

Lead Poisoning in the World and Iran

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Abstract

Lead is a relatively ubiquitous heavy metal with particular features such as resistance to corrosion, high malleability and wide variety of industrial applications. In medicine, however, it is considered as a slow-acting toxic substance affecting multiple body systems, specifically functioning as a potent neurotoxin in the central nervous system. Lead poisoning may be acute or chronic and can be due to occupational or environmental exposures. The history of lead poisoning dates back to ancient times. The present paper briefly describes the worldwide historical accounts of lead poisoning with a special focus on Iran.

Keywords: Lead poisoning; History of medicine; Iran

Introduction

Lead is among the oldest known metals with wide applications since ancient times and was common in human environment for over 5000 years.¹ For instance; Egyptians refined and used it around 3000 BC.² The symbol of Pb used to designate this element in chemistry originates from its Latin equivalent, “*plumbum*.”³ Nonetheless, the term “lead” is an old English word originating from German.⁴

Lead poisoning (or plumbism) is a well-documented entity in the history of medicine. Lead poisoning seems to be one of the earliest known occupational diseases mostly related to Greco-Roman cultures in antiquity.⁵ Up to the mid-19th century, the clinical picture of lead poisoning was broadly described in the medical literature. For instance, in 1848, a treatise entitled “Lead Diseases” was published in which the symptoms of lead intoxication including “lead colic” were fully discussed.⁶

Acute lead poisoning usually presents

as gastroenteritis in adults and encephalopathy in children. The chronic cases, however present with anemia, constipation, colicky abdominal pain, paralysis with wrist drop, gout, black discoloration of the gums (lead line), interstitial nephritis, convulsion and even coma.⁷

Despite the gradual progress of our knowledge about lead poisoning, the exact mechanism of intoxication is not still completely understood, although several enzymes are thought to be the primary targets of lead.⁸ Usually, blood lead levels <3 µg/dL are considered safe; values ≥10 µg/dL are treated as abnormal.⁹ Trace amounts of lead are available in foods, water and soil¹⁰ and lead can be absorbed through the intestine, lung and skin.²

The global history of lead exposure

The first physician who described the symptoms of abdominal colic in metal workers was the well-known Greek physician, Hippocrates (500 BC).¹¹ It is thought

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that in ancient times, many artisans working with lead probably developed the signs of lead toxicity.¹² Then, in Rome and Pompeii, lead pipes were used as a conduit for the transfer of water in a vast piping network and that would be a major potential source of lead exposure and poisoning in people consuming that water.¹³ Another potential source of lead poisoning was the lead-lined containers and pots which were mainly used for the preservation and sweetening of wine. That would also result in the toxicity presented as paroxysmal abdominal colicky pains (lead colic)—a symptom which had been described in the medical literature many years before its exact etiology became evident. From the ancient Roman Empire up to the 18th century, a widespread deadly disease known as “*colica Pictonum*” or “*colic Poitou*” presented with severe abdominal colic followed by paralysis and other nervous system dysfunctions was reported. The etiology of this disease remained unclear until the 17th century when medical investigators found that the disease was due to ingestion of lead treated wines. In 1697, Eberhard Gockel, the city physician of Ulm, Germany, correctly described this association.¹⁴

Afterwards, an English physician, George Baker (1722–1809) explained the cause of unexplained deaths from “Devonshire colic” in England. He showed that drinking apple cider (also known as soft or sweet cider) prepared in lead-lined containers was the source of poisoning in the victims.

In the ancient world including China, Egypt and Iran, leaded cosmetic products had been used. For instance, Egyptian women used lead sulfide to make their eyelids black as a cosmetic or perhaps for magic purposes.¹⁵

Lead has been connected with daily human activities for several thousand

years.¹⁶ Lead pigments were available in paints and used in lead-glazed potteries and ceramic manufacturing. Therefore, painters are potentially exposed to develop lead poisoning. More recently, the cases of lead colic in painters are also known as painter’s colic and those presented with central nervous system involvement are called chronic painters’ syndrome.¹⁷ In the 17th century, the Italian physician, Bernardino Ramazzini (1633–1714), known as the father of occupational diseases, for the first time studied systematically the work-related disorders including lead poisoning and wrote a comprehensive book entitled “*Diseases of Workers*.”¹⁸

After the Industrial Revolution from the 18th to 19th century, the likelihood of environmental or occupational lead exposure increased tremendously, especially in developing countries where no limiting regulations on lead exposure and no protective health measures exist, the chance of greater exposure to lead became higher than developed countries. Lead and its derivatives have been widely used in plumbing pipes, acid batteries, bullets, glass manufacturing, high voltage power cables, hot metal typesetting, pesticides manufacturing, pipe for sewerage system, color pencils, paints, ceramic glazing, shielding from ionizing radiation, leaded gasoline (tetraethyl lead is added to gasoline as an anti-knock in cars’ engines), *etc.*^{2,3,19} With advancement of industrial process, the possibility of lead exposure and environmental contamination with lead increased and therefore, the healthcare authorities and physicians warned against the hazardous effects of lead exposure. Dr. Alice Hamilton (1869–1970), the first woman professor at Harvard University, was a pioneer and influential expert who mainly focused on work-related diseases including occupational lead poisoning. She was the most important critic of leaded petrol

at the “Tetraethyl Lead Conference” held in 1925 in Washington.²⁰

Rules and regulations on occupational lead exposure were imposed between 1890 and 1900 in England. This happened in the US in the 20th century, although federal regulations did not come to action until 1970s.²¹

As Eldridge pointed out, by the middle of the 1920s, the American Painters’ Union tried to eliminate lead from their working environment.²² One of the major public health achievements in the US in the 20th century was the removal of leaded gasoline.²³

Yet lead is widely used in as many as 900 industries¹⁰ and despite the implementation of the protective measures in developed countries, as Landrigan and Todd said, lead poisoning was “the most common disease of toxic environmental origin in the USA” in 1994.²⁴

The history of lead and lead exposure in Iran

The history of metal extraction and refining in Iran dates back to 5000 years ago.²⁵ Figure 1 shows a metal pot for smelting metals belongs to the Achaemenids Period around 2500 years ago which is found in Persepolis (*Takht-e Jamshid*) near Shiraz, Iran.

The renowned Iranian physicians, Haly Abbas (Ali ibn Abbas Majusi Ahvazi; 10th century CE), Rhazes (Mohammad Zakariya Razi; 865–952 CE) and Avicenna (Pour Sina; 980–1037 CE) knew the concept of lead poisoning.

Rhazes in his book on alchemy, “Secret of Secrets” (*Ser-ol-Asrar*) described metals smelting process including lead.²⁶ According to Samuel L. Dana in his book “Lead Diseases” published in 1848, “Rhazes and Haly Abbas well knew the effects of lead preparations on the system, and their remarks apply well to lead colic.” He then

added that “Avicenna has given a lengthened description of lead colic, adding to all which was known to preceding writers, his own accurate observations and defining lead colic and its varieties with a clearness and force which ought to have made this disease better known in that age.” He also pointed out that “Avicenna described fatal epilepsy in lead colic.”⁶ Furthermore, it is said that Avicenna has described lead colic in painters²⁷ and in the second book of “Canon of Medicine” (*Mofradat* or Simple Drugs) has mentioned the antidotes to impure lead oxide.²⁸

Iranians were familiar with lead from ancient times. They used lead products for different purposes including facial powder (the white lead), and the red lead for painting and traditional tile brick glazing. The colorful glazed brick relief tiles used in Persepolis palace in Fars province and Susa (*Shush*) in southern Iran during the Achaemenids dynasty almost 2500 years ago (Fig. 2) and later, in the Iranian traditional tile making, the application of red lead for glazing continued because of its exquisite bright orange-red color.²⁹



Figure 1: A metal pot for smelting metals belongs to 2500 years ago, Achaemenids period (Persepolis Museum, Shiraz, Iran)



Figure 2: The tile art on a wall belonging to Achaemenid period, 2500 years ago, showing two Persian soldiers (Susa, Khuzestan province, southwestern Iran).

Iranian painters also used red and white lead in their paintings for a long period; this continued at least until the 17th century.³⁰ The white lead was made of lead treated with vinegar as described by the great Iranian scholar, Abu Rayhan Biruni (973–ca 1050 CE) in his book—*Sydaneh*, meaning pharmacy. He used the term *Sefidaj* (later known as *Sepidak* or *Sefidab* meaning “white solution”) for white lead (lead carbonate) and the word *Soranj* for red lead (Pb_2O_3).³¹ *Sefidab* (white lead) was widely used as a cosmetic facial powder by Iranian women in the 19th century, despite its potential toxic effects.³²

A book entitled *Marefat-o-Somoum* (Knowledge of toxins), written in Persian by Dr. Mirza Abdul Hossein Khan Sartip (*Rokn-ol-Hokama*) published in 1895 in 175 pages (Fig. 3), contained the topics

of acute and chronic lead poisoning and their therapeutic modalities.³³ In his book, *Rokn-ol-Hokama* addressed the opinions about treatment of lead toxicity of two European physicians—an Austrian physician, Dr. Jacob Eduard Polak (1820–1891), the first medical teacher of modern medicine at *Dar-ol-Fonun* School founded in 1851, and a Dutch physician, Dr. Johan Louis Schlimmer (1819–1881), another medical teacher at *Dar-ol-Fonun*.³⁴

Like many other developing countries, many industries in Iran including the mining industry had not been managed in a modern way until the 1930s. Therefore, the miners were exposed to many occupational diseases. For instance, in 1934, an European traveler named Gabriela, came to Iran and described the poor conditions of lead mine workers in Anarak near Yazd in central part of Iran and explained how they died in pain of chronic lead poisoning.²⁹

The activity pertaining to the safety of workers and the occupational health standards has been started in Iran with a marked delay from 1946, after which time some rules and regulations were approved and the Labor Inquiry General Administration (*Edarey-e Koll Bazrasi-e Kar*) became in charge of the safety measures at work and the health of workers. In 1984, the Ministry of Health (*Vezart-e Behdari*) took this duty over; the agenda was revised in 1991 and the Ministry of Health and Medical Education became the responsible body for the occupational and industrial health.³⁵

Nowadays, the main source of environmental lead contamination, especially in large crowded Iranian cities such as Tehran, Mashhad, Shiraz, Isfahan and Tabriz is cars. Painters and the traditional tile workers are potentially at risk of lead poisoning.³⁶ In the past two decades, cases of lead exposures have been reported

سُورِب

علاج در سمومیت خادّه مشربا الطای و
 البومنی و شربند هندا که خوانی سم سببیش نشو انکه کون
 ان مرفین بتحت حمله بودارند معده و با تا لیه شویند
 و صد کیمیا نتر سولفات و پتاس و سولفات
 دو سو و سولفات در مینر است زیرا که اسید لفور
 موجود در این املاح با سرب مرکب شده جسم غیر محلول
 بوجود آورند :

و در این سمومیتها کوکر دینر مسجل اند اگر ایند کوزا
 موجود نباشند نین مخلوط با آب مجسمه بخوراند و در صورتیکه
 از اسهال املاح مذکوره قبل اسهال ارض نشد و رض
 کوچک بد هندا (دکتر مهنر) :

بعقیده دکتروپولاک بهترین مقیسات در این موسولفات
 دوز نک است زیرا که اگر قه هم نیاید از ترکیب جوهر کوکر
 موجود در آن با سرب ملج به ضرر بوجود آید :

مقاله دوم

۱۲۲ و تهوع و از روعهای مجربتی و به حته بعضه مواضع بدنه
 و صداع جبهه شدید یاد دار و هندان و احسا الشیخا که
 و جو خاسر هندان ظاهر کردی و این حالات انفلا بعد
 از بیخ و شش سمانه بی نوم غرق میشو و هم در این هنگام
 ممکن است که مثل عطفه زده سموز اهلانک توکر دست
 دهد و نیز در اکثر اشخاص کشته و فلج غار ارض عضلات
 شده و در برخی حالات صغر بروز نمود و هم بتدریج این
 مستموم بعضه خوانی بتجکانه را مثلا نمود موجب کردی و
 کوپرس سرب الزوال میکرد این علامت حیا کانه با جمع
 بفاصله کما مختلفه رضع و تجدد شده فاصله هر نوبت
 چند ماه و گاه چندین سال بوده و در بعضه استسقا و
 البومنی چون بو غار ارض شد از اجماع این علامت مشعو
 ناریک و بند بیج بهلاک منتهی شو چون مرگ بزود
 دترسد میشو که از اثر معانتهی شیفاشو :

Figure 3: Pages of Marefat-o-Somoum (Knowledge of toxins) describing treatment of lead toxicity. The text is in Persian and authored by Dr. Mirza Abdul Hossein Khan Sartip (Rokn-ol-Hokama) in 1895.

among the opium addicts.³⁷ One recent study reported that some opium samples were contaminated by 1.88 ppm of lead. The authors believed that the lead was probably added to the opium to increase its weight to gain more profit.³⁸ Another study showed that opium addicts had a higher mean blood lead level than a control non-addict group.³⁹

Lead and lead toxicity have come side by side of human through the history. It seems that the best way we can keep ourselves away from this disease is to use preventive measures. The primary prevention strategies recommended for control of lead poisoning include identification of environmental lead and its elimination

as well as continuous monitoring of lead exposures and their resultant health hazards.⁴⁰

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Winged bull made of glazed bricks with tile work in King Dariush palace in Susa, southwestern Iran. Lead toxicity is not uncommon in tile workers. (See page 81)