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Case Report

Association between the intake of cocaine and a strong physical and emotional stress: A case report of a sudden death

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ABSTRACT

Cocaine is a powerful sympathomimetic agent that determines its effects either by inhibiting synaptic reuptake of noradrenaline or through the direct stimulation of the release of catecholamines from the adrenal gland.

Cocaine abuse is associated with various cardiovascular events including ventricular arrhythmias, systemic hypertension, myocardial infarction, and left ventricular hypertrophy. These effects are independent of the dose and route of administration of the substance and can be noticeably enhanced by the synergistic action of factors such as stress, smoking, and alcoholism. Here, we report a case of a 48-year-old man, who died of acute myocardial infarction, which arose as the result of an intake of a large amount of cocaine and a strong physical and emotional stress.

KEY WORDS: Forensic Sciences, forensic pathology, cocaine, physical stress, emotional stress, sudden death, synergism

INTRODUCTION

Stress can be defined as a process in which environmental demands strain an organism's adaptive capacity, resulting in both psychological and biological changes that could place a person at risk for illness [1]. The physical and emotional stress factors ("stressor") could lead to the activation of neuroendocrine systems, acting on the sympathetic nervous system and on the hypothalamic-pituitary-adrenal axis. The cardiovascular system can be damaged by both stress-related vascular and metabolic effects [2,3], due to the increasing of blood pressure, heart rate, myocardial, contractility, and endothelial dysfunctions [4-6]. As a consequence, a myocardial ischemia is commonly observed [7-9]. Multiple factors may act concurrently enhancing the stress effects and increasing the risk of cardiovascular event, even fatal. Cocaine abuse is one of the most important factors associated with cardiovascular events, as well as alcoholism and smoking [10]. Cocaine is a powerful sympathomimetic drug and its consumption results in an alert state, activation of the cardiovascular system, tremors, muscle twitching, and mydriasis [11,12].

We report the case of a man who died as a consequence of an acute myocardial infarction due to a combination of physical stress and cocaine intoxication.

CASE REPORT AND AUTOPSY FINDINGS

A 48-year-old white male broke into the camper of a nomad family in the night, where a child was sleeping. Upon entering the camper, the man started masturbating in front of her. After a while, the mother of the child discovered him, and he ran away from the camper. While escaping, he was struck in the head by a stone thrown by the mother and he fell to the ground. When he was lying on the ground, the woman started to strike him several times using a stick and became unresponsive. The cardiopulmonary resuscitation made by paramedics had no effect and the subject was pronounced dead at the scene.

At autopsy on external examination, two superficial linear lacerations were found on the head [Figure 1]. The underlying skull bones were intact. The examination of the rest of the body showed no abnormalities or injuries.

At the post-mortem examination, upon reflecting the scalp and entering the cranial cavity, no injuries to the meninges and to the brain were found. The heart weighted 560 g and showed a 60% occlusion of anterior descending coronary artery. The other organs were congested and unremarkable. The histological examination of the heart showed cardiomyocyte hypertrophy with hypercontracture of the myofibrils. A moderate to

diffuse thickening of the Z-lines was present, but no nuclear pyknosis was found. A focal area of contraction band necrosis was observed in which Z-lines showed a severe thickening [Figure 2].

The toxicological analyses were positive for cocaine (1.0 μg/ml) and benzoylecgonine (2.1 μg/ml) in blood samples. According to the analyses, the results were consistent with cocaine intoxication.

DISCUSSION

In this case report, we assume that the combined action of stress and cocaine may have led to a sudden cardiac death. A sympathetic hyperstimulation may result from physical and/or psychic "stressor," as a consequence of the activation of the sympathetic nervous system and catecholamine release due to endocrine- and metabolic dysfunctions- related-stress [13-16].

Once activated, the sympathomimetic effects may be enhanced by cocaine, due to a norepinephrine reuptake inhibition in synapses and even to the stimulation of the release of catecholamines from the adrenal gland [17]. The result of the combined action of stress and cocaine [Figure 3] is an increase in sympathetic activity resulting in a reduction of the ventricular fibrillation threshold, increase in myocardial excitability, in heart rate, in blood pressure and in myocardial oxygen demand, and is associated with a reduced availability of oxygen due to a vasoconstriction of the coronary arteries by the catecholamines [18-20]. When an atherosclerotic coronary artery disease is already present, these effects are obviously more severe [21].

In our case, the combined action of stressors and cocaine intoxication led to catecholamine release and resulted in myocardial ischemia and/or fatal arrhythmias. This pathophysiology is consistent with our histopathological findings that showed contraction band necrosis and development of hypercontractility of the myofibers. These features are consistent with an excess of catecholamines in the blood [22,23].

According to the available data, we were able to understand that the man was in a state of an intense psycho-physical stress due to the masturbation and physical stress due to the escape after being discovered by the mother of the child. The cocaine intoxication found by toxicological analyses together with the evidence of no significant head trauma were consistent with a stress-related death.

According to our reconstruction, the man, after escaping from the camper, suffered from a myocardial ischemia that led to a fatal arrhythmia due to the psychophysical stress combined with the cocaine intoxication. The wounds to the head produced by multiple blunt force traumas showed no significant vital reaction, meaning that they were inflicted once the man was already dead or in the perimortem period. The histological findings of thin hypercontracted fibers and

Figure 1: Wounds found in the right parietal region

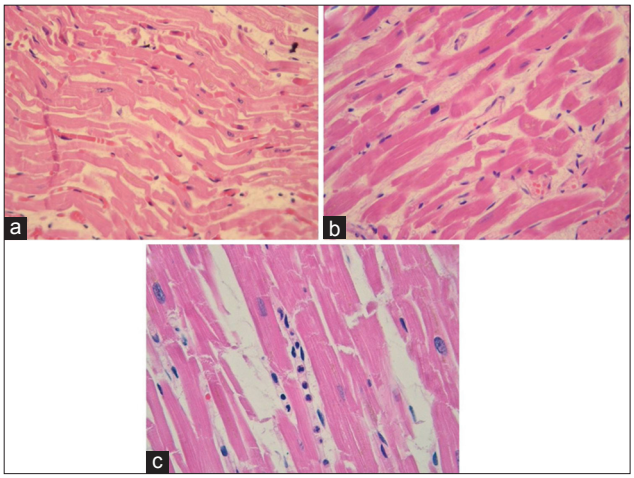

Figure 2: (a) Left ventricular myocardium, subendocardial region of the anteroseptal wall: cardiomyocytes with sarcoplasmic hypereosinophilia and thinned and wavy aspect. The nucleus of some cells is not detectable or appears discolored. At the interstitial level there is a marked capillary congestion and mild edema (×20), (b) left ventricular myocardium, anterior-septal wall: cardiomyocytes with wavy and thinned aspect and not evident cores that are adjacent to cells with evident nucleus, sometimes with increased volume. It is associated the finding of interstitial capillary congestion (×40), (c) focal phenomena of neutrophil margination (×40)

the contraction band necrosis are consistent with cocaine chronic abuse, but they are not specific of cocaine-related death.

These features can be found also in normal hearth specimens. Likewise, the lymphocytic infiltrate and edema can be present in normal cardiac tissue and are not pathognomonic signs of damage by cocaine. Before our findings, the woman was charged of voluntary manslaughter, but we were able to demonstrate that the blunt force traumas were not the cause of death.

CONCLUSION

In all suspected cases of sudden cardiac death, information concerning the circumstances of death, the medical history,

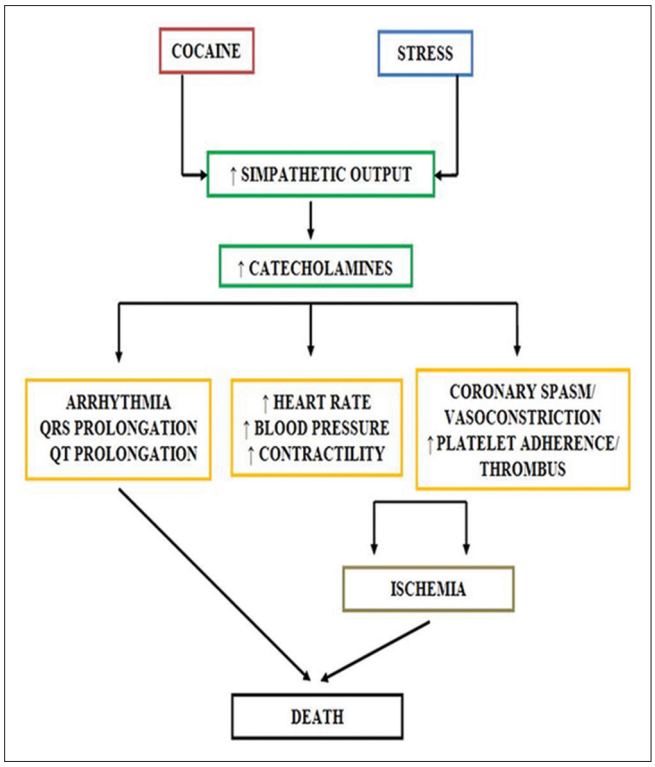

Figure 3: Sympathetic stimulation induced by cocaine and stress, with related increased release of catecholamines and induction of systemic effects

as well as a complete autopsy including histological and toxicological analyses are necessary to reach the correct diagnosis.

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