This Summer in the Mountains

Welcome to the second edition of International Mountain Medicine Center's newsletter!

NEWSLETTER CONTRIBUTORS

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NEWSLETTER DEADLINE

The Mountain Dispatch is a semiannual newsletter released every summer and winter. If you would like to contribute to the newsletter, your submission must be received by October 1st for the winter edition or by March 1st for the summer edition.

DISCLAIMER

The International Mountain Medicine Center and its faculty, contributing authors, and the affiliate entities shall not be liable or responsible for the advice or safety of any techniques described in this newsletter. It is the responsibility of the medical provider or rescuer to investigate technical and medical techniques and evaluate them for safety, effectiveness, and applicability. Reliance on any information provided by this newsletter is solely at your own risk.

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Paramedic and DiMM graduate Aaron Miller describes what it means to be a volunteer rescuer for Grand Canyon National Park.

In the first of a 3-part series, Dr. Darryl Macias introduces basic concepts of pain management and the role of NSAIDs when managing pain in the backcountry.

Why are so many rescue teams switching to two-tensioned rope systems? Faculty member Trevor Mayschak explains the research behind the shift.

Want to know what we have coming up? Check out the courses and events that we have planned for the coming year!
Mountain Medicine Symposium
Silverton CO

September 20-24, 2017

September 20-22, Pre-symposium workshops
State of the art medical education, and rescue techniques in austere mountain environments. Intended for MD, RN, EMT-P, EMT-B, WFR
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INSIDER’S PERSPECTIVE: SEARCH AND RESCUE AT THE GRAND CANYON

Aaron Miller

It’s 113° as I round the corner on Bright Angel Trail. Another ranger and I are headed uphill from Phantom Ranch Ranger Station at the bottom of the Grand Canyon. We’re responding to a rest house up-trail where reports of a distressed hiker with symptoms of heat illness are surfacing. Upon approach, we locate the exhausted hiker. She begins crying with relief. After reassurance, fluid resuscitation, and anti-emetics, the hiker reports dramatic relief. Comforted by the thought that she is not alone in this seemingly remote area of the canyon, we are able to encourage her to continue her journey out of the canyon and back to civilization. My name is Aaron; I’m a volunteer paramedic for the

Peering into the Grand Canyon from Yaki Point
National Park Service in the Grand Canyon. As a recent college graduate with a BS in EMS and Diploma in Mountain Medicine (DiMM), I began my 5-month internship at the Grand Canyon as part of a joint collaboration between the National Park Service and the University of New Mexico. During my internship, I was able to be a part of many rescues while at the Grand Canyon National Park. This program is designed to foster DiMM graduates practical experience in a high-volume and professional search and rescue program. Certain days I wake early to prepare for technical rescue training. Only hours later I find myself dropping over a 500-foot cliff to practice patient packaging. At days end, I head to the park service lodging that I call home. More often than not, community dinners with other EMS providers are ensuing. At night, both EMS and SAR calls are paged out by dispatch. It is a busy summer filled with excitement and experiences that could not be found elsewhere.

Paramedics working for Grand Canyon Emergency Services see a broad range of typical and atypical rescues. Their days include rescues ranging from river trip retinal detachments to upper-trial cardiac arrests. Shifts are eight hours long and provide around the clock paramedic staffing at Phantom Ranch Ranger Station Clinic, a clinic located at the bottom of the Grand Canyon. This spot sees heavy traffic: the canyon’s most popular trails intersect here at the Colorado River. EMS calls can be as benign as blister care and as critical as cases warranting overnight care until medevac (helicopter evacuation) is available. Patients with simple heat illness who can be treated/monitored in-clinic are released to continue on their hike upon improvement, thus mitigating a high-risk helicopter medevac. The variety is stunning.

In addition to practicing both village and wilderness EMS, Grand Canyon
paramedics also staff National Park Service helicopters as flight paramedics. These air medics provide a resource for more remote medical or search and rescue needs. I was fortunate to attend in-house flight paramedic training and fly throughout the season on search and rescue missions. Grand Canyon technical rescue is equally challenging and progressive. Each training is catered to the various geographical features of the canyon. Diverse canyon environments require training on a variety of techniques including raises and lowers, confined space rescue, short-haul rescue, and swift water rescue. Frequently, “over the edge” scenarios are practiced in which hiker falls from the canyon rim are simulated. These trainings involve technical lowers, often hundreds of feet, which offer comprehensive big wall training as well as breath-taking views. Grand Canyon paramedics are responsible for some EMS education at the canyon. Providers host case reviews, skills trainings, and annual EMS refreshers. I practiced my teaching skills while simultaneously learning about the unique canyon protocols. The canyon’s wild backcountry is juxtaposed with its front-country village, thus providing EMS experiences ranging from rural to urban. I became attuned to making critical patient care decisions that would not only play a role in immediate patient care, but would also play a role in long term care. (The nearest hospital is over 80 miles away). This
desolate environment demands an inherent understanding of patient conditions and new skills adoption; SAR scope of practice is far greater than that of traditional paramedic training. In response, Grand Canyon paramedics carry ketamine, tranexamic acid (TXA), 3% hypertonic saline, antibiotics, and a variety of supplemental tools including iStats to immediately analyze blood values. There is so much to be said about the Grand Canyon and the people who work there. It is a unique and beautiful place that offers countless opportunities to practice progressive medicine, technical rope rescue, and search and rescue. I am incredibly grateful for the opportunity to have spent a season in the canyon and look forward to future adventures.
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ICAR - International Commission for Alpine Rescue
ISMM - International Society for Mountain Medicine
Case 1: You are the medical leader for a local hiking group on a three-day backpacking trip into a remote northern New Mexico wilderness area. After reaching the turnaround point, the group of ten begin to walk 20 miles back toward the trailhead. Halfway there, a 45-year old male with a history of chronic low back pain complains of 8/10 pain to the lower lumbar area and is unable to carry his 60-pound backpack. The pain radiates down the posterior side of his left thigh and his symptoms worsen with walking. Past medical history is negative, vital signs are normal. Physical and neurological exams reveal left lumbar paraspinous tenderness as well as worsening of the symptoms when you lay him supine on the ground and lift his left leg up. He is asking you for a muscle relaxant. What will you do?

The ideal pain medication for backcountry use should be compact and lightweight, durable, non-sedating with minimal side effects, stable chemically in an outdoor environment, and have multiple routes of administration. The person administering the medication should have some experience with the use of that medication. Most minor pain syndromes are amenable to “conservative” treatment – treatment without medication, called “PRICE therapy” per the Wilderness Medical Society Practice Guidelines for the Treatment of Acute Pain in Remote Environments. This consists of comfort care, where a compassionate, reassuring provider can significantly decrease the sensation of pain; “P” would be protection of the injury, which may include immobilization, “R” is for rest, “I” is for ice (which can attenuate pain and inflammation in acute musculoskeletal injuries, as long as the injured area does not undergo cold injury), “C” is for the application of a non-constricting elastic compression bandage, and “E” for elevation of the affected extremity. This treatment scheme could also be applicable in the initial stages of treating a more severe injury.

Nonopioid analgesia and nonsteroidal anti-inflammatory agents (NSAIDS)

The side effect profile of NSAIDs and acetaminophen (paracetamol) in healthy individuals is fairly minimal, and are without the hemodynamic concerns posed by opiate medications. This class of medication is often

Even during complex rescue operations in harsh conditions, appropriate pain management remains an essential component of patient care.
For many orthopedic injuries, basic splinting is arguably the most widely taught method of pain management in wilderness medicine classes. In the wilderness setting, this may require some improvisation. Photo by Dane Abruzzo.

Even for major trauma - such as spinal cord injuries - the "P" in "PRICE" is emphasized in management. Pictured here is a group of medical students providing spinal protection as they move a patient. Photo by Darryl Macias. True testament to his passion for pain management, Dr. Macias marks his climbing gear with Ketamine labels!

the first medication a rescuer would go to for most injuries. NSAIDs work by inhibiting the injury-initiated inflammation, producing cyclooxygenase enzymes (COX-1, COX-2, and COX-3). COX-2 is the main culprit that forms that nasty arachidonic acid/prostaglandin cascade that acts on peripheral neural receptors to sense pain. However, COX-1 is responsible for good blood flow to the kidney, GI tract, and platelet function. Some of the common NSAIDs, such as ibuprofen or naproxen, are non-selective and will inhibit COX-1 and COX-2, rendering them effective in mitigating pain and inflammation but may result in gastrointestinal (GI) side effects and renal insufficiency. The renal effects are due to hypoperfusion or direct action on renal tissue, producing acute tubular necrosis. Although most outdoor participants would not likely suffer these side effects, proper rehydration and short-term administration of NSAIDs can mitigate these effects. Active GI bleeding would be a contraindication to these medications; otherwise, short-term administration appears to be safe. While platelet function may also be affected, it does not appear that bleeding is increased during the acute phase of hemorrhagic trauma.

administered orally, GI symptoms can be decreased with the administration of food. Keep in mind that some may experience a mild rash from NSAIDs due to histamine release.

Most recommend that 1200-2400 mg/day of ibuprofen or 660 mg/day of naproxen in three divided doses is safe. Other NSAIDs, such as diclofenac and sulindac, may have less effects on renal function. Of note, intramuscular and intravenous forms of NSAIDs (ketorolac and ibuprofen) are also available, and ideal for those unable to take medication by mouth. Ketorolac is usually given as a 60 mg IM dose, or a 30 mg IV dose, once. Topical diclofenac has been reported to be as effective as an oral NSAID, but this has not been the case in my pre-hospital experience. Topical methylsalicylate (Ben-Gay, Icy Hot, and the like) can also be used temporarily for minor trauma, but keep in mind the potential for salicylate toxicity if used excessively. Specific COX-2 inhibitors appear to decrease the effects of renal hypoperfusion since these medications do not inhibit COX-1. These medications include rofecoxib, celecoxib, and meloxicam. While this is some concern that
these COX-2 inhibitors may increase the likelihood of nonfatal myocardial infarction or stroke by approximately 37%, this does not appear to be a concern for acute pain management. Meloxicam is the NSAID of choice for the tactical combat casualty care trauma pack: it can be administered once daily at a dose of 7.5-15 mg by mouth.

Acetaminophen does inhibit COX-3, having a negligible anti-inflammatory effect, but recent data suggests that it affects neurologic serotonin pathways (the same neurotransmitter targeted by certain antidepressant medications, but don’t use this medication as an antidepressant) responsible for decreasing pain sensation. Acetaminophen also appears to decrease TRPV-1 vanilloid receptors – we will discuss this receptor later, and it has nothing to do with the oft-cited Haagen Dasz receptor. 4 grams daily in divided doses appears to be safe; larger doses are responsible for fulminant hepatotoxicity. An intravenous form may be available in many hospitals, and is more readily available in Europe. Combining an oral NSAID with acetaminophen appears to have an additive effect on mitigating pain.

The patient in case 1 could simply benefit from PRICE therapy along with some NSAIDs, as well as some teaching about carrying a lighter backpack next time. A trigger point injection might be helpful if all else fails. Muscle relaxants act as a sedative and relax the brain but do not relax muscles in the true sense of the word. Most of us would not necessarily recommend opiates as a first line agent. ■

*In part 2 of this series, Dr. Darryl Macias will discuss opioids, NMDA antagonists, and other methods of pain management. Don’t miss out!*
A rock climber has been struck in the head by falling rock and is unable to follow commands. She is located midface on a 5-pitch climb, approximately 250 feet from the top of the climb. A local Search & Rescue team familiar with the area makes the decision to bring the injured climber to the top of the rock climb, where she will then be evacuated by helicopter. At the top of the cliff, nine rescuers begin to rig the rope systems that will be used to move the climber up the cliff face. They have the equipment necessary to run two ropes down to the injured climber. How will they use these ropes? In this hypothetical situation, there are many possible solutions to safely and efficiently rescue the climber. While many teams in North America would utilize a dedicated mainline and a dedicated belay line, some recent studies give reason to make the switch to a two-tensioned rope system.

Before looking at the literature, some basic premises should be understood. In many instances of high-angle rope rescue, teams will utilize two ropes such that the system has redundancy. The idea behind redundancy is that should any single component in the system fail, there remains a backup to prevent catastrophe. Ropes used for rescue may vary in qualities such as weight or elongation, but they are all adequately strong for rescue work. The average rescue rope will have a minimum
breaking strength greater than 20 kilonewtons (4,500 lbs force) even after it has been knotted. Forces great enough to outright break a rope do not typically occur; instead, rope failure is far more likely to occur as a result of a rope running over a sharp edge or being struck by a falling rock. It is important to recognize that a rope is more susceptible to this type of failure when it is under tension; an unweighted rope is less susceptible to damage from an edge. It has been assumed that an unweighted rope is also less susceptible to damage from rock fall, although this has not been tested until recently.

With these concepts in mind, many rescue teams have used a main line and belay line as their primary rescue system. In this system, the mainline holds 100% of the load while the belay line remains unweighted. The belay line’s purpose is to arrest a fall should the mainline fail. One of the primary justifications for a main and belay system is that the unweighted belay line may be less susceptible to failure from a sharp edge or rock fall. There are some known drawbacks to the main and belay system. Should a mainline fail, the belay line will go from seeing 0% of the load to 100% of the load in a short amount of time. This results in a dynamic event on the system. Some research has shown that a mainline failure with a standard 200 kg rescue load can result in 9% elongation of the belay system when using 11mm static nylon rope. If the rescuer and patient are just 100 feet below the cliff edge when the mainline failed, the result would be at minimum a 9 foot drop before the belay line arrested the fall. A fall of this distance under these circumstances could easily result in trauma to the rescuer and the patient.

The most commonly used rescue belay is the Tandem Prusik Belay. Utilizing two 8mm prusiks to arrest a fall, the Tandem Prusik Belay can have varied results based on operator technique. It has been found that mismanagement of belays can lead to failed belay catches and ground falls\textsuperscript{[11]}. The age and wear of the prusiks have also been identified as variables that introduce uncertainty in belay performance.

An alternative system is the two-tensioned rope system (TTRS). While many rescue organizations are just now switching to this system, it...
is far from new. Rescue teams that frequently operate on big walls, such as Yosemite Search and Rescue, have been using this system for quite some time. The idea behind TTRS is that both ropes share the load, ideally with each rope seeing 50% of the load. International mountain guide and rope rescue expert Kirk Mauthner has been extensively studying how two-tensioned rope systems compare to main and belay systems. In an extensive 74-page report published by Emergency Management British Columbia, Mauthner summarizes the advantages of TTRS over main and belay systems. Mauthner’s research has found that TTRS perform better than main and belay systems when subjected to sharp edges. When a main line fails due to a sharp edge, the load transfer causes the belay line to fail sequentially as it experiences a dynamic event over the same edge. By reducing the load seen by each rope, TTRS reduces the likelihood of failure over an edge. In regards to the fall distance, Mauthner showed that a belay line will allow the load to travel 8-10 times further when compared TTRS. The maximum arresting force was consistently 50% less in TTRS. It was also shown that TTRS was no more prone to damage from rock fall when compared to main and belay systems. In most scenarios, it would appear that TTRS provides a better safety profile than a main and belay system [12].

While this is only a brief summary of the literature comparing the main/belay system to the two-tensioned rope system, the research is showing more and more that the latter is the safer and more efficient system. It is encouraged that organizations take a close look at the research and evaluate which system they will use in their rescue operations. If a team decides to utilize a different system, it is imperative that they seek guidance from professionals in the field and train regularly to ensure proficiency amongst the team. ■
Upcoming Courses & Events

WILDERNESS EMT UPGRADE
Sept. 20-21, 2017
Silverton, Colorado
Learn how to adapt your pre-hospital skill set to the wilderness and rescue setting. This course consists of 24 hours of online content followed by 16 hours of practical skills sessions. Register for this pre-conference workshop by clicking here! $400

1ST ANNUAL MOUNTAIN MEDICINE SYMPOSIUM
Sept. 22-24, 2017
Silverton, Colorado
A collaboration of Silverton EMS, San Juan County SAR, Silverton Avalanche School, and UNM International Mountain Medicine Center, this conference will bring together leading experts from the fields of mountain medicine and rescue. Attendees will receive 14 AMA Category 1 CME credits. Click here to register.

EUROPEAN WFR REFRESHER COURSE
Sept. 26-27, 2017
Chamonix, France
A collaboration with Mountain Guide Medical & Dr. Alan Oram IFMGA, this WFR Refresher is designed for American Mountain Guides working in Europe. Contact us at HSC-IMMC@salud.unm.edu if you are interested.

COLLABORATION CONFERENCE WITH MASTERS IN MOUNTAIN MEDICINE
Oct. 2-3, 2017
Albuquerque, New Mexico
The University of Insufría, Italy, Master’s in Mountain Medicine program will be traveling to Albuquerque to collaborate with UNM. Join us for 2 days of conference lectures at the UNM Department of Emergency Medicine. Contact us at HSC-IMMC@salud.unm.edu if you are interested in joining.

ICAR CONGRÈS
Oct. 18-21, 2017
Sardegna, Andorra
This year, the ICAR Congrès will take place in Sardegna, Andorra. This conference brings together the top experts in various disciplines of mountain rescue, including avalanche rescue, technical rescue, and helicopter operations. This year's general topic will be rescue from big walls. Registration for the conference can be found here.

WILDERNESS FIRST RESPONDER REFRESHER - AMERICAN MOUNTAIN GUIDES ASSOCIATION
Oct. 29-30, 2017
Salt Lake City, Utah
The UNM IMMC will be providing a WFR refresher course for the AMGA Annual Conference in Salt Lake City. This course will consist of 12 hours of online content paired with 12 hours of practical skills. Topics will focus on emergencies that mountain guides are likely to encounter. Contact us at HSC-IMMC@salud.unm.edu if you are interested in this opportunity. $200.

WILDERNESS FIRST RESPONDER/WILDERNESS EMT REFRESHER
Nov. 17, 2017
Albuquerque, New Mexico
Join us to renew your Wilderness First Responder certification. This course combines 12 hours of online content with an 8 hour in-class practical session to train WFRs in current best practices at the basic life support level. Additionally, this course awards licensed EMS providers with 24 hrs of continuing education to renew their licenses. $200

DIPLOMA IN MOUNTAIN MEDICINE - SUMMER SEMINAR
May 16 - 24, 2018
Albuquerque, New Mexico
Our seminar format of the Diploma in Mountain Medicine is designed for medical providers from all over the world. The summer seminar completes half of the program with 25 hours of online content followed by a 9 day practicum in New Mexico. Participants will then complete the 2nd half of the program in August. Apply here!

INTERNATIONAL SOCIETY FOR MOUNTAIN MEDICINE WORLD CONGRESS
Nov. 21 – Nov. 24, 2018
Kathmandu, Nepal
The ISMM 2018 World Congress will take place in Kathmandu, Nepal. Conference topics will include high altitude research, travel medicine in the Himalayas, and mountain rescue at high altitude. Contact office@ismm.org for more information.

DIPLOMA IN MOUNTAIN MEDICINE - WINTER SEMINAR
Jan. 1 - Feb. 8, 2018
Albuquerque, New Mexico
Our seminar format of the Diploma in Mountain Medicine is designed for medical providers from all over the world. The winter seminar completes half of the program with 25 hours of online content followed by a 9 day practicum in New Mexico. Participants will then complete the 2nd half of the program in August. Apply here!

WILDERNESS MEDICINE ELECTIVE
April 1 - 29, 2018
Albuquerque, New Mexico
The UNM Wilderness Medicine Elective is for 4th year medical students that have an interest in wilderness medicine and mountain rescue topics. Learn about medical support for endurance events, treating a variety of bites and stings, expedition medicine, and much more! This course will take place in the Albuquerque area, Red Mountain Pass in Colorado, and Sedona, Arizona. Email us at HSC-IMMC@salud.unm.edu if you’re interested! $875

For more details on our courses, visit our website here!

Need a course? Are you a member of a group looking for wilderness medical or rescue training? Be a recreational group or SAR team, our faculty can provide tailored courses to meet your specific needs. Contact us to discuss options!
REFERENCES

**Medicine Review**


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**Nuts & Bolts**


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