CASE REPORT

Avalanche Survival After Rescue With the RECCO Rescue System: A Case Report

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We report a case of survival of a completely buried avalanche victim after being located with the radar-based RECCO Rescue System. In the winter of 2015, 2 off-piste skiers were completely buried in an avalanche near the secured ski area in Baqueira Beret, Spain. The first victim was located with the RECCO Rescue System in less than 35 minutes and was alive and conscious at extrication. This system emits radio waves and requires a specific reflector. It is a portable device that is used by more than 600 rescue organizations worldwide, especially in secured ski areas. The device should be brought to the avalanche site together with electronic avalanche transceivers, a probing team, and avalanche dogs. In the hands of experienced professionals, the device may allow rapid location of victims not carrying an electronic avalanche transceiver. Although it is not the first successful extrication of a victim with the RECCO Rescue System, it is the first case published in the medical literature and is intended to encourage data collection and to increase our understanding of the effectiveness of this device in avalanche rescue.

Key words: avalanche, RECCO Rescue System, safety equipment, backcountry skiing, organized avalanche rescue

Introduction

Approximately 150 persons die annually in North America and Europe in avalanches.¹ If a winter recreationist is caught in an avalanche, the overall survival rate is approximately 46%.² Rapid extrication is the most important factor to increase a victim's chance of survival as survival probability continues to decrease every minute.^{2,3}

Previous studies have shown that avalanche transceivers and standard rescue equipment (transceiver, probe, and shovel) increase the chance of survival by reducing the time of extrication.^{4,5} In a sample of completely buried avalanche victims, those located via avalanche transceiver had a relative reduction in mortality of 74% (95% confidence interval, 52% to 86%) compared with those located without a transceiver.⁴ In an in-field survey of backcountry users, only 75% of persons carried an avalanche transceiver and 66% carried standard rescue equipment.⁶ Another study reported

that 44% of completely buried avalanche victims did not have a transceiver.⁵ Off-piste skiers, who commonly use mechanized support for ascent and who descend outside the secured ski area, are less frequently equipped with rescue devices.^{5,7} Therefore, a device that could detect buried victims who are not carrying a transceiver is an attractive rescue option.

The RECCO Rescue System is used by more than 600 rescue organizations worldwide (especially in ski areas) and is described in textbooks on rescue and wilderness medicine.⁸ It is considered standard rescue equipment in some areas together with transceivers, a probing team, and avalanche dogs. However, medical literature about this device is lacking in indexed databases. In contrast, there are several articles about the use and effectiveness of avalanche transceivers and avalanche airbags. This limits our understanding of its use, effectiveness, and impact on survival. We present a case of survival of an avalanche victim after being located by the RECCO Rescue System and discuss the advantages and limitations of this device in avalanche rescue.

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Case Report

On February 2, 2015, 4 skiers left the secured ski area in Baqueira Beret, Spain (2300 m). During the descent, the group triggered an avalanche (60 m wide, 80 m long, 1 m [range, 0.6–1.2 m] average depth), which completely buried 2 of them. Neither skier was equipped with a transceiver, shovel, or probe. A third companion (who was not buried) was able to immediately call the rescue service, and after 3 minutes, the first ski patrollers arrived at the avalanche site. They started to search for the 2 buried victims with transceivers and the RECCO detector in a 10-m-wide search strip. After 6 minutes, the ski patroller using the RECCO detector received a weak signal. It was later determined that this signal was from a mobile phone carried by the victim in his chest pocket. The location of the victim (male, 45 years old, in supine position) was confirmed by probing and he was extricated alive, uninjured, and conscious after less than 35 minutes of burial from a depth of 1.3 to 1.5 m.

The RECCO was also used to search for the second victim, but no signal was detected. After 15 to 20 minutes, a probing team found the second victim (female, 40 years old), and she was extricated alive and conscious after 45 to 50 minutes from a depth of 1.3 m, not far from the first victim. The second victim had mild hypothermia (grade 1) and several contusions. Both victims were brought to a local hospital by helicopter. They survived without any neurological deficits.

In total, 17 ski patrollers, 5 firefighters, and 1 helicopter were involved in this rescue.

Discussion

Survival of the first victim can probably be attributed to fast extrication. Even without the RECCO Rescue System, it is possible that the victim would have been located rapidly via the probing line and extricated alive. This is an example, though, in which searching with the

RECCO Rescue System was faster than probing. The ski patrollers were able to arrive on site quickly because of the vicinity of the accident site to the patrolled ski area. In general, victims rescued by organized rescue teams have a lower probability of survival than victims rescued by companions because of the time required to arrive on site (mean arrival time is >40 minutes).⁹ The second victim probably had a patent airway to survive complete burial longer than 35 minutes.³

The RECCO Rescue System consists of 2 parts: 1) a lightweight (<1 kg) portable detector, and 2) a small, flat capsule reflector (Figure). The detector is carried to the avalanche site by the rescue team or used by rescuers on a helicopter. The reflector is worn by the recreationist and has been integrated into outerwear, helmets, protection gear, and boots of several outdoor clothing brands. The reflector works continuously without a battery.⁸ The detector transmits a highly directional radar signal on the 800-MHz frequency band that is received by the reflector, which doubles the frequency of the received signal and reflects it toward the detector.

The detector can also identify a signal reflected from other electronic devices such as cell phones, cameras, radios, and avalanche transceivers. In this case, neither of the buried skiers was wearing a RECCO reflector. The mobile phone of the first victim was oriented toward the surface of the avalanche and could be detected. Had the phone been oriented toward the ground, the signal might have been too weak to be detected. These electronic devices (cell phones, cameras, radios, etc) are not specific for the frequency of the RECCO detector, and the reflected signal is much weaker. The producer estimates a maximum range of the detector signal of 200 m in air and 20 m in snow (using the RECCO reflector), but this is dependent on the snow conditions and may decrease in wet snow.

The RECCO Rescue System can be an adjunct to standard rescue equipment for organized rescue teams.

Figure. The RECCO Rescue System consists of a reflector (left) and a detector (right).

Table. Selected cases of completely buried avalanche victims found by the RECCO Rescue System (2005–2015)

<i>Location</i>	<i>Activity</i>	<i>Transceiver</i>	<i>Group size (n)</i>	<i>Completely buried (n)</i>	<i>Burial depth (cm)</i>	<i>Burial duration (min)</i>	<i>Method of localization</i>	<i>Reflector type</i>	<i>Status after extrication</i>
Hinterstein, Germany	Snowshoeing	No	2	1	150	45	RECCO	Camera	Conscious
Val-Frejus, France	Off-piste snowboarding	No	1	1	150	18	RECCO	Walkman	Conscious
La Plagne, France	Off-piste skiing	No	3	1	150	22	RECCO	RECCO reflector	Conscious
St. Moritz, Switzerland	Off-piste skiing	No	2	1	100	30	RECCO	RECCO reflector	Conscious
Valmorel, France	Off-piste skiing	No	2	1	150	20–30	RECCO	RECCO reflector	Slightly responsive
Porté-Puymorens, France	Off-piste skiing	Yes	5	1	20	–	RECCO	RECCO reflector	Conscious
Reutte, Austria	Off-piste skiing	Yes	2	1	150	60	RECCO ^a	Transceiver	Conscious
Tignes, France	Off-piste skiing	No	2	2	150	20	Probe	NA	Conscious
					150	40	RECCO	Electronic device	Cardiac arrest
Speikboden, Italy	Off-piste skiing	No	5	1	50	25–30	RECCO	RECCO reflector	Cardiac arrest
Banff, Canada	Ice climbing	No	2	1	270	6 days	RECCO	Headlamp	Dead
Cervières, France	Snowshoeing	No	2	2	150	1 day	RECCO	RECCO reflector	Dead
					170	2 days	Probe	NA	Dead
Zakopane, Poland	Hiking ^b	No	2	2	100	4 days	RECCO	Mobile phone	Dead
					250	4 days	RECCO	Mobile phone	Dead
Orelle, France	Off-piste skiing	No	4	1	40	13	RECCO	Mobile phone	Unconscious
Baqueira Beret, Spain	Off-piste skiing	No	4	2	130–150	< 35	RECCO	Mobile phone	Conscious
					130	45–50	Probe	NA	Conscious

NA, not applicable.

These data were provided by RECCO AB, Sweden.

^a The victim could not be located with the transceiver due to interfering signals from other skiers in the area.

^b No information on whether the victims had snowshoes.

Any method to rapidly locate the victim increases the chance of survival (by reducing the time of burial). Anyone traveling in avalanche terrain should ideally equip themselves with a transceiver, shovel, probe, and partner in case of burial. However, many user groups (off-piste recreationists, snowshoers, ice climbers) do not.^{6,7,10,11} In addition, many avalanche fatalities occur close to the secured ski areas. For these situations, the RECCO Rescue System potentially offers a second option to transceivers for locating these victims. Similarly, because the reflector is integrated into outerwear, helmets, or ski boots, it is carried passively by recreationists not educated in avalanche safety. The combination of an avalanche transceiver and the RECCO Rescue System provides a higher chance to locate a buried victim than one device alone. However, it does not substitute for standard rescue equipment.

Widespread use of the RECCO Rescue System would have many advantages, but there are also some limitations. As the RECCO detector is only used by organized rescue services, the time needed to arrive on site limits the potential advantages of the system for rapid extrication.^{9,12,13} As with other rescue equipment, proficiency with this device requires training. (There are no uniform standards for minimum training. The manufacturer provides a basic training course and recommends monthly practice.) The system provides only an acoustic signal without a display and depends on the orientation of the detector and the reflector. The signal from the reflector or an electronic device will be weak if the orientation is poor or if the path to the detector is obstructed. The detector also receives signals from other electronic devices or metallic objects within the snow or worn by the rescuers or other people around the avalanche site.⁸ Hence, every signal received from the RECCO detector has to be verified by probing. The ground or other surfaces and objects (eg, rocks, metal, garbage) can also reflect the signal, but the received signal is much weaker than that from the reflector. To receive the best signal possible, RECCO recommends wearing 2 RECCO reflectors on different parts of the body.

SELECTED CASES INVOLVING THE RECCO RESCUE SYSTEM

The Table shows avalanche accidents documented by RECCO AB (Lidingö, Sweden) involving completely buried victims located with the RECCO Rescue System between 2005 and 2015. Most of the victims located by the RECCO Rescue System were buried while off-piste skiing or snowboarding and were extricated in less than 35 minutes. Two of them were extricated within 18

minutes. Only 2 persons were equipped with an avalanche transceiver. As discussed previously, the vicinity of the accident sites to the patrolled ski area could explain the fast localization and extrication, and the high rate of survivals.

Conclusions

The RECCO Rescue System may be a suitable additional rescue device for organized rescue teams, especially for off-piste accidents, because many victims do not have transceivers and ski patrollers are able to arrive at the avalanche site quickly. The RECCO reflector is practical for the user and requires no knowledge or maintenance as it is integrated into sporting equipment, does not require a battery, and is lightweight. In comparison with the body of knowledge on avalanche transceivers, airbags, and the AvaLung,^{4,5,14,15} further studies are needed to examine the impact of the RECCO Rescue System on survival.

Disclosure

None of the authors has been supported by any company producing avalanche rescue equipment and there is no financial relationship between any author and a producer of avalanche rescue equipment, including RECCO AB (Lidingö, Sweden). The cases listed in the Table were recorded by the manufacturer of the device.

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