Ultrasound guided locoregional anesthesia in the setting of cave rescue

Alexandre Moser [1,2,3,4], Sarah Wagner [2,5,6], Katrin Habegger [2,6,7], Luca Cioccari [8], Sylvain Tosetti S [2,4,9]

1: Department of Anesthesia and Resuscitation, Hôpital Fribourgeois, Fribourg, Switzerland
2 :Swiss Cave Rescue Organization (Spéléo-Secours Suisse), La Chaux-de-Fonds, Switzerland
3: Swiss Alpine Rescue, Zürich, Switzerland
4: Helicopter Emergency Medical Services, Air Glaciers, Sion, Switzerland
5: Swiss Air-Ambulance REGA, Zürich, Switzerland
6. Emergency Medical Services, Regionalspital Emmental, Langnau, Switzerland
7. Department of Emergency Medicine, Lindenhof Bern, Switzerland
8. Department of Intensive Care Medicine, Kantonsspital Aarau, Aarau, Switzerland
9: Mobile Anesthesia Care, Bulle, Switzerland

Introduction

Caving accidents are rare, but when they occur, they represent a unique logistical, technical, and medical challenge. Retrieving the patient to the surface involves specialized multidisciplinary teams[1,2] and may take several days.[3,4]

It involves the rigging of shafts and even the use of explosives to expand parts of the cave. Transporting the patient often means navigating stretchers through narrow corridors with limited options for monitoring and interventions. (Fig. 1 and 2)

Since the patient is usually not fasted, opioids and sedatives should be used with extreme caution, because management of complications or clinical deterioration might be challenging.

Therefore, alternative analgesic techniques such as locoregional nerve blocks are a promising strategy for pain control in such cases, improving patient comfort and safety during cave rescues.

Methods

We describe two cases of cave rescues in Switzerland in which portable point-of-care ultrasound equipment was used to supplement clinical assessment and provide locoregional anesthesia to facilitate patient evacuation and transport.[5] In this context, we discuss the role of portable ultrasound-guided locoregional anesthesia in cave rescue and in the global preclinical context.

Results

In the first case, we performed two ultrasound guided nerve blocks with sentinel neurostimulation, an interscalene brachial plexus block and a popliteal nerve block both using ropivacaine and clonidine (Fig. 3) in a 45-year-old female cave explorer who fell from a height of about 8 meters, 530 meters away from the cave entrance and 70 meters below the surface.

In the second case, an infra-inguinal ultrasound-guided blockade of the fascia iliaca compartment (FICB) was performed with ropivacaine and epinephrine in a 39-year-old speleologist who was hit on the pelvis by a boulder weighing several hundred kilograms, 100 meters from the cave entrance and 50 meters below the surface.

In both cases, resuscitative equipment (portable suction, AMBU bag), intralipids and benzodiazepines were readily available in case of LAST (Local Anesthetic Systemic Toxicity).[6]

Figure 1 and 2: Patient transport during cave rescue

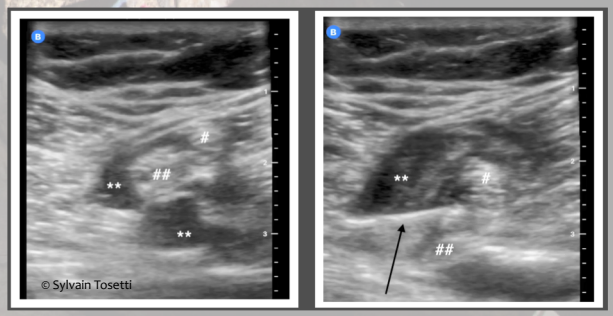
Discussion

While it is used daily in perioperative medicine, locoregional anesthesia is used sporadically in prehospital and emergency medicine, although it may be useful in the initial stages of trauma care.[7,8]

In our two cases, Point-of-Care Ultrasound allowed us to exclude life-threatening injuries as well as to facilitate patients' evacuation. This approach may be particularly helpful in situations where continuous monitoring of vital signs and securing the airway proves difficult, especially in non-fasting patients at risk of aspiration.

Because evacuation under general anesthesia with intubation would be technically too complicated in the setting of cave rescue, the need for alternative analgesic strategies becomes apparent.

Figure 3: Locoregional nerve block (popliteal block of the first patient) inside the cave



Local anesthesics (**) around peroneal (#) and tibial (##) nerve and injection needle (black arrow)

Conclusion

Our cases demonstrate that the administration of ultrasound-guided prehospital locoregional anesthesia is a safe, rapid and effective procedure even in extreme situations such as cave rescues.

The advent of portable, high quality ultrasound equipment may open the door for more widespread application of this technique in the global preclinical setting.

1. Charpilloz C, Gnaegi A, Selz Amaudruz F, Tosetti S, Moser A. Difficult setting rescue: what complementarity. *Rev Med Suisse*. 2022;18(791):1497-500.
2. Sette P, Carlini M, Berti D, Rucci I, Marchiori F, Toffali F, et al. Complex alpine extrication: case report of mountain and speleo- logical rescue cooperation. *Wilderness Environ Med*. 2015;26(2):180–4.
3. Lawthaweesawat C, Harris R, Isara W, Pongpirul K. Prehospital care of the 13 hypothermic, anesthetized patients in the Thailand cave rescue. *N Engl J Med*. 2019;380(14):1372–3.
4. Schneider TM, Bregani R, Stopar R, Krammer J, Göksu M, Müller N, et al. Medical and logistical challenges of trauma care in a 12-day cave rescue: a case report. *Injury*. 2016;47(1):280–3.
5. Moser A, Wagner S, Habegger K, Cioccari L, Tosetti S. From the Operating Room to the Cave: Ultrasound-Guided Locoregional Anesthesia in the Setting of Cave Rescue – A Description of 2 Cases. *Wilderness Environ Med*. 2023;34(4):553-7
6. Harvey M, Cave G. Lipid emulsion in local anesthetic toxicity. *Curr Opin Anaesthesiol*. 2017;30(5):632–8.
7. Wu JJ, Lollo L, Grabinsky A. Regional anesthesia in trauma medicine. *Anesthesiol Res Pract*. 2011;2011, 713281.
8. Lopez S, Gros T, Bernard N, Plasse C, Capdevila X. Fascia iliaca compartment block for femoral bone fractures in prehospital care. *Reg Anesth Pain Med*. 2003;28(3):203–7.

alexandre.moser@h-fr.ch