with oral zinc

sulfate, raise a question if thallium poisoning interact in away or another with zinc or niacin metabolism , so causing their deficiency ,resulting in clinical features simulating that of these elements deficiency. These possibilities may explain why zinc supplements is helpful in the treatment of those with thallium poisoning , so that these points should be considered in any further studies. On the other hands the dramatic improvement of all cases after treatment with oral zinc sulfate necessitate further studies to identifying the mechanism of it's action including animal study that is strongly recommended. As thallium is tasteless and colorless so it can be used as chemical weapons especially when it is freely available in the market as rat poisoning. So thallium poisoning seems to appear more in wars and in a bad political and security

situations like what is happening in Iraq, after 2003. So any patient with sudden onset of hair fall of anagen type with skin and neurological problems that appear as acute state should be diagnosed thallium poisoning unless proved otherwise. Accordingly thallium as rat poisoning should be considered as chemical weapons and should be banned as rodenticide from markets.

In conclusion Outbreak of thallium poisoning is now occurring in recurrent rate in Iraq which may be lethal to human being as a result of accidental ingestion or for criminal purposes.It gives a characteristic skin and hair manifestation that are very helpful for diagnosis. So thallium should be banned as a rodenticide and its better to let rats run free than to kill human beings.

## Figures



Fig (1): Rat poison.



Fig.(2) : The hair of the scalp from thallium poisoning.



**Fig.(3): Showing patient with dermatitis like picture on the dorsa of both hands.**



Fig.(4):Showingpatient with dermatitis like picture on the face mainly perioral anddermatitis like picture on the dorsa of both hands.

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## التسمم بالثاليوم: ملاحظات سريرية من خلال نوبتا تفشي في البصرة

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### ملخص البحث

#### الهدف:

إعداد تقرير عن حالة تفشي التسمم بالثاليوم في البصرة.

#### المرضى والطرائق:

أجريت هذه الدراسة في قسم الأمراض الجلدية والزهرية في مستشفى البصرة التعليمي للفترة من كانون الثاني ٢٠٠٩ إلى شباط ٢٠١٠ حيث تم تسجيل ٣٢ إصابة بالتسمم بالثاليوم وبعد إجراء فحص الثاليوم في البول كانت النتائج موجبة لجميع المرضى. حيث تم تسجيل تاريخ المرض مع الأخذ بالاعتبار عمر المرضى والجنس وطريقة دخول الثاليوم للجسم والأعراض السريرية وقت الإصابة وتاريخها مع فحص سريري دقيق للجلد وأي حالة انهماك لأجهزة الجسم الأخرى.

#### النتائج:

المرضى السبعة عشر خلال ٢٠٠٩ كان ١٣ منهم ذكور و ٤ إناث وتتراوح أعمارهم من ١١-٣٣ سنة وبمتوسط ٢٤ سنة وكان وصول الثاليوم للجسم في هؤلاء المرضى عن طريق أكل الكيك الملوث بالثاليوم ، في حين المرضى الخمسة عشر خلال ٢٠١٠ كان ٨ منهم ذكور و ٧ إناث وتتراوح أعمارهم من ٥-٣٠ سنة وبمتوسط ١٥ سنة وكان وصول الثاليوم للجسم في هؤلاء المرضى عن طريق أكل سم الفأران عن طريق الخطأ. في كلا الفترتين كانت الأعراض الجلدية بشكل رئيسي هي تساقط الشعر في طور التنامي وبشدة متباينة واسعة الانتشار او مرقعة في فروه الرأس وشعر الأطراف مع كدمات حمرة قاتمة في الوجه خصوصا حول الفتحات واليدين والساق تشبه لالتهاب الجلد. أما الأعراض العصبية فمعظمها التهاب الأعصاب المحيطية مع وهن عضلي فقط حيث سجلت عند ٥٠% من مرضى المجموعه الثانيه .

#### الاستنتاج:

تفشي حالة التسمم بالثاليوم تحدث الآن بصورة متكرر قد تكون مميتة للإنسان بسبب التناول العرضي او عن طريق أسباب اجراميه، والحالات المرضية لها خواص جلدية وعصبية ونفسية مرضية يمكن أن تؤدي إلى التشخيص الصحيح.

مفتاح الكلمات: تفشي التسمم بالثاليوم، مرضى البصرة، جنوب العراق.

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