Bring the patient to the hospital, not the hospital to the patient: the use and limitations of advanced medical technology in technical rescue.

James Corbin, MS, PA-C, WEMT-P, FAWM

Physician Assistant, Division of Neurosurgery
University of Arizona Medical Center

Wilderness Paramedic, Rescue Technician I
Maricopa County Sheriff's Office Mountain Rescue

For the past 15 years, the progression of miniaturization and ruggedness of medical technology has lead to more and more advanced technological tools being placed in the hands of pre-hospital responders. Urban ALS units are now carrying portable 12-lead ECGs, capnography, glucometers, and portable i-stats. Field portable ultrasounds are just now beginning to make their way into the pre-hospital armamentarium.

These views come from a Backcountry Rescue/Mountain Rescue perspective where every piece of equipment taken into the back country replaces other items like food, water, clothing. However in every high angle rescue each piece of equipment loaded onto a liter in the vertical realm adds weight and risk to the system. The interface with the urban and resource-deprived environments (Urban SAR, Wilderness, International) presents the question – what information do we truly need, and which of these pieces of medical technology will provide it to us. What deserves a place on the technical rescue platform?

The 12-lead monitor/defibrillator

The 12-lead monitor/defibrillator began to see use in the pre-hospital communities in the early 1990s, and has had a great impact on how cardiac patients are treated in the field and often what facility they are transported to. The 12-lead is a powerful tool in the hands of the ALS provider in treating the cardiac patient, giving them the ability to monitor, defibrillate, pace, monitor blood pressure, pulse oximetry, and recently capnography. However the utility of the 12-lead capacity in trauma (the predominant injury pattern seen in technical rescue) has never been well established.

Myocardial injury from blunt chest trauma may cause significant arrhythmia or more subtle ST segment deviations. Arrhythmias and ECG changes are a known complication from traumatic subarachnoid hemorrhage. However the clinical implication of these cardiac changes are usually negligible in the pre-hospital setting, and, more importantly, they are rare.

12-lead monitor/defibrillators are heavy; the Medtronic Lifepack12 (by way of example) starts at 14 pounds and goes up from there. Miniaturization has brought weights down slightly, but as features are added (such as capnography), the weights, on a whole, have remained fairly constant. While the combination modern 12-lead does offer valuable data (such as pulse oximetry, blood pressure, etc), this information is also available 'a la carte' through smaller monitors.

The one glaring exception to the above is in an industrial tower-type setting or in high-power
electrical line work where both electrocution (either primarily through the line or though lightening) and suspension trauma are real concerns. In these cases, specifically with electrocution, 12-lead capability may be life saving.

**Advanced airways/ventilation**

Backcountry and wilderness rescue involves, by definition, prolonged time to reach patients, and often prolonged extrication. The increasing availability of helicopter evacuation is changing this paradigm, but most evacuations of patients in the wilderness are still effected by ground on foot.

The decision to secure an airway with an advanced airway device in the field, even in an urban setting, is not one taken lightly. Even more so in a wilderness setting. The risks of placing an advanced airway include esophageal intubation, dislodgement or displacement of the airway, hyper and hypo-ventilation, among others. These complications happen regularly in hospital environments with skilled providers; in a backcountry setting with all of the stressors included it is a higher risk.

Again, the primary injury pattern in these patients is trauma. While protecting an airway in maxilofacial trauma is a high-level indication, it is quite rare. Most trauma patients are intubated due to altered mental status secondary to either hypovolemia and hemorrhage or head injury (GCS less than eight = intubate). In the urban pre-hospital environment this is reasonable and achievable. In fact pre-hospital endotrachial intubation has been shown to improve the survival of patients with severe head injury. However this is an urban retrospective and likely has little relevance to the backcountry and wilderness patients.

Securing an advanced airway in a vertical environment on a moving platform (or patient) is especially fraught with peril. Moreover this is an extremely rare occurrence; technical rescuers can go their whole careers without ever encountering an airway problem in a suspended patient. Again, the caveat to this is industrial tower-type setting or in high-power electrical line workers.

A reasonable approach is for backcountry providers to primarily carry small portable airways such as nasopharyngeal airways and oropharyngeal airways, with oxygen available with the second wave of rescuers. The question of portable bottled oxygen may be one of the most vexing questions in backcountry rescue, and every team will have a different approach and solution. The important thing is to pre-plan and have protocols in place.

**Advanced Life Support Medications**

The typical pre-hospital ALS 'drug box' weighs approximately 25 pounds; this of course varies depending on the material the case is made out of and the particular drugs being carried. Many of the drugs carried are cardiac/ACLS-type drugs that have limited or no utility in the type of patient we encounter. Primary patient type in backcountry and wilderness rescue is exhaustion/dehydration and environmental injury, followed by trauma. ALS medications DO have a very real and valid role, but they must be chosen carefully; carrying an entire pre-hospital 'drug box' is foolish and adds needless weight to a rescuer and slows them down.

There are significant barriers to deploying into the field a slimmed down 'wilderness drug box'. Many managing EMS agencies are not familiar with wilderness medicine and rescue, and are not
comfortable giving the wilderness provider the go-ahead to leave some medications behind and carry a selected list.

Some have argued that if some "standard" ACLS event occurs at Base, and a paramedic is available, we want the paramedic to be able to do standard ACLS things at Base. This is easily settled by making sure there is a full set of ACLS equipment available at the trail head.

A sample 'Mountain Rescue Mini Drug Kit' is listed in Appendix A.

**Ultrasound**

Lastly, the one technology with real potential to change not only backcountry rescue but pre-hospital care in general has yet to be deployed in this country. Many other countries are using hand portable ultrasound to evaluate and diagnose multiple traumatic injuries in the field, and guide the treatment and transport of these patients.

Particularly in international and disaster medicine, ultrasound has continued to show potential. In wilderness trauma the ultrasound could fill in for the one potential injury for which an argument could still be made for carrying a 12-lead ECG; myocardial injury.

An in-depth discussion on the use and utility of field portable ultrasound is beyond the scope of this

**References**


**Appendix A**

**Sample Mountain Rescue Mini Drug Kit**
Naloxone 0.4mg/ml 1ml vial x 2
Odansetron 4mg/2ml 2ml vial x 2
Diphenhydramine 50mg/ml 1ml vial x 2
Epinephrine 1mg/ml 1ml ampule x 2
Methylprednisolone 125mg/2ml 2ml act-o-vial x 2
Midazolam 5mg/ml 1ml vial x 2
Morphine 10mg/ml 1ml vial x 2
D50 (0.5mg/ml) 50 ml syringe x 1
ASA 81 mg 1 bottle x 1
Normal Saline IV fluid 1000cc bag x 2

3cc syringe x 2
1 cc syringe x 2

18g needle x 4
21 g needle x 4
Filter needle x 2
IV start pack x 1
Blood tubing 10 drops/ml x 1
IV tubing 15 drops/ml x 1
IV catheters 14g, 16g, 18g, 20g, 22g, 24g x 2 each
10 cc syringe x 2
5 cc syringe x 2
Intermittent Injection Port x 2