

# The evaluation of traumas of victims in Avalanche disasters in Van province, Turkey on February 4-5, 2020

Duygu Mergan İliklerden<sup>1\*</sup>, Tolga Kalaycı<sup>2</sup>, İsmail Can Karacaoglu<sup>3</sup>

<sup>1</sup>Department of Thoracic Surgery, Faculty of Medicine, Van Yuzuncu Yil University, Van

<sup>2</sup>Erzurum Regional Education and Research Hospital General Surgery Clinic, Erzurum, Turkey

<sup>3</sup>Van Regional Education and Research Hospital General Surgery Clinic, Van, Turkey

## ABSTRACT

Avalanche is a rapid flow of snow down of a slope, such as a mountain or a hill. In this study, we aimed to evaluate the traumas of the victims who were hospitalized in two avalanche disasters that occurred in Van province, Turkey on February 4 and 5, 2020.

On February 4-5, 2020, two avalanche disasters occurred in Van province, Turkey. The data of all victims were gathered from hospital records and register of Disaster and Emergency Management Presidency of Turkey retrospectively. Victims who were treated and died in the avalanche area were excluded from the study.

At two avalanches, 126 victims were affected. The mean age of the hospitalized victims (50 victims) was  $36.84 \pm 10.70$  (18-61), 48 were male. 15 victims were affected (8 alive, 7 death) at the first avalanche, while 111 were affected (76 alive, 35 death) at the second avalanche. The burial time was nearly 90 minutes in the first avalanche and 30 minutes in the second avalanche. The most common pathology was scalp laceration in 12 (24%) victims. 46 (92%) victims were treated with medical treatment. The overall mortality of two avalanches was 33.3%, while the mortality rate of the first avalanches was 46.7%. No complications or mortality occurred in any patient admitted to the hospital.

Avalanche disaster is a serious problem and requires early access to the area to shorten the burial time. Early access provides early intervention. Early intervention was delayed due to weather conditions and mortality rates increased.

**Keywords:** Avalanche, Burial time, Crush syndrome, Early intervention, Mortality

## Introduction

Avalanche is a rapid flow of snow down of a slope, such as a mountain or a hill. Avalanche mostly occurs on sloping lands where density of the forest is very sparse or absent. Wintertime is when most avalanches tend to happen. However, avalanche deaths can be seen for every month of the year (1).

Avalanches can occur spontaneously, due to factors such as snowpack, or external factors such as people, earthquakes, animals. Large avalanches have the ability to capture and move trees, ice, and rocks (2).

In avalanche disaster, the main problem is to access earlier to the avalanche area and to start early intervention of victims. Arriving at the avalanche area may be delayed due to the difficulty

of the current climatic conditions and the risk of avalanches again. Mortality increases as the arrival to the avalanche area is delayed. In a study conducted in Switzerland, while the probability of survival in 15 minutes was 92%, it decreased to 30% in 35 minutes, leading to death through asphyxia. It is impossible for those who are under an avalanche for 35 minutes or more to survive without an air pocket. After 90 minutes, victims gradually succumb to hypoxia and hypothermia unless the air pocket is opened to the outside. That is why earlier intervention is important after avalanche (2-4).

In this study, we aimed to evaluate the traumas of the injured who were hospitalized in 2 avalanche disasters that occurred in Van province, Turkey on February 4 and 5, 2020.

\*Corresponding Author: Duygu Mergan İliklerden, Department of Thoracic Surgery, School of Medicine, Van Yuzuncu Yil University

E-mail: duyguergan@hotmail.com, Telephone: +90 (0530) 115 97 77

ORCID ID: Duygu Mergan İliklerden: 0000-0001-8203-3946, Tolga Kalaycı: 0000-0002-6977-1757, İsmail Can Karacaoglu: 0000-0002-2273-5097

Received: 07.06.2021, Accepted: 27.06.2021

**Table 1.** The Data and Current Pathologies of The Victims Treated In The Hospital

Variables	Value or n (%)
Age	36.84±10.70 (18-61)
Gender	
Male	48 (96%)
Female	2 (4%)
Treatment Clinic	
Emergency Department	13 (26%)
Nephrology	10 (20%)
Orthopedics	8 (16%)
Neurosurgery	8 (16%)
Thoracic Surgery	4 (8%)
General Surgery	4 (8%)
Plastic Surgery	2 (4%)
Anesthesia	1 (2%)
Detected Pathology	
Scalp Laceration	12 (24%)
Crush Syndrome	10 (20%)
Vertebral Fracture	8 (16%)
Bone Fracture or Bone Crack	5 (10%)
Abdominal Pain	3 (6%)
Lung Contusion	2 (4%)
Costa Fracture with Lung Contusion	2 (4%)
Zygoma Fracture	2 (4%)
Malleolus fracture	2 (4%)
Humerus Fracture	1 (2%)
Suspicious Liver Laceration (Grade I)	1 (2%)
Vertebra Burst Fracture with Costa Fracture	1 (2%)
Treatment	
Conservative	47 (94%)
Surgical	4 (8%)
Length of hospital stay	2.87±3.6 (0-14)

## Material and Methods

On February 4-5, 2020, two avalanche disasters occurred in Van province, Turkey. The data of two avalanches victims were gathered from hospital records and register of Disaster and Emergency Management Presidency of Turkey retrospectively.

After ethical committee approval from Van Yuzuncu Yil University (Decision Number: 2020/07), age and gender of the victims, area where victims are treated, pathologies detected during hospital evaluation and their treatments, reasons for hospitalization, and hospital stay were searched. Victims who were treated and died in the avalanche area were excluded from the study.

## Results

Two avalanches happened on February 4, 2020, and February 5, 2020. At these two avalanches, 126 victims were affected. In the first avalanche disaster, 15 victims were affected, and 13 victims (8 alive, 5 dead) were rescued on the first day. However, two victims could not be rescued due to impossible climate conditions (Figure 1).

The next day, the other avalanche occurred during the rescue of the two remaining victims. 111 victims, including rescue workers, were affected in this attack. 37 victims were found dead. 26 victims were treated at the avalanche area (Figure 2). Since only the data of victims who were taken to the hospital could be accessed, these victims were included in the study.



**Fig. 1.** A photo from the first avalanche disaster that occurred in Van province, Turkey on February 4, 2020

50 victims were taken to the hospital for detailed examination. The mean age of 50 victims was  $36.84 \pm 10.70$  (18-61), 48 (96%) were male. 13 victims were evaluated at the emergency department and no pathology that require hospitalization was detected. 10 victims were hospitalized for crush syndrome, 8 victims for orthopedic problems, 8 victims for vertebral pathologies, 4 victims for thoracic pathologies, 4 victims for abdominal pathologies, two victims for maxillofacial trauma, and one victim for multisystem trauma. The data and current pathologies of the victims treated in the hospital are shown in Table 1.

46 (92%) victims were treated with medical and conservative treatment. All victims with crush syndrome were treated with fluid replacement therapy. Victims with scalp laceration were treated with simple sutures and daily cleaning. Two of the victims with orthopedic problems required surgical intervention, and the remaining victims with orthopedic problems were treated with suitable plaster or splint. Surgical intervention was not required in the victims with vertebral pathologies because they had spinous process fractures or transverse process fractures. All victims with thoracic pathologies were treated with conservative management. No victim with abdominal pain required surgical intervention, including the victim with suspicious liver laceration. While surgical intervention was required in one victim with maxillofacial Le fort III trauma, surgery was not required in the other victim due to Le fort I trauma. The victim with multiple traumas had rib fractures and surgically treated thoracic vertebra burst fracture.

The mean length of stay was  $2.87 \pm 3.6$  days (0-14). The overall mortality of two avalanches was 33.3%, while the mortality rate of the first avalanches was 46.7%. No complications or mortality occurred in any victim admitted to the hospital.



**Fig. 2.** A photo from the second avalanche disaster that occurred in Van province, Turkey on February 5, 2020

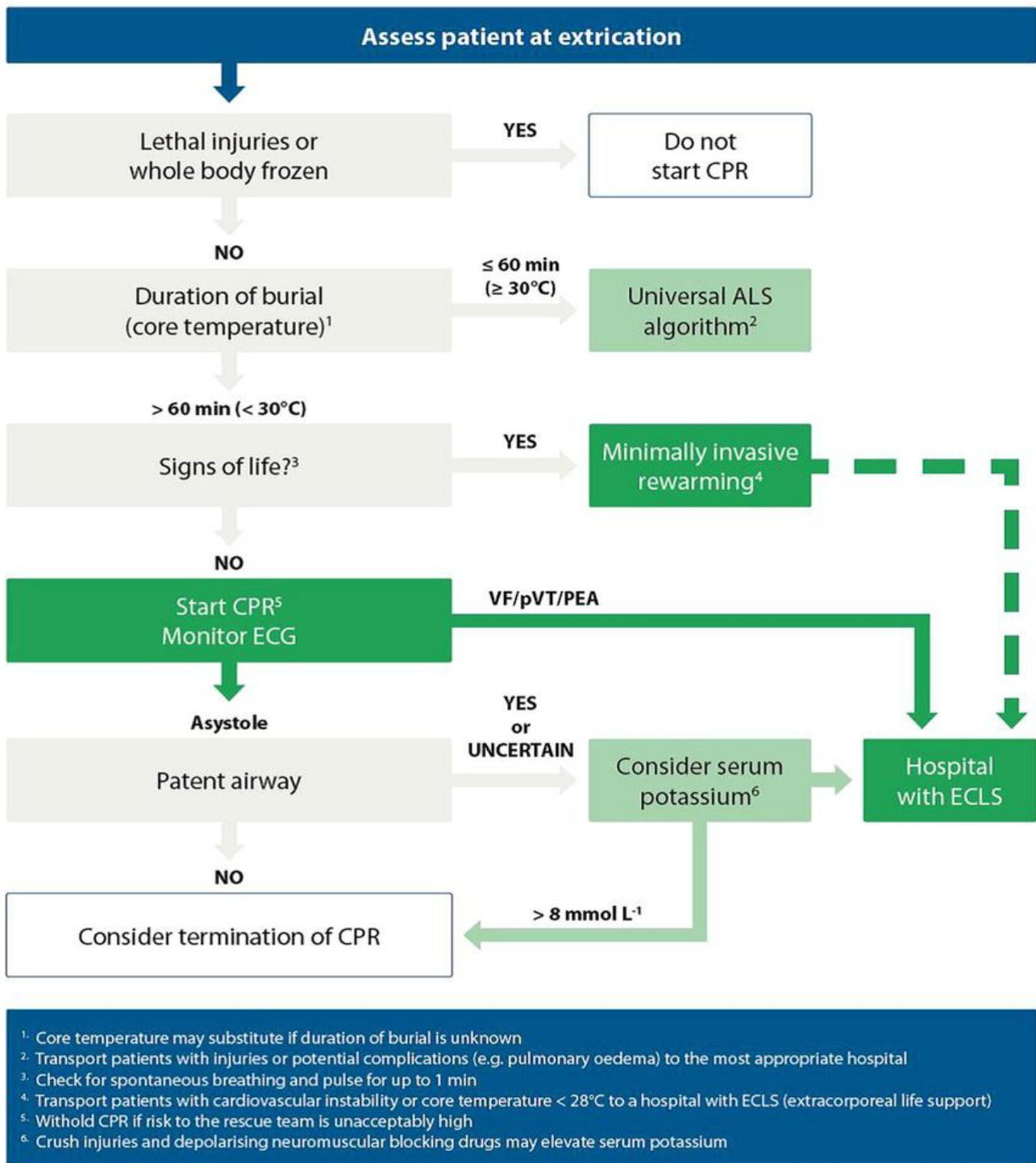
## Discussion

Avalanche disasters are important social problems both for our country and for the world. Especially in regions where the winter is harsh and long, the risk of avalanche disaster is higher. Avalanches in Europe and North America kill about 150 people a year (2). An average of 21 deaths per year have been reported in avalanche disasters in Turkey (5).

In Turkey, avalanche disasters are more common in the Eastern Anatolia Region and the Black Sea region. There are 448 avalanche disasters recorded since 1958 in our country. The worst of these disasters is the avalanche disasters that caused 328 deaths in the winter season of 1991-1992 (5). In this study, avalanche disaster of 4-5 February 2020 was presented.

Avalanche accidents can be divided into two main categories: accidents in recreational areas and accidents in residential, industrial and transportation areas (6). Jamieson et al. found that 83% of all avalanches in the recreational setting were caused by those who were involved in the accident (7). In contrast, all of the accidents in the residential, industrial, and transportation settings were due to spontaneous natural avalanches. In the presented study, avalanche disasters were present in a residential and a transportation area.

Avalanche accidents are frequently fatal events with an overall mortality rate of 23%. In cases of complete burial, the mortality rate rises dramatically to 50%. With today's dense networks of ambulance services and rescue helicopters, healthcare workers are often involved in the early stages of avalanche rescue. Military personnel are also needed in some devastating avalanche accidents. In the second avalanche, 19 civilians, 21 military personnel and 2 firefighters lost their lives. The overall mortality of two avalanches was 33.3%, while the mortality rate of the first avalanche was 46.7%. Since no autopsy was



**Fig. 3.** The avalanche management algorithm

CPR: Cardiopulmonary resuscitation, ALS: Advanced life support, ECG: Electrocardiography, ECLS: Extracorporeal life support

performed on the dead, there is no clear data on the causes of death.

While the probability of survival in 15 minutes was 92%, it decreased to 30% in 35 minutes, leading to death through asphyxia. It is impossible for those who are under an avalanche for 35 minutes or more to survive without an air pocket.

After 90 minutes, victims gradually succumb to hypoxia and hypothermia unless the air pocket is opened to the outside. That is why earlier intervention is important after avalanche (2-4).

Survival after avalanche depends on the grade and duration of burial and the pathological processes of asphyxia, trauma and hypothermia. Grade of

burial is the strongest single factor for survival. Burial time determines treatment strategy (2, 8). In the asphyxia phase where airway patency cannot be achieved, survival decreases rapidly as time passes. The ancillary presence of an air pocket should be determined by digging from the side of the victim in order to not harm the victim or destroy the air pocket. If burial time is longer than 60 minutes, airway patency should be established quickly. If duration of burial is unknown core temperature may substitute.

In the first evaluation, the presence of vital injuries and whether the whole body is frozen are evaluated. If there is vital injury and there is evidence of frozen throughout the body, cardiopulmonary resuscitation (CPR) is not performed. Otherwise, the burial time and body temperature are evaluated (9). Rapid extrication and standard advanced life support (ALS) which includes ventilation and chest compressions is started in victims with burial time less than 60 minutes or body temperature higher than 30°C. Resuscitation may be terminated in normothermic victims if ALS is not successful after 20 minutes. In the victims with burial time longer than 60 minutes or body temperature lower than 30°C, vital signs are evaluated. Treatment of hypothermia including gentle extrication, full body insulation, ECG and core-temperature monitoring is recommended, as well as advanced airway management if appropriate. In victims without vital signs, CPR is started (10). The victims who respond to CPR are transported to the hospital with extracorporeal life support (ECLS). Victims with cardiac instability or in cardiac arrest (with a patent airway) should be transported with uninterrupted CPR to an extracorporeal membrane oxygenation (ECMO)/cardiopulmonary bypass (CPB) rewarming centre (11). Management should include spinal precautions and other trauma care as indicated. In the first avalanche of Van province, 7 of 15 victims died due to late access to the avalanche area, nearly 90 minutes. The mortality rate of the first avalanche was 46.7%. However, since the second avalanche occurred during the search and rescue efforts, the rescue process started in a shorter time, nearly 30 minutes. The mortality rate of the second avalanche was 31.5%. The fact that the mortality was lower in the second avalanche disaster shows the importance of early burial time. The avalanche management algorithm is seen in Figure 3.

Avalanche disasters are important social problems both for our country and for the world, especially in regions where the winter is harsh and long. Survival after avalanche depends on the grade and duration of burial, and the pathological processes of asphyxia, trauma and hypothermia. Grade of burial is the strongest single factor for survival, and burial time determines treatment strategy. That is why earlier intervention is important after avalanche.

## References

1. Ceyhun G. Çığ Olgusu ve Ormancılık. *Türkiye Ormancılık Dergisi* 6: 49-63.
2. Brugger H, Durrer B, Adler-Kastner L, Falk M, Tschirky F. Field management of avalanche victims. *Resuscitation* 2001; 51: 7-15.
3. McIntosh SE, Grissom CK, Olivares CR, Kim HS, Tremper B. Cause of death in avalanche fatalities. *Wilderness & environmental medicine* 2007; 18: 293-297.
4. Falk M, Brugger H, Adler-Kastner L. Avalanche survival chances. *Nature* 1994; 368: 21.
5. Gürer İ. Türkiye’de Yerleşim Yerlerine Yönelik Kar ve Çığ Problemleri. *Türkiye Mühendislik Haberleri* 2002; 420: 147-154.
6. Pasquier M, Hugli O, Kottmann A, Techel F. Avalanche accidents causing fatalities: are they any different in the summer? *High altitude medicine & biology* 2017; 18: 67-72.
7. Jamieson B. *Backcountry avalanche awareness: Revelstoke, BC: Canadian Avalanche Association* 2000.
8. Brugger H, Durrer B, Elsensohn F, et al. Resuscitation of avalanche victims: evidence-based guidelines of the international commission for mountain emergency medicine (ICAR MEDCOM): intended for physicians and other advanced life support personnel. *Resuscitation* 2013; 84: 539-546.
9. Hohlieder M, Brugger H, Schubert HM, Pavlic M, Ellerton J, Mair P. Pattern and severity of injury in avalanche victims. *High altitude medicine & biology* 2007; 8: 56-61.
10. Paal P, Strapazon G, Braun P, et al. Factors affecting survival from avalanche burial-A randomised prospective porcine pilot study. *Resuscitation* 2013; 84: 239-243.
11. Ruttman E, Weissenbacher A, Ulmer H, et al. Prolonged extracorporeal membrane oxygenation-assisted support provides improved survival in hypothermic victims with cardiocirculatory arrest. *The Journal of thoracic and cardiovascular surgery* 2007; 134: 594-600.