

Avalanche Incidents

Before leaving base

- Request MULTIAGENCY talk group
- Ask SSD to consider tasking SORT
- Take Mechanical CPR device
- Take VHF radio - Channel 62A

On arrival

- Meet with MRT leader(s) and SAR helicopter commander
- Ensure all understand patient to be assessed on site and not taken directly to hospital
- Set up clinical area for patient reception
- MRT leader is responsible for scene safety
- Do not enter areas requiring ropes, crampons or ice axes

Information gather

- Time of avalanche
- Time of rescue
- If airway clear or obstructed with snow or ice
- If air pocket around head

Do not start resuscitation attempt

- Chest wall frozen and incompressible
- Burial >60 mins AND asystole AND airway obstructed

Cardiac arrest survival unlikely

- Buried <60mins (likely asphyxia or trauma not hypothermia)
- Provide 20 minutes standard ALS then consider stopping

Resuscitation of hypothermic arrest

- See hypothermic cardiac arrest card

Water Incidents

Before leaving base

- Request MULTIAGENCY talk group
- Ask SSD to consider tasking SORT
- Take Mechanical CPR device
- Take VHF radio - Channel 62A

On arrival

- Meet with incident commanders of all agencies
- Ensure all understand patient to be assessed on site and not taken directly to hospital
- Set up clinical area for patient reception
- Wear life jacket within 3m of waters edge

Information gather

- Time into water
- Time of rescue
- Head above or below water
- Measure water temperature if safe to do so

Survival is unlikely

- Submerged >30 mins in water >6°C
- Submerged >90 mins in water <6°C
- Provide 20 minutes standard ALS then consider stopping

Resuscitation of hypothermic arrest

- See hypothermic cardiac arrest card

Hypothermic Cardiac Arrest

Patient management

- Palpate pulse for 1 minute to confirm arrest
- Consider cardiac ultrasound
- Intubate trachea
- Deploy mechanical CPR device
 - usually contraindicated in children due to size
- Measure oesophageal temperature
- Measure potassium and glucose
- Defibrillation - maximum 3 shocks if temperature $<30^{\circ}\text{C}$
- ALS/PALS drugs
 - $<30^{\circ}\text{C}$ - no drugs
 - $30-35^{\circ}\text{C}$ - double dose intervals
- Insert orogastric tube
- Consider arterial line - avoid femoral arteries

Calculate HOPE score

- Call Glasgow PICU about children - do not use HOPE score.
- Use EMRS app or www.hypothermiascore.org
 - asphyxia: submersed or airway obstructed by snow
 - no asphyxia: immersed or airway clear in avalanche
 - use no asphyxia if uncertain
 - potassium – enter 4.5 if unable to measure
- Refer for ECLS if survival chance $> 10\%$

Hospitals with ECLS capability

- Aberdeen ECMO: 01224 607018 (or 07917 068628)
- Edinburgh ICU: 0131 242 1181
- Glasgow Children's PICU: 0141 452 4718

CG013 Accidental Hypothermia

2. Document History			
Reference Number	CG013		
Version	2		
Writing group (Lead author in bold)	Alastair Baird	Emergency Physician	EMRS West
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	ScotSTAR	EMRS West	✓
		EMRS North	✓
		Paediatric	X
		Neonatal	X
Tayside Trauma Team		✓	



3. Scope and purpose

- Overall objectives:

Moderate-severe hypothermia is defined as a core temperature $<32^{\circ}\text{C}$ and is usually associated with altered conscious level and loss of shivering. There is significant potential for rapid deterioration and cardiovascular instability, however favourable outcomes following cardiac arrest can be achieved despite prolonged resuscitation. This guideline aims to provide recommendations for managing patients with moderate-severe hypothermia including the approach to drowned and avalanched victims.

- Statement of intent:

This guideline is not intended to be construed or to serve as a standard of care. Adherence to guideline recommendations will not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgement must be made by the appropriate healthcare professional(s) responsible for clinical decisions regarding a particular clinical procedure or treatment plan.

- Feedback:

Comments on this guideline can be sent to: sas.cpg@nhs.scot

- Equality Impact Assessment:

Applied to the ScotSTAR Clinical Standards group processes.

- Guideline process endorsed by the Scottish Trauma Network Prehospital, Transfer and Retrieval group.

4. Explanatory Statements		
4.1 Before leaving base	Authors' recommendation	Level [Reference]
<ul style="list-style-type: none"> Request multiagency talk group. 	GPP	
<ul style="list-style-type: none"> Ask SSD to consider tasking SORT. <p>SORT can provide additional manpower, scene management and logistical support (OG038 SORT). SORT also have water rescue capability and can provide PPE and equipment for working in and around water (life vests, helmets, reach poles, inflatable raft / stretcher).</p> <p>Specific specialist equipment includes:</p> <ul style="list-style-type: none"> Flectalon blankets basket and MIBS stretchers all terrain vehicle scene lighting and tentage search technology (range finder, night vision device, thermal image camera) 		
<ul style="list-style-type: none"> Take mechanical CPR device. 		
<ul style="list-style-type: none"> Take VHF radio - Channel 62A <p>All MRT members carry a VHF radio and should be contacted on channel 62A. Some teams have access to Airwave and should provide a talk group to ACC.</p>		
4.2 On arrival		
<ul style="list-style-type: none"> Meet with incident commanders of all agencies. Ensure it is understood for the patient to be assessed on site and not taken directly to hospital. Set up clinical area for patient reception. MRT leader is responsible for scene safety. Do not enter areas requiring ropes, crampons or ice axes. Wear life jacket if <3m from water's edge. <p>The medical role is not to perform rescue operations but to assess and stabilise the patient following extrication. This should occur distant to the incident site where possible.</p>	GPP	

4.3 Information gather	Authors' recommendation	Level [Reference]
<ul style="list-style-type: none"> • <i>Times: incident / rescue services arrival / rescue.</i> <p>Determine submersion time from arrival of first emergency service; eye-witness accounts of submersion times are unlikely to be accurate.</p>	Conditional	4 [7]
<ul style="list-style-type: none"> • <i>If airway clear or obstructed with snow or ice.</i> • <i>If air pocket around head</i> <p>Survival from avalanche burial is 70-80% in the first 15 minutes, dropping to 7-32% at 35 minutes. This reflects a significant proportion of asphyxial deaths. Prognosis is dependent on burial time, core temperature, mode of cardiac arrest and associated injuries. Air pocket presence implies a patent airway has been present for at least part of the burial.</p>	Strong	Guidelines [3,6]
<ul style="list-style-type: none"> • <i>Head above or below water.</i> <p>Distinguish submersion (i.e. head under) from immersion (i.e. head above). The prognosis for immersed patients is much better than those who have been submerged.</p>	Strong	4 [7]
<ul style="list-style-type: none"> • <i>Measure water temperature if safe to do so.</i> <p>Water temperature has a significant impact on outcome. Inland water may remain below 6°C from December until April. Coastal water in Scotland rarely falls below 6°C.</p>	Conditional	4 [7]
4.4 Do not start resuscitation attempt		
<ul style="list-style-type: none"> • <i>Chest wall frozen and incompressible</i> • <i>Avalanche: burial >60min AND asystole AND airway packed with snow or ice.</i> <p>Snow or ice impacted in airway suggests primary asphyxial arrest.</p>	Strong	Guideline [3]
4.5 Survival is unlikely		
<ul style="list-style-type: none"> • <i>Submerged ≥30 mins in water >6°C</i> • <i>Submerged ≥90 mins in water <6°C</i> • <i>Provide 20 minutes standard ALS then consider stopping</i> <p>There have been no recorded survivors of submersion longer than 30 minutes in water warmer than 6°C or more than 90 minutes in colder water. Cardiac arrest in warm water should be managed as a primary asphyxial event. The patient will not have cooled quickly enough to confer a neuroprotective effect. There is a low chance of favourable outcome if submersion time is >25mins. Submersion in icy water may induce hypothermia rapidly and provide some neuroprotection, particularly in children.</p>	Strong	Guideline [3,7]
4.6 Cardiac arrest survival unlikely		
<ul style="list-style-type: none"> • <i>Avalanche and <60min burial time.</i> • <i>Provide 20 minutes standard ALS then consider stopping</i> <p>It is unlikely that sufficient time will have elapsed to induce severe hypothermia.</p>	Conditional	Guideline [3]

4.7 Patient management	Authors' recommendation	Level [Reference]
<ul style="list-style-type: none"> Palpate pulse for 1 min to confirm cardiac arrest. Consider cardiac ultrasound. <p>Confirmation of PEA in severe hypothermia is difficult in a pre-hospital environment. Ultrasound can help confirm inadequate cardiac activity corresponding to electrical activity.</p>	Strong	Guidelines [1,3] 4 [2]
<ul style="list-style-type: none"> Intubate trachea. <p>Intubation is the preferred means of airway management in the severely hypothermic patient. Reduced chest compliance may require higher pressures to achieve effective ventilation. Supraglottic airways may not achieve an adequate seal in a cold airway to allow for effective ventilation.</p>	Conditional	Guidelines [1,3]
<ul style="list-style-type: none"> Deploy mechanical CPR device. <p>Prolonged CPR is often required in hypothermic patients. Within the constraints of pre-hospital teams and working within the aeromedical environment mechanical CPR is a useful tool to achieve the duration and quality of CPR required. Manufacturer guidelines state that the LUCAS should not be used if patients are too small. The LUCAS device will alarm if the patient is too small for the device (EG030 LUCAS3 Mechanical CPR device). This is likely to include the majority of patients <12 years old.</p>	Conditional	Guidelines [1,3,10]
<ul style="list-style-type: none"> Measure oesophageal temperature. <p>Monitoring at the lower third of the oesophagus provides accurate representation of actual core temperature.</p>	Strong	Guidelines [1,3] 4 [2]
<ul style="list-style-type: none"> Measure potassium and glucose. <p>The potassium is a component of the HOPE score. Upper limits of detection for the iSTAT point of care analyser is 9mmol/l, and 12mmol/l for the EPOC. Most hospital laboratories can measure up to 15mmol/L.</p>		
<ul style="list-style-type: none"> Defibrillation - maximum 3 shocks if temperature <30°C <p>The cold myocardium will be resistant to defibrillation and so rewarming should be achieved before further attempts to defibrillate are made.</p>	Strong	Guideline [3]
<ul style="list-style-type: none"> ALS/PALS drugs: <ul style="list-style-type: none"> <30°C - no drugs. 30-35°C - double dosing intervals. <p>Vasoactive drugs may be ineffective in severe hypothermia and can accumulate to toxic levels as the enzymes normally involved in their metabolism are often inactive.</p>	Strong	Guidelines [1,3]
<ul style="list-style-type: none"> Insert orogastric tube. <p>Gastrostasis and/or water ingestion may result in gastric distension. Gastric decompression will facilitate ventilation.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> Consider arterial line - avoid femoral arteries 	GPP	

4.8 Calculate HOPE score	Authors' recommendation	Level [Reference]
<ul style="list-style-type: none"> • <i>Call Glasgow PICU about children - do not use HOPE score.</i> <p>The ERC [3] specifically advise against use of the HOPE score in children. The single false negative case in the HOPE validation cohort was a child and the authors advised caution in its use in children.</p>	Strong	Guideline [3] 3 [5]
<ul style="list-style-type: none"> • <i>Use EMRS app or www.hypothermiascore.org</i> <ul style="list-style-type: none"> - <i>asphyxia: submersed or airway obstructed by snow</i> - <i>no asphyxia: immersed or airway clear in avalanche</i> - <i>use no asphyxia if uncertain</i> - <i>potassium – enter 4.5 if unable to measure</i> • <i>Refer for ECLS if survival chance > 10%</i> <p>The HOPE score is recommended [3] for prognostication and performs better than traditional serum potassium cut offs. The score was derived from a retrospective cohort data set [4] and subsequently validated [5] in a heterogenous population of patients undergoing extra-corporeal rewarming for hypothermic cardiac arrest. The area under the receiver operating characteristic curve in the validation cohort was 0.825 (95%CI 0.753 to 0.897).</p>	Strong	Guideline [3] 3 [4,5]
4.10 ECLS without cardiac arrest		
<ul style="list-style-type: none"> • <i>Consider referral with hypothermia and any of:</i> <ul style="list-style-type: none"> - <i>systolic blood pressure <90mmHg</i> - <i>ventricular arrhythmia</i> - <i>temperature <30°C (or <32°C in old or multimorbid)</i> <p>Patients with evidence of cardiovascular instability or at high risk of such should be referred to a centre capable of ECLS.</p>	Strong	Guidelines [1,3] 4 [2]
<ul style="list-style-type: none"> • <i>Consider ECLS if submerged in water <6°C.</i> <p>Patients submerged in icy water may have cooled sufficiently prior to arrest to confer a neuroprotective effect. These patients may benefit from ECLS rewarming.</p>	Conditional	3 [7, 8, 9]
<ul style="list-style-type: none"> • <i>If transferring for ECLS then inform local hospital of change in destination.</i> <p>If the patient is to be transferred for ECMO then ensure the local hospital is aware that they will not be receiving the patient as they may be awaiting their arrival.</p>	GPP	

5. References

1. Zafren K et al. Wilderness Medical Society Practice Guidelines for the Out-of-Hospital Evaluation and Treatment of Accidental Hypothermia. *Wilderness Environ Med.* 2014;25:425-445. [guideline]
2. Paal P et al. Accidental Hypothermia: 2021 Update. *Int. J. Environ. Res. Public Health* 2022, 19, 501. [expert opinion].
3. Lott C et al. European Resuscitation Council Guidelines 2021: Cardiac arrest in special circumstances. *Resuscitation* 2021; 161: 152-219.
4. Pasquier M et al. Hypothermia outcome prediction after extracorporeal life support for hypothermic cardiac arrest patients: The HOPE score. *Resuscitation.* 2018;126:58-64
5. Pasquier M et al. Hypothermia outcome prediction after extracorporeal life support for hypothermic cardiac arrest patients: An external validation of the HOPE score. *Resuscitation* 2019; 139: 321-328.
6. Brugger H., Durrer B., Elsensohn F., Paal P., et al. Resuscitation of avalanche victims: Evidence-based guidelines of the international commission for mountain emergency medicine (ICAR MEDCOM). *Resuscitation.* 2013;84:539-546
7. Tipton M., Golden F. A proposed decision-making guide for the search, rescue and resuscitation of submersion (head under) victims based on expert opinion. *Resuscitation.* 2011;82:819-824
8. Burke C., Chan T., Brogan T., Lequier L., et al. Extracorporeal life support for victims of drowning. *Resuscitation.* 2016;104:19-23
9. Weuster M., Haneya A., Panholzer B., Kluter T., et al. The Use of Extracorporeal Membrane Oxygenation Systems in Severe Accidental Hypothermia After Drowning: A Centre Experience. *ASAIO J.* 2016;62:157-162
10. https://www.lucas-cpr.com/files/1757365_101034-01%20Rev%20F%20LUCAS%203%20IFU%20EN_lowres.pdf