

# 2017 Guidelines for Management of Marathon Related Medical Emergencies

## **MANAGEMENT GUIDELINES**

### **TOPICAL**

Blisters and skin abrasion are common. Blisters should only be drained under aseptic conditions and the skin left in place. Subungual haematomas (black nails) should be left to the podiatrists or chiropodists or A&E. Department and may be drained through the nail with a drill or heated needle.

### **MUSCULOSKELETAL**

Cramps are common and may be severe. Single spasms respond to stretching the relevant muscle often best achieved by assisted walking. Repeated cramps need treatment with fluids and carbohydrate (usually oral). Massage does not help unless fluids are given first. Very severe cramps in a collapsed runner may require iv fluids and even iv Diazepam 1-5 mg.(monitor respiration) Magnesium sulphate has also been used ( up to 5 grams iv, in 1g boluses over 10-20 mins.) NB- 1 gm Magnesium sulphate is equiv.to 4mm Mg ++

Bone pain may indicate a stress fracture and the runner should be cautioned about continuing. Accurate diagnosis takes time.

### **CONSTITUTIONAL**

Most runners falling into this category present with collapse. The most frequent cause of collapse is Exercise Associated Collapse, but other causes of collapse may also occur, for example, cardiac arrest, intracranial haemorrhage, hypoglycaemia, epileptic seizures, anaphylaxis and severe asthma.

#### **1. EXERCISE ASSOCIATED COLLAPSE**

(see separate sheet Assessment of collapsed marathon runner on page 12)

##### Pathophysiology

Exercise associated collapse is a term used to describe lack of postural tone that occurs after prolonged exercise, such that the participant cannot walk or stand upright without assistance. This is not synonymous with syncope which is also associated with loss of consciousness and may be

associated with a more ominous outcome if treatment is not instituted immediately.

Exercise associated collapse is 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 vaso-vagal feature and e) hyperthermia or hypothermia depending upon environmental conditions.

Presenting symptoms include fatigue, muscle cramps, dizziness, nausea, and vomiting, abdominal pain, diarrhoea, feeling hot or very cold. Muscle cramps are due to fluid and fuel depletion and build of lactate within the skeletal muscle. Gastro-intestinal symptoms are due to bowel ischaemia since blood is preferentially shunted away from the splanchnic circulation to skeletal muscle during exercise. These patients may present after they have arrived home to their local A&E.

### Assessment (see page 12)

The severity of EAC (other causes of collapse excluded) is graded on the following:-

- Mental status (use Glasgow Coma Score)
- Heart rate, blood pressure and respiratory rate measurements (Oxygen saturations from the peripheral regions are not helpful)
- Ability to take oral fluids
- Severity of muscle cramps
- Continuing fluid loss from vomiting or diarrhoea
- Ability to mobilise (i.e. walk about)
- Presence of hypothermia or hyperthermia, which cannot be diagnosed by state of peripheral circulation but requires a RECTAL (CORE) temperature.

Ominous features include altered mental status, epileptic seizures or neurological signs. ALL PATIENTS WITH THESE FEATURES REQUIRE CORE TEMPERATURE MEASUREMENT. PLASMA SODIUM MEASUREMENT (to check of exercise associated hyponatraemia) IS MANDATORY IF THE TEMPERATURE ALONE CANNOT EXPLAIN THE PRESENTATION. Plasma sodium measurements will be possible at the finish.

### Management of EAC

1. Fluid redistribution or replacement 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 therapy with intravenous fluids provided there is no objective evidence of exercise associated hyponatraemia.
2. Replace body fuel. Sugary drinks or energy bars are useful in individuals who are not vomiting.

3. Treat temperature (see under hypothermia and hyperthermia)
4. Treat plasma sodium (see under exercise induced hyponatraemia).

## 2. HYPOTHERMIA

Hypothermia is defined as a rectal temperature below 35 °C. Cramps and mental confusion (particularly amnesia) are common. It occurs in slow moving runners particularly on wet cold windy days. The diagnosis is made on clinical suspicion and by measuring core temperature.

### Management

1. Strip runner of wet clothing, dry and wrap in blankets and warm clothing and place in warm environment. Foil blankets over wet kit are useless.
2. Give glucose drink as even mild hypoglycaemia inhibits shivering. Severely confused cases merit iv glucose.
3. Warm drinks if available are helpful as are tent or ambulance heaters on a cold day.

## 3. HYPERTHERMIA AND EXERCISE INDUCED HEAT STROKE

Marathon runners can have a high core temperature while running. This usually settles rapidly but if it persists may indicate early heat stroke. Exercise induced hyperthermia may be due to ambient temperature, an increase in relative humidity, inadequate acclimatisation and training or hydration status.

Persisting exertional hyperthermia is defined in runners as a rectal temperature above 40° C more than 10 minutes after running. **If neurological symptoms develop the diagnosis is heatstroke**, a potentially lethal condition with progressive end organ damage and high mortality if not recognised and treated promptly. Heatstroke affects 1 in 10,000 marathon runners.

Hyperthermia CAN OCCUR IN RUNNERS EVEN ON A COOL DAY and is perpetuated by cramps and shivering. It cannot be recognised from the state of the peripheral circulation since marked dehydration due to excess sweating may cause paradoxical features such as peripheral cyanosis and cool dry skin and shivering which may be misleading. All confused runners should have a core temperature measurement as part of the initial assessment.

Presentation of hyperthermia and exercise induced heat stroke may be delayed and the patient may present to a local A&E later in the day / evening.

### Diagnosis

HYPERTHERMIA AND CONFUSION IS DIAGNOSTIC

### Management

Heatstroke is serious and is associated with high mortality if treatment is delayed. All collapsed or confused runners with hyperthermia should always be treated as potentially progressing to heatstroke and managed promptly with high priority until rectal temp <38 degrees C. Best outcomes occur if the temperature can be brought down within an hour or presentation 'The Golden Hour'.

1. Cooling and fanning
2. Sponging the axillae, neck and groin with towels immersed in ice water.
3. Rectal temperature should be taken every 15 minutes until below 38°C.
4. If treatment as listed does not produce a rapid fall in temperature, or the mental state does not improve, consider evacuation to hospital, MAINTAINING COOLING IN THE AMBULANCE AND ON ARRIVAL IN HOSPITAL.

REMEMBER THE 4 C's: **C**ollapsed and **C**onfused should prompt **C**ore temperature measurement and rapid **C**ooling.

In the past runners with rectal temperatures of over 42° C, have all responded to first aid measures instituted by marathon healthcare staff, whereas several cases presenting later in the process, going directly to hospital, have taken much longer to recover. Some of these patients have needed over 48 hours in the intensive care unit. In the 2010 marathon two runners with heatstroke required intubation and ventilation. Another runner was intubated in 2013 and we had our first death from heatstroke last year. As from 2015, CAERVESTS are available in the intensive care units at the finish to help cool semi-conscious patients with hyperpyrexia.

### **IMPORTANT MESSAGE**

**A RECTAL (CORE) TEMPERATURE MUST BE RECORDED ON ANY SICK OR CONFUSED RUNNERS OR ANYONE WHO HAS UNDERTAKEN AN EDURANCE EVENT.**

### **4. Exertional Hyponatraemia (Water Intoxication)**

This presents several hours after the start of the race as a result of excessive fluid intake with headache, mental confusion and often vomiting and in severe cases, epileptic seizures. Core temperature rules out heat-stroke. There may be recognisable features of fluid overload with tight fitting rings, oedema, and clinical evidence of fluid overload (JVP raised, no features of hypovolaemia). It has become a major problem with non-elite runners drinking too much fluid before, during and after the race. After sporadic previous cases in the LM there were 15 cases in 2003 and 2007 (all with fits or collapse) including one death in 2007.

Hyponatraemia usually presents after several hours of excessive water drinking but can occur even with glucose electrolyte drinks. This condition is found particularly with slow charity "runners" and may be aggravated by iatrogenic over-enthusiastic iv fluids, especially i.v. dextrose or dextrose-saline for "dehydration", both by St John units and in hospital.

Intravenous fluids should NOT be given automatically to a well hydrated collapsed or confused runner. Abbot iSTAT point of care analyzers which give sodium levels will be available at the finish area of the London Marathon and should be used in all suspected cases of hyponatraemia. Assessment includes not only the sodium level but the general state of the patient and whether they are improving or deteriorating. The sodium level can continue to fall for some time after the last fluid intake.

### Management

When confirmed, in severe cases with epileptic seizures or severe mental changes suggesting worsening cerebral oedema, exercise associated hyponatraemia should be treated with hypertonic saline (to correct sodium to a level of 125 mmol/l over 1-2 hours, and to normal level over the following 2-4 hours.)

It is recommended that a bolus of 100 ml 3% saline is administered to raise the sodium quickly and prevent cerebral oedema. Up to 2 further boluses of 100 ml 3% saline may be administered at 10 min intervals if there is no clinical improvement. Initiation of treatment in the finish area of the London Marathon should only be performed under senior medical supervision while awaiting ambulance transfer to hospital ie it should not delay rapid transfer to hospital.

Unlike chronic hyponatraemia commonly seen in medical patients, where a slow restoration is required to avoid central pontine myelinolysis (CPM), CPM has NOT been reported in any case of EXERTIONAL hyponatraemia treated with hypertonic saline. Experience from 2003 and from the USA suggests that normal saline may have no obvious benefit and is an illogical treatment for a fluid overloaded patient. Milder cases should be treated by withholding fluids (oral and iv) and awaiting the correcting diuresis. Fortuitously diagnosed asymptomatic hyponatraemia does not require treatment other than encouragement to eat salty food and take salty drinks. They can also be given advice to report to hospital if they develop symptoms in the next few hours.

## **5. Cardiac Arrest**

Cardiac arrest occurs in 1 in 50,000 to 1 in 100,000 runners usually in runners with severe coronary artery disease. In previous LM events (>600,000 runs) there have been 5 successful cardiac resuscitations, and 9 cardiac deaths five with ischaemic heart disease, two from hypertrophic cardiomyopathy, 1 from arrhythmogenic right ventricular and 1 from sudden arrhythmic death syndrome. We have also observed 5 non cardiac deaths: 1 from hyponatraemia, 1 from heatstroke, 1 from inadvertent use of a performance enhancing agent containing DMAA and 2 from subarachnoid haemorrhage.

Cardiac arrest protocols on the route will be conducted in accordance with the latest guidelines by the Resuscitation Council (UK).

All cardiac arrests from the finish area are to be transferred to St Thomas' Hospital who will also have an ECMO team on standby if required.

## **6. Chest pain**

Any runner presenting with chest pain will be assessed fully for acute coronary syndrome, and although chest wall, lung and oesophageal pathologies may be the cause it is difficult to exclude a cardiac cause on the route. Where an ECG shows criteria for direct transfer to a HAC is available on the route the patient will be conveyed directly to the specialist centre however you may receive patients who need an ECG on arrival at the A&E and onward transfer.

## **7. Other Medical Emergencies**

Runners may have known or latent co-morbidity including asthma, cardiac and cardiovascular disease, diabetes, epilepsy.

## **8. Other medical issues**

### **a) Diabetes Glucose Testing**

Doctors on the route will have access to glucose meters to monitor blood sugar levels at their ambulance stations. Mild cases may be treated with glucogel (also provided) if required.

### **b) Treatment with Intravenous (i.v.) fluids**

IV fluids are really only indicated in runners with severe EAC who are hypovolaemic with a low BP even when nursed in the head down position and who cannot drink or tolerate oral fluids, or who have continuing fluid loss from vomiting or diarrhoea, or who have significant hyperthermia (see above). Even with these runners an iSTAT measurement should be made if possible to assess the situation and exclude the diagnosis of hyponatraemia).

## Choice of iv fluids

Initial restoration in these circumstances should be conducted with Hartman's solution or normal saline. In adults up to 1 Litre iv solution can be given over 20-30 mins, but following this the ability to absorb oral therapy should be re-examined and the advice of a senior medical officer sought before embarking on a further 1 litre of IV solution if clinical signs of hypovolaemia persist.

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 runners with type 1 or type II diabetes who have "overdosed" their hypoglycaemic agents, especially insulin, but 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 finger prick techniques may give inaccurate results under very cold conditions.

5% Dextrose solution does not provide sufficient glucose substrate to be really 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.

Dextrose solutions may worsen existing hyponatraemia due to "water intoxication"

Such patients may also benefit from fluid and calorie replacement if they fall ill near the end of the race but be aware of HYPONATRAEMIA or WATER INTOXICATION patients who may well become worse if given any iv fluid load (see use of hypertonic saline below). This condition has in the last few years become more common in marathon races and is discussed below.

Professor Sanjay Sharma MD, FRCP, FESC  
Medical Director

Dr Fenella Wrigley  
LAS Medical Director and Emergency Medicine Consultant

(On behalf of the London Marathon Medical Committee)

## **Assessment of collapsed marathon runner**

(Collapse = inability to walk unassisted) To be used in conjunction with London Marathon Medical Guidelines 2011)

### **Assessment** (repeat abnormal observations every 15-30 min)

- Mental state
- Blood glucose
- Serum Na ( 1 hourly if abnormal)
- Rectal temp (essential if confused, say they feel cold or not responding to Rx)
- BP and pulse (any postural drop)?
- Assess state of hydration
  - dehydrated dry mouth, no saliva, low skin turgor, low JVP
  - overhydrated, tight rings, tight shoes, oedema. Normal pulse and BP
- Ability to take oral fluids
- Presence of diarrhoea or vomiting
- Improving or deteriorating

### **Probably Benign** (exercise associated collapse EAC)

- Occurred at end of race (after running)
- Awake and alert
- Rectal temp  $>36 <39$
- Presence of postural hypotension, but feels OK if legs elevated.
- Recover quickly with oral fluids and carbohydrate elevation of legs and pelvis
- Muscle cramps settle rapidly

### **Could Be Serious**

- Occurred before the finish (while running)
- Confused, or mood change (aggressive)
- Presented with a fit or loss of consciousness or amnesia
- Persistent vomiting and or diarrhoea
- Severe headache
- Rectal temp  $<35$  or persistently  $>39$
- Hypoglycaemia
- Hyponatraemia  $<130$
- If well hydrated (tight ring, oedema, high JVP) check Sodium
- Persistent cramps or rigors

### **Definitely Serious**

- Comatose or violently aggressive and disorientated
- Severe hypotension and tachycardia.
- Rectal temp  $<35$  or  $>40$  and not responding to treatment
- Chest pains or rapid irregular heart rate
- Signs of stroke or CVA
- Worsening cramps or rigors
- Headache and malaise getting worse
- Fit or Fits unless known Epileptic
- Deteriorating level of consciousness



Modified from R Sallis Oct 04 revised by DSTP (LM) and T.Noakes