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Case Study

Hot Air Balloon: An Unusual Cause of Multicasualty Trauma Incident

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A B S T R A C T

Hot air balloon incidents are few and far between compared with the total number of flights. Nevertheless, hot air balloon incidents may produce severe trauma involving several patients and are linked to significant mortality. The prehospital management of injured patients starts after having secured potential surrounding dangers, such as fire or explosion. In the context of a rescue by helicopter, close attention must be paid to potential obstacles, like trees or electrical wires, and the risk of aspiration of the balloon envelope into the rotor. Patients involved in such incidents are often split up in a closed perimeter around the crash point. The severity of the trauma depends essentially on the height of the fall. The most frequent traumatic lesions involve fractures of the lower limbs, the spine, and the pelvis as well as severe burns caused by the balloon fire. Because of the number of patients present, an initial triage is usually required at the site. The use of rescue helicopters can be helpful. They can perform aerial reconnaissance, provide on-site high-level resources, enable access to the patients even in hostile environments, and quickly transport them to trauma center hospitals.

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Hot air balloons use hot air in order to ascend, in contrast to aerostats, which use a light gas such as helium and are usually tethered to the ground. The fuel used by hot air balloons is generally propane in liquid form.[1] A mixture of propane and air is ignited and then rehashed by a burner placed under the balloon. Hot air balloon incidents are few and far between compared with the total number of flights. On the other hand, incidents of this type generate severe trauma involving several patients and are therefore linked to significant mortality.[1] The medical literature is relatively poor on this subject, and there is no existing register reporting injuries on such incidents. Therefore, the objective of this article is to highlight, through a clinical case, the elements that cause the occurrence of hot air ballooning incidents and to present the different traumas that may be caused. The particularities of helicopter emergency medical services (HEMS) operation and safety elements in this context are also discussed.

Case Report

In August 2013, a Cameron Z-120–type hot air balloon with a pilot and 4 passengers lifted off from Château d'Oex in the Canton of Vaud, a mountainous region of western Switzerland. At 8:35 AM, while landing, the hot air balloon touched a 30-meter-high high-voltage power line and crashed to the ground without catching fire.

The emergency medical service (EMS) dispatch center was alerted by witnesses and immediately sent 3 paramedic-staffed ambulances. A pretriage was realized by the paramedics first on-site, resulting in 5 seriously injured patients within a radius of 50 meters around the crash (Fig. 1). According to the dispatch procedures, an HEMS from the Swiss Air-Rescue organization (Rettungsflugwacht/Garde Aérienne [REGA]) staffed with a pilot, a paramedic, and an emergency physician was simultaneously alarmed. This helicopter arrived at 9:00 AM, 10 minutes after the arrival of the first ambulance and just after the second ambulance. The aerial reconnaissance identified the high-voltage power line and confirmed the absence of any other hazard.

The emergency physician asked for 2 other physician-staffed Swiss Air-Rescue helicopters and a total of 5 paramedic-staffed ambulances. The medical triage at the site was the following:

1. A 65-year-old man in cardiopulmonary arrest with a severe thoracic trauma who died on-site despite cardiopulmonary resuscitation procedures.

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Figure 1. Crash site with the nacelle and the patients split up around the crash point.

2. A 54-year-old woman with a serious maxillofacial trauma with an airway obstruction, requiring endotracheal intubation after rapid sequence induction. After spinal and pelvic immobilization, the patient was transported to a trauma center level I university hospital. During transport, mechanical ventilation and hemodynamic support with fluid perfusion and inotropic medication were performed. The investigations in the emergency department revealed a patient who was hemodynamically unstable with a hemopneumothorax; multiple rib fractures; fractures of the mandible, the pelvis, the left femur, and the L5 vertebra (with instability); and a serious hepatic laceration.
3. A 24-year-old unconscious woman with hemodynamic instability and multiple fractures of the lower limbs. She was intubated on-site after rapid sequence induction. The fractures were reduced and splinted before leaving the site. During the transport, mechanical ventilation and hemodynamic support with fluid perfusion were performed. The investigations in the trauma center level I university hospital revealed a bilateral pneumothorax; a fracture of the left femur, the right tibia, and the L5 vertebra; and a facial trauma with a Le Fort II fracture.
4. A 25-year-old woman with hemodynamic instability and major trauma of the lower limbs. Treatment on-site included endotracheal intubation after rapid sequence induction, hemodynamic support with fluid perfusion and inotropic medication, and spinal and pelvic immobilization. The investigations on her arrival at another trauma center level I university hospital revealed a maxillofacial trauma, a bilateral pneumothorax, fractures of the ribs and the right femur, and multiple lumbar spine fractures (L2 burst fracture; fractures of the transverse processes of L2, L3, and L4; and fractures of the spinous processes of L4 and L5).
5. The pilot of the hot air balloon, a 65-year-old man, presented with multiple upper and lower extremity fractures without initial hemodynamic instability. He was admitted to a level III nonuniversity hospital. The investigations revealed several rib fractures; bilateral fractures of the femurs; fractures of the T9 and T10 vertebrae, the left forearm, and the right fibula; and contusion of the left kidney.

Discussion

This case shows several interesting issues related to helicopter rescue. First, the accident occurred in western Switzerland, which is a wealthy country with high-level hospitals and many EMS resources. In the whole country (8 million inhabitants, surface area of 16,000 square miles), there are 5 university hospitals serving as level I trauma centers, 7 additional regional hospitals considered as level II trauma centers, and more than 100 small hospitals with emergency services (24 hours per day 7 days per week). Therefore, the mean transport times to a university hospital or a level II trauma center generally do not exceed 15 minutes. Switzerland's geography is characterized by noticeable urban areas; rural areas; and alpine valleys, mountains, rivers, and lakes, a context favorable to leisure and sport activities.[2]

In the region of the accident, trained nurses or paramedics coordinate the prehospital EMS using keyword-based dispatch protocols. Ambulances with paramedics are the primary response of the EMS. Prehospital emergency physicians may be sent on-site by ground (particularly in the urban areas and in the western part of Switzerland) or air through HEMS.[2] Three different companies provide helicopter rescue in Switzerland. Two companies, AirZermatt and AirGlaciers, operate in the alpine regions and are specifically trained in mountain rescue operations. The main HEMS organization is Swiss Air-Rescue (REGA) with around 11,000 missions per year and 17 helicopters distributed throughout Switzerland. The REGA helicopter team consists of a pilot, an experienced paramedic, and an emergency physician.[3]

The medical equipment onboard includes intubation material (endotracheal tubes, supraglottic devices, cricothyroidotomy equipment, and an electric suction device), a transport emergency ventilator for invasive or noninvasive ventilation, an advanced monitor/defibrillator, a mechanical chest compression device, drugs for emergency and intensive care conditions (including tranexamic acid), chest drains

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