5.15b Spinal injuries: immobilization and extraction. Peter Wernicki, M.D., Peter Fenner, M.D., David Szpilman, M.D.

"A spinal injury happens in an instant... it lasts a lifetime."
(Tom Gregor)

Introduction

The effects of spinal cord injury can be devastating. The aquatic environment is a common location for these events. Lifesavers and other emergency professionals should therefore expect to be called upon to rescue and manage spinal injury victims in the water. This requires an understanding of the injury, development of protocols, appropriate training, preparation, and availability of proper equipment.

Spinal cord injuries occur with alarming frequency throughout the world (e.g. 52 per million population in the U.S.) Although auto accidents account for the greatest numbers, recreational activities may be the second leading cause. Within this category aquatic accidents are the majority. Most are due to diving injuries. In fact, in some areas more than 60% of all sports and recreational spinal injuries are diving related. They can occur in the open water or pool environment. Their causes may involve striking bottom in shallow water, striking underwater objects, being twisted or thrust to the bottom by surf, or watercraft accidents. Spinal cord injuries usually occur in young people. The average age is 28.7 years with the median age being only 19. Males comprise 82% of these victims and most injuries occur on summer weekends. Alcohol, horseplay, and poor judgment are often contributing factors.

Studies suggest that actual spinal injures are relatively few in emergencies to which lifesavers respond. One study in the surf environment evaluated 46,060 rescues and found that .009% had some spinal injury.[1] A retrospective survey of more than 2,400 drowning ~~deaths~~ with a history of obvious trauma from diving, falling from height, or a motor vehicle accident, found that less than .5% had a spinal cord injury.[2] Circumstances may vary though, depending on the presence or absence of sandbars, wave action, water visibility, or aquatic activities. Regardless of frequency, spinal injury can have severe outcomes and can be worsened by inappropriate handling. Therefore, it is critical that lifesavers use great caution when spinal cord injury can reasonably be suspected.

The spinal cord runs through the bones known as vertebrae, which help protect it from injury. Spinal injuries sustained in the aquatic environment, including spinal cord injuries, most commonly occur in the neck at cervical vertebrae 5, 6, and 7, due to flexion forces. When fractures, dislocations, or other vertebral injuries occur with significant force, the spinal cord itself can be damaged. This will often lead to permanent quadriplegia (four extremity paralysis), and frequently death, depending on the specifics of the injury. Even when the victim survives a spinal cord injury, the impact can be devastating to the victim and the victim's family. Future lifelong care and tremendous expenditures (often public) will be required. Thankfully, many more people suffer damage to the spine (vertebral column) without spinal cord damage, thus without nerve damage or paralysis.

The epidemiology of spinal injuries is well known and there is a tremendous amount of ongoing research with respect to medical and surgical treatment. Unfortunately, the techniques to stabilize and transport victims of suspected spinal injury have been developed rather subjectively, with limited scientific study. No significant studies are available on aquatic techniques. Therefore, further scientific research on the rescue itself, which is the first and possibly the most important link in the chain of care of spinal injuries, is needed.

Treatment of suspected spinal cord injury, whether ashore or in-water, is generally focused on the goal of doing no inadvertent harm. In some cases, an initial trauma to the spine may not have immediately severe consequences, but further manipulation of the spine, by the victim or rescuers, may cause life-long injury or even death. This is the reason why proper handling of these victims by rescuers is so crucial.

Standard protocols for treating suspected spinal injury focus on immobilizing the victim in an effort to avoid further injury. Various techniques have been developed for this purpose. Each has specific pros and cons which vary under differing conditions and situations. Lifesaving professionals should use the following information to help develop and evaluate their own appropriate protocols and training programs.

Recognition

The first step in treatment of spinal injury victims is recognition. Any neck pain after injury (even trivial) or head trauma should create a suspicion of possible spinal injury. Numbness, pins and needles, or weakness, even if temporary, are all serious signs of possible spinal injury. A person with an abrasion to the forehead may well have sustained it by falling forward or by hitting a sandy bottom after body-surfing. Victims found in the surf or floating in shallow water, or those seen diving prior to an injury, need appropriate precautionary care for possible spinal injury.

Initial Treatment

Airway, breathing, and circulation (ABC) should be first addressed. Despite the importance of treating spinal injury, breathing takes obvious precedent. If the victim is not breathing or unable to breath (e.g. face down in the water) the face should needs to be carefully removed from the water and rescue breathing begun as soon as possible, using appropriate techniques to minimize spinal movement. The modified jaw thrust or jaw thrust maneuvers are the recommended methods. They will allow the rescuer to maintain the neck in as neutral a position as possible.

The victim is first approached by the rescuer who should avoid causing unnecessary turbulence. If the victim is close to the edge of a pool, for example, jumping or diving should be avoided. The lifesaver with the highest degree of medical skill should direct the process and take control of the victim's head. Unless the victim is not breathing, all actions should be done slowly, carefully, and in unison.

The rescuers' goal is to stabilize the spine and maintain the neck from further motion, usually in a neutral (straight) position or in the position of comfort. Ultimately, this involves use of a backboard, straps, and cervical collar. Then the patient can be safely transferred by ambulance to hospital

facilities for definitive care. The interim steps between recognition and transport are where the rescuer's training and techniques most importantly come into play. Proper immobilization will protect from further damage, facilitate moving to shallow water, and allow for efficient permanent immobilization.

The methods used depend on several factors:

1. Location – onshore or offshore, deep or shallow water, surf or stillwater, distance to shore.

2. Rescuer size, training, and the number of rescuers available.

3. Victim size and condition - face up or face down, breathing or non-breathing, other injuries.

4. Equipment and transportation available.

Onshore Presentation – Standing Backboard Technique

The most common scenario, and the easiest to deal with, is the victim who walks up to the lifesaver onshore complaining of neck pain or injury. Immediate steps should be taken to immobilize the victim and the *standing backboard technique* should be used.

The first lifesaver advises the victim not to move, explains the importance of immobilizing the spine, and simultaneously moves to the rear of the victim to stabilize the head and neck with one hand on each side (over the ears). A second lifesaver applies a properly fitted cervical stabilization collar. A backboard is then slid in between the first rescuer and the victim. While the first lifesaver maintains neck stabilization, two other lifesavers then stand facing the victim, grasp opposite sides of the backboard through the victim's armpits, and gently lower the backboard to the sand. Standard protocols are then followed to secure the victim to the backboard.

In-Water Presentation

In-water techniques fall into three main maneuvers and one or more are used by almost all lifesaving organizations throughout the world. There are however, no standard terminologies referring to these techniques and numerous confusing names are used. Instances are even seen where different lifesaving organizations use different techniques, but use the same names. The following three standard names are suggested for each technique. Some are better under different conditions and one may not fit all circumstances.

Vice-Grip

The rescuer approaches from the victim's side, places the rescuer’s dominant arm along the victim's sternum (breastbone), and stabilizes the chin with the hand. The rescuer’s other arm is then placed along the spine with this hand cupping the back of the victim's head. The arms are squeezed together forming a vice which provides stabilization. If the victim is face down, the victim is slowly rotated toward the rescuer to a face-up position.

This method is quickly and readily applied by any size rescuer to any size victim. It works in deep or shallow water and positions the rescuer well to check respiratory status and carry out rescue breathing. Care must be taken to avoid excessive pressure on the airway.

Body Hug

In the case of a face-up victim, the rescuer approaches from behind and partially submerges. The rescuer then slides the rescuer’s arms through the victim's armpits and places open hands on either side of the head over the victim's ears, thus providing stabilization. The rescuer's face is placed next to the victim's head. In the case of a face-down victim, the technique is also applied from behind, in a similar manner. After the rescuers arms have been slid through the victim’s armpits and the victim’s head grasped, the rescuer rolls the victim to a face-up position.

This method provides exceptional immobilization. It is of limited value in shallow water. It may not be feasible if there is a significant size mismatch between rescuer and victim. A lone rescuer cannot adequately perform rescue breathing without changing grip, although some modifications are used by some lifesaving organizations. Before placing the victim on a backboard, a change in immobilization, with assistance of a second rescuer, is required.

Extended Arm Grip

The rescuer moves to a position at one side of victim and grabs the victim's nearest arm just above the elbow, using the right hand for the right elbow or left hand for the left elbow. Both of the victim's arms are then carefully raised above the victim's head by the rescuer pressing them together against the ears. This immobilizes the victim's head and neck. The head grip can be maintained by the rescuer with only one hand holding the victim's two arms together. Further stability can be obtained if the rescuer uses two hands to hold the arms together while at the same time using the rescuer’s thumbs to support the back of the victim's head. A face down victim has the method applied as above. The victim is then gently glided head first and slowly rolled toward the rescuer, thus positioning the victim on the rescuer's free arm.

This is probably the most unique and complex method. It can allow the rescuer a free hand to support the body or to check for and begin rescue breathing. It can even allow a free arm for side or backstroke to assist in moving the victim toward shore or recovering the victim from a submerged position. It works in deep or shallow water and is arguably the only method for a single rescuer to roll a victim in the turbulent or extremely shallow water. This is done using one hand to apply the overhead arm pressure and the other to roll the victim's hips. It further allows for easy transition to a backboard. There may be some concerns about the degree of immobilization provided with this method, especially towards flexion forces.

Other methods are used by some lifesaving organizations, but cannot be recommended at this time. Their levels of immobilization are not sufficient or equal to those presented here.

<u>Deep Water Presentation</u>

If in deep water, the victim should be carefully moved toward shore or a rescue boat. As a last resort the rescuer could straddle a rescue tube and continue the immobilization until further help arrives.

General Recommendations

Lifesaving organizations are strongly encouraged to make spinal stabilization equipment readily available to stabilize victims of suspected spinal injury. This equipment, including a backboard, straps, and cervical collar, should be properly maintained. Securing a victim to a backboard cannot be accomplished by a single rescuer and is difficult with less than three. It is helpful to have more. Unless water turbulence or cold water preclude it, the victim should be kept in shallow water until sufficient help and equipment arrive. Specifics on strapping and movement also need to be taught and trained. Movement is usually carried out in a 45-90° angle towards approaching waves or current. Oxygen should be applied. Lifesaving organizations with this equipment available should have all lifesavers practice coordinated transition from the immobilization methods described here to backboard stabilization.

If a backboard is not available to extricate the victim from the water (if in-water) and to stabilize the victim, choices must be made. The best approach, if feasible, is to limit movement of the victim to the barest minimum required to ensure the highest possible level of stabilization. This may mean, for example, that a suspected spinal injury victim in warm water with little turbulence is left in the water, held immobilized by lifesavers until an ambulance with appropriate spinal immobilization equipment arrives. In cases where the victim must be removed from the water because of turbulence, cold, ABC priorities, or for other reasons, lifesavers may consider use of a flat rescue board or a unified carry involving several lifesavers with arms laced under the victim. In either case, the move should be as slow as possible, with great care taken to avoid unnecessary movement of the spine.

No single in-water spinal immobilization technique fits all circumstances. Lifesavers should be trained in at least two water immobilization methods. Which ones? Perhaps the vice-grip and extended arm grip are best. These have more versatility and universal applications. That said, there are no scientific studies known to the authors which address the benefits of one method over another. There are only anecdotal reports and opinions. What is needed is specific scientific research on neck movement during these maneuvers. Such studies could help us choose and modify our techniques. For now, however, each lifesaver should learn and practice the various methods. Proficiency will further the lifesaver's ability to save lives and better prevent spinal cord injuries with their devastating results.

References

1. Szpilman D, Brewster C, Cruz-Filho FES, Aquatic Cervical Spine Injury – How often do we have to worry? World Congress on Drowning, Netherlands 2002, Oral Presentation.
2. Watson RS, Cummings P, Quan L, Bratton S, et al. Cervical spine injuries among submersion victims. J Trauma. 2001;51:658-62.