Management of Common Obstacle Sports Injuries

This document is intended to provide a basic introduction to injuries common or unique to Obstacle events. This document is written for Local Organizing Committee Medical Directors (LMD) and physicians/residents providing medical coverage at events. The below recommended treatment approaches are designed to support physicians in assessment and management. They are based on the evidence available at the time of publication, as well as the previous experiences of endurance and ultra-endurance sports physicians. These guidelines are not designed to override clinical judgement or local area protocols, best practices, or pre-established medical directives. Medical treatments occurring at events occur under the direction of the LMD, and health care providers who are unsure of treatments should immediately discuss the case with the LMD, as required.

1. TOPICAL
   - 1.1. Blisters, lacerations, rope burns, and skin abrasion are common.
     - 1.1.1. Blisters should only be drained under aseptic conditions and the skin left in place.
     - 1.1.2. Lacerations should be cleaned and assessed and closed under aseptic conditions by the attending physician or referred to local emergency departments, as required.
     - 1.1.3. Subungual haematomas (black nails) should be left to physicians confident in the procedure and may be drained through the nail with a drill or heated needle. If providers are not confident, this may be referred to another physician to address after the event and is not an emergency.

2. MUSCULOSKELETAL
   - 2.1. Cramps are common. Most often cramps are minor and appropriately treated with conservative therapy. Treatment by athletic therapists or physiotherapist may be appropriate.
   - 2.2. Occasionally cramps may be refractory and severe.
     - 2.2.1. Repeated cramps may need treatment with fluids and carbohydrates. All attempts should be made for oral rehydration prior to obtaining IV access.
     - 2.2.2. Very severe cramps in a collapsed athlete may require IV fluids.
       - 2.2.2.1. If severe, refractory cramping, consider Diazepam 1-5 mg IV. Some practitioners, in extreme cases, have also used magnesium sulphate up to 5 grams IV, in 1g boluses over 10-20 mins.

     NB- Monitor respirations. 1 gram Magnesium sulphate is equivalent to 4 mm Mg ++

2.3. Bone pain may indicate a fracture and the athlete should be cautioned about continuing. Accurate diagnosis takes time and potentially advanced medical imaging. Athletes should be appropriately assessed and advised. Team physiotherapists may be beneficial in more thorough assessments and advising the physician accordingly.

2.3.1. Injuries should be assessed for stability and splinted/immobilized accordingly.

2.3.2. Injuries suggestive of an open fracture (break in the skin and unstable and/or suspicious for fracture) are at increased risk for infection and long-term complications to the athlete. These injuries should be immobilized and evacuated to the nearest emergency department. Consider initiation of prophylactic antibiotics if the expected transportation time will be more than 2-3 hrs. Please refer to local antibiograms for suggested antibiotic use as pathogens will vary by region.

2.4. Joint dislocations are common to Obstacle events. Consider field reduction if adequate analgesia is available and practitioners are experienced in reduction techniques. Dislocations are extremely painful to athletes and complicate evacuations. Common joints amenable to field reductions include shoulders, fingers/toes, and patella. Once reduced, distal circulation should be reassessed, the joint should be immobilized, and the athlete should be referred to a local emergency department for reassessment and consideration for post-reduction imaging.

3. CONSTITUTIONAL

Depending on the length of the Obstacle event, athletes may present with a variety of constitutional illnesses specific to endurance/ultra-endurance sports, as outlined in this section. Unless experienced in endurance event medicine, many of these aetiologies may not be well known to members of the medical team. The LMD and team physicians/residents should ensure that they are familiar with these common aetiologies and should prepare the medical team appropriately. Events at increased risk for these constitutional aetiologies include; Obstacle courses over 10km in length, courses where the average participant is expected to be on course for over 4 hours, and extreme weather conditions.

Most athletes falling into this category present with collapse of unknown aetiology. Research from triathlons and other multi-sport ultra-endurance events suggests that the most frequent cause of collapse is exercise associated collapse (EAC) or exercise associated postural hypotension (EAPH) – both benign conditions – however, other more sinister causes should also be considered and ruled out. These include

exercise-associated hyponatremia (EAH), exertional rhabdomyolysis, cardiac arrest, intracranial haemorrhage, hypo/hyperthermia, hypoglycaemia, seizures, anaphylaxis, dehydration, and severe respiratory distress.

IMPORTANT: A RECTAL (CORE) TEMPERATURE MUST BE RECORDED ON ANY SICK OR CONFUSED ATHLETE.

Privacy can be obtained while this is done using blankets or screens. If consent cannot be obtained because the athlete is confused or a minor, it is still imperative to obtain such a reading, which should be obtained by a senior nurse and/or doctor exercising his/her duty of care, with another member of the medical team present as a witness. The procedure must be documented on the patient's chart with names of the provider and witness. Under these circumstances, it is extremely unlikely a criminal or civil claim of indecent assault or battery would proceed.

3.1. EXERCISE ASSOCIATED COLLAPSE (EAC) & EXERCISE ASSOCIATED POSTURAL HYPOTENSION (EAPH)

EAC & EAPH are very similar conditions occurring in athletes after endurance competition. The athlete presents with fatigue, collapse, dizziness/light-headedness, or even syncope, usually after finishing the event. This is due to a combination of normal physiological changes that occur during exercise including blood flow redistribution to working muscles, increased cardiac output, lactic acidosis, and venous compression from muscle contraction (and refractory pooling/vasodilation when exercise stops). Experience from triathlons and ultra-endurance events indicate that the medical team can expect that up to 4% of competitors will suffer EAC/EAPH. Most patients can be managed on site; however, 2- 4% of all cases require more intensive treatment with intravenous fluids, and aggressive cooling methods which may only be possible in a fully equipped emergency department.

Definitions & Pathophysiology

EAC/EAPH are terms used to describe lack of postural tone that occurs after prolonged exercise. Participants should be conscious but may be to walk or stand upright without assistance. True syncope is rare in this population, and if present the clinician should consider potential for a more ominous outcome if treatment is not instituted immediately. Clinicians should also recall a differential diagnosis for syncope and ensure other possible causes are ruled out (ie. Cardiac causes, exercise-associated hyponatremia).

EAP/EAPH are due to one or a combination of a) fluid and electrolyte loss through sweating; b) fuel depletion within skeletal muscle; c) lactic acidosis; d) altered baroreflexes causing vasovagal feature and e) hyperthermia or hypothermia depending upon environmental conditions.

Presenting symptoms include collapse, fatigue, muscle cramps, dizziness, nausea, and vomiting, abdominal pain, diarrhoea, feeling hot or very cold. Muscle cramps are common and are due to fluid and fuel depletion and build-up of lactate within the skeletal muscle. Gastro-intestinal symptoms are due to bowel ischemia since blood is preferentially shunted away from the splanchnic circulation to skeletal muscle during exercise.

3.1.1. ASSESSMENT

3.1.1.1. Initial assessment of EAC/EAPH focuses on assessing the patient's overall clinical picture and ruling out other potentially dangerous causes of collapse.

- Mental status (use Glasgow Coma Score) and ABCs
- Vital signs (Oxygen saturations from the peripheral regions are not helpful, particularly in hypothermic patients)
- Assess for presence of hypothermia or hyperthermia
  - May requires a RECTAL (CORE) temperature
- iSTAT sodium assessment (to R/O EAH), if clinical suspicion
- Determine hydration status, ongoing fluid losses (vomiting/diarrhoea) & ability to tolerate oral fluids
- Severity of muscle cramps & ability to walk

3.1.1.2. RED FLAG features: altered mental status, seizures, intractable vomiting/diarrhoea, or focal neurological signs. If red flag symptoms are present:

3.1.1.2.1. Monitor ABCs and consider aggressive resuscitation,

3.1.1.2.2. Initiate early evacuation to emergency department, if able,

3.1.1.2.3. All patients with these features require core temperature and iSTAT sodium measurement, and clinicians should keep in mind a broad differential diagnosis.

3.1.2. MANAGEMENT OF EAC

3.1.2.1. Position to improve cerebral or core circulation. Lie patient supine and raise legs. Encourage oral fluids if the patient is conscious and able to drink. Patients who have

altered mental status and are unable to drink or are vomiting excessively may require intravenous fluids. (Providers must ensure they have ruled out EAH prior to initiating aggressive rehydration measures).

3.1.2.2. Replace body fuel. Sugary drinks or energy bars are useful in individuals who are not vomiting.

3.1.2.3. Treat temperature (see hypothermia and hyperthermia)

3.1.2.4. Treat plasma sodium (see exercises associated hyponatremia).

3.1.2.5. Reassess the patient and monitor for expected clinical improvement.

Note: Most cases of EAC/EAPH are mild and can be treated effectively with oral fluid resuscitation and on-site management. Monitor for Red Flag features above and consider urgent evacuation if recovery is not following the expected clinical course.

3.2. EXERCISE-ASSOCIATED HYPONATRAEMIA - EAH (Water Intoxication)

Exercise-Associated Hyponatremia (EAH) is a relatively common cause of death in endurance events and presents several hours after the start of the race. A common precipitating factor is excessive fluid intake. Electrolyte drinks or water with salt tabs usually do not appropriately replace necessary sodium and can contribute to EAH. The key to preventing mortality from EAH is quick diagnosis, fluid restriction, and urgent transfer to an acute medical facility. On-site management of EAH is 3% hypertonic saline infusion, however this should not delay transport to an emergency department.

While most clinicians are familiar with guidelines for slow correction of hyponatremia commonly seen in medical patients (in order to avoid central pontine myelinolysis), EAH is an acute cause of hyponatremia, and central pontine myelinolysis has not been reported in any case of EAH treated aggressively with hypertonic saline. Mild exertional rhabdomyolysis is also common in this patient population, and this has led some physicians to administer isotonic fluids. Isotonic fluids should be avoided in EAH patients, particularly in the field setting.

Milder cases of EAH should be treated with fluid restriction and time to allow the kidneys to slowly correct the underlying problem. Clinicians should be aware that the sodium level may continue to drop after initial diagnosis, even with fluid restriction, depending on the amount of fluids the patient consumed prior to presentation.

Asymptomatic mild hyponatremia does not require treatment other than fluid restriction and encouragement to eat salty food and take salty drinks. Athletes can also be given advice to report to hospital if they develop symptoms in the next few hours.

3.2.1. ASSESSMENT OF EAH

3.2.1.1. Patients often initially present with mental confusion and vomiting. For practitioners who are not familiar with EAH, the patient may appear to be to be dehydrated, or suffering from heat injury. A core temperature will quickly rule out heat illness, and EAH patients usually appear clinically euvolemic or fluid overloaded (not hypovolemic as in dehydration). In some cases, there may be recognisable features of fluid overload (tight fitting rings, oedema, and JVP raised).

3.2.1.2. Point of care lab testing (example: iSTAT) should be available to the medical team on-site at Obstacle events and should be used in suspected cases of EAH. Assessment includes not only the sodium level, but also the general state of the patient. For most labs, the diagnostic threshold for hyponatremia is any blood [Na^+] below 135 mMol/L regardless of the presence or absence of signs and symptoms.

3.2.1.3. EAH usually presents after several hours of excessive water drinking and exercise and can occur with glucose/electrolyte drinks. If not considered early in the assessment of any athlete with altered mental status, this condition may be aggravated by iatrogenic over-enthusiastic IV fluids, especially IV dextrose or dextrose-saline for "dehydration". Intravenous fluids should NOT be given automatically to a well-hydrated collapsed or confused athlete.

3.2.1.3.1. Initial assessment of EAH focuses on assessing the patient's overall clinical picture and preparing to transport the patient to an emergency department

- Mental status (use Glasgow Coma Scale) and ABCs
- Vital signs (Oxygen saturations from the peripheral regions are not helpful, particularly in hypothermic patients)
- Assess for presence of hypothermia or hyperthermia
  - May requires a RECTAL (CORE) temperature
- iSTAT sodium assessment
- Determine hydration status, ongoing fluid losses (vomiting/diarrhoea) & ability to tolerate oral fluids
- Consider the need for immediate hypertonic saline bolus.

3.2.2. MANAGEMENT

3.2.2.1. Initial management should focus on diagnosis and consideration for immediate evacuation to an emergency department.

3.2.2.2. Ensure appropriate management of ABC, as these patients often present with altered mental status.

3.2.2.3. Fluid restriction should be initiated (including IV fluids) immediately on all patients with altered mental status presenting to the Medical Team, until iSTAT Na+ testing and core temperature can be obtained, and the diagnosis narrowed.

3.2.2.4. In severe cases (seizures or mental changes suggesting worsening cerebral edema), or cases of delayed patient evacuation/long transportation times, EAH should be treated immediately with hypertonic saline.

- Bolus 100 ml of 3% hypertonic saline IV
- There is often marked clinical improvement in mental status with hypertonic saline administration.
- Up to 2 further boluses of 100 ml of 3% hypertonic saline may be administered at 10 min intervals if there is no clinical improvement.
- Do not administer isotonic fluids to EAH patients - this is associated with delayed recovery and death.
- The goal should be to correct sodium to a level of 125 mMol/L over the first1-2 hours, and to normal level over the following 2-4 hours.

3.2.2.5. Initiation of treatment on-site should only be performed under senior medical supervision while awaiting ambulance transfer to hospital. It should not delay rapid transfer to hospital.

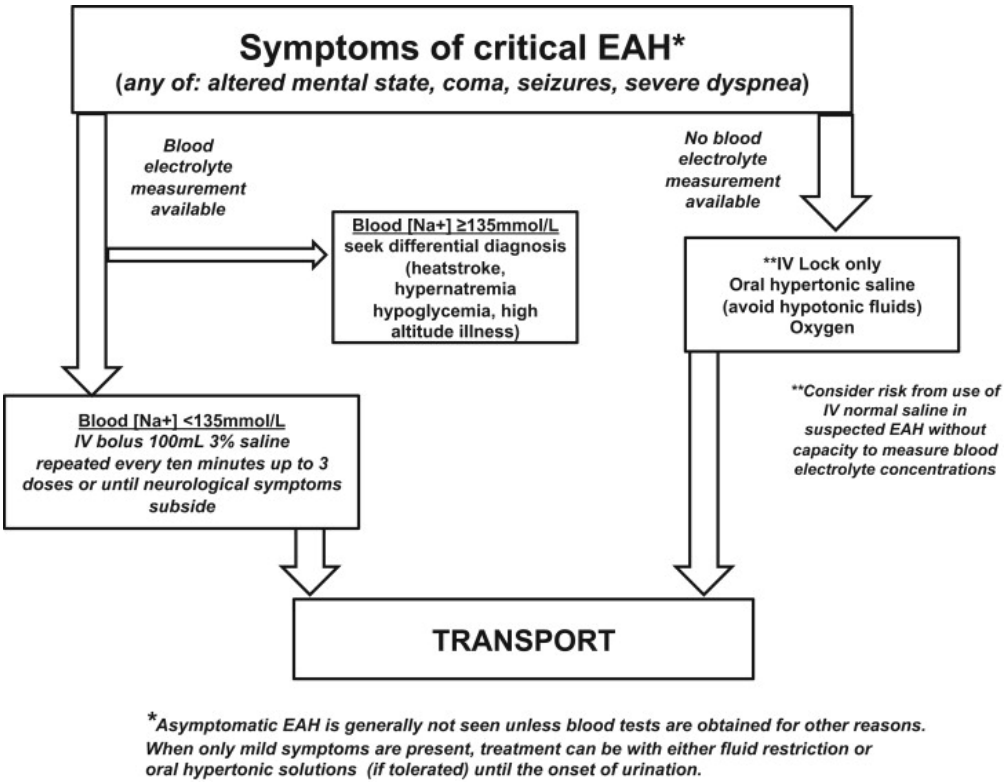

Image taken from Wilderness Medical Society Practice Guidelines for Treatment of Exercise-Associated Hyponatremia.

4. HEAT AND COLD EMERGENCIES

4.1. HYPOTHERMIA

Hypothermia is defined as a rectal temperature below 35°C. Cramps and mental confusion (particularly amnesia) are common. It occurs more often in slow moving athletes particularly on wet, cold, windy days, however the nature of Obstacle events make this diagnosis possible even on warm summer days. The diagnosis is made on clinical suspicion and by measuring core (rectal) temperature.

4.1.1. MANAGEMENT

4.1.1.1. Strip athlete of wet equipment and clothing

4.1.1.2. Dry and wrap in blankets/dry clothing and place in warm environment.

4.1.1.3. Foil blankets over wet kit are useless.

4.1.1.4. Give sugary drink - even mild hypoglycaemia inhibits shivering. Severely confused patients merit consideration for IV glucose.

4.1.1.5. Give warm drinks, if available. Medical tents and evacuation vehicles should be equipped with heating capabilities, even on warm days.

4.2. HYPERTHERMIA AND EXERCISE INDUCED HEAT STROKE

Heat generation is a normal physiological response to exercise, especially for short, high intensity exercise (under 40 minutes). If measured, the athlete's body temperature is usually substantially elevated in this initial phase (up to 40°C) and does not pose any immediate threat to the athlete. This response usually settles rapidly, but if physiological or environmental conditions cause this elevation to persist, the athlete is at risk for heat injury. Risk for exercise-induced heat stroke may be increased due to ambient temperature, an increase in relative humidity, inadequate acclimatisation, and training or hydration status.

Note: All FISO Events must use the Event Alert System; see Environmental Considerations in the Technical Delegate package.

Persisting exertional hyperthermia is defined as a rectal temperature above 40°C more than 10 minutes after running. If neurological symptoms (altered level of consciousness, seizures, etc.) develop the diagnosis is heatstroke, a potentially lethal condition with progressive end organ damage and high mortality if not recognised and treated promptly. Heat stroke is s significant risk to endurance athletes, affecting approximately 1 in 10,000 marathon athletes.

Hyperthermia can occur in athletes even on a cool day and may be difficult to diagnose clinically. All confused athletes should have a core (rectal) temperature as part of the initial assessment. Heat injuries may be masked on clinical presentation as significant dehydration (due to excess sweating) may cause paradoxical features such as peripheral cyanosis, cool, dry skin, and shivering which may be misleading.

4.2.1. ASSESSMENT

4.2.1.1. Hyperthermia and confusion is diagnostic for heat injury and these athletes are at risk for clinical deterioration due to exercise-induced heat stroke.

4.2.2. MANAGEMENT

4.2.2.1. Exercise induced heat stroke is a serious medical emergency and is associated with high mortality, if not treated quickly.

4.2.2.2. Collapsed or confused athletes with hyperthermia should always be managed promptly with high priority until rectal temp <38°C. Temperature should be lowered within an hour of presentation for the best outcome.

4.2.2.3. Initiate aggressive cooling, and monitor ABCs. Consider intubation as required.

4.2.2.4. Cooling

4.2.2.4.1. Sponging or ice packing in the axillae, neck, and groin with towels immersed in ice water is initial treatment. Have a team member fan the athlete, or place a fan, blowing across the body. This will aid in heat loss.

4.2.2.4.2. If possible, consider immersion in cold water for rapid cooling. This should only be considered and undertaken if the medical team is able to support the patient and there is no risk for airway compromise. This may also induce hypothermia if patient is left in the water bath for too long. Discuss cooling options with RMD prior to event.

4.2.2.4.3. Rectal temperature should be taken every 15 minutes until below 38°C.

4.2.2.4.4. If treatment as listed does not produce a rapid fall in temperature, or the mental state does not improve within 1 hour, consider urgent evacuation to hospital. MAINTAIN COOLING TECHNIQUES DURING EVACUATION AND ON ARRIVAL IN HOSPITAL.

4.2.2.5. Previous cases of hyperthermia have demonstrated that aggressive field cooling is paramount to an athlete's potential recovery. Any delay in the cooling (evacuating to a hospital prior to initiating cooling) is associated with worse outcomes and increased care needs (stays in intensive care units, intubations/ventilation, mortality).

All cases of hyperthermia, especially those presenting with altered mental status, should be immediately cooled on-site.

5. CARDIAC ARREST / CHEST PAIN

5.1. Cardiac arrest occurs in 1 in 50,000 to 1 in 100,000 athletes in running endurance races, usually in people with underlying coronary artery disease. Cardiac arrest protocols should be conducted in accordance with the latest guidelines by the American Heart Association (AHA), Resuscitation Council (UK), or equivalent. All physicians on site should be skilled at, and prepared for, cardiac resuscitation. Remember that successful resuscitation from cardiac arrest in the medical tent may

also require treatment for hypovolemia and hypoglycemia, and stabilization for transfer to an acute medical facility.

5.2. Any athlete presenting with chest pain must be assessed fully for acute coronary syndrome, although chest wall, lung, and oesophageal pathologies should be considered as appropriate. All doctors should have a supply of aspirin 300 mg chewable tablets and GTN. The medical tent should be equipped with AED or defibrillator devices, and appropriate cardiac monitoring equipment. The medical tent should also have a full supply of ACLS drugs and opiates, to be reviewed pre-event by the LMD. All first responder / mobile response units shall be equipped with an AED and equipment/providers capable of BLS care.

6. ACUTE SHORTNESS OF BREATH

6.1. Any athlete presenting with acute shortness of breath must be fully assessed for common causes of the presentation, including asthma, anaphylaxis, hyperthermia, acute coronary syndrome, pulmonary embolism, and spontaneous pneumothorax. Treatments will depend on the clinician's opinion regarding the underlying cause of the shortness of breath.

6.2. Salbutamol, epinephrine, and other necessary first line medications will be available at the medical tent, as required. Discuss specifics with the LMD prior to event day.

6.3. As Obstacle events are often held in a wilderness environment, certain resources may be limited. Consider the application of oxygen judiciously and discuss supply and indications with LMD prior to the event.

7. TRAUMA

7.1. Obstacle events involve athletes navigating a variety of obstacles, and over a variety of terrains. Medical personnel, as well as event staff, are often operating all-terrain vehicles and/or heavy machinery. As such, there have been instances of significant trauma at Obstacle events, and physicians should be prepared to provide trauma assessment and care, as required.

7.2. Follow local protocols and training for accurate assessment and interventions, such as ATLS (Advanced Trauma Life Support) protocols. Please discuss specific treatment capabilities (thoracic needle decompression, surgical airways, chest tube insertion, pelvic binding, etc.) with LMD prior to the event and know where this advanced equipment is kept.

7.3. Urgent evacuation to an acute medical facility is paramount for patients presenting with significant trauma. Significant trauma may be nearly impossible for an event medical team to manage, and treatments should focus on initial hemodynamic and physical stabilization of the patient, communication with the receiving medical facility (as required), and timely evacuation to definitive medical care.

8. DIABETES

8.1. Diabetic athletes have been advised to carry their own glucose meters to monitor blood levels. Medical staff are asked to help them if requested.

8.2. Glucose monitoring will also be available at the medical tent and with first responders on course. Treatment for diabetes is in accordance with local protocols and available supplies.

9. GENERAL MEDICINE

Athletes may have known or latent co-morbidity including asthma, cardiac and cardiovascular disease, diabetes, epilepsy. Known medical conditions must be listed as part of the registration process for each athlete and be instantaneously available in the athlete database by race number and name. A reasonable range of medications and monitoring equipment shall be supplied to Medical Tent, and physicians should be prepared to treat a variety of general medical conditions.

10. ENVIRONMENTAL MEDICINE

Obstacle events are often held at locations where wildlife, altitude, weather, or other common wilderness medical issues may become a factor. If this is the case, the LMD, MD, and RD should discuss the potential risks and impact to athletes and prepare accordingly. Many medical practitioners may not be confident with wilderness or environmental medicine presentations, so please ensure that the medical team is appropriately educated, and consider consulting local experts, if required, as some treatments are specific and specialized in nature.

10.1. ALTITUDE

Altitude illness is regularly associated with mountaineering and climbing sports, however these illnesses could be a potential issue at Obstacle events held in mountainous regions (>3000m above sea level), particularly for athletes travelling from sea level. Increased altitude is associated with a decrease in the density of the atmosphere, which decreases available oxygen, reduces water vapour, and allows greater

ultraviolet penetration. As haemoglobin oxygen saturations decrease, mild hypoxia will set in – this can have a noticeable effect on performance and, if the altitude continues to increase, can develop into altitude illness.

Without getting into the complex physiology of altitude illness, recall that the body's natural compensatory response to hypoxia is hyperventilation and increased cardiac output (mild increase in heart rate and blood pressure). This compensatory effort results in mild respiratory alkalosis and rise in blood pH. As the hypoxia worsens, capillary dilation and leakage begins to occur, which lead to the two potentially lethal complications of altitude: cerebral and/or pulmonary edema.

10.1.1. HIGH ALTITUDE CEREBRAL EDEMA (HACE)

10.1.1.1. Mild HACE manifests as headache, decreased appetite, nausea/vomiting, and mild balance/gait changes – similar to any other patient presenting with slight increases in ICP. This usually develops in susceptible people within hours of arrival to a moderate altitude and, if the athlete is given time to acclimatize, should resolve within 48hrs.

10.1.1.2. The initial treatment for mild HACE is to maintain elevation and manage symptoms with medications such as Aspirin, ibuprofen or other NSAIDS. The athlete should be allowed time to acclimatize at this level (full resolution of symptoms) before increasing elevation further or engaging in strenuous physical activity.

10.1.1.3. If the oxygen demands on the athlete are increased (such as competing in Obstacle events) or the athlete continues to increase elevation, prior to appropriate acclimatization, the level of cerebral edema increases and the clinical status of the patient worsens. This manifests as mental status deterioration, worsened vomiting, and possible changes to gait/balance. If allowed to continue (increasing elevation/exertion), this may develop into severe HACE – ataxia, altered level of consciousness, and persistent vomiting. Fortunately, severe HACE rarely occurs below 4000m

10.1.1.3.1. Symptoms of severe HACE can mimic other common Obstacle issues, such as hypoglycaemia, hyper/hypothermia, EAH, etc. If the event is being held at elevation, the team should include HACE in the differential for patients with altered LOC.

10.1.1.3.2. The treatment for moderate to severe HACE is immediate decent from altitude by at least 1000m, and exertion should be minimized. Medications such as Acetazolamide (125mg Q12H) and Dexamethasone (8mg loading dose, then 4mg Q6H IM, SC, or PO) may be used in moderate to severe HACE. Severe HACE is an ominous sign, and athletes are not likely to survive if aggressive treatments are not initiated.

10.1.2. HIGH ALTITUDE PULMONARY EDEMA (HAPE)

10.1.2.1. Unlike HACE, HAPE does not develop immediately on arrival at altitude; HAPE develops several days after arrival. HAPE can develop with or without symptoms of HACE. At moderate altitude (3000-4000m), HAPE tends to occur as an isolated illness.

10.1.2.2. HAPE initially manifests as shortness of breath on exertion, dry cough, and occasionally a fever. People with underlying respiratory disease/illnesses are at increased risk for developing HAPE. Patients suffering from HAPE often feel they have developed a respiratory tract infection.

10.1.2.3. As pulmonary edema worsens, so will the shortness of breath and cough. Eventually crackles will be audible with chest auscultation. Moderate HAPE indicates the need for immediate supplemental oxygen and immediate descent of at least 300m, if possible. Any physical exertion will worsen the patient's condition.

10.1.2.4. Emergency medications for HAPE include Acetazolamide (125-250mg Q12H), Nifedipine 20mg PO Q8H, and beta agonist inhalers.

If the Obstacle event is such that there is risk for moderate to severe HAPE or HACE (elevations >3-4000m), this should be identified prior to the event and the LMD, RD, and MD will need to develop protocols and obtain the proper equipment, medications, and training to deliver medical treatment.

10.2. LIGHTNING

10.2.1. Lightning strikes are rare, and can hopefully be avoided with proper planning, education, and response to local weather changes and warnings. Remember, the safety of the medical team is paramount in this situation. If lightning is striking in the area, consider the risks to rescuers.

10.2.2. Lightning, although powerful, is extremely brief in duration – most of the current passes over the skin on the way to the ground. As such <20% of lightning victims die of their injuries. Most victims are not hit directly but are affected by indirect ground current exposure. This exposure is generally less devastating than a direct hit.

10.2.3. ASSESSMENT & MANAGEMENT

10.2.3.1. Lightning strikes are associated with a variety of traumatic and electrical injuries. The direct current can cause respiratory and cardiac arrest, as well as superficial burns. The blast-like explosive force can cause blunt and penetrating trauma, as well shock wave damage to tympanic membranes and hollow organs.

10.2.3.2. Due to the variable nature of injuries, physicians are advised to take a "treat what you see" approach. Patients in cardiac arrest may benefit from prompt initiation of CPR/cardiac resuscitation. Other injuries should be treated in accordance with local trauma protocols/training.

10.3. TOXINS, ENVENOMATION, LOCAL DISEASES

10.3.1. Exposure to wildlife is common at Obstacle events. It is important that the medical team consider potential causes of envenomation or toxin exposure (ie: bee stings, snake bites), and discuss potential treatments available in the area. All course first response teams should be equipped with epinephrine auto-injectors for use in anaphylaxis as required

10.3.2. Local plants may also be a cause for skin irritation. Caution should be taken to ensure that the medical team is not exposed to the toxins, and wound cleaning/treatment should be initiated in accordance with best practice for the specific area/exposure.

10.3.3. Local diseases (ie: water/food borne] disease) and vector-borne illnesses (i.e.: mosquito-borne illnesses) should be considered in the planning stages of the event and identified risks may need to be communicated to athletes prior to participating in the event. This will be at the discretion of the RD, MD, and LMD.

10.3.4. The medical staff should also be educated regarding local wildlife, plant life, and vector-borne illnesses to ensure appropriate medical information and advice is given to any athletes who may inquire.

11. ON-SITE USE OF INTRAVENOUS (IV) FLUIDS

11.1. Obstacle events are often held in rural/remote wilderness locations. As such, resources may by limited. Physicians are asked to be judicious about initiation of invasive or resource-heavy treatments in the field, unless clinically warranted.

11.2. IV fluids are only indicated in the following cases: severe presentation in which fluid rehydration is clinically indicated, the athlete is unable to tolerate oral fluids, the athlete has continuing fluid loss

from vomiting or diarrhoea, or athletes with significant heat or cold related injuries. All athletes should be considered for EAH prior to initiation of IV fluids and point of care lab testing should be done to rule this out.

11.3. Choice of IV fluids

11.3.1. Initial restoration of fluids should be conducted with isotonic fluids (exception is EAH, where 3% hypertonic saline is the indicated treatment). The selection of IV fluids is at the discretion of the LMD prior to the event and supplied IV fluids will be available at the Medical Tent.

11.3.2. In adults, an initial fluid bolus of up to 1 Litre IV solution can be given. The patient should then be reassessed for the ability to tolerate oral replacement fluids. If there is ongoing concern, the medical team should re-examine the patient and seek the advice of a senior physician or LMD prior to delivering more IV fluids.

11.3.3. Dextrose containing solutions should only be given after circulating volumes have been restored and/or measured hypoglycaemia exists (Blood glucose less than 4 mM/L). This is most likely to occur in athletes with type I or type II diabetes who have "overdosed" their hypoglycaemic agents, especially insulin. Hypoglycemia can rarely occur in non-diabetics and is an aggravating factor in hypothermia, as it may interfere with the shivering reflex. Intermittent blood sugar analyses should be conducted to avoid rebound hyperglycaemia but note that finger prick techniques may give inaccurate results under very cold conditions.

11.3.3.1. 5% Dextrose solution does not provide sufficient glucose substrate to be useful, so 10% dextrose should be given with care and regular inspection of the infusion site to detect extravasation and potential skin damage. Concentrations above 10% will slough the skin if extravasated outside the vein and should ideally only be administered through central venous access catheters, thus not indicated for on-site medical care.

11.3.3.2. Dextrose solutions may worsen EAH. This condition has in the last few years become more common in endurance races and was discussed in detail in the sections above.

12. MEDICOLEGAL ISSUES

12.1. The medical defence unions generally indemnify insured medical professionals providing they are acting competently and within the limits of their training and experience. Since event conditions vary, healthcare professionals must follow internationally established protocols and seek advice from senior staff whenever there is doubt about the correct diagnosis or treatment to be followed.

All diagnoses, decisions, and treatments must be carefully documented to avoid future medico-legal consequences.

12.2. Doctors must have reached sufficient level of training to be licensed for independent practice in the local area. Residents and medical students should act only under the appropriate supervision of a licensed physician, and this supervision should be discussed with the LMD prior to the event.

13. DOCUMENTATION

13.1. All interactions and treatments administered by the medical team shall be documented on a chart or casualty card, no matter how trivial. The forms used for documentation are at the discretion of the event organizers and the LMD. The FISO Medical Commission can provide a sample casualty card for event use, if required. Please ensure accurate documenting of the patient's demographics, the time and date, and the race specifics. Please ensure you write legibly – preferably print. Sign and print your name on the document.