E18 Ice Cold Cases: When Glaciers Give Back Corpses

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Learning Overview: After attending this presentation, attendees will understand the complexity of personal identification on human remains recovered after a prolonged stay in a high-altitude environment.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing information about the peculiar effects of glacier environment on corpses after a long period of time since death.

The Alps are the highest mountain system in Europe, with dozens of summits that reach over 4,000m and some massive glaciers. The region called "Valle d'Aosta" includes the Italian side of many legendary mountains, such as Mont Blanc, Monte Rosa, and Cervino. These mountains welcome countless hikers and skiers, and every year many people are involved in fatal accidents. While most of the corpses are recovered in a short time, in some cases, this is not possible due to the prohibitive environmental conditions that would put the rescue teams in serious danger. The fate of unrecovered bodies depends on where they lay. Glaciers are dynamic settings that significantly alter and gradually expose once-hidden corpses as part of their turnover process.[1] The glacier movement, which reaches speeds of about 100m per year, can affect where remains are ultimately recovered.

This presentation reports the data about the human remains of eight people returned by Alps glaciers from 1974 to 2018 at altitudes above 2,000m. They were recovered by the "Guardia di Finanza," the military Italian enforcement that patrols the "Valle d'Aosta" summits, and were studied by the Aosta Office of the Medical Examiner. The aim of the identification effort after such a long time since death was to restore family links and clarify the fate of the missing people.

The recovered remains included bones and frozen soft tissues: in two cases, the entire bodies were recovered; in one case, bone fragments were not identifiable, while in the remaining five cases, a combination of numerous bones and teeth were collected. They were found in the hottest periods, following the melting of the glaciers. In all cases, the remains were accompanied by personal effects, such as clothing, technical equipment, or medicines. Personal identification required a holistic approach. In fact, achieving the goal was complicated by the large number and heterogeneous origin of the people missing in "Valle d'Aosta," who were mostly tourists from all over the world.

The suspect's identity was first tracked down through the careful examination of anthropometric characteristics and personal effects. The plausibility of the attribution was then assessed by estimating the trajectory that the corpse should have followed due to the glacier movements from the point where the person was last seen alive to the recovery location. Finally, DNA analysis was used as confirmation evidence, through the National DNA Database or if close relatives were available.

Six out of eight victims were identified: they were all adult male subjects (average age was 36.7 years) involved in accidents during excursions or skiing from 1954 to 1992. Two out of six were French, two were German, one was Turkish, and one was Italian. The average gap between the disappearance and the recovery of the corpse was 20 years. The average altitudes of the points of disappearance and of recovery were respectively 3,400m (range 4,000–3,000m) and 2675m (range 3,100–2,000m). The dynamics of the fatal accidents have been hypothesized as follows: two people were buried by avalanches; in two cases, trauma due to precipitation along crevasses was the cause of death; in one case, there was the combination of the previous two dynamics; and in one case, the victim froze to death during a snow storm. Bone analyses helped to distinguish peri-mortem from postmortem lesions and corroborated the hypothesis about death dynamics.

Factors such as cold temperatures, freezing, freeze-thaw cycles, and glacier movement are unique taphonomic agents.[2] Therefore, it is important to be familiar with these environmental agents and with their effects on bones. In fact, while glaciers have always been typically remote, in the foreseeable future, materials of anthropological interest may increasingly be revealed due to global warming and glacial retreat worldwide. This presentation provides attendees with a greater awareness of the importance of a multi-step approach to highly complex cases of personal identification on human remains that have been altered by extremely cold and ever-changing environments.

Reference(s):

1. Jouvet G., Funk M. Modelling the trajectory of the corpses of mountaineers who disappeared in 1926 on Aletschgletscher, Switzerland. *J Glaciol.* 2014;60(220):255-261.
2. Pilloud M.A., Megyesi M.S., Truffer M., Congram D. The taphonomy of human remains in a glacial environment. *Forensic Sci Int.* 2016;261(161):e1-e8.

Human Remains, Personal Identification, Glaciers

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