

BRIEF REPORT

Body Positioning of Buried Avalanche Victims



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Objective.—The immediate medical management of buried avalanche victims will to some extent be dictated by the victim's body positioning in the snow. Medical personnel are trained to assess and manage victims in a supine body position. Furthermore, avalanche first responders are trained to handle extricated avalanche victims carefully out of concerns for causing hemodynamic instability or for aggravating spinal injury. Thus, locating and extricating avalanche victims in positions other than supine has the potential to complicate immediate medical management. To our knowledge, the current medical literature does not detail the body positioning of buried victims.

Methods.—In order to ascertain the most common body positioning of buried avalanche victims we reviewed the avalanche incident database of the Colorado Avalanche Information Center (CAIC). This comprehensive database strives to track over 160 fields of information for each avalanche victim, including the body and head positioning of buried victims.

Results.—Head positioning was recorded for 159 buried victims. We found that 65% of buried avalanche victims were found with their heads in a downhill position, 23% with their heads uphill and 11% with their heads in the same level as the rest of their bodies. Body positioning was recorded in 253 victims. 45% of victims were found lying prone, 24% supine, 16% were sitting or standing and 15% were found lying on their sides. We identified 135 victims where both head and body position was registered. 40% of victims were found prone with their heads in a downhill position

Conclusions.—The majority of victims will be extricated with their heads in a downhill position. Moreover, almost half of victims will be found prone. We believe this will have significant impact on the immediate medical management. We believe current training in avalanche medical rescue should emphasize managing victims in non-supine positions. Finally, our findings may represent another benefit of modern extrication techniques.

Key words: avalanche, avalanche burial, mountain rescue, prehospital care, rescue, mountain medicine, wilderness medicine

Introduction

Buried avalanche victims experience a mortality rate of almost 50% where the vast majority die of asphyxia, trauma, and hypothermia.¹ The survival rate for buried victims drops precipitously the first half hour as the majority of victims succumb to asphyxia from having their upper airways or breathing obstructed by avalanche debris. After 35 minutes of complete avalanche burial, roughly 35% of victims remain alive.^{1,2} Survival beyond this initial “asphyxia phase” requires the presence of a patent airway and the ability to ventilate.

Buried victims who survive the asphyxia phase succumb to gradually increasing hypercapnia, hypoxia,

and hypothermia.² It follows that avalanche rescue is a desperate race as rescuers attempt to locate and extricate the victims within their time window of survival. Companion rescue, appropriate equipment as well as efficient extrication methods will improve outcomes by reducing search and extrication times. Buried victims are ideally located by immediate bystanders using a combination of visual estimation and avalanche transceivers, often followed by pinpointing their position using avalanche probes. Without functioning transceivers, victims may face prolonged burial times and may have to rely on extrication by organized avalanche rescue.³ Medical management starts the moment the rescuers or clinicians gain access to the face and chest. Rescuers must immediately re-establish airway patency as well as restore oxygenation. Rescuers

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may face victims who are critically ill or in cardiac arrest and must also be prepared to manage a wide range of traumatic injury as well as hypothermia.⁴

Consequently, the medical rescue of avalanche victims may involve a wide variety of interventions including airway management, providing basic or advanced life support, monitoring, cannulation, surgical interventions, and spinal immobilization as well as providing protection from environmental exposure.⁴ How clinicians perform these interventions will to some extent be dictated by the victims body position upon extrication. Medical providers normally manage victims who are lying supine. In addition, medical scenario training is commonly performed with the mannequin or marker in a supine position. Thus, buried avalanche victims who are extricated in body positions other than supine may pose a challenge as they force care providers to perform potentially life-saving interventions working in ways they are not accustomed to nor frequently practice for. Obviously, some victims could simply be pulled out of the snow and turned supine to facilitate management. Unfortunately, that is often not the case. Settled avalanche debris is often of high density and of low compliance, sometimes described as of a concrete quality, meaning extrication efforts may be protracted, forcing clinicians to provide emergent medical management under awkward conditions for extended periods of time.^{5,6}

To our knowledge, the current medical literature does not report on which body positions are common in buried avalanche victims. In order to address this, we performed a retrospective review of a large avalanche incident database that for some incidents provide information on the body positioning of buried avalanche victims.

Methods

In order to determine the body positions of buried avalanche victims we approached the Colorado Avalanche Information Centre (CAIC). CAIC is a program within the Colorado Department of Natural Resources tasked with providing avalanche forecasting and observations as well as promoting avalanche information and education.⁷ The CAIC maintains databases of avalanche victims and accidents in the United States. The archive grew out of data compiled in the 1960s and 1970s by the US Forest Service and has been used by many researchers since.^{8–10} Data abstraction is carried out retrospectively by CAIC avalanche forecasters and relies on primary sources such as witness statements and reports from Search and Rescue organizations, coroners, and the US Forest Service. Most sources are public

records, but these are often supplemented by additional data from interviews of victims, witnesses, or rescuers. The current database strives to track over 160 fields of information per avalanche victim, including the body and head positioning of buried victims.

In this database we identified data entries describing the characteristics of completely buried victims. Complete burial was defined as to occur when the victim was buried completely beneath the snow surface with no body part or attached equipment visible. We then further isolated the entries where body positioning was detailed in accordance with an established classification system.⁹ The database describes head and body positioning. Head position was classified as uphill or downhill in relation to the rest of the body or as lying sideways with the head in the same level as the rest of the body. Body positions upon localization were classified as prone, supine, the victim lying on his/her side, or as sitting/standing.

Results

The database consists of data entries for 1989 avalanche victims from incidents occurring between April 1951 and March 2014. After excluding non- or partially buried victims as well as entries that did not state the degree of burial, we identified 1085 victims who had experienced complete burial. Twenty-nine percent of victims experienced avalanche burial in Colorado, 12% in Washington state, 12% in Alaska, 11% in Montana, and 10% in Utah, while the remaining 26% were buried in incidents in other states. Only 2 victims were recorded to have successfully deployed avalanche airbags, of which 1 experienced complete burial.

Head positioning was recorded for 159 buried victims. Sixty-five percent were found with their heads in a downhill position, 23% had their heads uphill, and 11% were found with their heads across the slope (Table 1). Mode of travel at avalanche impact was known for 114 of these victims. Eighty-two percent ($n = 94$) were skiers including backcountry, sidecountry, and inbounds skiers. The remainder were snowboarders ($n = 8$) and those travelling on foot ($n = 9$) or on snowshoes ($n = 3$). In order to better describe the most common type of avalanche victims, we charted the head positioning of

Table 1. Head positioning of buried avalanche victims

<i>Head position</i>	<i>Overall</i>	<i>Skiers</i>
Downhill	104 (65%)	62 (66%)
Uphill	37 (23%)	23 (24%)
Across slope	18 (11%)	9 (10%)
Total	159	94

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