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LOSS OF CONSCIOUSNESS DURING PARACHUTE JUMPS

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Abstract

Mazurek K, Plutecka N, Chełmicki S, Klukowski K. Loss of consciousness during parachute jumps. *Med Sports* 2007, 11(3): 63-65. Parachute sport belongs to extreme sports. Parachute jumps may result in hypobaria, hypoxia, hypothermia, overload, physical effort and stress. The case report presented in the paper concerns loss of consciousness during a parachute jump. A 37 year old, experienced jumper performed the CRW-2 task from 4000 m together with his instructor, immediately opening the parachute. At an altitude of 1000m, after finishing his acrobatic evolution, he lost of consciousness for 2,5 minutes. He landed in a tree, next recovered consciousness and safely went down. The results of medical examination were normal. The authors analyze a physiological mechanism underlying loss of consciousness, diagnosing slide hypoxia, physical effort and stress that caused hyperventilation and constriction of cerebral arteries. Interruption of physical effort caused the decreased venous return and cardiac output, critical decrease in cerebral blood flow and loss of consciousness. The jumper was diagnosed as fit for parachute jumping with limitation to 3000m and without excessive physical effort.

Key words: *parachutes jumping, accidents, altitude hypoxia, hyperventilation*

Introduction

Aviation sports belong to extreme sports, entailing increased risk as they are usually done in exposure to adverse and changeable physical factors, such as atmospheric conditions, stress and intensive physical overload (1,2).

Parachute jumps may be performed from airplanes, helicopters, balloons, as well as from bridges, buildings or natural elevations (base jumping). Modern parachutes, of the so-called "flying wing" type act in a similar way as an airplane or helicopter wings. Contemporary forms of sport and recreational parachuting include solo jumps, tandem and group jumps, jumps with certain acrobatic figures, jumps for landing marksmanship and acrobatic jumps. One of the most advanced forms of acrobatic is Canopy Relative Work - Canopy Formation (CRW). In this form of acrobatics, jumpers open their parachutes, usually immediately after jumping from an aircraft, grasping parts of their parachutes or the jumper's clothing and they perform various acrobatic figures (3). The presented case of consciousness loss during a parachute jump was due to a cumulative effect of numerous adverse environmental and physiological factors.

Case description

A parachute jumper, T.B., aged 37 performed 198 jumps between the year 1999 and May 2006. He had a third class medical certificate, so he had a designation for a parachutist. He had never experienced any in-flight incidents or health problems before.

On May the 6th at Chrcynno airport (Warsaw Aero Club) he performed training acrobatic parachute jumps together with his instructor. He also performed a CRW-2 task for the first time in his life. Two jumpers, T.B. and the instructor jumped from an altitude of 4000 m over the sea level, immediately opening their parachutes and they tried to form an acrobatic formation and they failed in their multiple attempts to perform it. At an altitude of about 1000 m over the sea level, the instructor decided to stop task performance and to start landing. After a while, the instructor noticed that T.B. did not respond to his signals (loss of consciousness?) and carried by the wind he landed outside the airfield, in a tree. Later, T.B. reported that he regained consciousness soon, unbuckled his parachute and descended by himself. Based on the estimation of the distance and time of arrival at the venue, we can say that loss of consciousness might last for about 2.5 minutes.

Immediately following the event, the jumper underwent a thorough medical examination. No abnormalities were found in his health condition. It should be stressed that the examination comprised diagnosing, necessary for medical analysis of causes of consciousness loss during the parachute jump. The result of hypobaria tolerance test in the low pressure chamber, under conditions corresponding to the altitude of 5000 m for 30 minutes at rest was normal. A thorough cardiologic examination, comprising echocardiograph, 24-hour Holter ECG monitoring and exercise ECG test, did not reveal any abnormality.

Neither neurological examination, nor magnetic resonance of the brain revealed any changes. The result of resting ECG was normal, the examination following hyperventilation however, revealed changes

in the form of numerous polymorphic slow waves. The arrest response was found. The photo-stimulation test did not intensify slow elements. A control examination was recommended. The psychological test revealed no abnormalities.

T.B. was diagnosed as unfit for parachute jumping. After 6 months, the control examination was repeated, including: nuclear magnetic resonance (NMR), hypoxia and tolerance test in the Low Pressure Chamber (LPC) and psychological examination. The results of all these examinations were normal. In March 2007, T.B. was qualified as fit for parachute jumping by the Aeromedical Board, although at the limited altitude up to 3000 m over the sea level and without any over standard physical effort (4).

Discussion

Extreme environmental conditions during parachute jumping include decreased atmospheric pressure, decreased partial oxygen pressure and decreased temperature. Further, parachute jumpers are in exposure to rapid changes in body positioning, which may result in spatial disorientation, G-load in different axes, physical effort and stress (5,6).

Parachutists from the U.S. aero club performed 2100000 jumps including 20 fatal ones, which means one fatality per 105 000 jumps. In Poland there were 5 fatal accidents per 40 000 parachute jumps. The total of 169 in-flight accidents during parachute jumps, recorded in the Archive of National In-Flight Accident Examination Board during the years 2003-2006, 99 (58.6%) in-flight accidents and incidents were caused by the least experienced jumpers, who performed 1-50 jumps. One accident that occurred during jumping was fatal. In this group of parachutists, technical errors were most frequent reasons for accidents (72%). No accident was due to health problems. Among the most experienced jumpers, who performed 501–5000 jumps, 50 incidents and accidents were recorded (29.6%), including one fatal. It was found that 50% of the accidents were due to technical errors, none to health problems (4,7). Considering jumpers medically fit for parachuting is based on examination and certification by the authorised specialists in aviation medicine. Periodic examinations are carried out every 5 years in people below 30, every 2 years in people below 50 and every 12 months in people over 50 (8).

Recreational and sport parachute jumps are usually performed at an altitude of 4000 m, where atmospheric pressure is about 462 mm Hg and 3000 m, where atmospheric pressure is about 526 Hg. Atmospheric pressure values corresponds to partial oxygen pressure, which is 97 mm Hg and 110 mm Hg respectively. The zone of complete high altitude hypoxia compensation is below 3000 m over the sea level. Above this altitude, hemoglobin oxygen saturation drops below 90%, which results in exposure to high altitude hypoxia (2,9).

High altitude hypoxia (hypoxic hypoxia) may result in symptoms defined as acute altitude illness. The cells of the Central Nervous System (CNS), particularly the cerebral cortex are most sensitive to hypoxia. For this reason, the first symptoms of hypoxia manifest as cognitive and emotional disorders (10). The symptoms of hypoxia include: disorders of motor coordination, mental arousal that may lead to euphoria, decreased criticism, rapid breathing (tachypnoea), and muscular tremor. In exposure to high altitude hypoxia, people experience: apnea, accumulating fatigue, restlessness or euphoria, headaches and vertigo, nausea and visual impairment. In most cases, the course of hypoxia is insidious. Loss of consciousness may be preceded by the above-mentioned symptoms, it may also occur suddenly. Tolerance to hypoxia is an individual trait, and it decreases when ascending rapidly at high altitudes, during a long stay in hypoxic zones, physical effort, in exposure to stress and low temperatures (1,6,11).

T.B. descending with his parachute open from 4000 to 3000 m, at a speed of about 5 m/sec, stayed in the zone of incomplete compensation for about 3 minutes. The adverse factors affecting his tolerance to hypoxia included: the time necessary to perform the task, intensive physical effort lasting about 7 min (oxygen effort) and stress resulting from performing a difficult task the jumpers failed to perform.

Hyperventilation was an additional and probably the most important physiological factor, which resulted in the decrease in cerebral blood flow. Hyperventilation, which was probably associated with the circumstances of the in-flight incident, does not affect significantly oxygen blood level, although it decreases the level of carbon dioxide (CO_2) and hydrogen ions (H^+). Blood alcalisation, affecting central chemoreceptors, causes contraction of the cerebral arteries and decrease in cerebral blood flow (11).

We can assume that excessive physical effort while jumping (descending from 4000 m to about 3000 m), increased heart rate (HR) and elevated blood pressure (BP) caused the increase in cardiac output and maintained sufficient cerebral blood circulation. End of physical effort, muscle relaxation, the decrease in venous return, pulse rate and blood pressure probably resulted in the decrease in cardiac output. Partial CO_2 pressure decrease and lowered pH resulted in critical decrease of cerebral blood flow and loss of consciousness.

Analyzing the reported case of consciousness loss during parachute jumping, the Aeromedical Board concluded that:

1) A healthy, experienced parachute jumper experienced loss of consciousness due to the decreased

tolerance to several environmental conditions, which occurred at the same time during an acrobatic jump;

2) The parachutist was considered fit for further parachute jumps, although at a limited altitude up to 3000 m over the sea level, without over standard physical effort.

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Author's contribution
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection