

The ICAR MEDCOM

Commission for Mountain Medicine
of the International Commission for Alpine Rescue

www.alpine-rescue.org



ICAR MEDCOM RECOMMENDATION

Nr.	MED-REC-0037-2020
Version	1.0
Title	Multiple Trauma Management in Mountain Environments - A scoping review
Author(s)	Sumann Guenther, Moens Didier, Brink Bruce, Brodmann-Maeder Monika, Greene Mike, Jacob Mathias, Koirala Pranawa, Zafren Ken, Ayala Marin, Musi Martin, Oshiro Kazue, Sheets Alison, Strapazzon Giacomo, Macias Darryl, Paal Peter
Responsible person	Paal Peter
Originally based on	N/A
Date of publication	12/14/2020
Valid Until	12/13/2025

1. Background

Multiple trauma in the mountains may be associated with increased morbidity and mortality compared to urban environments. The objective of the paper is to provide evidence-based guidance to assist the rescuer in multiple trauma management in mountain environments and to present an algorithm for the management of multiple trauma in mountainous terrain.

2. Recommendations

Nr.	Recommendation	Grade
	Situation awareness and Safety	
1	Consider terrain, weather, transport conditions and limited resources when treating a multiple trauma patient in the mountains.	1C
2	On-scene safety to rescuers takes precedence over patient safety.	1C
3	Wear helmets to protect against traumatic brain injury (TBI).	1B
4	Use additional safety equipment to prevent injuries and infection.	1C
5	Consider a “grab and go” over a “stabilize on site” approach in a dangerous environment.	1C
	A- Airway and C- Spine	
6	Provide oxygen (2B) especially at higher altitude (e.g. 2.500m a.s.l.) (1A).	2B, 1A
7	Rescuers should be competent in opening, clearing and maintaining an airway patent.	1C
8	Only experienced rescuers should perform prehospital tracheal intubation.	1B
9	Consider advanced airway management with seriously impaired gas exchange.	2B
10	Be cautious with advanced airway management prior to extrication by hoist because the artificial airway may dislocate or the patient being hypoventilated.	1C
11	Consider a videolaryngoscope and an introducer to facilitate tracheal intubation.	1B
12	Consider a supraglottic device as an alternative to tracheal intubation.	2A
13	Reserve tracheal intubation for children to experienced rescuers and ventilate with bag-valve-mask instead.	2B
14	After establishing an advanced airway use capnography to confirm correct position and guide normo-ventilation	2B
15	Do not immobilize the C-spine of all blunt trauma patients nor neurologically intact patients with penetrating trauma.	1A
16	Do not pre-hospitally clear the C-spine in children.	1C

17	Immobilize the C-spine using manual in-line stabilization, SAM-splints or cervical collars.	1B
	B - Breathing and Thoracic Injury	
18	Establish normoventilation with lung-protective ventilation and establish normoxia, and normocapnia in TBI patients.	1A
19	Identify respiratory distress and use a pulse oximeter.	1B
20	Consider the potential critical expansion of pneumothorax during helicopter evacuation.	1B
21	If severe respiratory or circulatory compromise occur consider a deteriorating tension pneumothorax causative and immediately decompress the pleural cavity with a “mini-thoracostomy” or pigtail catheter	1B 2B
	C – Circulation and Bleeding Control	
22	Stop haemorrhage.	1A
23	Maintain oxygenation and perfusion (mean arterial pressure (MAP) ≥ 65 mmHg in priorly normotensive patients).	1C
24	With uncontrolled haemorrhage, allow for permissive hypotension.	1B
25	In case of severe haemorrhage rapid transport is key.	1B
26	Bleeding control: First, attempt direct manual compression.	1A
27	Use a modern tourniquet for uncontrolled extremity bleeding, it facilitates extraction.	1B
28	Release tourniquet only after provision of definitive care. Avoid release of the tourniquet every two hours.	2B 2C
29	Consider non-compressible truncal haemorrhage control with expandable sponges and junctional tourniquets for the axilla and inguinal areas.	2C
30	Consider temporary aortic occlusion with resuscitative balloon occlusion of the aorta (REBOA) for internal abdominopelvic haemorrhage.	2C
31	Consider pelvic binders to close the pelvic ring.	2C
32	Bleeding control: Administer TXA within three hours post-trauma.	1B
33	Consider desmopressin for patients on platelet inhibitors, with von Willebrand disease.	2A
34	Consider desmopressin for patients with hypothermia-induced hypocoagulation.	2C
35	Consider fibrinogen concentrate administration over fresh frozen plasma (FFP).	2B
36	Consider coagulation factor concentrates administration.	2A
37	Consider reversal of coagulation factor inhibitors	2A
38	Consider haemostatic dressings over plain gauze.	1C

39	Establish at least one large bore IV-access for administration of fluid.	1C
40	Establish IO access if IV access is impossible after three attempts and fluid and drug administration are required.	1C
41	Consider rapid volume repletion judiciously to restore cardiac preload.	1A
42	Consider norepinephrine in non-critically bleeding TBI patients to maintain cerebral perfusion pressure during prolonged transport.	1C
	D- Disability and Neurotrauma	
43	In TBI, assess ventilation clinically and monitor patients with pulse-oximetry to minimise hypoxia.	1C
44	Use capnography to establish normocapnia and established airway.	1C
45	In TBI, aim for a systolic blood pressure ≥ 110 mmHg.	2C
46	In TBI, expedite rescue and do not delay evacuation by maintaining head elevation	1C
47	In TBI, administer tranexamic acid within the first three hours after trauma.	1A
48	In TBI, avoid hypothermia.	1C
49	Immobilise the spine of all multiple trauma patients when the conscious level is altered.	1C
50	Use a clinical decision rule to identify patients at risk from secondary spinal injury and only if positive immobilize the spine.	1B
51	Limit spinal motion with a combination of manual stabilisation, head blocks and hard or soft transfer devices.	1C
52	For spine immobilisation, use techniques with minimal handling.	1C
53	Do not log roll unstable trauma patients.	1C
54	Consider a vacuum mattress for a long comfortable transfer.	1C
55	Consider a KED or similar device for extrication in a non-horizontal position.	1C
	E- Environment and Exposure	
56	For patient assessment, consider whether exposure is helpful in a given setting.	1C
57	Exam sequentially by body regions avoiding heat loss and preserving insulating clothing.	2C
	First aid, splinting and immobilisation	
58	Consider early splinting to reduce pain and blood loss and ease transportation.	1C
59	Use splinting devices you are familiar with.	1C
60	Consider the use of a vacuum splints.	1C
	Analgesia	
61	Consider non-pharmacologic interventions (e.g. immobilization).	1C

62	Consider the use of ketamine and other non-opioid analgesics (1C). Use opioids judiciously.	1C
63	Consider regional anaesthesia in wilderness especially with painful injuries during long and difficult extrications or during fracture and joint reposition, repair and foreign body removal.	1B
64	Regional anaesthesia may be ideal if respiratory compromise is of concern with systemic analgesia.	1B
65	Ultrasound guidance of regional anaesthesia is recommended.	1C
	Temperature Management and Hypothermia	
66	Without any diagnostic device use the Swiss staging system for hypothermia.	1C
67	Epitympanic thermistor thermometers may be reliable for core temperature monitoring but lack of available equipment for field operations limit their use.	1B
68	In patients with a secured airway consider core temperature measurement with an oesophageal probe.	2A
69	A hypothermic patient should be extracted from the cold and covered by a tightly fitting vapor barrier followed by whole-body insulation.	1C
70	Rewarming devices should be used in conjunction with vapor barriers and insulation.	1C
	Transport and hospital selection	
71	Expedite transport of a multiple trauma patient.	1C
72	Use light and stable stretchers for transport.	1C
73	Avoid verticalizing the patient as this may lead to arterial hypotension especially in exsanguinated and vasoplegic patients.	1C
74	Use helicopters for patients with spinal injury or who are haemodynamically unstable.	1C
75	Transport TBI patients airborne if this saves time to definitive treatment.	1B
76	Use helicopters to reach a distant high-level trauma centre, bypassing smaller local hospitals.	1B
77	Balance the benefits of air rescue with its inherent risks.	1C
	Ultrasound	
78	Consider point-of-care ultrasound (POCUS) in multiple trauma patients but do not considerably delay arrival to hospital.	2B
79	Consider POCUS to manage a difficult airway.	2C
80	Consider POCUS to detect pneumo- and haemothorax and pericardial effusion.	1A
81	Consider POCUS to detect fractures.	2B

82	Consider POCUS to detect increased intracerebral pressure.	2B
83	Consider FAST in patients in shock.	1B
84	Use ultrasound for vascular access and nerve blocks.	1A

3. Literature

Recommendation originally based on:

Sumann, G., Moens, D., Brink, B. *et al.* Multiple trauma management in mountain environments - a scoping review. *Scand J Trauma Resusc Emerg Med* **28**, 117 (2020)

<https://sjtrem.biomedcentral.com/articles/10.1186/s13049-020-00790-1>

The Grading System of the American College of Chest Physicians

Grade	Description	Benefits vs risks and burdens	Methodological quality of supporting evidence
1A	Strong recommendation, high-quality evidence	Benefits clearly outweigh risks and burdens or vice versa	RCTs without important limitations or overwhelming evidence from observational studies
1B	Strong recommendation, moderate-quality evidence	Benefits clearly outweigh risks and burdens or vice versa	RCTs with important limitations or exceptionally strong evidence from observational studies
1C	Strong recommendation, low-quality or very low-quality evidence	Benefits clearly outweigh risks and burdens or vice versa	Observational studies or case series
2A	Weak recommendation, high-quality evidence	Benefits closely balanced with risks and burdens	RCTs without important limitations or overwhelming evidence from observational studies
2B	Weak recommendation, moderate-quality evidence	Benefits closely balanced with risks and burdens	RCTs with important limitations or exceptionally strong evidence from observational studies
2C	Weak recommendation, low-quality or very low-quality evidence	Uncertainty in the estimates of benefits, risks, and burden; benefits, risk, and burden may be closely balanced	Observational studies or case series

American College of Chest Physicians classification scheme for grading evidence and recommendations in clinical guidelines. RCT, randomized controlled trial.

Source: Guyatt et al. Chest 2006;129:174-81.