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REVIEW OF THE NEW AVALANCHE RESCUE PROCEDURES ACCORDING TO THE NEW ERC 2025 GUIDELINES

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ABSTRACT

Introduction and objective: Emergency medicine is nowadays a highly specialised branch of medicine. Regular updates on rescue procedures lead to the compilation of highly specialised guidelines. The rise in mobility among people encourages travel and participation in sports. Winter sports such as skiing and snowboarding increase the average time spent in mountain regions, thereby increasing the risk of avalanche exposure. To ensure high-quality avalanche rescue, official guidelines must be published and regularly revisited.
Review Methods: A comprehensive literature review was conducted, analyzing studies indexed in PubMed and the official ERC Guidelines from 2021 and 2025.
Brief description of the state of knowledge: The first official avalanche rescue guidelines were published in 2021 by the European Resuscitation Council. Since then, studies have examined their efficacy and sought better solutions. In 2022, a group of experts published an algorithm—Avalife—that outlined systematic, step-by-step Basic Life Support (BLS) recommendations in case of a shortage of rescuers at the site of an accident. The latest ERC Guidelines, published in 2025, introduce a new avalanche-rescue algorithm and incorporate the Avalife algorithm into official procedures, thereby establishing a cohesive avalanche-rescue policy.
Summary: In this review, we analyse the existing literature, with particular emphasis on the new ERC 2025 Guidelines, to present the current state of knowledge on this issue.

KEYWORDS

Avalanche, Hypothermia, Rescue, ERC

CITATION

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Introduction:

The ever-growing popularity of snow sports underscores the importance of clear avalanche-rescue procedures. According to the European Warning Avalanche System (EWAS), approximately 100 people in Europe die each year from avalanches. Death is caused by asphyxia, trauma, and hypothermia. Surprisingly, despite advances in rescue technology, educational campaigns, and rescue helicopters, the number of deaths did not decrease significantly. (Techel et al. 2016). A response to this trend is an update of the ERC 2025 Guidelines. The European Resuscitation Council guidelines are a regularly updated set of instructions for responding to a variety of emergencies. In 2025, a series of updates was made relative to the 2021 ERC Recommendations. One of the updated sections was the hypothermia and avalanche sections, which are part of the "Special Circumstances in Resuscitation" chapter (Table 1) (Lott et al. 2025). Moreover, it was stated that a heart rate <45 beats per minute was a new high-risk criterion for hypothermia-induced cardiac arrest. Additionally, the requirements for qualification for extracorporeal life support do not apply for rewarming of arrested hypothermic patients.

Table 1. Updates in ERC 2025 Guideline

What's new in ERC 2025 Guideline - Hypothermia Management and Avalanche Rescue (Lott et al. 2025)
● Revised Swiss Staging for hypothermia, when core temperature cannot be measured. ● Heart rate < 45/min as a new high-risk criterion for hypothermia-induced cardiac arrest. ● Criteria for qualification for extracorporeal life support do not apply for rewarming of arrested hypothermic patients, e.g., unwitnessed cardiac arrest, asystole as presenting arrhythmia. ● New avalanche rescue algorithm. ● BLS avalanche rescue algorithm for cases with insufficient personnel on site

Hypothermia

Hypothermia is defined as a state in which the core body temperature falls below 35 degrees. It can develop when the body loses heat faster than it can produce it (Lloyd 1994) in an environment where the surrounding temperature is lower than the body temperature. (Tom, Garmel, i Auerbach 1994) Hypothermia can be primary (accidental) and secondary. Primary hypothermia appears when a healthy individual, due to environmental exposure, suffers from an extended and unintentional heat loss. Secondary hypothermia happens due to somatic diseases or impairments that can lead to a lowering of the core body temperature. (Danzl i Pozos 1994; Mohr, Jenabzadeh, i Ahrenholz 2009). Each year in Europe, approximately 400,000 people die from cold-related causes. (García-León et al. 2024). Factors that increase the risk of accidental hypothermia are winter sports performed outdoors, homelessness, and intoxication. (Fujimoto et al. 2020; Paal et al. 2022).

The widely used classification of accidental hypothermia, the Swiss staging of accidental hypothermia, considers core temperature as a classification criterion. (Paal et al. 2022) There are four stages of hypothermia: I - mild; II - moderate; and III and IV are considered severe (Table 2). Specific clinical findings on physical examination characterize each stage of hypothermia. Moreover, the duration of cold exposure can be another factor used to classify hypothermia. Hypothermia can be acute (minutes), subacute (hours), or chronic (days), depending on the time of development. (Hypothermia 2003)

Table 2. Types of hypothermia

Stages of hypothermia	
Stage	Core Temperature
I (mild)	35 - 32
II (moderate)	< 32-28
III (severe)	<28
IV (severe)	Classically < 24

To accurately assess the severity of hypothermia, it is necessary to measure the body's core temperature. According to the 2025 ERC Guidelines, the gold standard for diagnosing hypothermia is the use of a low-reading thermometer (Paal et al., 2022). The location of the temperature measurement depends on the patient's condition. In spontaneously breathing patients, tympanic temperature measurement is recommended (Lott et al., 2025), and in patients with a tracheal tube or supraglottic airway in situ, oesophageal temperature measurement is recommended. (Pasquier et al. 2020) If measuring core temperature is impossible, the ERC 2025 Guidelines recommend using the Revised Swiss Staging System (Table 3), whereby temperature can be assessed based on the level of consciousness (Musi et al., 2021).

The Revised Swiss System for staging of accidental hypothermia uses the known scale AVPU (alert, verbal, pain, unresponsive) to estimate the stage of hypothermia and risk of cardiac arrest. (Lott et al. 2025):

A - “Alert” patients represent mild Hypothermia I and low risk of cardiac arrest.

V - “Verbal” patients represent moderate Hypothermia II and moderate risk of cardiac arrest.

P - “Painful” and “Unconscious” with vital signs patients represent severe Hypothermia III and high risk of cardiac arrest.

U - “Unconscious” with no vital signs patients represent severe Hypothermia IV and hypothermic cardiac arrest.

Table 3. Revised Swiss System for staging of accidental hypothermia

Revised Swiss System				
Stage of hypothermia	I	II	III	IV
Clinical state of the patient	ALERT	VERBAL	PAINFUL or UNCONSCIOUS with vital signs present	UNCONSCIOUS and no detectable vital signs
Risk of cardiac arrest	Low	Moderate	High	Hypothermic cardiac arrest

The Revised Swiss System, like any scale, has its limitations. Medical conditions impairing consciousness may falsely suggest a higher risk of cardiac arrest. Meanwhile, alertness and verbalization observed in a patient can lull vigilance and lead to disregard of signs of haemodynamic or respiratory instability, such as bradycardia, bradypnoea, or hypotension. (Paal et al. 2022)

Avalanche accident

In the 2025 ERC Guidelines, the section on special circumstances includes a substantially updated subsection compared with the 2021 ERC Guidelines: “Avalanche rescue”. According to the 2025 changes, avalanche rescue comprises:

- Cardiopulmonary Resuscitation (CPR) of critically buried victims in case of a cardiac arrest; (Figure 1)
- The Avalife algorithm for BLS providers, in cases involving the burial of multiple people and insufficient on-site staff,

Critically buried victim, meaning a victim with face and chest buried under snow. CPR is based on core temperature, burial time, airway patency, and the presence or absence of a witness to the cardiac arrest. Primarily, in the presence of any lethal injuries, it is advised to discontinue CPR or refrain from starting in the first place.

If the duration of burial is longer than 60 min, the ECG presents asystole, no one witnessed the cardiac arrest, and the airways are obstructed, it is advised to terminate the resuscitation. In contrast, for burials lasting less than 60 min, ECG findings of VF or PEA, the presence of a witness to the cardiac arrest, and patent airways warrant proceeding with rescue efforts; subsequent procedures are determined by oesophageal temperature. If the oesophageal temperature is unknown or under 30°C, transport the patient with ongoing CPR to the hospital with ECLS. On the contrary, in the case of temperature over 30°C, consider termination of resuscitation if, after 20 minutes of CPR, there is no return of spontaneous circulation (ROSC).

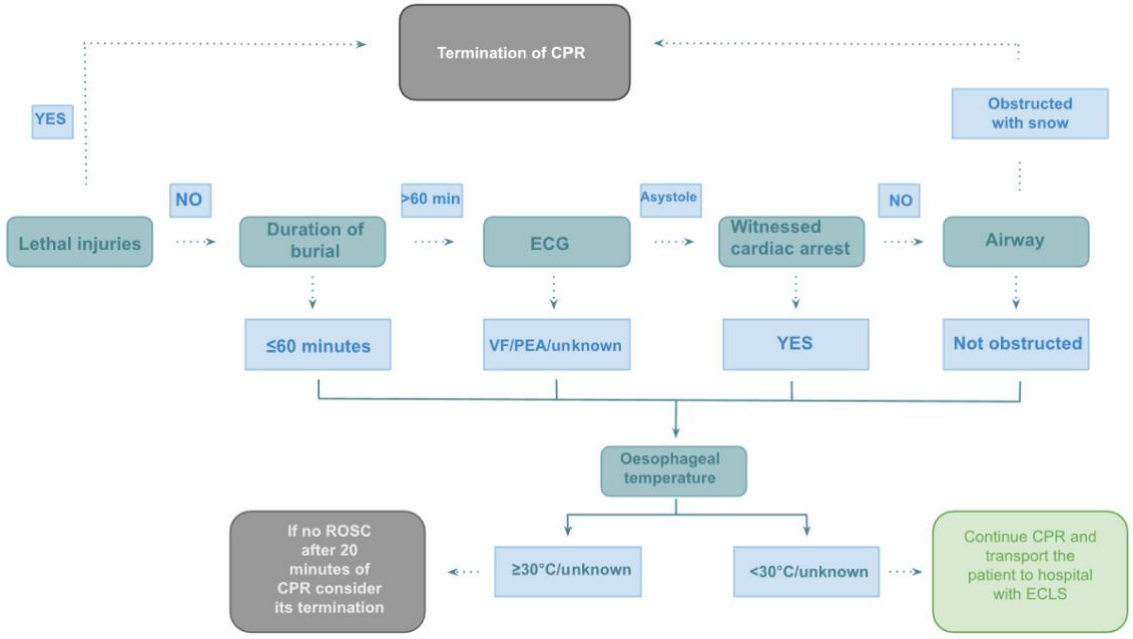

Fig. 1. *Avalanche rescue algorithm in case of a cardiac arrest*

As a significant number of avalanche victims suffer from hypothermia, it is essential to transport them to a hospital with accessible ExtraCorporeal Life Support (ECLS). Veno-Arterial Extracorporeal Membrane Oxygenation (VA-ECMO) is the preferred method of ECLS. (Mendrala et al. 2024; Ruttmann et al. 2007). VA-ECMO may externally oxygenate blood removed from the body in case of heart and lung failure. Moreover, when removing cold blood from the body, rewarming it externally and then replenishing the patient with warmed blood, ECLS increases body temperature, thereby helping to rewarm the whole body. To assess the patient's condition and estimate prognosis, the HOPE score is recommended. The HOPE score can be calculated using an online calculator. The factors considered are age, sex (male or female), presence or absence of asphyxia, duration of CPR, serum potassium level(mmol/L), and temperature.

The AvaLife algorithm

The AvaLife algorithm, designed by Manuel Genswein and other experts from scratch, using mathematical and statistical approaches, including Monte Carlo simulations, was published in 2022. The ERC 2025 Guidelines were updated to include the AvaLIfe algorithm as the recommended procedure for multiple avalanche victims with too few people on site, enabling identification of the buried subjects who should be excavated first and establishing the duration of resuscitation.

The AvaLife procedure is divided into four parts:

1. Search and Excavate;
2. Out-of-hospital Medical Treatment;
3. Hypothermia Staging;
4. iCPR.

Section “ Search and Excavate” prioritizes searching avalanche victims buried below less than 1.5 m of snow in more probable burial areas, including areas with no trees, no high fall, no crevasses or seracs, and

preferably victims with increased survival chances indicated by vital data of the transceiver. When found, it is advisable to focus primarily on excavating the head and chest.

When the patient's upper or whole body is completely excavated from under the snow, we proceed to the "out-of-hospital medical treatment".

As in any BLS scenario, we should assess for signs of consciousness, airway obstruction, and breathing. If no signs of breathing are observed, we perform five rescue breaths, as asphyxia is one of the most common death causes in avalanche victims. (Romy et al. 2025) Similar conduct is advised in drowning victims and strangulation victims.

If no signs of life appear, the next medical actions depend on the cause of the patient's unconsciousness - asphyxia or hypothermia. To determine that, the questions of core temperature and burial duration must be answered. While hypothermia appears when the core temperature is < 30°C and burial time > 60 minutes, asphyxia can be suspected when core temperature ≥30°C and burial time ≤ 60 minutes.

In case of asphyxia, we start CPR, except if injuries that are not compatible with life are present. If no life-incompatible injuries are identified, we should base our next step on the ECG. The presence of VF/pVT or PEA leads us to follow a universal ALS algorithm. When asystole is observed or it is impossible to perform an ECG we ought to follow the universal ALS algorithm if all buried subjects are excavated, or in case of other victims remaining under snow CPR should be continued for 6 minutes, if no signs of life are observed by that time, we should consider termination of CPR, maximalizing the chance of rescuing a greater number of victims.

In cases of hypothermia, we are guided by the ECG. When bradycardia is present, continuous monitoring and prevention of further cooling of the patient are recommended.

ECG reading of VF, pVT, and PEA urges us to start CPR. In the presence of any injuries incompatible with life, consider termination of CPR.

If asystole or no ECG is obtained, and the airways are patent, continue CPR. Airway obstruction and the presence of injuries incompatible with life prompt us to terminate CPR.

In all cases of CPR in patients with no injuries incompatible with life or simply in patients with bradycardia during the rescue mission, alert a hospital with ECLS.

After performing the "out-of-hospital medical treatment" mentioned above, we may identify and clarify the stage of hypothermia. It is helpful to use the Revised Swiss Staging. (Table 2)

Subsequently, the use of intermittent CPR (ICPR) (Figure 2) must be discussed. ICPR is considered only when transport is unavoidable and effective CPR is impossible, or when continuous CPR is impossible due to extremely limited resources. To qualify for ICPR, the body's core temperature must be <28°C, and the burial duration must be >60 minutes. When we decide to take advantage of ICPR, we must first always perform CPR uninterruptedly for one-third of the burial duration. Core temperature of 28°C - 20°C requires at least 5 minutes of CPR and can be followed by a maximum of 5 min without any CPR. A core temperature <20°C provides an additional 5 minutes without CPR, for a total of 10 minutes.

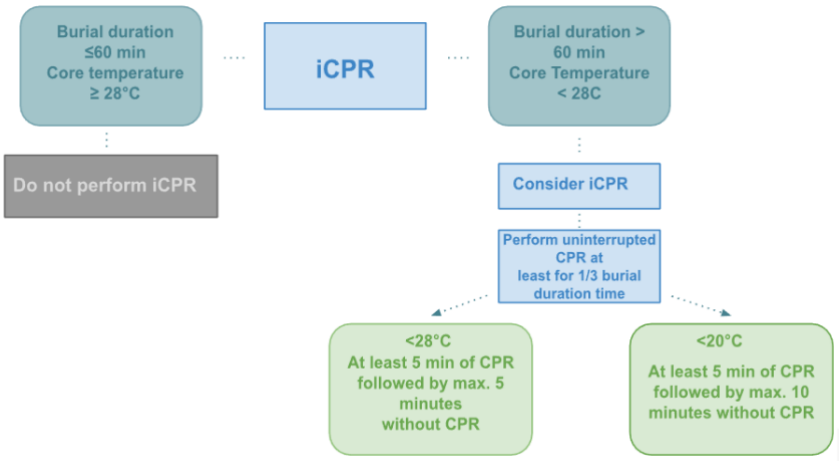

Fig. 2. *iCPR algorithm*

Conclusions

The rise in popularity of winter sports has prompted health organizations to publish concise guidelines for managing avalanche-related accidents. The European Resuscitation Council systematically updates its recommendations for use in emergencies. The 2025 ERC updates introduced a significant change in avalanche procedures: a new avalanche rescue algorithm and BLS guidelines for cases with insufficient on-site personnel.

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