Comparison of different mechanical chest compression devices in the alpine rescue setting: a randomized triple crossover experiment

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Goal

In 2020, 261 people died in the Austrian Alps. Contrary to popular believe, only about 4 % of them died because of avalanche burial, whereas 22% died due to non- traumatic cardiac arrest (1). Current guidelines support the use of mechanical chest compression devices during transport after hypothermic cardiac arrest (2). Use of such devices might, however, be also helpful for normothermic patients, e.g. during transportation through rough terrain, or even helicopter hoist rescue. . Currently, there is little evidence on the quality of CPR by chest compression devices in rough alpine terrain (3). We therefore aimed to investigate the feasibility and quality of continuous mechanical chest compression during alpine terrestrial transport.

Methods

Randomised triple crossover prospective study in an alpine environment. Nineteen teams of the Austrian Mountain Rescue Service trained according to current ERC guidelines performed three runs each of a standardised alpine rescue-scenario, using three different devices for mechanical chest compression. Quality of CPR, hands-off- time and displacement of devices were measured.

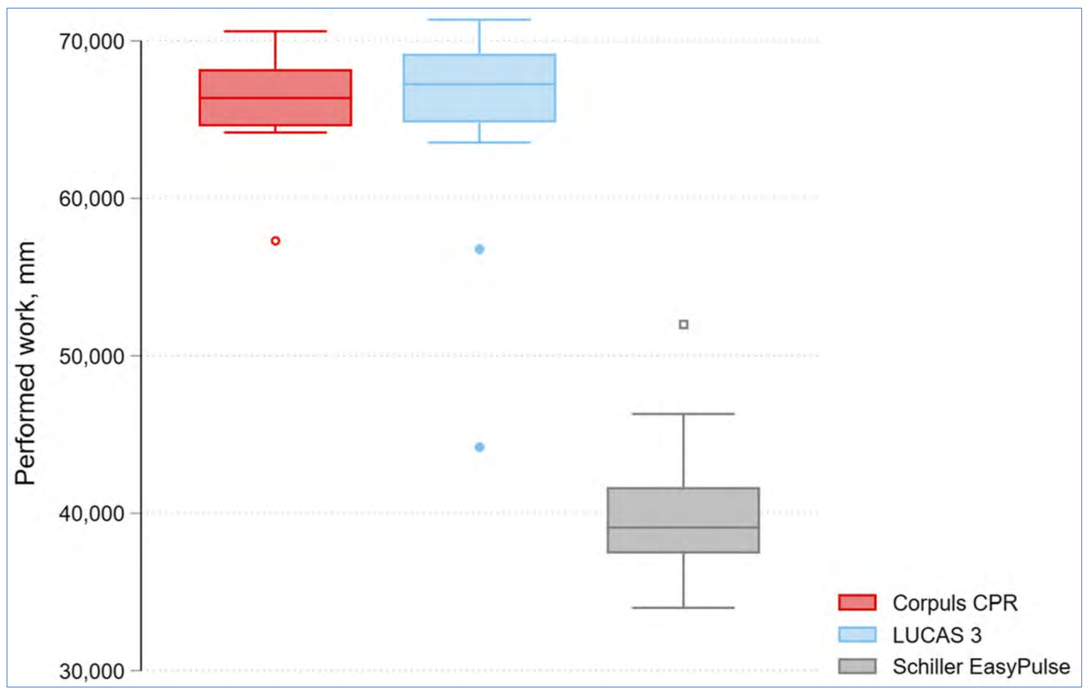
Transport in alpine stretcher – PhysioControl LUCAS

Results

The primary outcome of performed work (defined as number of chest compressions x compression depth) was 66,062 mm (2,832) with Corpuls CPR, 65,877 mm (6163) with Physio-Control LUCAS 3 and 40,177 mm (4,396) with Schiller Easy Pulse. The difference both between LUCAS 3 and Easy Pulse (Δ 25,700; 95% confidence interval 21,118 – 30,282) and between Corpuls CPR and Easy Pulse (Δ 25,885; 23,590 – 28,181) was significant. No relevant differences were found regarding secondary outcomes.

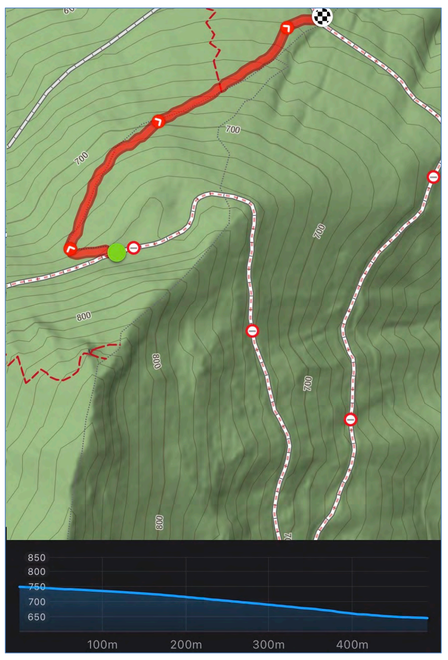
Conclusion

Mechanical chest compression devices provide a viable option in the alpine setting. For two out of three devices (Corpuls CPR and LUCAS 3) we found adequate quality of CPR. Those devices also maintained a correct placement of the piston even during challenging terrestrial transport. Adequate hands-off-times and correct placement could be achieved even by less trained personnel.



Main outcome (performed work) by device

Device used in the study – Corpuls CPR



Map of hiking trail

References

1. Sicherheit ÖKfA. Jahresrückblick Alpinunfälle 2020. 20.01.2021 (https://www.alpinesicherheit.at/data/docs/2021/presseaussendung_rueckblick%202 020_alpinunfallzahlen.pdf). Accessed 7 Feb 2021.
2. Lott C, Truhlář A, Alfonzo A, Barelli A, González-Salvado V, Hinkelbein J, Nolan JP, Paal P, Perkins GD, Thies KC, Yeung J, Zideman DA, Soar J; ERC Special Circumstances Writing Group Collaborators. European Resuscitation Council Guidelines 2021: Cardiac arrest in special circumstances. Resuscitation. 2021 Apr;161:152-219. doi: 10.1016/j.resuscitation.2021.02.011. Epub 2021 Mar 24. PMID: 33773826.
3. Thomassen O, Skaiaa SC, Assmuss J, Østeraås Ø, Heltne JK, Wik L, et al. Mountain rescue cardiopulmonary resuscitation: a comparison between manual and mechanical chest compressions during manikin cardio resuscitation. Emerg Med J. 2017;34(9):573-7. (In eng). https://doi.org/10.113 6/emermed-2016-206323.

Efficacy and Safety of Methoxyflurane for Treatment of Acute Traumatic Pain by EMTs during Alpine Rescue Operations: The "PainDrop" Trial

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Backround

Treatment of acute traumatic pain is a core task for mountain rescue services. Intravenous access, however, is often difficult, and the vast majority of missions are carried out without a physician at the scene. The spectrum of analgesics available for use by non-physician personnel is limited. Inhaled analgesics, such as methoxyflurane, might prove useful, but currently no data exist on their application by non-physicians in the alpine setting.

Methods

Prospective observational alpine field study. Over a period of 15 months, patients suffering traumatic injury and moderate to severe pain (pain score ≥ 5) after downhill bike accidents in the Tyrol mountains (1,362m to 2,666m above sea level) were enrolled. Teams of four mountain rescue service members, one of them a trained EMT, treated the patients with 3ml of methoxyflurane by inhaler. We measured efficacy as reduction in pain from baseline to 15 minutes after treatment on a numerical rating scale. Safety was assessed by change in vital signs or occurrence of side-effects. Sample-size calculations were based on the efficacy-outcome and yielded a need for 20 patients at a power of 0.8.

Abb. 1: Inhalator Device Methoxyfluran (Quelle: Hersteller)

Results

From June 29, 2020 to September 30, 2021, a total of 20 patients (two females, mean age 37 years) were included. The mean age of the patients was 37 years (range 18-51 years). The most common indication for pain therapy was shoulder injury (n = 11, 55%), followed by injury of the forearm (n = 4, 20%), and injury of the chest (n = 3, 15%). The mean time from emergency call to arrival on-scene was 13min (range 1 – 23 min). The mean sea level of the emergency locations was 1,910m (SD 278m), and the mean ambient temperature was 16°C (SD 4°C).

Initial NRS pain scale was 7.2 (SD 1.0) points. Reduction in NRS pain scores within 15mins, the primary efficacy outcome, was significant by 2.9 points (95% CI 2.2 to 3.6; SD 1.4; p<0.001). Age, BMI, sex, region of injury, and initial pain score had no significant influence on this effect. Regarding the primary safety outcome, no relevant deterioration of vital signs, and none of the pre-defined major side effects were observed. Eight patients reported light-headedness, and four reported dizziness, with no cases of respiratory depression, agitation, nausea or vomiting

Before initiation of pain therapy all patients included in the study would have required an emergency physician for treatment of pain, according to local protocol. Fifteen minutes after the start of inhalation, adequate analgesia was achieved in 13 patients (65%), whereas an emergency physician was still needed for extended analgesia in the remaining seven patients (35%). Initial NRS pain scale of those seven patients was slightly higher (7.7 points) compared to patients not needing extended analgesia later on (6.9 points).

Conclusion

This is the first study to demonstrate the efficacy and safety of pain therapy with methoxyflurane by EMTs in alpine rescue operations. EMT-guided analgesia with methoxyflurane in the moderate altitude alpine rescue setting provided appropriate reduction of pain at the same high level of safety as previously described in other settings. This approach could reduce the need for emergency physicians to provide procedural analgesia in hemodynamically stable patients with non-life threatening injuries. In some circumstances, noninvasive analgesia will be the only available option at all.

	N=20
Efficacy	
Reduction of NRS within first 15 min (mean, 95% CI)	2.9 (2.2-3.6) (p<0.001)
NRS at 0 min (mean, SD)	7.2 (1.0)
NRS at 5 min (mean, SD)	5.5 (1.5)
NRS at 10 min (mean, SD)	4.8 (1.6)
NRS at 15 min (mean, SD)	4.4 (1.9)
NRS at 20 min (mean, SD)	4.1 (1.5)
Need for further analgesia by physician (n, %)	7 (35%)
Safety	
Major side-effects (n, %)	
- Relevant change in vital signs*	0 (0%)
- malignant hyperthermia	0 (0%)
- respiratory depression	0 (0%)
- nausea	0 (0%)
- vomiting	0 (0%)
- agitation	0 (0%)
Minor side-effects (n, %)	
- dizziness	8 (40%)
- light-headedness	4 (20%)

Tab 1: Primary and secondary outcomes

References

- Pietsch U, Strapazzon G, Ambühl D, Lischke V, Rauch S, Knapp J. Challenges of helicopter mountain rescue missions by human external cargo: need for physicians onsite and comprehensive training. Scand J Trauma Resusc Emerg Med. 2019;27(1):17.
- Berben SA, Schoonhoven L, Meijs TH, van Vugt AB, van Grunsven PM. Prevalence and relief of pain in trauma patients in emergency medical services. Clin J Pain. 2011;27(7):587-92.
- Ellerton J, Tomazin I, Brugger H, Paal P. Immobilization and splinting in mountain rescue. Official Recommendations of the International Commission for Mountain Emergency Medicine, ICAR MEDCOM, Intended for Mountain Rescue First Responders, Physicians, and Rescue Organizations. High Alt Med Biol. 2009;10(4):337-42.
- Becker J, Runer A, Neunhäuserer D, Frick N, Resch H, Moroder P. A prospective study of downhill mountain biking injuries. Br J Sports Med. 2013;47(7):458-62.
- Rugg C, Woyke S, Voelckel W, Paal P, Ströhle M. Analgesia in adult trauma patients in physician-staffed Austrian helicopter rescue: a 12-year registry analysis. Scand J Trauma Resusc Emerg Med. 2021;29(1):28.
- Bredmose PP, Lockey DJ, Grier G, Watts B, Davies G. Pre-hospital use of ketamine for analgesia and procedural sedation. Emerg Med J. 2009;26(1):62-4.
- Ellerton J, Paal P, Brugger H. Prehospital use of ketamine in mountain rescue. Emerg Med J. 26. England2009. p. 760-1.
- Jennings PA, Cameron P, Bernard S, Walker T, Jolley D, Fitzgerald M, et al. Morphine and ketamine is superior to morphine alone for out-of-hospital trauma analgesia: a randomized controlled trial. Ann Emerg Med. 2012;59(6):497-503.
- Ellerton J, Milani M, Blancher M, Zen-Ruffinen G, Skaiaa SC, Brink B, et al. Managing moderate and severe pain in mountain rescue. High Alt Med Biol. 2014;15(1):8-14.
- Middleton PM, Simpson PM, Sinclair G, Dobbins TA, Math B, Bendall JC. Effectiveness of morphine, fentanyl, and methoxyflurane in the prehospital setting. Prehosp Emerg Care. 2010;14(4):439-47.
- Buntine P, Thom O, Babl F, Bailey M, Bernard S. Prehospital analgesia in adults using inhaled methoxyflurane. Emerg Med Australas. 2007;19(6):509-14.
- Porter KM, Siddiqui MK, Sharma I, Dickerson S, Eberhardt A. Management of trauma pain in the emergency setting: low-dose methoxyflurane or nitrous oxide? A systematic review and indirect treatment comparison. J Pain Res. 2018;11:11-21.
- Windsor J, van der Kaaij J, Ellerton J, Oxer H, Hillebrandt D, Rodway G. Methoxyflurane as an analgesic for prehospital use at high altitude. High Alt Med Biol. 2009;10(2):201-2.
- Jedlicka J, Groene P, Linhart J, Raith E, Mu Stapha DV, Conzen P. [Inhalational anesthetics]. Anaesthesist. 2021;70(4):343-55.Trimmel H, Egger A, Doppler R, Beywinkler C, Voelckel WG, Kreutziger J. [Volatile anesthetics for prehospital analgesia by paramedics-An overview]. Anaesthesist. 2021:1-9.
- Jephcott C, Grummet J, Nguyen N, Spruyt O. A review of the safety and efficacy of inhaled methoxyflurane as an analgesic for outpatient procedures. Br J Anaesth. 120. England: © 2018 British Journal of Anaesthesia; 2018. p. 1040-8.
- Downie WW, Leatham PA, Rhind VM, Wright V, Branco JA, Anderson JA. Studies with pain rating scales. Ann Rheum Dis. 1978;37(4):378-81.
- Trimmel H, Egger A, Doppler R, Pimiskern M, Voelckel WG. Usability and effectiveness of inhaled methoxyflurane for prehospital analgesia - a prospective, observational study. BMC Emerg Med. 2022;22(1):8.
- Johnston S, Wilkes GJ, Thompson JA, Ziman M, Brightwell R. Inhaled methoxyflurane and intranasal fentanyl for prehospital management of visceral pain in an Australian ambulance service. Emerg Med J. 2011;28(1):57-63.

In-ear-Temperatur- und Perfusions-Monitoring im Rahmen TherapeUtischer HypotheRmiE – Akronym: In-ear TemPerATURE

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cooperation partner:

HINTERGRUND

Die **Therapeutische Hypothermie** (TH) beschreibt die gezielte Reduktion der Körperkerntemperatur innerhalb eines streng kontrollierten Rahmens. Ziel ist dabei die **Reduktion des zerebralen Stoffwechsels** im Sinne einer Neuroprotektion

a) nach Herz-Kreislauf-Stillstand (Zieltemperatur 32-34°C) sowie
b) bei Eingriffen im Rahmen der Aortenchirurgie (Zieltemperatur 24-27°C)

Entscheidend ist dabei eine Methode zur **kontinuierlichen Erfassung der Körperkerntemperatur**, die dynamische Temperaturentwicklungen zuverlässig und schnell erfassen kann.

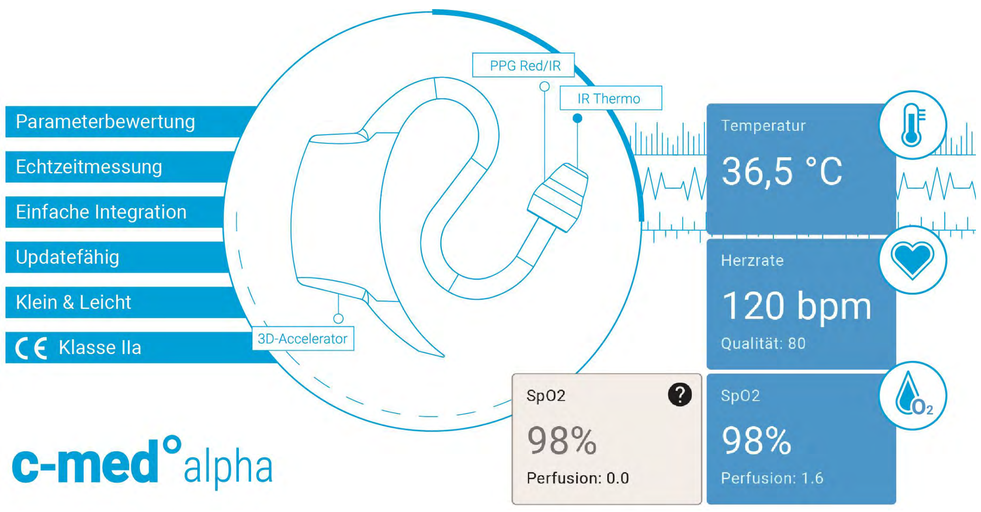
Als Goldstandard gilt bisher die Applikation invasiver Messsonden, beispielsweise im distalen Ösophagus.

Als **nicht-invasiver Messort** bietet sich alternativ dazu der **externe Gehörgang** durch seine gute Zugänglichkeit sowie die Nähe zu hirnversorgenden Arterien als vielversprechende Methode zur Messung der Körperkerntemperatur an.
Um die Validität dieser neuen Methode zu prüfen, vergleicht die **In-Ear TemPerATURE Studie** die im Gehörgang ermittelten Temperaturwerte mit denen invasiver Messsonden, sowohl in dynamischen wie auch statischen Phasen der Hypothermie.

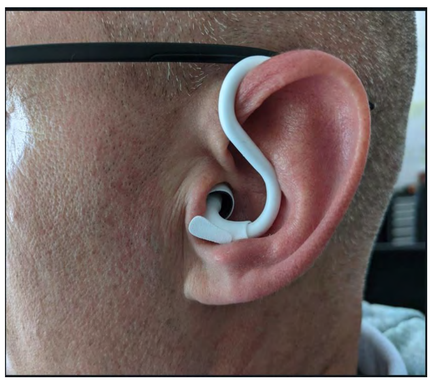
METHODE

- Sensor: Cosinuss® c-med°alpha
- OP Herzchirurgie, Klinikum Großhadern (München)
- Probanden:
  - N = 24 (18m, 6w)
  - Alter 28-80 Jahre (Mittel: 56.8 Jahre)

- Messsonden:
  - Nasopharynx (Thermistor-Sonde)
  - Harnblase (Thermistor-Sonde)
  - Rektum (Thermistor-Sonde)
  - Ösophagus (Thermistor-Sonde)
  - Tympanon (Infrarotthermometer)
  - Gehörgang (Kontaktthermometer)



Darstellungsbeispiel aus Produktblatt



Ergebnisse

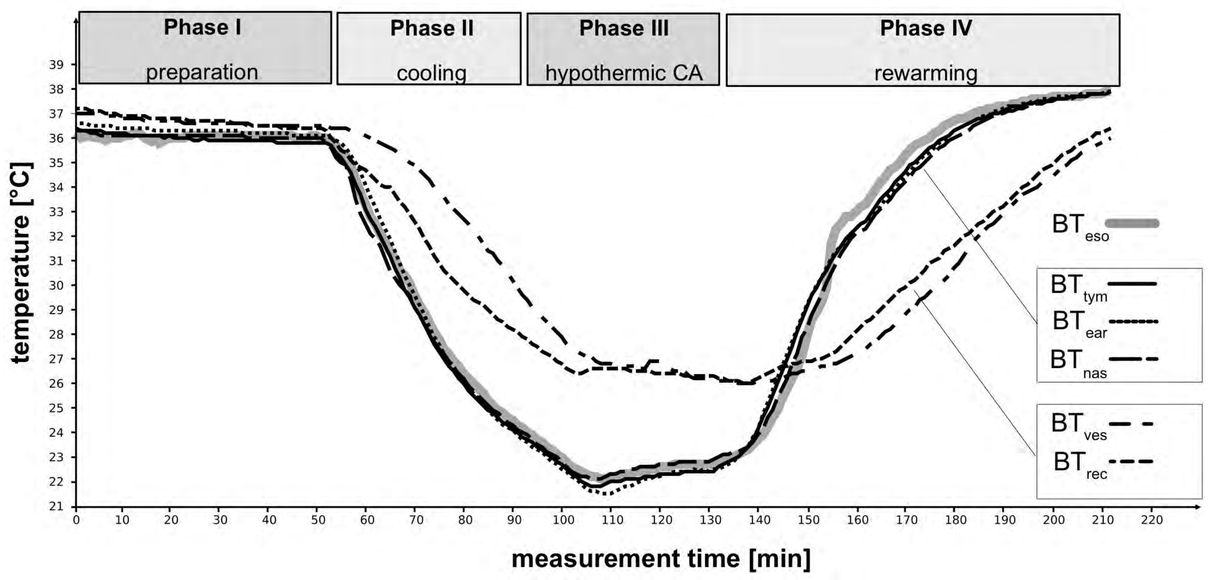


Abb. 1: Beispielmessung; man beachte die gute Korrelation zwischen den Sonden im Ösophagus (BT_{eso}), Tympanon (BT_{tym}), Gehörgang (BT_{ear}) und Nasopharynx (BT_{nas}) im Gegensatz zu Harnblase (BT_{ves}) und Rektum (BT_{rec}).

	BT_{tym}		BT_{ear}		BT_{nas}		BT_{ves}		BT_{rec}	
Phase	**ICC**	**F | p**	**ICC**	**F | p**	**ICC**	**F | p**	**ICC**	**F | p**	**ICC**	**F | p**
static phases										
1	**.825**	5.9 | .000	**.814**	5.7 | .000	**.865**	7.4 | .000	**.591**	5.7 | .000	**0.462**	5.2 | .000
3	**.923**	16.8 | .000	**.861**	7.0 | .000	**.918**	13.1 | .000	**-.067**	0.8 | n.s.	**0.160**	2.0 | .000
dynamic phases										
2	**.983**	58.9 | .000	**.975**	47.6 | .000	**.959**	26.0 | .000	**.753**	9.8 | .000	**0.719**	9.3 | .000
4	**.986**	72.9 | .000	**.979**	57.6 | .000	**.975**	40.7 | .000	**.879**	12.4 | .000	**0.861**	11.2 | .000

Tab. 1: Intraclass-correlation-coefficient (ICC, in Relation zu Goldstandard BT_{eso})

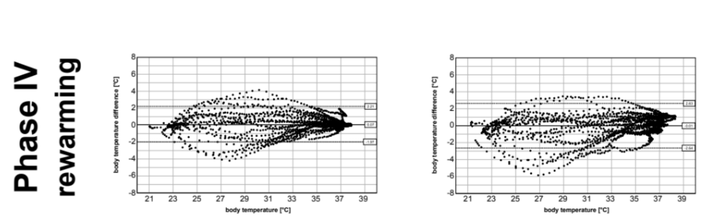


Abb. 2: Bland-Altman-Plots; jeweils Gesamtheit aller 24 Messungen; Temperaturdifferenz von Messsonde zum Goldstandard BT_{eso} in Abhängigkeit der Temperatur; Y=0 entspricht Übereinstimmung der Temperaturwerte

SCHLUSSFOLGERUNG

- **Sehr hohe Übereinstimmung** der gemessenen Körpertemperaturen im Gehörgang sowie Tympanon mit dem Ösophagus (Goldstandard)
- **Minimale Invasivität** und leichte/ sichere Applikation des Ohr-Sensors
- **Geringere Störanfälligkeit bei Kreislaufzentralisation** aufgrund der gemeinsamen regionalen Blutversorgung von Gehörgang/ Tympanon und Gehirn
- Limitationen
  - Einfluss von **Umweltfaktoren** (Wind, kalte Umgebungstemperatur etc.) noch unklar
  - Im Gegensatz zu akzidentieller Hypothermie i.d.R **schnellerer Temperaturabfall** durch intravasale Kühlung mittels Herz-Lungen-Maschine
  - Limitierung durch **lokale Veränderungen und Fremdkörper** im Gehörgang (z.B. Caerumen, Schnee, Trommelfellruptur, Otitis media etc.)

Gelofusin as volume resuscitation shows no association with acute kidney injury or renal replacement therapy in critically ill traumatic ICU patients

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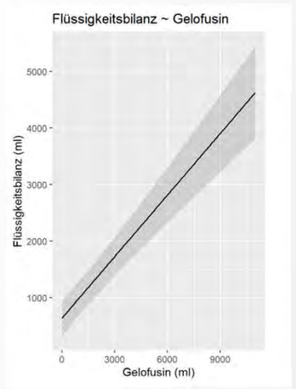
Background:
Fluid resuscitation is a key element in the treatment of severely traumatized patients. The correct fluid regimen is a hot topic and subject to ongoing debate. Since studies have shown increased mortality and higher rates of renal replacement therapy (RRT) with the use of hydroxyethyl starch (HES) solutions [1], they have been banned from intensive care units, operating rooms and emergency departments. Because of the safety concerns about HES, all synthetic colloidal fluids are generally suspected of doing more harm than good, especially with regard to renal function. As there is limited data on the use of succinylated gelatin specifically in trauma patients, we conducted a retrospective study here to analyse the effects and outcomes of succinylated gelatin (Gelofusin Iso, BBraun, Melsungen GER) for volume resuscitation in critically ill trauma patients.
The aim of this study was to assess the relationship between the amount of succinylated gelatin administered and acute kidney injury (AKI) and the need for RRT.

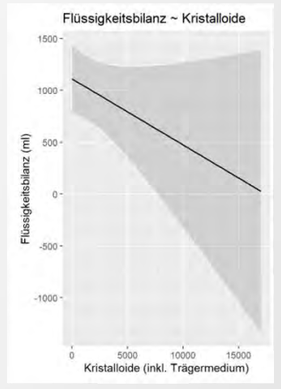
Methods:
Retrospective data were collected from 236 critically ill trauma patients in our trauma intensive care unit at the Medical University of Innsbruck, Austria, from 2015 to 2020. The patients included in this analysis had an Injury Severity Score (ISS) of at least 16 and had to be treated in the ICU for more than 24 hours. Data on fluid resuscitation, transfusions, clotting factor substitution, laboratory results and outcomes were collected over a 7-day period in the ICU, including prehospital and perioperative timeframes. Youden index analysis was used to calculate optimal cut-offs for daily weight-based infusion volumes of succinylated gelatin and cristalloids in relation to development of AKIN grade 3 and need for RRT.

Results:
73.8% of patients were male, with a median age of 49 years (IQR 31-65) and median AAAM/DGU ISS scores of 26 (17-38). **No significant association was found between treatment with gelofusin >10ml/kg/d and the initiation of renal replacement therapy** (OR=1.27, p=0.695) **or development of AKIN 3** (OR=1.36, p=0.661). A significant decrease in creatinine clearance rates among patients receiving high doses of gelofusin was shown only on Day 2 of the ICU stay with a median of 129.96 ml/min (75.59-170.97) vs. 97.46 ml/min (55.33-133.32), associated with significantly higher amounts of positive fluid balance, with 1927 ml/d (917-2896) for patients vs. 1280 ml/d (369-2126) for low amounts of gelofusin. All other days of ICU stay showed no significant differences of creatinine clearance and blood urea levels between patients receiving high amounts of gelofusin and those who did not.

Conclusion:
There was no significant association between even high doses of succinylated gelatin and high grade kidney injury (AKIN 3) or the need for RRT.
Our results suggest that succinylated gelatin may be used as a safe and effective alternative to crystalloids in regards to renal function in critically ill severly traumatized patients for the treatment of hypovolemic shock.

References:
[1] Perner A, et al; Scandinavian Critical Care Trials Group. Hydroxyethyl starch 130/0.42 versus Ringer's acetate in severe sepsis. N Engl J Med. 2012 Jul 12;367(2):124-34.





Gelofusin was shown to have a significant effect on fluid balance, with 1 ml of Gelofusin resulting in an increase of daily fluid balance by 0.36 ml (95% CI 0.29 to 0.44; p < 0,001)
No significant correlation could be established for the effect of cristalloid fluids on fluid balance, with an estimated effect of -0.06 ml (95% CI -0.15 to 0.02; p=0.139)

Gelofusin

	Total (n=218)[a]	<= 10 ml/kg/d (n=101)	> 10 ml/kg/d (n=117)	Estimate with 95% CI[b]	p value[c]	Not known
Kreatinin Clearance ml/min auf 1.73 m^2 gerechnet	107.92 (64.39-149.54)	129.96 (75.59-170.97)	97.46 (55.33-133.32)	31.75 (15.52 to 50.19)	0.0003	13/10
Harnstoff	42.95 (30.18-63.15)	38.7 (28-58.05)	45.45 (31.35-67.42)	-5.8 (-11.5 to -0.3)	0.0378	6/1
Flüssigkeitsbilanz gesamt pro Tag	1510 (740-2549)	1280 (369-2126)	1927 (917-2896)	-674 (-1060 to -323)	0.0004	0/0

[a] Data presented as medians (25th to 75th percentile)
[b] Estimated median difference
[c] Assessed by Wilcoxon Rank Sum Test

Kristalloide

	Total (n=218)[a]	<= 15 (n=165)	> 15 (n=53)	Estimate with 95% CI[b]	p value[c]	Not known
Kreatinin Clearance ml/min auf 1.73 m^2 gerechnet	107.92 (64.39-149.54)	105.35 (61.27-145.49)	129.95 (77.09-156.7)	-19.35 (-39.97 to 1.17)	0.066	19/4
Harnstoff	42.95 (30.18-63.15)	46 (31.4-64.5)	33.3 (25.4-48.38)	9.6 (4 to 16.2)	0.001	6/1
Flüssigkeitsbilanz gesamt pro Tag	1518 (740-2549)	1659 (805-2598)	1266 (557-2280)	221 (-211.46 to 655.05)	0.2948	0/0

[a] Data presented as medians (25th to 75th percentile)
[b] Estimated median difference
[c] Assessed by Wilcoxon Rank Sum Test

Only day 2 of the ICU period showed significant differences in Creatinine Clearance rates and blood urea levels between the Gelofusin an Cristalloids groups, with lowered creatinine clearance rates and higher blood urea concentrations in patients receiving high amounts of gelofusin

RRT ~ group(Gelofusin) (ml/kg/d)

	Estimate with 95% CI	p-value	Significance	OR
Intercept	-2.66 (-3.67 to -1.64)	<0.001	•	0.07 (0.03 - 0.19)
Gelofusin >= 10 (ml/kg/d)	0.24 (-0.96 to 1.44)	0.695		1.27 (0.38 - 4.24)

AKIN ~ group(Gelofusin) (ml/kg/d)

	Estimate with 95% CI	p-value	Significance	OR
Intercept	-2.96 (-4.12 to -1.8)	<0.001	•	0.05 (0.02 - 0.17)
Gelofusin >= 10 (ml/kg/d)	0.31 (-1.06 to 1.67)	0.661		1.36 (0.35 - 5.31)

No significant correlations between daily Gelofusin supply of >10 ml/kg/d and initiation of RRT or AKIN could be established

Sponsors and collaborators:

Medizinische Universität Innsbruck
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UMIT TIROL DIE TIROLER PRIVATUNIVERSITÄT
tirol kliniken

Bergrettung im Wandel der Zeit: Eine 15-jährige Analyse des Patientenalters in Niederösterreich und Wien (2008-2022)

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Hintergrund

Die demographische Veränderung der Bevölkerungsstruktur wirkt sich auch auf den organisierten Bergrettungsdienst aus. Die immer älter werdende Bevölkerung entdeckt das alpine Gelände zunehmend für sich. Begünstigt wird diese Entwicklung durch den Bau immer neuer Aufstiegshilfen, die ältere und somit potentiell kränkere Personen noch einfacher in alpines Gelände und somit in das Einsatzgebiet der alpinen Rettungsdienste verbringen können.

In unserer Arbeit wollen wir die Altersverteilung der PatientInnen des Bergrettungsdienst NÖ/W über einen Zeitraum von 15 Jahren retrospektiv betrachten.

Methodik

Retrospektive Auswertung aller Einsätze des Bergrettungsdienst Niederösterreich/Wien in den Jahren 2008-2022. Eingeschlossen wurden alle 11.059 PatientInnen im 15-jährigen Beobachtungszeitraum. Die statistische Aufarbeitung wurde unter anderem mittels ANOVA sowie einer Regressionsanalyse durchgeführt.

Resultate

Das durchschnittliche Patientenalter nahm von 30,5 Jahren im Jahr 2008 auf 38,4 Jahre im Jahr 2022 signifikant zu ($p>0,001$). Abbildung 1 stellt den stetigen Anstieg graphisch dar.

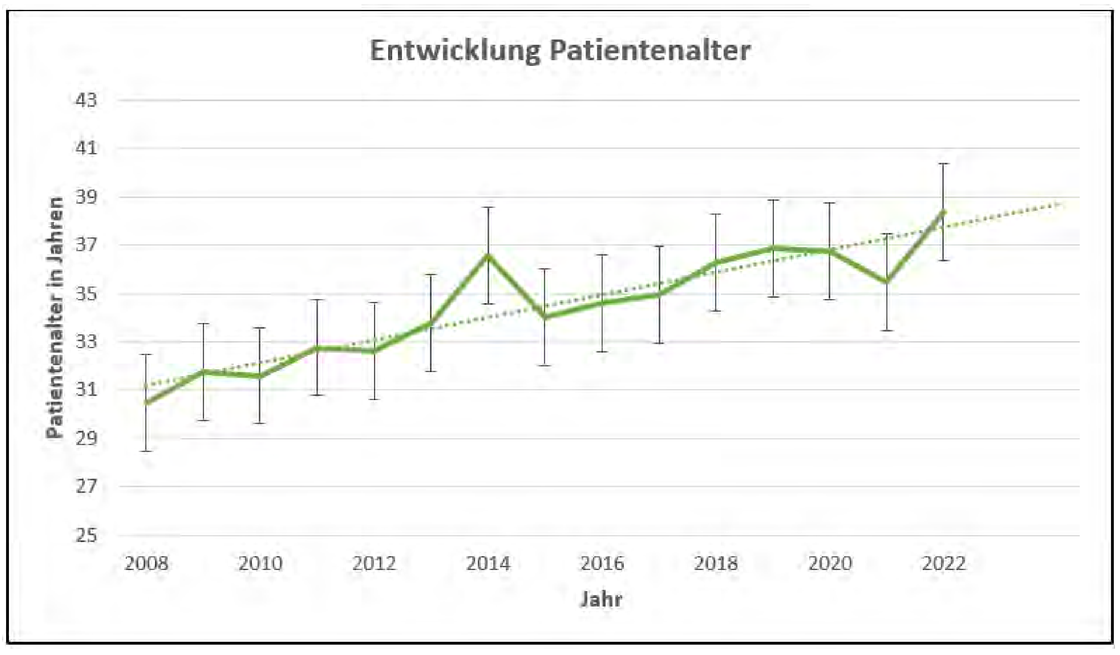

Abbildung 1, Entwicklung Patientenalter

Abbildung 2 verdeutlicht den Anstieg jener PatientInnen, die älter als 65 Jahre sind. Diese Gruppe nahm von lediglich 4% Prozent im Jahr 2008 auf knapp 10% im Jahr 2022 ebenfalls signifikant zu ($p<0,001$).

Das pädiatrische Patientgut und dessen Entwicklung im Laufe des Untersuchungszeitraumes wird in Abbildung 3 graphisch dargestellt. Hier zeigt sich ein Rückgang von 32,8% im Jahr 2008 auf 18,9% aller PatientInnen im organisierten Bergrettungsdienst im jahr 2022.

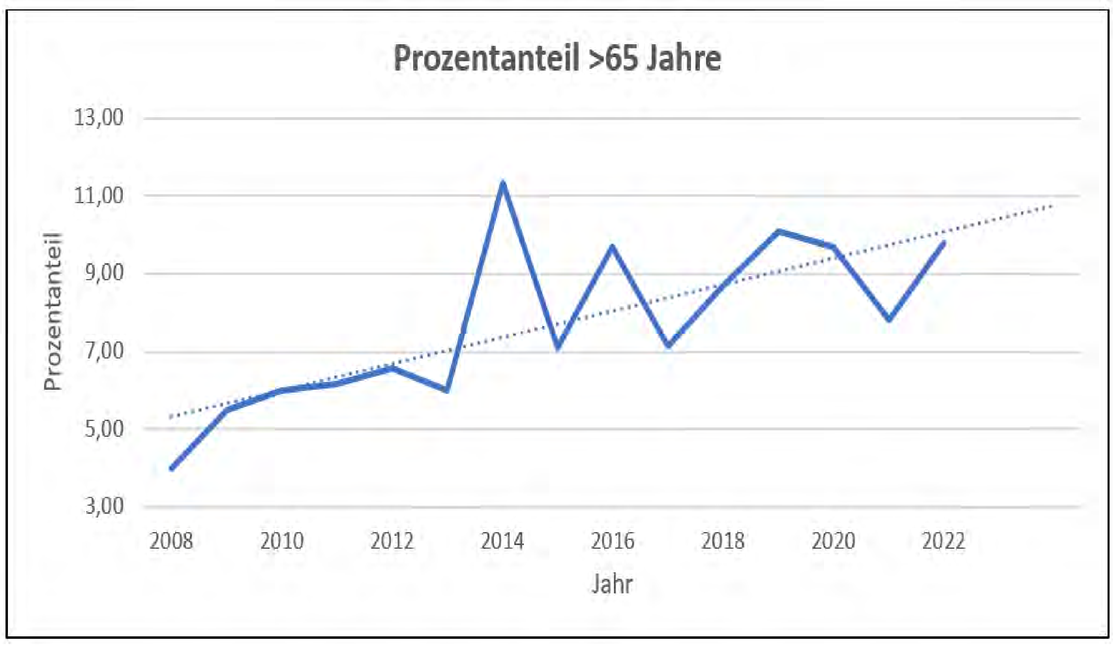

Abbildung 2, Prozentanteil >65 Jahre

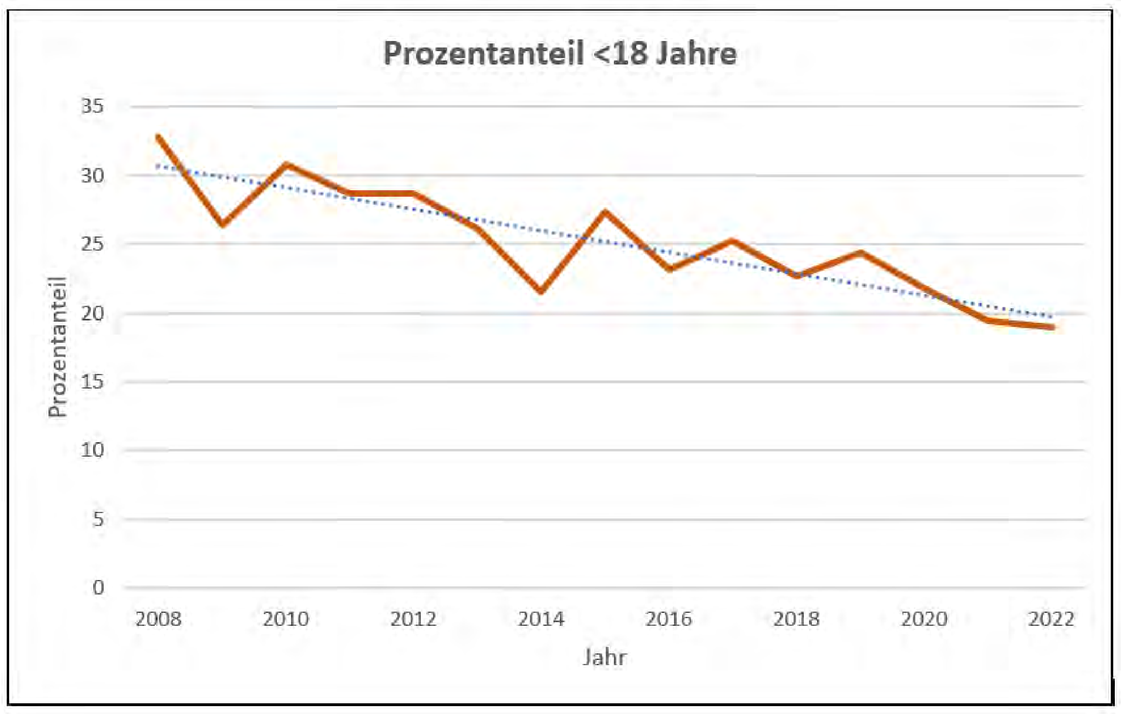

Abbildung 3, Prozentanteil <18 Jahre

Diskussion

Die vorliegenden Zahlen verdeutlichen den Wandel der Demographie, auf den sich der organisierte Bergrettungsdienst auf vielen Ebenen der Organisation einstellen muss. Ältere Patienten erfordern spezielle Fähigkeiten in Diagnostik und Therapie. Dies bedarf einer Adaptierung der Aus- und Fortbildung innerhalb der alpinen Rettungsdienste.

Trotz eines deutlichen Rückgangs muss auch das pädiatrische Patientengut Beachtung finden. Immer noch ist knapp jeder 5. Patient unter 18 Jahre alt.

Insgesamt zeigt sich ein immer heterogeneres Bild in der Altersverteilung, auf welches der organisierte Bergrettungsdienst in den kommenden Jahren reagieren wird müssen.

Impact of an Ascent to High Altitude on Rescuers' Heart Rate during BLS CPR

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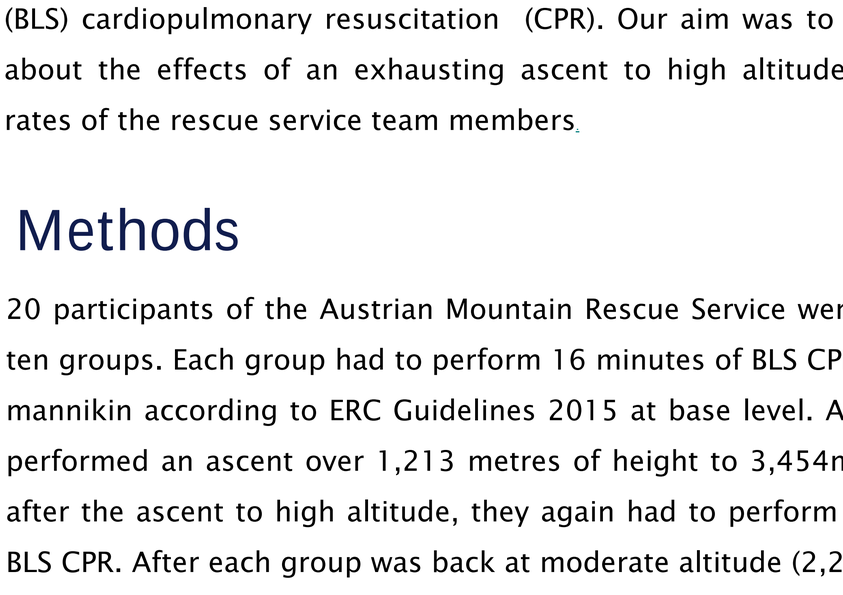
Objective

In this study we analysed the impact of an ascent (1,213 metres of height) to high altitude (3,454m) on rescuers heart rate during basic life support (BLS) cardiopulmonary resuscitation (CPR). Our aim was to find out more about the effects of an exhausting ascent to high altitude on the heart rates of the rescue service team members.

Methods

20 participants of the Austrian Mountain Rescue Service were split up into ten groups. Each group had to perform 16 minutes of BLS CPR on a training mannikin according to ERC Guidelines 2015 at base level. Afterwards they performed an ascent over 1,213 metres of height to 3,454m. Immediately after the ascent to high altitude, they again had to perform 16-minutes of BLS CPR. After each group was back at moderate altitude (2,241m) they had to repeat the previously performed exercise unite once again. During the whole testing period, the participants wore a pulse watch, which measured and saved the heart rate at every second. In addition to that, right before and right after every BLS CPR cycle, the participants vital signs were measured, and neurocognitive test was conducted.



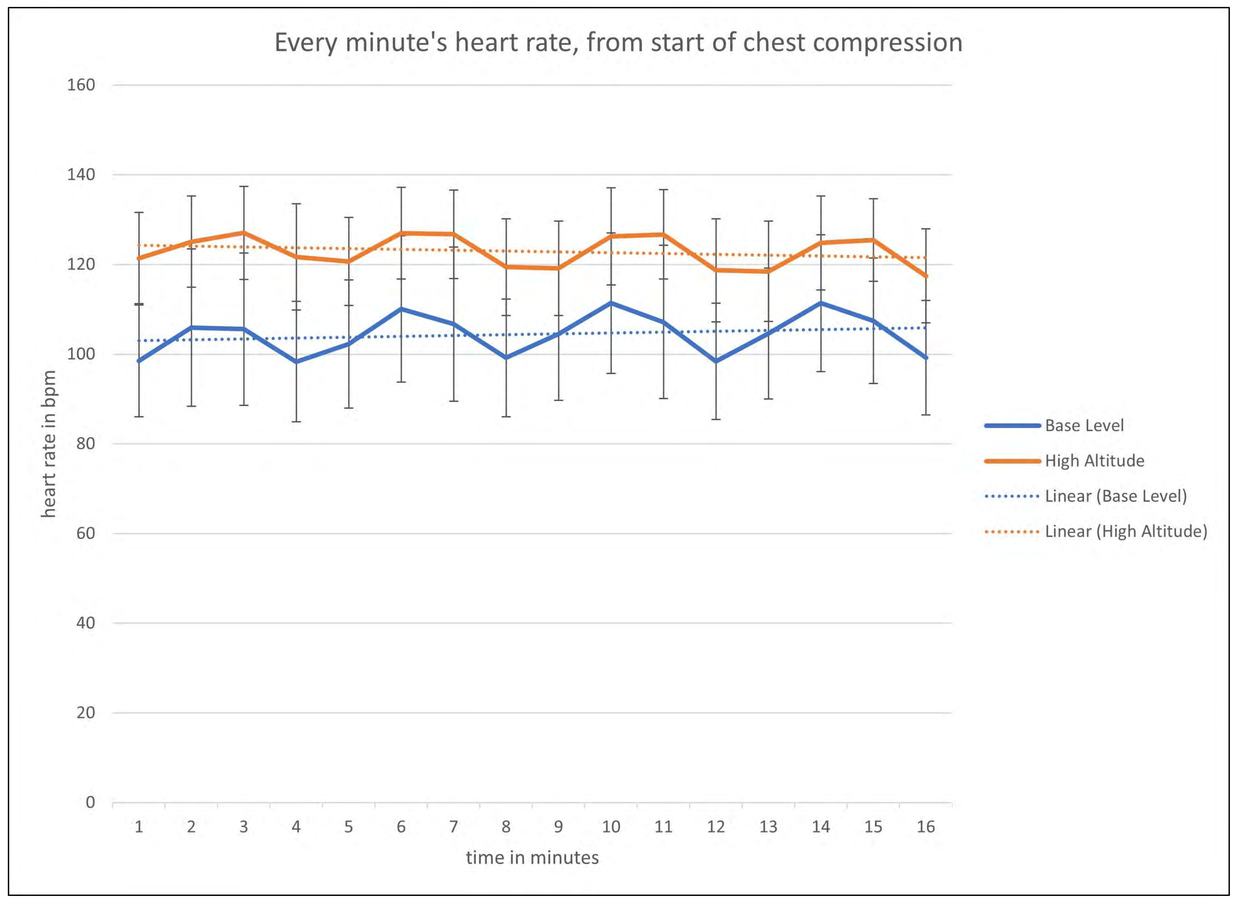
A team performing BLS-CPR at High altitude, own work

Results

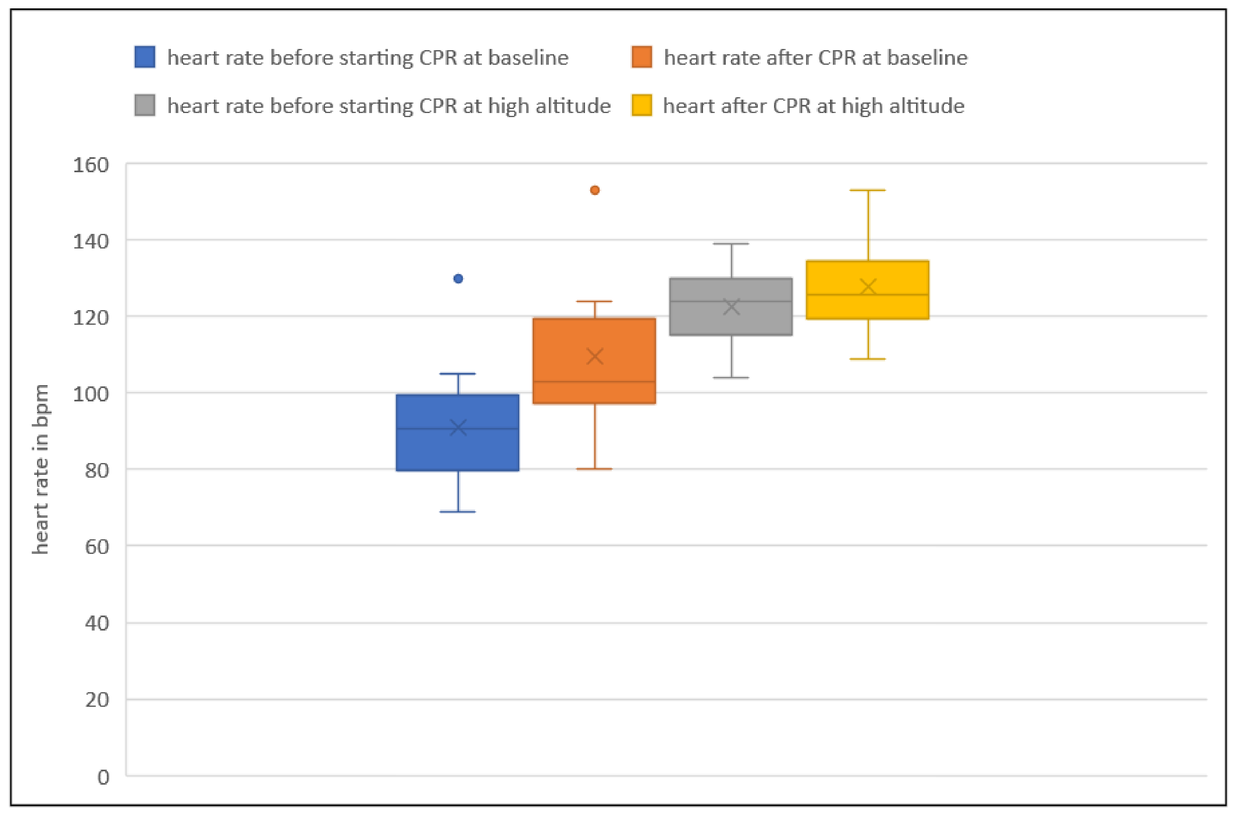
At any time during the 16-minutes lasting BLS CPR cycle, the average heart rate at high altitude was significantly higher than at base level, overall about +19.3bpm ($p<0.01$).

At high altitude (-44bpm) as well as at base level (-5bpm), the heart rate decreased during ventilation phases, when chest compressions were paused.

Heart rate was also higher after a 16-minutes BLS CPR unit compared to the initial heart rate, this was only significant at base level (+17bpm, $p<0.05$), not at high altitude (+5bpm, $p=0.12$).



Heart rates for 16 minutes BLS CPR



pre-post comparison of the rescuers heart rate

Conclusion

Performing BLS CPR is causing exhaustion at base level and at a high-altitude level. Compared to the already elevated heart rate during ascent, the heart rate increased even more during BLS CPR performed at high altitude.

References

Soar J, Nolan JP, Bottiger BW, Perkins GD, Lott C, Carli P, et al. European Resuscitation Council Guidelines for Resuscitation 2015: Section 3. Adult advanced life support. Resuscitation. 2015;95:100-47.

Perkins GD, Handley AJ, Koster RW, Castren M, Smyth MA, Olasveengen T, et al. European Resuscitation Council Guidelines for Resuscitation 2015: Section 2. Adult basic life support and automated external defibrillation. Resuscitation. 2015;95:81-99.

Oral transmucosal fentanyl citrate analgesia in prehospital trauma care: an observational cohort study

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Study aims and background

Pain is one of the major prehospital symptoms in trauma patients and requires prompt management.

Recent studies have reported insufficient analgesia after prehospital treatment in up to 43% of trauma patients, leaving significant room for improvement. Good evidence exists for prehospital use of oral transmucosal fentanyl citrate (OTFC) in the military setting.

We hypothesized that the use of OTFC for trauma patients in remote and challenging environment is feasible, efficient, safe, and might be an alternative to nasal and intravenous applications.

Methods

This observational cohort study examined 177 patients who were treated with oral transmucosal fentanyl citrate by EMS providers in three ski and bike resorts in Switzerland. All EMS providers had previously been trained in administration of the drug and handling of potential adverse events

Results

OTFC caused a statistically significant and clinically relevant decrease in the level of pain by a median of 3 (IQR 2 to 4) in NRS units (P<0.0001).
Multiple linear regression analysis showed a significant absolute reduction in pain, with no differences in all age groups and between genders.
No major adverse events were observed.

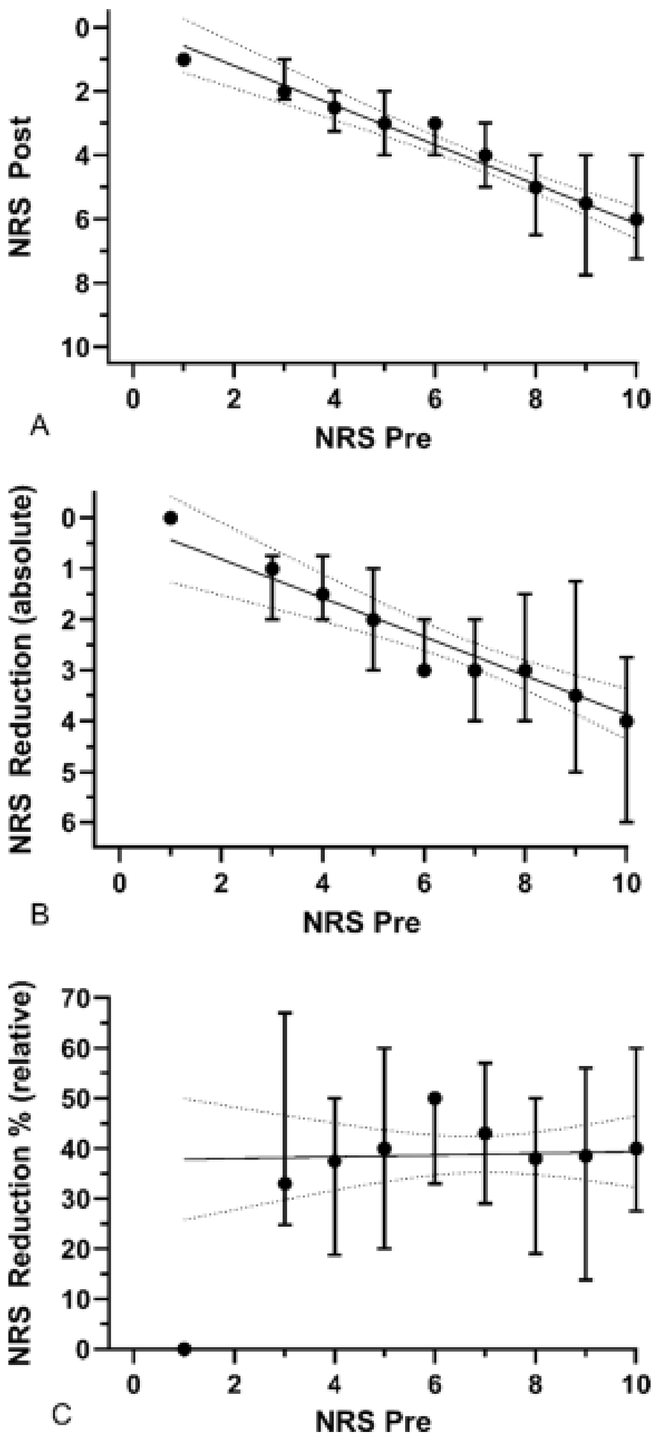

Fig 1 Distribution of absolute and relative reduction depending on pain level

Graph A shows the pain level before and after administering OTFC. Graph B includes the absolute reduction depending on pain level before OTFC. Moreover, the effect of higher efficiency with higher NRS when administering fentanyl can be seen in both. Graph C includes the relative reduction in percentage. Here, we were able to show equal pain reduction depending on the initial pain level, with an average just below 40%.

Tab 1. Pain reduction in different subgroups

Subgroup	NRS initial, n (IQR)	NRS after OTFC, n (IQR)	NRS Reduction absolute, n (IQR)	Pain Reduction Percentage (SD)	*P* value
Men	7 (6–8)	4 (3–6)	3 (2–4)	39.8% (24.6%)	P<0.0001
Women	7 (5–8)	4 (3–5)	2 (1–3)	37.4% (23.6%)	P<0.0001
Age < 20	7 (6–8)	4 (3–5)	3 (2–4)	43.8% (26.9%)	P<0.0001
Age 20–60	7 (5.25–8)	4 (3–5.75)	2 (1–4)	38.1% (23%)	P<0.0001
Age > 60	7 (5.75–9)	5 (3–7.25)	2.5 (1–4)	34.5% (26.6%)	P<0.0001
Upper Extremities	7 (6–8)	4 (3–6)	2 (1.75–4)	36.7% (22.4%)	P<0.0001
Lower Extremities	7 (5–8)	4 (2–5)	3 (1–4)	39.8% (26.2%)	P<0.0001
Thorax, Abdomen and Spine	7 (6–8)	3 (3–5.5)	3 (2–5)	45.7% (25%)	P<0.001

Absolute pain reduction in all subgroups was around 40%, showing an efficient analgetic effect of OTFC on a broad range of patients. The subgroups of injuries in the thorax, abdomen and the spinal column combined due to small case load each. Additionally, we could show that absolute reduction in pain (expressed in NRS) was directly proportional to the initial pain level (see Fig. 1, Graph A to C), whereas the relative reduction in pain (expressed in % of initial NRS) was stable throughout the initial intensity of pain

IQR inter-quartile range, *SD* standard deviation, *P* significant < 0.05

Conclusions

Prehospital OTFC administered in a hostile alpine environment is safe, easy, and efficient for different types of injuries, means of extrication and transport in all age groups and gender; side effects were few and mild. This could provide a valuable alternative without the delay of an intravenous line in trauma patients with severe pain, especially in remote areas, where fast action and easy administration are important.

https://sjtrem.biomedcentral.com/articles/10.1186/s13049-023-01066-0#citeas

Stability of Drugs Stored in Helicopters for Use by Emergency Medical Services: A Prospective Observational Study

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Study aims and background

In the out-of-hospital setting, emergency drugs are sometimes exposed to extreme environmental conditions. How such exposure affects drug potency and reliability is largely unknown. Drugs stored in rescue helicopters may be subject to extreme environmental conditions. The aim of this study was to measure whether drugs stored under the real-life conditions of a Swiss helicopter emergency medical service (HEMS) would retain their potency over the course of 1 year.

Methods

A prospective, longitudinal study measuring the temperature exposure and concentration of drugs stored on 2 rescue helicopters in Switzerland over 1 year. The study drugs included epinephrine, norepinephrine, amiodarone, midazolam, fentanyl, naloxone, rocuronium, etomidate, and ketamine. Temperatures were measured inside the medication storage bags and the crew cabins at 10-minute intervals. Drug stability was measured on a monthly basis over the course of 12 months using high-performance liquid chromatography. The medications were considered stable at a minimum remaining drug concentration of 90% of the label claim.

Results

Temperatures ranged from −1.2 °C to 38.1 °C (29.84 °F to 100.58 °F) inside the drug storage bags. Of all the temperature measurements inside the drug storage bags, 37% lay outside the recommended storage conditions. All drugs maintained a concentration above 90% of the label claim. The observation periods for rocuronium and etomidate were shortened to 7 months because of a supply shortage of reference samples.

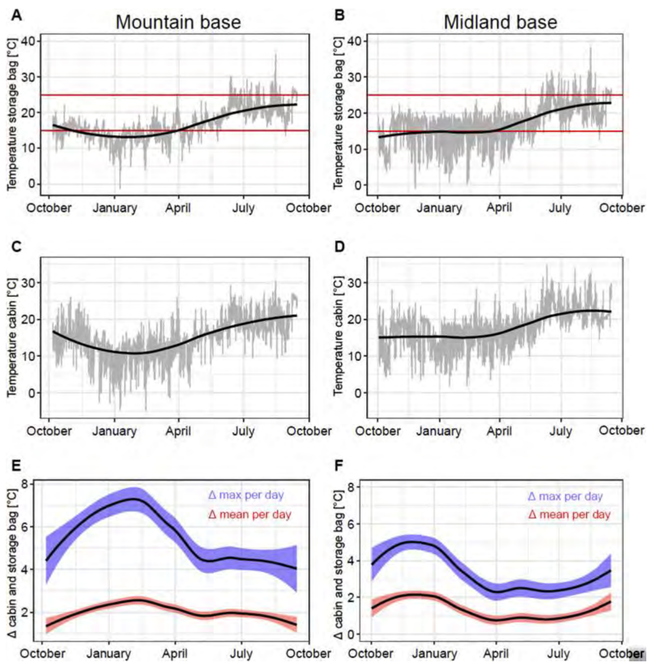


Fig. 1 Temperature exposure. Left: Helicopter based in the mountains (Da Vinci). Right: Helicopter based in the midlands (H145). A and B, Temperatures in degree Celsius measured over the 12-month observation period inside the drug storage bag; red lines indicate manufacturer storage range for the majority of drugs. C and D, Temperature recorded inside the crew cabin. A to D, the black line represents smoothed regressions, and gray shows the variation in temperature (time-series). E and F, The graphs show the daily absolute maximum (blue) and daily mean (red) temperature difference between the drug storage bag and crew cabin with 95% confidence intervals. max, maximum.

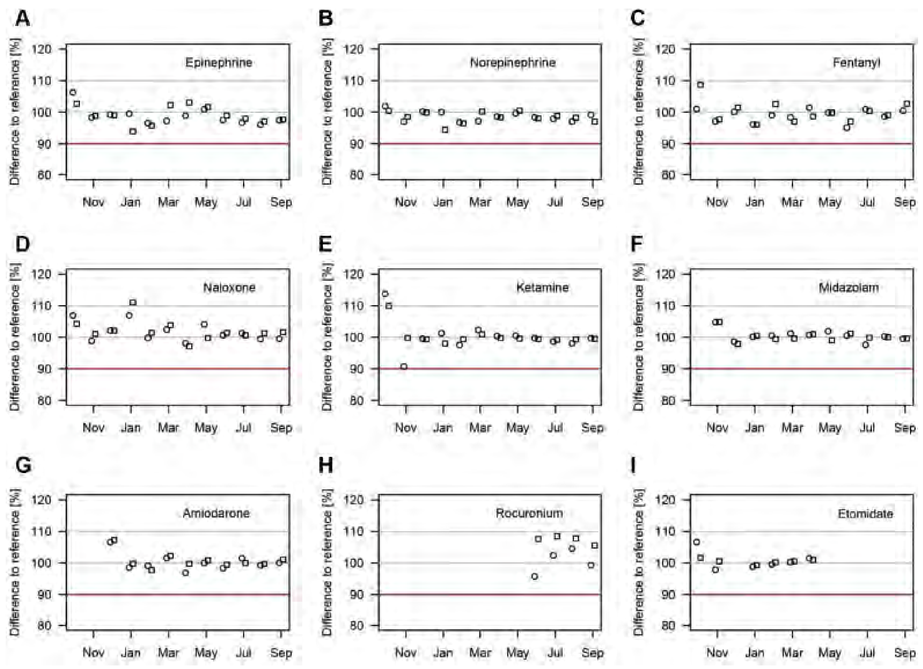
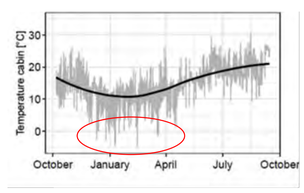


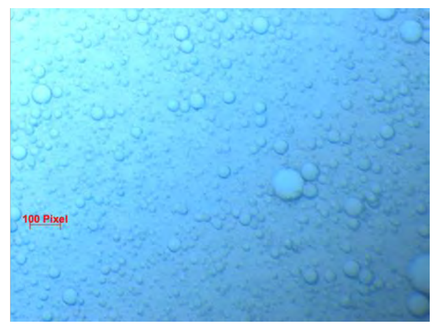
Fig 2. Study drug performance. Performance of each drug throughout the observation year. *A to I*, Each panel shows the performance of a single drug, sampled from either helicopter (circles: mountain base; squares: midlands base), relative to the reference samples (y-axis; as percentage difference of the mean of the helicopter samples compared to the mean of the reference samples). Gray lines indicate 100% performance (same values for helicopter samples and reference samples), and red lines mark the 90% threshold. A total of 12 monthly sampling points were available (x-axis; October 2020 to September 2021; points are slightly offset in x-direction to improve visibility). The observation periods for rocuronium and etomidate were shortened by a COVID-19 pandemic–related supply shortage of reference samples. Missing values indicate that no reference sample was measured. Because of a preanalytical issue in preparing the samples for high-performance liquid chromatography testing, the first measurements of midazolam and the first 2 measurements of amiodarone were declared void.

Problem of formation of lipid droplets big enough to cause pulmonary embolism.

Etomidate sample exposed to -3.6°C/ 2h



Relevance?



Etomidate sample – exposed to --22°C/ 12h

Under the extreme conditions of emergency medicine the possibility of adverse events due to physical drug degradation potentially exists.

Conclusions

Drugs stored under the real-life conditions of Swiss HEMS are subjected to temperatures outside the manufacturer's approved storage requirements. Despite this, all drugs stored under these conditions remained stable throughout our study. Real-life stability testing could be a way to extend drug exchange intervals.

Analyse von Umgebungsfaktoren auf den Erfolg einer kardiopulmonalen Reanimation mit AED, untersucht in der präklinischen Notfallmedizin der Berg- und Luftrettung in Bayern.

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Hintergrund

In dieser Studie wurde der Einfluss von erschwerten Umgebungsbedingungen auf die kardiopulmonale Reanimationen im alpinen Setting untersucht.

- 3 Untersuchungsstationen
- 450 Trainingssequenzen
- Teilnehmer aus der Berg- und Luftrettung in Bayern
- Prospektive Beobachtungsstudie

Keywords:
Notfallmedizin, Reanimation, Bergrettung, Luftrettung

Methoden

1

Prospektive Beobachtungsstudie

Analyse CPR-relevanter Parameter in 3 verschiedenen Trainings-Umgebungen. Datenerhebung anhand CPR Phantom und Videoanalyse

2

450

R

Station Riegel
Flacher Untergrund, 4x4m ohne Abgrenzung, Außentemperatur, alltägliche Geräuschkulisse

H

Station Höhe
Kleiner Vorsprung in 12m Höhe, 2,75x1,2m, unebener Untergrund, alpines Gelände exponiert und absturzgefährdet Außentempratur, alltäglihe Geräuschkulisse

K

Station Kälte
Bergwetterraum, 3x2,50m, felsiger Untergrund, -20 Grad Temperatur, Patient im Negativniveau

3

Untersuchungsparameter

Die Qualität einer CPR wurde anhand folgender Parameter gemessen:

•Unterbrechung der HLW
•Elektrodenposition
•Position Druckpunkt
•Fehlende Entlastung
•Drucktiefe
•Frequenz
•Durchschnittliche Analysezeit
•Zeitfenster Schock-Kompression
•Beatmungen pro Zyklus
•Durchschnittliche Zeit für 2 Beatmungen
•Beatmungsvolumen
•Durchschnit. No flow time
•Ergonomie

Ergebnisse

Die Ergebnisse dieser Studie zeigen, dass erschwerte Umgebungsfaktoren einen signifikanten Einfluss auf verschiedene CPR-Paramter haben, die das Outcome der PatientInnen negativ beeinflussen können. Die wesentlichen Unterschiede auf die CPR-relavanten Parameter zeigten sich durch die Einflüsse an den Stationen in exponierter alpiner Lage , als auch an der Station mit veränderten Witterungseinflüssen.

➢Exponiertes Gelände/ Witterung zeigten einen signifikanten Einfluss auf Thoraxkompressionstiefe der CPR.

➢Exponiertes Gelände/ Witterung zeigten einen signifikanten Einfluss auf die Ventilation während einer CPR

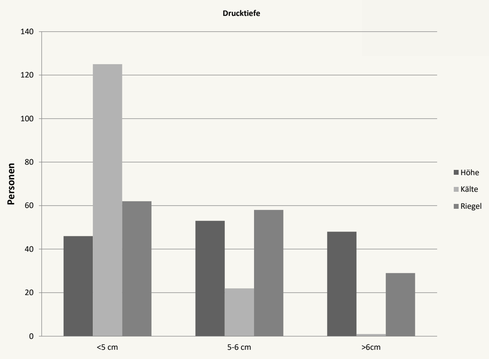
Drucktiefe in cm	< 5	5 bis 6	> 6	ausgeschlossen	gesamt
Anz. Pers. n (%)	233 (52,5)	133 (30)	78 (17,5)	6	450
Drucktiefe in Pers. in Höhe	46 (31,3)	53 (36,1)	48 (32,6)		147
Drucktiefe in Pers. in Kälte	125 (84,5)	22 (14,8)	1 (0,7)		148
Drucktiefe in Pers. in Riegel	62 (41,6)	58 (38,9)	29 (19,5)		149

Kruskal-Wallis-Test	n	Mittlerer Rang
Höhe	147	285,36
Kälte	148	130,43
Riegel	149	251,93

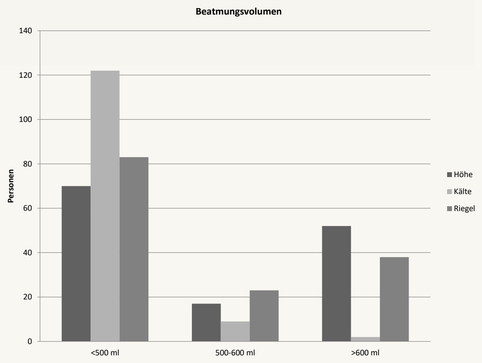
Kruskal-Wallis-H [2]	Wert	Signifikanz
Kruskal-Wallis-H	127,999	<0,001

Mann-Whitney-U-Test [2]	Wert	Signifikanz
Höhe vs. Kälte	3532,000	<0,001
Höhe vs. Riegel	9057,000	0,007
Riegel vs. Kälte	4746,000	<0,001

An den Stationen Höhe und Kälte zeigte sich eine deutlich zu geringe Thoraxkompressionstiefe. Interessanterweise war in allen drei Geländebereichen bei einer Überkopf Kompressionsposition eine erhöhte Drucktiefe erkennbar.

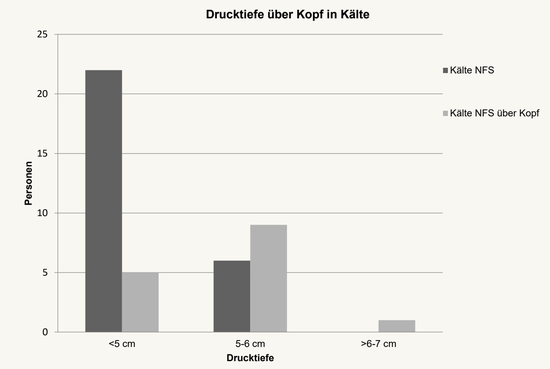


Die Grafik zeigt deutlich, eine zu geringe Drucktiefe (Normbereich 5-6 cm) an der Station Kälte gefolgt von Riegel und Höhe



Der Normbereich des Beatmungsvolumens von 500-600 ml wurde am häufigsten an der Station Riegel gefolgt von Höhe und Kälte erreicht. Zu wenig Volumen zeigt deutlich die Station Kälte gefolgt von Riegel und Höhe. Ein erhöhtes Volumen ist an der Station Höhe gefolgt von Riegel zu erkennen.

Auf Grund dieser Erkentnisse wurden in einer Nebenstudie 15 Sequenzen der Überkopf Thoraxkompressionen an der Station Kälte untersucht und analysiert.



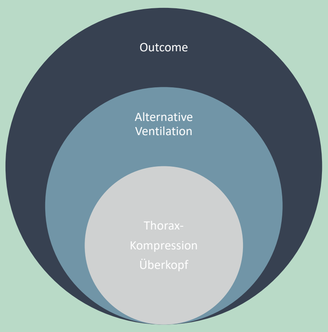
Die Ergebnisse der Studie zeigen, dass das Gelände bzw. die erschwerten Umgebungsfaktoren Einfluss auf den standartisierten Ablauf und auf die prognoserelevanten Parameter einer CPR im alpinen Setting haben. Die verminderte Thoraxkompressionstiefe als auch die unzureichende Ventilation könnten einen negativen Einfluss auf die neurologische Prognose der wiederbelebten PatientInnen haben.

Diskussion

Thorax-kompression → Ventilation → Outcome

Der Einfluss der genannten Umgebungsfaktoren auf prognoserelevante Parameter einer CPR wurden in drei Trainingssituatuationen untersucht. Es kann vermutet werden, dass die genannten Faktoren in einer realen Notfallsituation einen noch deutlicheren Einfluss auf die RetterInnen und damit auf die Durchführung einer CPR ausüben.

Es zeigt sich ein signifikanter Einfluss der Station Höhe und Kälte auf die wesentlichen Parameter der CPR im Vergleich zur Station Riegel, welcher einer gewöhnlichen Trainingsumgebung entsprach.
Die eindrücklichsten Ergebnisse zeigten sich dabei im Bereich Thoraxkompressionstiefe und Ventilation.



Thoraxkompressionstiefe

Eine ausreichende Thoraxkompressionstiefe ist ein entscheidender Faktor für den Erfolg einer CPR. Es zeigte sich in allen drei Geländebereichen bei Thoraxkompressionen Überkopf eine erhöhte Drucktiefe. Möglicherweise stellt die CPR Position Überkopf bei ungünstiger Lage der Patienten, z.B. Patientenlage im Negativniveau, eine Verbesserung der Thoraxkompressionstiefe dar.

Ventilation

Um den zerebralen Schaden der PatientInnen so gering wie möglich zu halten ist unter anderem eine effiziente Ventilation unerlässlich. Da die Beatmunssituation im alpinen Gelände erhebliche Probleme zeigte, könnte eine alternative Atemwegssicherung diesem Einfluss entgegen wirken.

Zusammenfassung

- Erschwerte Umgebungsfaktoren zeigen signifikanten Einfluss auf Prognose-relevante Parameter einer CPR im alpinen Gelände.
- Die Notwendigkeit realitätsnaher Trainingssimulation wird durch die vorliegende Studie unterstrichen
- Alternative Ventilationsformen sollten in Betracht gezogen werden, um den hypoxischen Schaden der PatientInnen zu minimieren.
- Eine Veränderung der Druckposition von lateral zu kranial bei ungünsitger Lage des Patienten, sollte anhand der vorliegenden Ergebnisse überdacht werden bzw. in weiteren Studien untersucht werden.

Verweise

Rieder C.Dr.MA.,2023, Analyse von Umgebungsfaktoren auf den Erfolg einer kardiopulmonalen Reanimation mit AED, untersucht in der präklinischen Notfallmedizin der Berg- und Luftrettung in Bayern., TUD Qucosa

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BERGWACHT BAYERN

28. Internationale
Bergrettungsärztetagung
3. und 4. November 2023
Congress Innsbruck

Training und Ausbildung - Wie die Lawinenrettung und die Chancen auf Überleben nach Lawinenverschüttung verbessert werden können

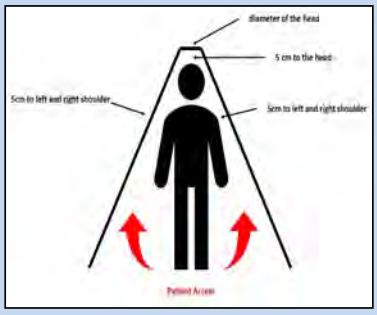
Fragestellung: Die beiden vorgestellten Studien hatten zum Ziel die Ausgrabung nach Lawinenverschüttung zu verbessern und die Verschüttungszeit zu verkürzen. Sie sollten die Frage beantworten, ob eine kardiopulmonale Reanimation (BLS-CPR) in atypischen Retterpositionen während der Ausgrabung mit gleicher Qualität wie in Standardposition durchgeführt werden kann.

Material und Methoden: Für die Ausgrabungsstudie mussten die 18 Proband:innen allein oder in Zweierteams eine Reanimationspuppe manuell aus einem simulierten Lawinenkegel von einem Meter Tiefe ausgraben. Es wurden drei aufeinanderfolgende Tests in drei Verschüttungspositionen in zufälliger Reihenfolge durchgeführt. Die Reanimationsstudie in atypischen Retterpositionen wurde prospektiv, randomisiert und im Cross-Over-Design durchgeführt. Die 25 Proband:innen führten die BLS-CPR in der Ein-Retter-Methode mit eingeschränktem Zugang zum Patienten in alternativen Retterpositionen (Becken- & Überkopf-Position (Abb. 1&2) unter Verwendung der Mund-zu-Mund-Beatmung oder der Pocket-Maske durch.

Atemwege frei	Einzelretter	Zweier Team	Alle
Head Down Prone	9.7 (2.3-16.7)	6.5 (4.8-19.2)	7.4 (2.3-19.2)
Head Uphill Prone	7.3 (5.4-12.7)	7.4 (5.7-10.9)	7.3 (5.4-12.7)
Head Uphill Supine	6.5 (4.2-20.4)	6.5 (2.8-9.5)	6.5 (2.8-20.4))
Alle Postionen	7.3 (2.3 – 20.4)	6.6 (2.8 – 19.2)	7.2 (2.3 – 20.4)

Tabelle 1: Mittlere Dauer der Befreiung bis zum Erreichen der Atemwege (min-max). Vergleich von Einzel- und Doppelrettern in drei verschiedenen Positionen.

Resultate: Die Ausgrabungsstudie zeigte, dass die mediane Zeit bis zum Erstkontakt 2,5 Minuten betrug, bis zum Freilegen der Atemwegen 7,2 Minuten und bis zum vollständigen Ausgraben und Start der CPR in Rückenlage 10,1 Minuten (Tab. 1). Insgesamt hatten die Anzahl der Helfer (p = 0,686) und die Verschüttungsposition (p = 0,428) keinen Einfluss auf die Ausgrabungszeit. Vorhandenes Training (p = 0,006) und ein während der Experimente erzielter Lerneffekt (p = 0,017) jedoch signifikant. Die darauffolgende Reanimationsstudie zeigte, dass nur 28 % aller Tidalvolumina den Reanimationsguidelines (400-800 ml) entsprachen, 59 % lagen unter 400 ml und 13 % über 800 ml. Es gab keinen signifikanten Unterschied bei den Beatmungsparametern, im Vergleich zwischen Standard- und atypischen Retterpositionen (Tab.2) oder durch die Pocket-Maske.



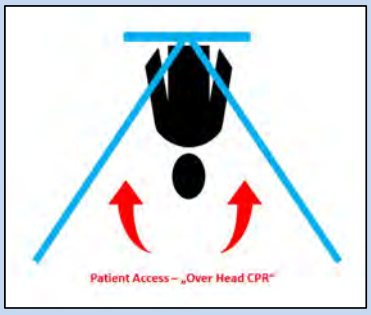


Abbildung 1 & 2: Darstellung der CPR in atypische Retterposition in Becken- (links) und in Über-Kopf-Position (rechts) mit eingeschränktem Zugang zum Patienten.

Retterposition	Standard n = 7,739*	Überkopf-Pos. n = 7,791*	Becken-Pos. n = 7,909*	Differenz zw. Gruppen
Kompress.tiefe > 50mm	n = 7,663 (99. 0%)	n = 7,721 (99.1%)	n = 7,694 (96.14%)	p = 0.164
Kompress.tiefe < 50mm	n = 76 (1.0%)	n = 70 (0.9%)	n = 305 (3.86%)	p = 0.094
Insuffiziente Entlastung	n = 3,306 (42.7%)	n = 3,480 (44.7 %)	n = 3,489 (44.1 %)	p = 0.322
Mittlere Frequenz	122 /min	128/min	124/min	p = 0.229

Tabelle 2: Tiefe und Frequenz der Herzdruckmassage während fünf aufeinanderfolgender CPR-Zyklen in Standard- und atypischer Retterposition

Diskussion: Nach Ortung eines komplett verschütteten Lawinenopfers dauerte es durchschnittlich 7 Minuten, um die Atemwege freizumachen und weitere 3 Minuten, um eine Herzdruckmassage in Rückenlage zu beginnen. Selbst minimales Training verkürzte die Verschüttungszeit deutlich. Die Qualität der BLS-CPR aus einer atypischen Retterposition mit eingeschränktem Zugang zum Patienten war in allen Parametern vergleichbar mit BLS-CPR in Standard-Retterposition. Unsere Daten legten nahe, mit der BLS-CPR noch während der vollständigen Bergung zu beginnen, um die Dauer der unbehandelten Asphyxie und des Herz-Kreislaufstillstand während der Lawinenrettung zu verkürzen. Dies sollte Teil jeder Lawinenrettungsausbildung sein.

Die BLS-CPR kann mit gleicher Qualität in atypischer Retterposition bei eingeschränktem Zugang zum Lawinenopfer durchgeführt werden. Wir empfehlen deshalb noch während der Ausgrabung mit BLS-CPR zu beginnen, um die Dauer der unbehandelten Asphyxie zu verkürzen und die Chancen auf das Überleben nach Lawinenverschüttung zu erhöhen!

Shoulder Reduction on the Scene: Current Practice and Outcome of the Bavarian Mountain Rescue Service – a Prospective Observational Study

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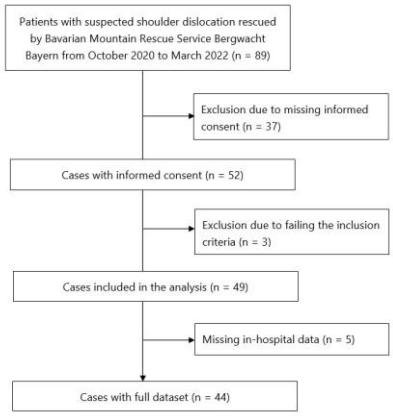
BACKGROUND

Shoulder dislocation is painful and immediate reduction markedly reduces pain level and facilitates evacuation (1). The Bavarian Mountain Rescue Service (Bergwacht Bayern, BWB) follows the Medical Commission of the International Commission for Alpine Rescue (ICAR MEDCOM) by recommending the Campell method also for it's trained non-physician-rescuers (2). Our study aims to evaluate the actual current practice in the Bavarian mountains.

MATERIALS and METHODS

Our prospective observational study included patients of any age being preclinically suspect of traumatic shoulder dislocation, treated and evacuated by the BWB. Between October 2020 and March 2022, data were systematically collected using three questionnaires: the first one completed on-site by the rescuer, the second one by the receiving physician in the hospital and the third one as a follow-up by the patient, mainly addressing the overall outcome.



Consort flowchart of "Shoulder Reduction on the Scene – Current Practice and Outcome of the Bavarian Mountain Rescue Service"

Figure: The Campell-method with two rescuers for reduction of shoulder dislocations (© Bergwacht Bayern)

RESULTS

Eighty-nine patients with traumatic shoulder dislocation were identified, forty-nine of them (age 42±18 years) were recruited and forty-four accomplished a complete dataset (out-of-hospital, in-hospital and follow-up) while in five cases the in-hospital data were missing (see Consort flowchart). In 34 (69%) of 49 cases included in the analysis, reduction on the scene was attempted. In most cases the operator was an emergency physician [18 (53%)] or mountain rescue paramedic [10 (29%)]. In six cases (18%) it was a mountain rescue member with basic medical training. The operator's formal qualification did not have an impact on success (p=0.217, n=28). The chosen method had no effect on success rate (Campell vs. Fares vs. other, p=0.864, n=27). The preclinically suspected shoulder dislocation was clinically confirmed in 37 of 44 (84%) cases. Concomitant injuries in other body regions were found in 8 of 49 (16%) cases, being strongly associated with incorrect diagnosis of shoulder dislocation (p=0.002). Younger age (p=0.043) and first event of shoulder dislocation (p=0.038) were associated with a higher success rate of reduction attempts. Out-of-hospital reduction led to significant pain release and no worse long-term outcome.

CONCLUSION

Our data suggest that shoulder reduction on the scene using the recommended Campell-method, even by non-physician rescuers of BWB, might be beneficial. However, predictors of success and incorrect diagnosis should be considered before. Beyond that, an intensive training especially enabling the BWB-rescuers to clinically discriminate between an isolated dislocation and a fracture appears desirable.

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1) Beeson MS. Complications of shoulder dislocation. Am J Emerg Med. 1999;17(3):288-95.
2) Forster H, Zafren K. Alpine Emergency Medicine Commission - Recommendation 0009 - Treatment of Shoulder Dislocations. Accessed on 27 April 2023. URL: https://www.alpine-rescue.org/articles/49--treatment-of-shoulder-dislocations.