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The Australasian Society for Motorsports Medicine and Rescue

Contents

Race control

Welcome to the sixth edition of the ASMMR newsletter. After a hiatus in October, it's back. We've seen the conclusion of the WRC for 2009, with Sebastian Loeb breaking more records, establishing himself as the most successful WRC driver to date, beating Mikko Hirvonen by a single point this year. Sebastian Ogier's finishing position shows he has the potential to threaten the top slots in the years to come.

Formula 1 also finished its season, with Jensen Button finally living up to expectations with the stunning Braun Team. Braun also took out the constructors title, which is impressive for a debut season, though many of its team members are not novices. Mark Webber's season was bittersweet, again finally justifying long-held faith is his ability, though he finished just off the podium and was outshone by the younger Sebastian Vettel who claimed second overall. It seems it was the year of the Sebastian.

Lastly, the MotoGP completed its season. Valentino Rossi came out on top again, with Casey Stoner ending the year in fourth. Next season starts in Qatar in April.

The A1 Grand Prix fell over in its attempt to kick off the season at the Gold Coast, succumbing to financial pressures. While it may not be as popular a category here as closed cockpit racing, or have as big a following as in Europe, but is still a worthwhile alternative to Formula 1 and brings an additional event to this continent. It will have considerable restoring faith after this stumble, but personally, I hope it does.

The V8s will compete on a street circuit at Olympic Park in Sydney at the start of next month and Oran Park will close in January after a long history in motorsports.

Given the season that we are heading into and the record temperatures that have been experienced

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in Adelaide, this months clinical section deals with emergent heat illness in the prehospital setting. Hopefully this will be of use to those who have been requested to provide medical coverage for events over the coming months.

Good luck.

Matthew Mac Partlin

Clinical review

Environmental hyperthermic emergencies – A review

Pathophysiology

Fever = elevation of core body temperature in response to cytokines released at sites of inflammation and controlled by the hypothalamus
Hyperthermia = abnormal elevation of core body temperature due to failed thermoregulatory control.

Heat generation + heat gain = heat loss - insulation → thermal balance

Heat generation:
- Metabolism
- Physical exertion

Heat gain:
- Environmental exposure
- High ambient humidity, which impairs effective heat dissipation

Heat loss:
- Sweating→ evaporative heat loss (becomes ineffective above a relative humidity of 75%)
- Vasodilation → radiant, conductive and convective heat loss (become less effective as the ambient temperature increases)
- Increased minute ventilation→ conductive and convective heat loss (again, less effective as the ambient temperature increases)

Insulation:
Decreases the efficacy of heat loss.
- Clothing
- High ambient temperature
- High ambient humidity

Hyperthermia results in increased oxygen utilisation and, above 42°C, enzyme dysfunction and uncoupling of oxidative phosphorylation, which leads to lactic acidosis and multiorgan failure. Liver, endothelial and nerve tissue are the most susceptible to the effect of hyperthermia.

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Clinical effects

1) Heat exhaustion:

Core temperature >38.5°C + fatigue + muscle cramps + sweating +/- vomiting +/- lactic acidosis

2) Heat stroke:

Core temperature is typically > 40°C with central nervous system deficits, from altered GCS to seizures, encephalopthy and coma.

There may be additional features of heat exhaustion, but there is often complete absence of sweating. Complications include multiorgan failure, disseminated intravascular coagulation, metabolic derangements (especially K^+, Ca^{2+} and $PO4^{3-}$), ARDS, seizures and rhabdomyolysis. There is a high mortality rate.

Classically divided into non-exertional ("Classic") and exertional heat stroke. Non-exertional occurs in at risk populations (extremes of age, cardiovascular disease, certain medications) exposed to a hot environment. Exertional heat stroke typically occurs in younger, healthy athletes and soldiers exerting themselves in a hot environment. Some individuals are subsequently found to have muscle fibre markers of predisposition for other heat emergencies such as malignant hyperpyrexia and neuroleptic malignant syndrome. Failure to maintain adequate hydration is a key factor and dehydration increases ATPase metabolic activity which independantly increases thermogenesis.

Mortality and morbidity are directly proportional to the height of the core temperature, the number of organ failures that occur, age and co-morbidities.

Assessment

<u>History</u>

Usually obvious at an event. May be a competitor, support crew or spectator.
Key features:

- Presence of neurological symptoms differentiates heat stroke from heat exhaustion
- Progression of symptoms
- Features of complications
- Risk factors: level of exertion, adequacy of hydration, co-morbidities, usual medications

<u>Examination</u>

- Vital signs → tachycardia, hypotension, tachypnoea, hypoxia
- GCS → differentiates heat stroke from heat exhaustion
- Core temperature → options include rectal and pharyngeal in the field. Tympanic and axilliary are unreliable.
- Features of complications → pulmonary oedema due to ARDS, bleeding due to DIC, dark blood positive urine due to myoglobinuria from rhabdomyolysis, seizure activity

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Investigations

May be limited in the field

- BSL: hypoglycaemia
- ECG: arrythmias
- Urinalysis: haematuria may actually be the reagent strip cross reacting with myoglobin due to rhabdomyolysis, especially if the urine is a dark muddy colour

Once in hospital, completion of investigations includes a CXR, FBC, coagulation screen with FDPs and fibrinogen, EUC, LFTs, CMP, CK, a formal myoglbinuria level, a CT brain if there are significant neurological features and a toxicological screen.

Management

Heat exhuastion

- Aggressive resuscitation is rarely required
- Usually responds rapidly to simple cooling measures such as removing the individual's clothing (within reason) and using a cooling fan with a fine mist spray of tepid (15°C) water. This strategy is probably the most effective of the non-invasive techniques and can decrease core temperature by an average of 0.3°C/minute.
- Ice packs in the axillae, groins and neck are effective but should be wrapped in cloth to avoid local tissue injury and may not be tolerated by an awake patient. Reduces core temperature by 0.02-0.03°C/minute
- Managing the person in an air-conditioned area, such as the back of an ambulance, helps.
- Rehydration is essential and may initially need to be intravenous
- Once cooled, the patient can usually be discharged, but should be advised to refrain from further exertion for the rest of the day, continue with oral hydration and avoid alcohol for the following 24 hours.

Heat stroke

Resuscitation

- Standard ABCD measures. Consider avoiding suxamethonium due to link with malignant hyperpyrexia.

Specific therapy

- Remove patient's clothing → promotes evaporative and radiant heat loss
- Mist spray with blow-over fan → promotes convective cooling. Non-invasive, easy to apply in the pre-hospital setting, effective and does not interfere with access to the patient.
- 1000mls 0.9% saline at 4°C will drop core temperature by 1.5 - 2°C. Be alert for pulmonary and cerebral oedema.
- Ice packs in the axillae, groins and neck are effective but should be wrapped in cloth to avoid local tissue necrosis and may not be tolerated by an awake patient.
- Ice-water baths should be avoided as they may result in significant hypertension and seizures and make patient access in the event of sudden deterioration difficult
- Cooling blankets are available in a number of formats including circulating cold water systems requiring a bulky cooling unit and a power supply (impractical in most pre-hospital

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scenarios) and jacket-and-cap kits that are kept in the freezer and alternated at regular intervals (again impractical if there is no access to a freezer)
- If the number of patients needing treatment is very low, managing them in the back of an ambulance with air-conditioning may help
- Invasive techniques such as gastric, peritoneal or vescicle lavage and dialysis are the domain of the emergency department and intensive care unit
- Shivering can be suppressed with benzodiazepine or, if intubated, non-depolarising neuromuscular blockade
- Antipyretics such as paracetomol annd ibuprofen do not help!
- Dantrolene, as used in malignant hyperthermia and neuroleptic malignant syndrome, is ineffective for heat stroke (Bouchama A, Cafege A, Devol EB, Labdi O, el-Assil K, Seraj M. Ineffectiveness of dantrolene sodium in the treatment of heatstroke. Crit Care Med 1991;19:176-80).
- Alcohol wipes are not advised, due to toxic potential.
- Cease active cooling once the core temperature is <39.5°C as there is usually a monitor lag and excessive cooling may result in iatrogenic hypothermia

Supportive therapy

- Oxygen supplementation
- Ongoing intravenous hydration.
- Monitor for features of cerebral oedema and organ failure
- Prevent hypoglycaemia
- Analgesia as required

Disposition

- Arrange transfer to nominated emergency department for ongoing management in intensive care
- If invasive therapy has been or is likely to be commenced, arrange for formal retrieval. Otherwise, transfer in a standard ambulance with an accompanying doctor, in case of deterioration en route.

Sources:

- UpToDate.com
- eMedicine.com
- Heat emergencies. Bross MH; Nash BT Jr; Carlton FB Jr . Am Fam Physician 1994 Aug;50(2):389-96, 398
- Heat stroke. Bouchama A; Knochel JP. N Engl J Med 2002 Jun 20;346(25):1978-88
- Heat illness. Tek D; Olshaker JS. Emerg Med Clin North Am 1992 May;10(2):299-310

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Recent race results

World Rally Championship

After completion of the Championship at Rally GB

1. S. LOEB 93	6. H. SOLBERG 33	11. M. OSTBERG 7
2. M. HIRVONEN 92	7. M. WILSON 28	12. K. AL-QASSIMI 6
3. D. SORDO 64	8. S. OGIER 24	13. E. NOVIKOV 4
4. J-M LATVALA 41	9. F. VILLAGRA 16	14. C. ATKINSON 4
5. P. SOLBERG 35	10. C. RAUTENBACH 9	

Formula 1 Grand Prix

At the season completion

1. Jenson Button 95	8. Jarno Trulli 32.5	15. Giancarlo Fisichella 8
2. Sebastian Vettel 94	9. Fernando Alonso 26	16. Sebastien Buemi 6
3. Rubens Barrichello 77	10. Timo Glock 24	17. Adrian Sutil 5
4. Mark Webber 69.5	11. Felipe Massa 22	18. Sebastien Bourdais 2
5. Lewis Hamilton 45	12. Heikki Kovaleinen 22	19. Kazuki Nakajima 0
6. Kimi Räikkönen 48	13. Nick Heidfeld 19	20. Nelsinho Piquet 0
7. Nico Rosberg 34.5	14. Robert Kubica 17	

V8 Supercars

After The Island 300. Next round Barbagallo Raceway Wanneroo 20 - 22nd November.

1. Jamie Whincup 1560	6. Lee Holdsworth 993	11. Fabian Coulthard 828
2. Will Davison 1386	7. Mark Winterbottom 957	12. Shane Van Gisbergen 798
3. Garth Tander 1212	8. Rick Kelly 903 453	13. Paul Dumbrell 789
4. Craig Lowndes 1110	9. Russell Ingall 830	14. Cameron McConville 786
5. Steven Johnson 1050	10. Michael Caruso 828	15. Jason Richards 777

MotoGP

1. Valentino ROSSI 306	5. Colin EDWARDS 161	9. Loris CAPIROSSI 110
2. Jorge LORENZO 261	6. Andrea DOVIZIOSO 160	10. Marco MELANDRI 108
3. Dani PEDROSA 234	7. Toni ELIAS 115	11. Randy DE PUNIET 108
4. Casey STONER 220	8. Alex DE ANGELIS 111	12. Chris VERMEULEN 108

After 17 rounds. Season completed.

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FIA Institue news

In a September release, the FIA Institue for Motorsport Safety and Sustainability announced that testing had been conducted on a collapsible steering column for KF3 class racing karts. The intention is to reduce the incidence of serious thoracic injury in karting. The outcome was that drivers found the column to be too compliant, leading to poor performance when turning and braking. The steering column will undergo further development.

Applications for funding motorsport safety projects from the FIA Institute's Motor Sport Safety Development Fund were submitted between the 31st of August and the 11th of September by a variety of National Sporting Authorities. Successful applicants will receive a share of the fund draw up a contract with the institute. It was not stated how the funding will be audited, nor whether the results of these projects will be reported and, if so, by whom. Last year over 20 projects received funding support, amounting to €1.6 million.

Caught by the cameras

From the Los Angeles Motorshow 2008
Motor Sport 2025 Design Challenge
A design entered by Mitsubishi as an all-terrain, omni-directional, 8 x 4-wheel drive competitive vehicle.
Check out http://www.laautoshow.com/DC09/ for more.

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