

## ARE WE READY?

### A Review of Western Canadian Hospital Resuscitation Capability in Response to Avalanche Victims

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**ABSTRACT:** Avalanches are a common risk thread that run throughout the backcountry in Canada, and can affect the safety of both recreational users and commercial operations that venture into these areas. Although not a commonly seen presentation in the emergency department, the potential for its occurrence is significant enough that those recreational users or professionals working in avalanche-affected areas, as well as emergency physicians, paramedics, search and rescue technicians, and evacuation personnel, should be aware of regional hospital capabilities to respond to avalanche victims, as part of their emergency management plan. This knowledge will aid in expediting care for avalanche victims in obtaining the necessary “life or limb-saving” measures as quickly as possible. Consideration should be given to the utilization of a region-by-region “Life Link Map” to act as a guide in pursuing the most immediate and capable hospital facility to provide this specialized care. Further, in accordance with the International Commission for Alpine Rescue (ICAR) guidelines delineating the optimal care of avalanche victims, early medical intervention in the way of on-site rescue-familiar emergency physicians or other advanced life support providers, as part of a rescue “medical strike team”, could significantly increase the likelihood for positive outcomes for avalanche victims who await lengthy rescue or evacuation times in Canada.

**Keywords:** *avalanche rescue, avalanche victim resuscitation, hypothermia, pre-hospital trauma, trauma resuscitation, cardiopulmonary bypass rewarming.*

#### 1. Introduction

Avalanches are frequent natural phenomena in the mountainous regions of Canada. When people venture into avalanche-able areas, there is a risk of being caught in such an event, with the consequences ranging from negligible to lethal. Much research and practical experience has been valuable in creating a systematic approach to on-site avalanche rescue of victims. However, what is the next step for a surviving yet injured (trauma, hypothermia, etc.) avalanche victim after they are successfully

rescued from the avalanche site and need advanced medical care? How do we effectively utilize ICAR guidelines and criteria for the resuscitation of avalanche victims in Canada, given the vast geographical distances, inherent time delays in providing rescue or medical evacuation services, and the infrequency of tertiary care trauma centres that can provide advanced life-saving measures such as cardiopulmonary bypass rewarming? Are we ready and capable of providing this advanced care in a timely fashion?

#### 2. Method and Materials

The area under study was taken to include British Columbia and Alberta (“western Canada”), as these two provinces collectively account for the majority of both mountainous terrain and operational/recreational use of avalanche-frequented areas within Canada.

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A review of local, regional, and provincial hospital capabilities, within the provinces of British Columbia and Alberta, Canada, to provide advanced level care (as per ICAR guidelines) for avalanche victims (for hypothermic and traumatic conditions, including airway asphyxiation) was performed by assessing information gathered from the following sources: BC Search and Rescue Association, Search and Rescue Society of British Columbia, Search and Rescue Alberta, Parks Canada (Public Safety Program), Justice Institute of British Columbia, Canadian Armed Forces, Royal Canadian Mounted Police, provincial Ministries of Health, the Provincial Health Services Authority (BC), BC Ambulance Service (BCAS), Cardiac Services BC, BCBedline, Southern Alberta Referral and Coordination Centre, Northern Alberta Referral Centre, Alberta Shock Trauma Air Rescue Society (STARS), regional health authorities, the Trauma Association of Canada, and the Departments of Emergency Medicine and/or Surgery at the Faculties of Medicine at the University of British Columbia (Vancouver), University of Alberta (Edmonton), and University of Calgary. In this regard, it was possible to identify the specific hospital locations of advanced resuscitation/trauma services in either province that an avalanche victim may be referred to, as well as the rescue service capabilities that most often deliver avalanche victims to nearby acute care hospitals.

This data was incorporated into a “Life Link Map” that showed the location of these trauma centres with capabilities to perform advanced medical trauma care as per ICAR guidelines.

### **3. Results**

In British Columbia and Alberta, all smaller regional acute care facilities are involved in, and largely responsible for, early resuscitation and stabilization of trauma patients. These sites are quite typically the first to receive an avalanche victim from local rescue services in rural, mountainous areas. Each of these acute care sites is able to initiate/continue early ICAR guidelines for the resuscitation and treatment of avalanche victims. However, once a patient is considered to have suffered traumatic injuries, including severe hypothermic status, they are obligated to be referred to an appropriate

regional trauma centre for ongoing advanced care.

Designated trauma facilities receive trauma patients on a referral basis from smaller regional acute care facilities, subsequent to physician-to-physician referral. Referral of avalanche victims who have been shown to have moderate to severe hypothermia (body core temperature < 30-32C) should be made to a trauma facility specifically capable of trauma specialist care *and* cardiopulmonary bypass rewarming. Within British Columbia, BCBedline is the call system responsible for finding the appropriate and closest referral trauma centre for a referring physician. In Alberta, Southern Alberta Referral Coordination Centre (for regions south of Red Deer, AB) and Northern Alberta Referral Centre (for regions north of Red Deer, AB) are responsible for addressing trauma transfers to the appropriate facility.

#### **3.1 British Columbia**

Within the province of British Columbia, there are 9 designated regional trauma centres. These centres are located within each health authority: Vancouver area (Vancouver General Hospital, Lions Gate Hospital, Royal Columbian Hospital, Richmond General Hospital), Victoria (Victoria General Hospital), Kamloops (Royal Inland Hospital), Kelowna (Kelowna General Hospital), and Prince George (Prince George Regional Hospital). The provincial quaternary trauma centre is Vancouver General Hospital, accepting all patients whose injuries include spinal, complex orthopedic, endovascular, and hepatobiliary trauma conditions. All pediatric trauma patients are referred to Vancouver (BC Children's Hospital).

Of these designated trauma centres, only 4 hospitals have the capability to perform cardiopulmonary bypass rewarming (CPBR) for patients with severe hypothermia. CPBR capabilities are located in Vancouver area (Vancouver General Hospital, St. Paul's Hospital, Royal Columbian Hospital), and Victoria (Victoria General Hospital).

#### **3.2 Alberta**

The province of Alberta has 3 designated adult trauma centres: Edmonton (University of Alberta Hospital, Royal Alexandra Hospital), and

Calgary (Foothills Hospital). Pediatric trauma is referred to specific children's hospitals in either Edmonton or Calgary.

Cardiopulmonary bypass rewarming services are available at all of these adult trauma centres.

### **3.3 "Life Link Map"**

Based on overall data, a "Life Link Map" framework for regions of British Columbia and Alberta can be created to readily identify specific health facility advanced care capabilities, in accordance with ICAR recommendation guidelines, for the treatment of avalanche victims.

## **4. Discussion**

The majority of mountainous, and thus avalanche-able, terrain in BC and Alberta lies within rural, sparsely, or non-populated regions of these provinces. Because of the lack of dense population base in these regions, tertiary care hospitals or trauma centres are typically not within close proximity, by distance or time. Hence, the ability to provide early advanced medical interventional care to an avalanche victim in these regions, such as trauma care or cardiopulmonary bypass rewarming (as cited by ICAR guidelines), is extremely limited. This seems to be contrary to what occurs in Europe, where a large population base exists in a relatively smaller geographical space. This densification affords far more trauma centres and subsequent higher level care capabilities within short distance and time from avalanche rescue sites; further, the existence of professional and devoted rescue teams with the ability to initiate advanced medical care by mountain rescue physicians or paramedics at the avalanche site allows for early intervention. The relative "ease" by which ICAR guidelines can be followed through to completion for avalanche victims in Europe, in an efficient and timely manner, is obvious.

In Canada, most initial medical resuscitative efforts for an avalanche victim will be performed at smaller acute care hospitals in rural areas once the patient is rescued from the avalanche site; from here, patients are referred on to a larger trauma centre. Although tertiary health care facilities exist that are capable of dealing

with moderate to severe trauma with hypothermia that is seen in avalanche victims, is it not regionally available for the most part. The lack of immediate availability of services such as cardiopulmonary bypass rewarming often precludes the use of these possibly life-saving interventions.

Among the greatest deficiencies is indeed the sparse allocation of cardiopulmonary bypass rewarming services for severely hypothermic patients. CPBR is limited to only a select few tertiary care hospitals where there exists specific specialist backup, and where use of these services is ongoing for other cardiac or thoracic surgery-specific conditions. Within British Columbia, the effective centralization of most trauma centre capabilities, including specifically cardiopulmonary bypass rewarming, to the southern coastal region (Vancouver and Victoria areas), virtually eliminates such intervention as a possibility within the "golden hour" time frame of avalanche patient resuscitation, for victims in the northern, central, and eastern regions of the province (including the vast majority of mountainous areas used by recreationists). This is due to the vast geographical distance that has to be covered by air ambulance transfers from a smaller hospital to a trauma centre. The difficulty in obtaining proximal intra-provincial care is illustrated further by the following example: a hypothermic avalanche victim in Smithers, BC (north central area of the province) would have to be transferred approximately 1140 kilometres/710 miles to obtain the closest cardiopulmonary bypass rewarming service in Vancouver, BC—this is the same distance that is required to travel from Paris, France to Venice, Italy. One saving grace is the option of cross-province tertiary care referrals to occur, whereby patients in northern or eastern areas of BC may be referred to relatively closer Alberta-based trauma facilities if circumstances necessitate this to occur (but only under the authority of BCBedline if no other reasonable option is first available within the province). This back-up system has the ability to significantly reduce air ambulance transfer time and expedite patient care. Still, significant distance and time limitations, both from initial rescue site to initial acute care treatment facility, and from here to an appropriate trauma centre, place heavy demands on the efficiency of the rescue and resuscitation continuum of patient care.

In BC and Alberta, this relatively long journey with one or more stop-over points en route to advanced trauma care emphasizes the need for efficiency from the very beginning of the rescue of an avalanche victim. Critical time delays can easily add up and place the victim at greater risk of severe morbidity or mortality, given that they may ultimately have to be referred and transferred thousands of kilometres, or even to another province. Given this, the use of a regional “Life Link Map” for backcountry operations, rescue or ambulance personnel, and emergency medical departments, may be an instant visual ‘reminder’ of the allocation of trauma services that are pertinent for avalanche victims, and thereby guide decision-making when choosing the closest and most appropriate facility to respond to the medical needs of an avalanche victim at each step along the patient care pathway. This map would outline the closest available rescue and ambulance services, the designated closest acute care facility capable of initiating advanced trauma life support (ATLS) protocols, and closest referral sites for obtaining advanced trauma care and cardiopulmonary bypass rewarming.

More and more thought is being given in Canada to the development of a system utilizing a “medical strike team” for providing advanced medical care on-site during rescue operations in remote regions. The purpose of such a team is to maximize the short window in which to establish early medical treatment and stabilize avalanche victims in situations whereby there are large distance and time constraints to arriving at an acute care facility. Currently, most of western Europe uses a similar type of system to attend to its avalanche victims and other patients in more rural or wilderness areas, in which mountain rescue physicians or paramedics accompany site rescue personnel to the avalanche scene. It would seem a benefit to have such an operational medical rescue service in Canada, given the difficulty in providing early advanced trauma care in most rural areas. However, while European nations participating in such programs tend to have higher call-out rescue rates and have fully-funded professional medical/rescue team members, Canada likely does not have the rate of accidents, nor funding for ongoing training, equipment, or member remuneration in which to justify the cost-to-benefit ratio of such a separate and highly trained, devoted team. Closest in kind for the purpose of professional rescue services in western Canada are the Canadian Armed Forces

SAR squadron (Comox, BC- Vancouver Island), and Parks Canada for the interior mountainous parks of BC/Alberta; neither employ physicians for actual on-site evaluation and treatment of avalanche/accident victims; CFB Comox does train its SAR-TECHS to an equivalent paramedic level, but its location in a south coastal region some distance from the majority of the province limits their effective striking distance. In Canada, there is reliance on volunteer search and rescue organizations to perform rescue and extrication of avalanche victims in the backcountry; medical assistance on-site is thus dependent on the availability of physicians or paramedics who happen to be SAR members themselves. However, the possibility of medical strike team development still holds a very bright light for future considerations. The question of how to effectively develop and utilize regional or provincial medical strike teams given the dispersed areas for rescue locations in such a large geographical area in Canada is yet to be answered.

## **5. Conclusion**

By reviewing the capabilities of western Canadian health systems to respond to avalanche victims, in accordance with ICAR guidelines, limitations in providing trauma and other advanced medical care are cited. These difficulties are notably the inherent large distances and lengthy time that rescue personnel often require to evacuate a patient from an avalanche scene to the closest appropriate acute care facility; the inability of most smaller healthcare facilities to perform specialist-level trauma care and interventions such as cardiopulmonary bypass rewarming; and the relative focal centralization of trauma care resources to densely populated regions and away from predominantly rural, mountainous areas where avalanches are most likely to occur. These issues underline the importance of establishing and maintaining an efficient response from the very beginning of an avalanche rescue, in order to minimize overall time loss in attaining advanced medical care during the brief window of patient resuscitation time. To this end, future consideration to having an on-site medical strike team attend to avalanche events in conjunction with rescue personnel may be the key in initiating early trauma care intervention for such patients, given their relative remote locations.

## **6. References**

- BCBedline (personal communication, July 15, 2008).
- British Columbia Provincial Emergency Program. Information retrieved from <http://www.pep.gov.bc.ca>
- British Columbia Search and Rescue Association. Information retrieved from <http://www.bcsara.com>
- Brugger, H. and Durrer, B. On-Site Treatment of Avalanche Victims. *High Altitude Medicine and Biology*. Dec 1, 2002, 3(4): 421-425.
- Cardiac Services BC (personal communication, July 16, 2008).
- Faculty of Medicine, University of British Columbia (personal communication, 2007).
- Faculty of Medicine, University of Alberta (personal communication, 2007).
- Grissom, C. Avalanche Victim Physiology and Medical Treatment After Rescue. *Proceedings from the 2007 World Congress of Mountain and Wilderness Medicine*. Aviemore, Scotland (2007).
- Grossman, MD, Saffle, JR, Thomas F, Tremper B. Avalanche trauma. *J Trauma*. 1989 Dec;29(12):1705-9.
- Hohlrieder, M., Brugger, H., Schubert, H., Pavlic, M., Ellerton, J., Mair, P. Pattern and Severity of Injury in Avalanche Victims. *High Altitude Medicine & Biology*. Mar 2007, Vol. 8, No. 1: 56-61
- International Commission for Alpine Rescue. Information retrieved from <http://www.ikar-cisa.org>
- Ministry of Health, Province of British Columbia (personal communication, March 10, 2008).
- Ministry of Health, Province of Alberta (personal communication, March 10, 2008).
- Northern Alberta Referral Centre (personal communication, July 14, 2008).
- Paal, P., Ellerton, J., Sumann, G., Demetz, F., Mair, P., Brugger, H. Basic Life Support Ventilation in Mountain Rescue. *High Altitude Medicine & Biology*. Jun 2007, Vol. 8, No. 2: 147-154.
- Parks Canada Public Safety Program. Information retrieved from [http://www.g8legacy.gc.ca/docs/pc/rpts/rve-par/27/3\\_e.asp](http://www.g8legacy.gc.ca/docs/pc/rpts/rve-par/27/3_e.asp)
- Lazar, H. The Treatment of Hypothermia. *N. Engl. J. Med.*, November 20, 1997; 337(21): 1545 - 1547.
- Royal Canadian Mounted Police. Information retrieved from [http://rcmp-grc.gc.ca/ccaps/sar\\_e.htm](http://rcmp-grc.gc.ca/ccaps/sar_e.htm)
- Ruttmann, E., Weissenbacher, A., Ulmer, H., Muller, L., Hofer, D., Kilo, J., et al. Prolonged extracorporeal membrane oxygenation-assisted support provides improved survival in hypothermic patients with cardiocirculatory arrest. *J. Thorac. Cardiovasc. Surg.*, September 1, 2007; 134(3): 594 - 600.
- Search and Rescue Alberta. Information retrieved from <http://www.saralberta.org>
- Search and Rescue Society of British Columbia. Information retrieved from <http://www.sarbc.org>
- Southern Alberta Rapid Referral Centre (personal communication, July 14, 2008).
- Trauma Association of Canada (personal communication, July 16, 2008); Information retrieved from <http://www.traumacanada.org>
- Webster-Smith, C., Ghosh, A. Bypass or external rewarming after hypothermic cardiac arrest. *Emerg. Med. J.*, January 1, 2001; 18(1): 60 - 61.