



Mines Rescue

CRUSH INJURY MANAGEMENT IN THE UNDERGROUND ENVIRONMENT

October 2013





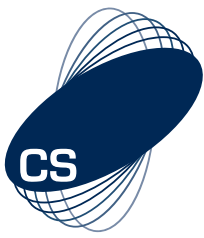
Background

Imagine a city just like the one you live in, where your children go to school, your friends and relatives share social gatherings a population that is thriving and then all of a sudden that population declines from a healthy one hundred and sixty thousand to sixty thousand in a matter of hours. This is the story of the people of Messina Italy after an earthquake in the early morning of November 5th 1910. A massive natural disaster followed by epidemics of the muscle crush syndrome was the first descriptions used by Germans who rendered assistance to the Italians after this disaster.

On the threshold of World War II, the English-language literature was still unaware of the crush syndrome. In May 1941, Dr Bywaters was the first to use the term crush injury, during the London Bombings; he conducted a study of four young healthy patients trapped in building rubble for 3 to 4 hrs. All had limbs crushed but survived the initial rescue, extrication, and hospital transport. They all developed the symptom complex of shock, swollen extremities, and dark urine. The patients survived the initial shock but progressed to renal failure. As a result there was the first calling of crush syndrome and established guidelines for the management of casualties.

The Granville rail disaster occurred on 18 January 1977 at Granville, a suburb in Western Sydney, Australia when a crowded commuter train derailed, running into the supports of a road bridge which came down onto two of its passenger carriages. Eighty-three people died, more than 210 were injured, and 1,300 were affected. It is the worst rail disaster in Australian history based on loss of life. Several injured passengers were trapped in the train, for hours after the accident, by part of the bridge crushing a limb or torso. Some had been conscious and lucid, talking to rescuers, but died of crush syndrome soon after the weight was removed from their bodies. This was due to the sudden release of substances such as potassium from the injured limb. This resulted in changes to rescue procedures for these kinds of accidents.

Chain Valley Colliery is 48 kilometres south of Newcastle. On the third of June 2011 a continuous miner was operating in the West 6 pillar extraction panel in the Fassifern seam. At 1.55pm a 4.8 metre slab of coal fell from the rib (wall) onto a miner. The slab broke in two when it hit the ground and the miner was trapped under a 2.3 metre piece weighing about 1.3 tonnes. The crew freed the injured miner within eight minutes of the incident. The injured miner was taken to pit bottom where he was having difficulty breathing. The injured miner was transferred to a drift dolly car for transport to the surface and was given CPR from his co-workers. The autopsy concluded that the miner had an overall pattern of injuries consistent with crush injury.



Definition

Crush Injury

An injury that occurs because of pressure from a heavy object onto a body part. A crush injury may also arise from squeezing of a body part between two objects. Depending upon their severity, crush injuries can be complicated by bleeding, bruising, broken bones, open wounds.

Crush Syndrome

Crush syndrome is localized crush injury with systemic manifestations. These systemic effects are caused by a traumatic rhabdomyolysis (muscle breakdown) and the release of potentially toxic muscle cell components and electrolytes into the circulatory system and renal system.

Issues for Mines Rescue

On looking at a number of first aid providers and questioning Mines Rescue Personnel there were differencing opinions on what the difference was between crush injury and crush syndrome. It was found that the major concern was time. Confusion ranged as to the times that a pressure force was applied and as to whether the mines rescuer should release the force or wait for paramedics. Some questioned were under the opinion that after 5-10 minutes they should wait for the Paramedics and do nothing but support the person. These times varied when questioned up to one hour. Current first aid manuals tended to broaden the term crush injury and syndrome together not giving a clear explanation of the difference between the two.



What is the difference?

The major difference is time and clinical presentations. Most of the term crush injury applies to that of a person that sustains an injury and is released quickly resulting in blood loss, fractures as the major problem facing the rescuer. These injuries are normally dealt with effectively from first aid training such as managing the bleeding and fractures. Crush syndrome however is prolonged crushing that occurs where the person is in consensus of opinion trapped over the one hour period and as a result the following occurs:

Clinical features of crush syndrome are predominantly due to traumatic rhabdomyolysis and subsequent release of muscle cell contents after pressure. Sodium, calcium and water leak trapping extracellular fluid inside the muscle cells. In addition, cells release potassium and other toxic substances such as myoglobin, phosphate and urate into the blood system. The result of these events is shock, hyperkalaemia and possibly cardiac arrest precipitated by high potassium concentrations, hypocalcaemia, metabolic acidosis, swelling, and acute renal failure.

Challenges

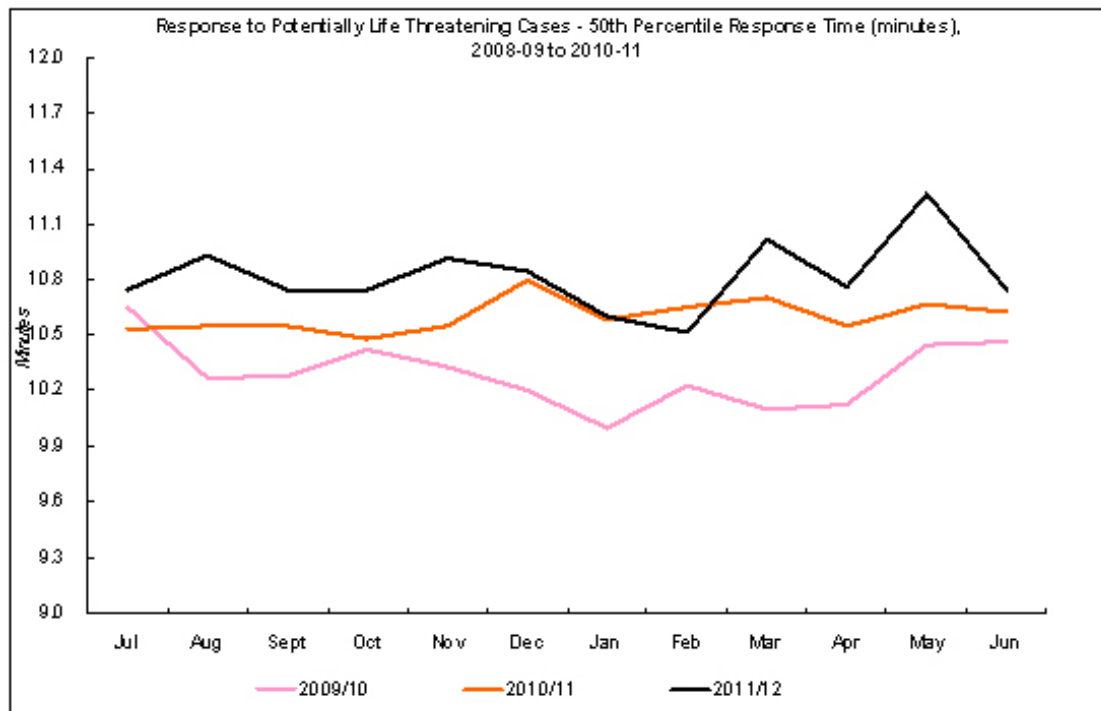
CHALLENGES FOR UNDERGROUND RESCUERS IN NSW, AUSTRALIA

Ambulance Emergency Response Time is the period between when a Triple Zero (000) emergency call is recorded by NSW Ambulance and the time the first ambulance resource arrives at the scene in a life-threatening case. In Australia, the 50th percentile response time is a key measure, allowing our performance to be compared with other states.

In 2011/12 the 50th percentile (median) response time for potentially life-threatening cases was 10.93 minutes for the State (this means that at least 50 per cent of potentially life threatening cases were responded to within 10.93 minutes).

The change in response performance is primarily due to higher demand and longer off stretcher times which limited the overall availability of ambulances to respond.

The 50th percentile response time for the highest priority cases is shown below.



The issues fronting the area of concern for Mines Rescue in NSW was that the mining community was more distant of major trauma centres than the average response on the street adding to that was the fact that if the casualty was underground the travel time into the pit was anything from twenty minutes to an hour depending on the pit layout and position of the casualty. This resulted in Ambulance paramedic arrivals being up to or greater than one hour and if the casualty was not released than the potential for crush syndrome greatly increased.

Another confronting report was that local media outlets in the Hunter Valley where a large proportion of mining takes place the response times were greater than the average as shown from the Newcastle Herald on 18th April 2013.

AMBULANCES in the Hunter Region are the slowest in NSW at responding to critical emergencies, according to data obtained by the Newcastle Herald.

Staff shortages and lack of resources mean towns outside Newcastle and Lake Macquarie local government areas, classified as Hunter Zone 2, are being left without ambulance crews every day.

Figures obtained under freedom of information laws reveal response times to critical emergencies in this region have been the worst in the state for the past two financial years.

The median response time for ambulances attending potentially life-threatening cases in Sydney last financial year was 9.43 minutes, compared to 12.73 minutes in Hunter Zone 2.



Solutions

In August 2012, Trade and Investment NSW, Mine Safety Branch concluded an investigation report into the fatality that occurred at Chain Valley Bay as mentioned earlier. In their recommendations it was identified that crew members had a basic understanding of crush injury management. However, issues were identified regarding the lack of appropriate equipment available to the crew for ongoing management of a crush injury.

- Information concerning the status of training and competency within the NSW mining industry relating to crush injury management was researched.
- No specific rescue response resources are provided by for the purpose of crush injury.
- No specific training and competency programs are provided concerning crush injury management.

At present no specific training course is available for management of crush injury. General awareness is contained in most industry first aid training or trauma management training.

It concluded after consultation with the Government Regulatory Body that NSW Mines Rescue has recommended that emergency response agencies including NSW Mines Rescue, Ambulance service of NSW and Australian Resuscitation Council develop a specific industry-based training package.

Mines Rescue who are a member organisation on the Australian Resuscitation Council approached the NSW Branch to brainstorm an appropriate recognition and treatment for crush injury and crush syndrome so that a package can be put together and train the mining workforce in Crush specific as a whole. This has now resulted in a package being designed for training distribution in December 2013. As an interim the current Australian Resuscitation Guideline would be used when discussing the topic.



CURRENT GUIDELINES- Australian Resuscitation Council

GUIDELINE 9.1.7

EMERGENCY MANAGEMENT OF A CRUSHED VICTIM

Introduction

Crush injuries may result from a variety of situations, including vehicle entrapment, falling debris, industrial accident or by prolonged pressure to a part of the body due to their own body weight in an immobile victim. Crush syndrome refers to the multiple problems that may subsequently develop, most commonly as a result of crush injuries to the limbs, particularly the legs. Crush syndrome results from disruption of the body's chemistry and can result in kidney, heart and other problems. The likelihood of developing acute crush syndrome is directly related to the compression time; therefore victims should be released as quickly as possible, irrespective of how long they have been trapped.

Management

- Ensure the scene is safe, and that there is no risk of injury to the rescuer or bystanders.
- Call an ambulance,
- If it is safe and physically possible, all crushing forces should be removed from the victim as soon as possible.¹
- A victim with a crush injury may not complain of pain, and there may be no external signs of injury. All victims who have been subjected to crush injury, including their own body weight, should be taken to hospital for immediate investigation 2-4
- Keep the victim warm, treat any bleeding. (ARC Guideline 9.1.1)
- Continue to monitor the victim's condition. If the victim becomes unresponsive and is not breathing normally, follow Australian Resuscitation Council and New Zealand Resuscitation Council Basic Life Support Flowchart (Guideline 8) if possible.
- DO NOT leave the victim except if necessary to call an ambulance
- DO NOT use a tourniquet for the first aid management of a crush injury



Mines Rescue

Coal Services

Corporate Office

T: +61 (2) 8270 3200

F: +61 (2) 9262 6090

Level 21, 44 Market Street

Sydney NSW 2000

GPO Box 3842

Sydney NSW 2001

Mines Rescue

Head Office

T: +61 (2) 4922 4400

F: +61 (2) 49583504

533 Lake Road

Argenton NSW 2284

PO Box 146

Booloolaroo NSW 2284