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IM - PHYSICAL EXAMINATION

Keep an eye on the pupil: developing countries under chemical attack

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Case report

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A 32-year-old man presented late in the night at the emergency department (ED) of our hospital for diarrhea, excessive salivation, and muscle weakness. The patient was an active, highly educated business man. The patient was doing fine till the previous afternoon when he consumed khat with some friends and relatives. He reported to be being a "weekend khat consumer". The patient's relatives suggested that the symptoms could be explained by the fact that he was not a regular khat consumer, and/or that he could have bought a bad quality of khat. Therefore, they asked for a prompt discharge from the ED. Physical examination revealed mild bradycardia (52 beats per minute), blood pressure 140/85 mmHg, temperature 36.5°C, respiratory rate 25 breaths per minute and oxygen saturation 98% while breathing air. The lung and heart examinations were unremarkable. However, the ED physician noticed that there was a pinpoint miosis. Khat (chatha edulis) contains amphetamine-like compounds (cathinone and cathine), and it is commonly consumed as fresh, unwashed, leaves in Yemen and the Horn of Africa. The ED emergency physician contacted an ophthalmologist who postulated that miosis could be related to some kind of associated intoxication. This led to the ED emergency physician to hypothesize that the symptoms and signs of the patient could be related to an acute case of organophosphate poisoning, pesticides used in khat cultivation. The patient was treated with atropine, and the next day, he was discharged free from all symptoms.

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The patient's eye findings made the physician suspicious because miosis after the assumption of a sympathomimetic agent is absolutely completely unexpected. The chewing of khat leaves indeed releases chemicals structurally related to amphetamine (2–10 folds times less active than amphetamine), which gives the chewer a mild excitation that some say is comparable with drinking strong coffee. The pharmacological effect of khat chewing is mainly because of the cathinone, an indirectly acting sympathomimetic alkaloid having catecholamine-releasing properties at both central dopaminergic and serotonergic synapses as well as at peripheral noradrenaline storage sites [1]. Khat chewers report euphoric and energetic energy effects and an increase of alertness after an hour of consumption. Acute toxic effects of khat are tachycardia, increased blood pressure, insomnia, constipation, urinary retention, paranoid psychosis, hypomanic illness with grandiose delusions. Khat, also known as qaat and jaad in Somalia, and chat in Ethiopia, is largely consumed as fresh leaves and young shoots in South West Arabia and in the Horn of Africa where the khat plant is widely cultivated [2]. Khat chewing, which is deep-rooted in the Yemeni society too, has a lifetime prevalence grown up to over 80% in men, which but is also growing also in females women (up to

50%), and in children under the age of 12 years (15–20%). Khat is usually consumed during a social gathering and within the family while smoking cigarettes and drinking tea and soft drinks [3, 4]. Between 1970 and 2000, owing to the increase of khat consumption, the area devoted to khat cultivation increased from 8,000 to 103,000 ha in Yemen. Nearly 60% of the land cultivated for cash crops is now devoted to khat, growing and up to 30% of Yemen's ground water goes into khat irrigation [4]. Therefore, Khat also distorts an already fragile economy with farmers ripping out fruit trees and coffee plants to replace them with the more lucrative crop [4]. The abuse of organophosphate (OP) pesticides to increase khat production may add further problems. Because khat is consumed as fresh, unwashed leaves, OP pesticides may be absorbed as well, as it happened to the patient in the case report. From the initial OP broad-spectrum insecticides, acting as reversible acetylcholine esterase (AChE) inhibitors, evolved were developed the irreversible AChE inhibitors used as combat agents in the Second World War (tabun, sarin). Clinical consequences of OP poisoning are related with to the extent of AChE inhibition and consequent accumulation of ACh at the neuroeffector junctions. Stimulation at muscarinic and nicotinic sites causes bradycardia, hypotension with hemodynamic collapse, muscle weakness, enhanced activity of different secretory glands leading to excessive salivation, lacrimation, bronchorrhea, diarrhea, and sweating; enhanced smooth muscle activity resulting in increased peristalsis, bronchial constriction and especially miosis [5]. The diagnosis of acute OP poisoning is primarily based on the history of exposure and on physical examination, the role of the laboratory being merely being confirmative. The simple objective scale proposed by Senanayake et al. [6] to assess the severity of poisoning is indeed based on the five common clinical parameters each assessed on a 3-point scale ranging from 0 to 2 points:

- miosis: >2 mm [0]; <2 mm [1]; pinpoint [2]
- fasciculation: none [0]; present but either generalized or continuous [1]; generalized and continuous [2]
- ventilatory frequency: <20 bpm [0]; >20 bpm [1], >20 bpm with central cyanosis [2]
- heart rate: >60 bpm [0]; 41–60 bpm [1]; <40 bpm [2]
- level of consciousness: conscious and rational [0]; impaired response to verbal commands [1]; no response to verbal commands [2].

It is noteworthy that this scale does not require cooperation from the patient and can also be used also in children. In particular, the presence of miosis is emphasized as being considered a pathognomonic sign for OP intoxication after the sarin terrorist attack in Tokyo in 1995 [7].

Although poisoning exposure in developed countries is mostly associated with drugs, alcohol and household chemicals, the common causal agents in developing countries are agrochemicals [8, 9]. Of the poisoning agents involved, pesticides cause the highest fatality rate, because of the wide use of the highly toxic OP compounds [10, 11]. Developing countries are, thus, under chemical attack. Regulations are being implemented in different developing countries to reduce the number of deaths, the majority from self-poisoning, by limiting the availability and the use of highly toxic pesticides. However, a closer inspection of pesticide-induced deaths revealed that there had been switching over to other highly toxic pesticides, as one was banned and replaced in agricultural practice by another [12].

The fact that khat is not considered by the World Health Organization (WHO) to be a "seriously addictive drug", does not mean that its consumption is without physiological, and psychological effects with social and economical repercussions [4]. It is not surprising that there is a growing consensus in Yemeni society that something needs to be changed and that khat chewing is to be stigmatized in the same way that cigarette smoking has been stigmatized elsewhere.

Conflict of interest statement The authors declare that they have no conflict of interest related to the publication of this manuscript.

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