Trauma Case Reports 5 (2016) 1–6

Contents lists available at ScienceDirect

Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr

Case Report

Hypothermia and near-drowning associated with life-threatening injuries: A remarkable recovery: A case report

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ARTICLE INFO

Article history:
Accepted 2 September 2016
Available online 3 October 2016

Keywords:
Polytrauma
Shock
Hypothermia
Coagulopathy
Trauma care

ABSTRACT

A young male suffered multiple severe injuries after a fall and near-drowning. On presentation to the emergency department (ED), he was in a critical and unstable condition and his chances of survival were deemed very low. This case illustrates the management of the hypothermic multi-trauma patient and the remarkable recovery made possible by a high standard of care.

Clinical record

A 46-year-old male was transferred to the ED of a level one trauma centre after a fall from height (approximately 10 m) into water. He was found in the water off a rocky coastline having suffered multiple injuries from the fall, near-drowning and hypothermia.

The patient was retrieved after 30 min in the water. Initial observations showed haemodynamic instability with a variable systolic BP (80–120) and HR (30–120), temperature of 27.6 °C and unrecordable oxygen saturations. Initially, pupils were equal but sluggish and he was moving all limbs, then he deteriorated to a Glasgow Coma Scale (GCS) of 5. At the scene, he was intubated, a right-sided needle thoracostomy was performed due to suspicion of pneumothorax and fluid and adrenaline were administered. The patient was then evacuated via helicopter.

In the ED, two hours after the injury, the patient remained unstable. BP was 80/40, HR 80 in atrial fibrillation and temperature 28 °C. He had obvious bilateral lower limb fractures.

Initial investigations showed pH 7.06, lactate 7.5, haemoglobin 138 and evidence of coagulopathy (INR of 2.33, which increased to 5.78 and undetectable fibrinogen). Chest X-ray demonstrated a right-sided

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http://dx.doi.org/10.1016/j.tcr.2016.09.001

pneumothorax and diffuse opacification throughout both lung fields consistent with aspiration/near-drowning (Fig. 1). There were no obvious pelvic injuries on X-ray.

Initial management was according to the Emergency Management of Severe Trauma (EMST) guidelines. This included maintaining a secure airway, spinal precautions, insertion of a right-sided intercostal catheter, ongoing mechanical ventilation, fluid resuscitation and inotropes as well as rapid rewarming (warm IV fluids, Bair Hugger and bladder irrigation). In the ED, he received 6 l of warm crystalloid and two units of packed red blood cells.

Despite initial management, the patient remained haemodynamically unstable, unresponsive despite weaning sedation and hypothermic at 29 °C. Surprisingly, oxygenation was adequate on mechanical ventilation with an FiO_2 of 80%.

A trauma CT was performed and the primary survey repeated revealing multiple injuries but no cause for hypotension. Repeat haemoglobin was 103. Transthoracic echo showed poor global contractility.

At this stage, the use of extracorporeal membrane oxygenation (ECMO) for rewarming and cardiac support was considered and plans made for cannulation. A transoesophageal echocardiogram was performed revealing an underfilled right ventricle, so further fluids were administered and a vasopressin infusion was added. He was transferred to the ICU for ongoing care.

Fortunately, the patient eventually responded to warm fluid resuscitation, inotropes and other rewarming techniques before ECMO was required. His responsiveness improved and he was able to obey commands with all four limbs.

A full assessment was now possible with multiple injuries noted (Table 1). The injury severity score (ISS) was 50.

The patient then proceeded to definitive surgical management of his multiple injuries over the proceeding days (Table 2).

The recovery process was slow and hindered by a number of complications. The left ankle wound required multiple washouts and debridements, VAC dressings, long-term IV antibiotics and eventually a free flap. This was secondary to infection with *Vibrio* species.

After ORIF of a right tibial plateau fracture (11th July), the patient developed respiratory distress and was found to have large bilateral pulmonary emboli (Image 5) and a right calf DVT. He had been receiving 5000 units of heparin twice daily up until the day of the surgery. He was readmitted to the ICU, an inferior vena cava (IVC) filter was inserted and therapeutic anticoagulation commenced (heparin infusion and warfarin).

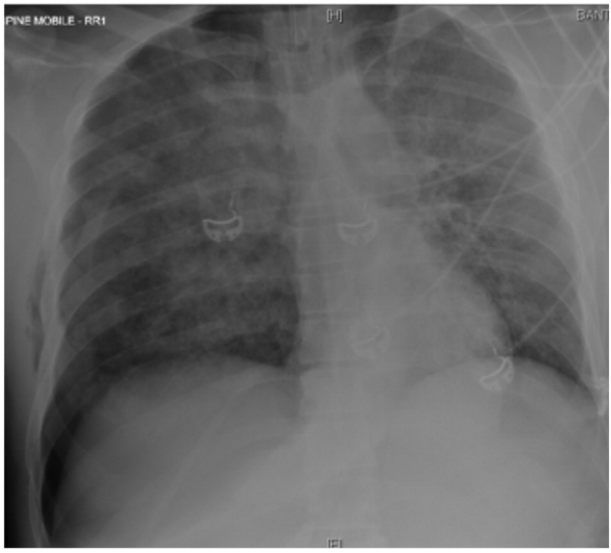

Fig. 1. Chest X-ray on admission.

Fig. 2. CT lumbar spine.

Almost two months after undergoing spinal fixation, the patient developed symptoms of a CSF leak. Conservative management was unsuccessful and operative repair of the dural tear was required.

Due to multiple lower limb and spinal injuries, an extended period of bed rest and joint immobilisation was required. Fortunately, it appeared that the lower limb weakness and poor mobility was secondary to significant deconditioning rather than neurological deficit.

After an inpatient stay of 15 weeks, he was transferred to a rehabilitation facility. Four weeks later, he was discharged home. The patient made a remarkable recovery considering his injuries and condition on presentation especially the complete neurological recovery. He has regained independence with mobility and self-care but was not yet able to return to work.

Discussion

This case illustrates the successful management of the hypothermic multi-trauma patient despite an initially poor prognosis. The patients' injury severity score (ISS) was 50 with a trauma and injury severity score (TRISS) of 0.129, indicating a 12.9% chance of survival.

Hypothermia, defined as core temperature less than 35 °C [1], is a well-recognised and serious problem in severe trauma. It has a significant impact on the outcome independent of ISS, with some studies showing mortality approaching 100% with temperatures less than 32 °C [2,3,4]. Jurkovich et al. demonstrated that in patients with similar ISS, those who became hypothermic had higher rates of mortality [2]. Hypothermia has many adverse physiological effects on organ function including cardiovascular, respiratory and central nervous system and the effects on coagulation [5]. Kashuk et al. first described the triad of hypothermia, acidosis and coagulopathy, which was associated with imminent death in trauma patients [6].

Fig. 3. Left tibial plateau fracture.

Fig. 4. Left open ankle fracture.

Table 1
List of injuries

Head and neck	Nil
Chest	Bilateral rib fractures (right 1, 5, 8, 10, 11 and left 5, 11)
	Aspiration pneumonia
	Bilateral lung contusions/consolidation
	Right sided pneumothorax
	Sternal fracture
Abdomen and pelvis	Right adrenal haemorrhage
Spine (Fig. 2)	L1—unstable 3 column burst fracture with retropulsion and canal narrowing to 9 mm
	L2—compression fracture
	L3—compression fracture with retropulsion and narrowing to 13 mm
	L4—vertebral body fracture
	T12–L2 haematoma
Lower limbs	Left tibial plateau fracture (Fig. 3)
	Left open ankle fracture (Fig. 4)
	Right calcaneus and distal fibula fracture
	Right tibial plateau fracture
Upper limbs	Nil

Table 2
List of surgical procedures

Day 1	Irrigation and debridement open left ankle fracture
	Open reduction internal fixation (ORIF) of left proximal tibia/fibula fracture
Day 3	Debridement and washout of left ankle wound and application of VAC dressing
Day 5	T10–L4 posterior spinal fusion
	Left ankle wound washout, debridement and change of VAC dressing
Day 8	ORIF right calcaneus, right distal tibia
	ORIF left ankle and
	ORIF tibial pillion fracture
Day 9	ORIF left fibula and distal tibia
	ORIF right calcaneus fracture and R distal fibula fracture
	Left gracilis free flap for ankle coverage
Day 21	ORIF right tibial plateau fracture
Day 36	Repair of dural tear at previous surgical site

Prevention and correction of hypothermia is a vital part of the resuscitation process in both the pre-hospital setting and in the emergency department. Core temperature should rapidly be restored to above 34 °C by aggressive rewarming strategies [1] to improve mortality [7]. Simultaneous management of complications, especially coagulopathy, is also of vital importance.

Our patient was severely hypothermic (core temperature less than 29 °C) in the pre-hospital setting, on arrival in the ED and on transfer to ICU with multiple associated complications. In this setting, active rewarming needs to be initiated promptly in the ED with continued management of other complications. Initially, less invasive measures should be used including administration of warmed IV fluids, warm bladder irrigation as well as use of a Bair Hugger. If the patient remains hypothermic, especially if associated cardiac instability is present, extracorporeal rewarming needs to be considered. ECMO is the preferred technique and provides adequate circulation as well as rapid rewarming [9]. The use of ECMO is limited by its availability and, in centres where it is available, preparation needs to be made well in advance.

Summary

This patient had a remarkable recovery despite a fall from a significant height onto rocks and then suffering near-drowning. He had profound hypothermia on arrival in the ED with the associated complications of acidosis and coagulopathy. Fortunately, his temperature derangements responded to simple active and passive rewarming techniques and invasive central warming was not required. He suffered major injuries

to his chest, spine and lower limbs and required extensive orthopaedic and reconstructive surgery. He also developed serious complications associated with his injuries including significant pulmonary emboli and a CSF leak associated with this spinal injury, both of which required active and invasive treatment.

This case demonstrates the value of the multidisciplinary approach to complicated trauma victims and the resilience of the human body particularly in a relatively fit young person with minimal comorbidities.

Conflicts of interest

None.

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