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Exertional Heat Stroke and Doping: What About Soldiers? A Case Report of Amphetamine Use

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Abstract

Introduction: Exertional heat stroke is a pathology well known to military doctors because it is not uncommon for our soldiers to regularly make intense efforts in difficult training or operational missions. Idiopathic etiology and genetics are by far the most described. We report for the first time a case of exertional heat stroke secondary to amphetamine use in the military environment and here, let's raise the issue of ethics in the Army.

Case Presentation: A young parachutist soldier presented an episode of general convulsions complicating an exertional heat stroke during an 8 km race in battledress and combat boots. After further investigations, laboratory results found amphetamine in the urine. Even if the soldier only allowed branched chain amino acids (BCAAs) supplements, this exertional heat stroke was due to amphetamine use. After a review of the physiopathological effects of amphetamine, we will recall the various means of screening with their limits. Many of our soldiers consume dietary supplements to be able to better endure the constraints to which they are exposed in internship or operations.

Conclusions: Doping, willingly or not, is a reality in our Army, even though we still struggle to understand it. Health and command chains must be vigilant to these lines to preserve the health of our military on the one hand and enforce a code of ethics on the other.

Keywords: Exertional Heat Stroke, Doping, Military Medicine, Operational Preparation

1. Introduction

The difficult training of our soldiers is a sine qua non-condition for them to be fully operational when they are projected on the mission. Exertional heat stroke is a pathology well known to military doctors, as it often happens in moments of high physical intensity in a preferential environment. If the last years made it possible to highlight predisposing genetic factors, it should not be forgotten that the first exercise heat stroke was favored by doping. At a time when sporting results are tainted daily with doping revelations, we report for the first time a case of exertional heat stroke secondary to amphetamine use in the military environment.

2. Case Presentation

A 22-year-old soldier with no past medical history suffering from 'malaise' while running in an 8 km race in battledress and combat boots. The young soldier presented with disorders of consciousness (Glasgow coma scale 7 out of 15 (eyes = 1; verbal = 2; motor = 4)) and an unstable hemodynamic state (heart rate (HR) = 165 beats per minute (bpm), blood pressure (BP) = 86/48 mmHg) in a context of hyperthermia (core temperature 40.2°C) and in the absence of hypoglycemia (8.2 mmol/L). Interrogation of his comrades revealed that the patient had visual hallucinations before staggering and collapsing a few meters from the finish line. Suspecting exertional heat stroke (EHS), the patient was completely undressed, cooled by placing cold packs at the major vascular axes (axillary troughs and inguinal folds), and received a vascular filling with 1000 mL of cold isotonic saline serum at 4°C. A few minutes later, an episode of general convulsions occurred. The administration of 1 milligram (mg) of clonazepam caused the epileptic seizure to stop. On arrival at the hospital, 45 minutes after the beginning

of the care, the patient was aware, with a stabilized hemodynamic state (HR = 112 bpm, BP = 110/77 mmHg), and his core temperature lowered to 38.8°C. The initial biological assessment showed rhabdomyolysis (creatine phosphokinase = 6500 IU/L) without alteration of renal function and a cytolysis five times the normal upper limit. Urine analysis showed the presence of amphetamines. An electrocardiogram showed isolated sinus tachycardia without signs of myocardial infarction. The biological anomalies were normalized within a few days, and the patient was discharged after 48 hours of hospitalization.

3. Discussion

In our armed forces, the incidence of EHS has been on a continuous downward trend since 2004 (1), notably as a result of several actions implemented by the French Army Health Service (FAHS) at different levels (epidemiological compendium, systematic follow-up, exploration of all incidences of EHS, and specific training for all unit doctors). If we identify new predisposing factors to EHS, we must not lose sight of those already known for several decades. Amphetamine, a group leader of several molecules, mainly used today for recreational purposes, is also used for doping because of its ability to dispel the feeling of fatigue. A review of the literature on this subject shows several cases of EHS associated with amphetamine use (2-5), the most famous being that of cyclist Tom Simpson during the Tour de France at Mount Ventoux in 1967. Amphetamine has a stimulating effect on the dopaminergic and noradrenergic systems and causes the release of high concentrations of dopamine (DA) and norepinephrine (NE) at the synaptic level. Hyperthermia is one of the many effects generated by stimulating these catecholaminergic pathways. To lower the core body temperature, the feedback triggered by the hypothalamic thermostat is inhibited by amphetamines that block physiologically loaded pre-synaptic channels to recover dopamine (DA) and norepinephrine (NE) at the synapse. The synaptic concentration of neuromediators is thus continuously increased and leads to malignant hyperthermia, which is responsible for multiple organ dysfunctions. In 1974, Borbely et al. (6) showed that amphetamine-induced hyperthermia also depends on the environmental stimulation of peripheral beta receptors.

The race conditions of our soldiers (heat, humidity, clothing with little breathability, often defective hydration) are indeed already well known. The side effects of taking amphetamine last between three and six hours, and the plasma half-life of amphetamine averages 8 to 13 hours but varies with urinary pH and can be up to 36 hours (7). In our case, the environmental conditions were met to favor an EHS with cloudy, warm, and humid weather. Nevertheless, this soldier was the only one to do an EHS. He had no history of EHS nor prohibited substance use. The young soldier denied using amphetamines but recognized the use of "branched chained amino acid (BCAA)" food supplements containing essential amino acids (valine, leucine, and isoleucine), which are supposed to optimize recovery, strengthen muscle tissue, and improve resistance to effort. Although it is very difficult to evaluate the practice of doping in our units (8), taking dietary supplements is common (9). It is not unusual to find anabolic steroids or amphetamine derivatives in these substances without the consumer's knowledge.

In this case, a blood test for amphetamines was not performed during the initial management, and the dietary supplement was not tested to know if it actually contained amphetamines. Blood testing for amphetamines can only be done for up to 12 hours, unlike urine screening, which can be positive up to four days later. Urinary testing, which has excellent fiability (sensitivity, specificity, positive and negative predictive values), seems to be the most appropriate means of screening our population, who would be able to administer these substances the day before or the day of the test. Today's army is professional, and for every test, the soldier must be the best to be eligible for a new qualification, mission, or assignment. It is, therefore, not surprising to find doping behavior in our military. These attitudes are disturbing and must be made known to all. The health chain must be informed to carry out preventive work, especially for young recruits, set up regular screening tests, and learn about the specificity of organic and psychiatric pathologies secondary to the use of prohibited substances. The chain of command must also be made aware of these practices to inform its men about the impact that a positive drug test would have on their military career and to be able to carry out unannounced screening before or immediately following physical or psychological tests. Professional sports are tainted by daily revelations of doping, and our army is, to a lesser extent, equally affected by this problem. Therefore, all factors of the FAHS must be vigilant in the face of this problem.

The views expressed in this article are the author's own and should not be considered the official point of view of the French Armed Forces Health Service.

Footnotes

Authors' Contribution: N. C. (assistant doctor at that time) and E. D. P. treated the patient during the prehospital phase. G. C. treated the patient during the in-hospital phase. N. C. and K. B. drafted the case report. C. D. and G. R. made a critical revision of the article. N. C., G. C., and G. R. approved the final version to be published.

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References

1. Bourdon L. [Editorial]. *Médecine et armées*. 2012;**40**(3):197–200. French.
2. Jordan SC, Hampson F. Amphetamine poisoning associated with hyperpyrexia. *Br Med J*. 2012;**2**(5202):844. [PubMed ID: 14407884]. [PubMed Central ID: PMC2097773]. https://doi.org/10.1136/bmj.2.5202.844.
3. Watson JD, Ferguson C, Hinds CJ, Skinner R, Coakley JH. Exertional heat stroke induced by amphetamine analogues. Does dantrolene have a place? *Anaesthesia*. 1993;**48**(12):1057–60. [PubMed ID: 7904429]. https://doi.org/10.1111/j.1365-2044.1993.tb07526.x.
4. Henry JA, Jeffreys KJ, Dawling S. Toxicity and deaths from 3,4-methylenedioxymethamphetamine ("ecstasy"). *Lancet*. 1992;**340**(8816):384–7. [PubMed ID: 1353554]. https://doi.org/10.1016/0140-6736(92)91469-o.
5. Simpson DL, Rumack BH. Methylenedioxyamphetamine. Clinical description of overdose, death, and review of pharmacology. *Arch Intern Med*. 1981;**141**(11):1507–9. [PubMed ID: 7283563]. https://doi.org/10.1001/archinte.141.11.1507.
6. Borbely AA, Baumann IR, Waser PG. Amphetamine and thermoregulation: studies in the unrestrained and curarized rat. *Naunyn Schmiedebergs Arch Pharmacol*. 1974;**281**(4):327–40. [PubMed ID: 4151425]. https://doi.org/10.1007/BF00499429.
7. Ghysel MH. Amphetamines. In: Kintz P, editor. *Forensic toxicology and pharmacology*. Elsevier: Amsterdam, The Netherlands; 2004.
8. Friedl KE. U.S. Army Research on Pharmacological Enhancement of Soldier Performance: Stimulants, Anabolic Hormones, and Blood Doping. *J Strength Cond Res*. 2015;**29 Suppl 11**:S71–6. [PubMed ID: 26506202]. https://doi.org/10.1519/JSC.0000000000001027.
9. Havenetidis K. The use of creatine supplements in the military. *J R Army Med Corps*. 2016;**162**(4):242–8. [PubMed ID: 26124259]. https://doi.org/10.1136/jramc-2014-000400.