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The Australasian Society for Motorsports Medicine and Rescue

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Race control

Welcome to the March edition of the ASMMR newsletter. I apologise for the hiatus, but work overtook for a while. Some holiday time might have had something to do with it too! Either way, it's season opening time and the IRC, WRC and Formula 1 have kicked off. The V8's stormed around Adelaide and the MotoGP and AORC marques are soon to get going.

The Clinical review outlines the principles and problems of a massive blood transfusion and the FIA releases a motorsport textbook for doctors and other clinical and rescue providers.

The 2010 season is taking off in earnest and if anyone wishes to contribute to the body of information for the Australian and wider rescue and medicine community via the ASMMR, you can do so by sending the article to me at mmacpartlin@ausdoctors.net or by posting a comment on the ASMMR Google Groups site (<http://groups.google.com.au/group/ASMMR>).

Good luck.

Matthew Mac Partlin

Clinical review

Massive blood transfusion

A massive blood transfusion (MBT) occurs when a large volume blood transfusion is given within a short period and often in the context of major trauma. There are a variety of definitions applied, depending upon the source of information, but it usually centres on the replacement of the total circulating blood volume within 24 hours. Working acute definitions include transfusion of more than 4 units of packed red blood cells (PRBCs) in the first hour with ongoing loss, or, loss of more than 50% of the circulating volume within 3 hours¹.

There are three problems with a massive blood transfusion. First is that it usually indicates severe, possibly multiorgan, injury and probable ongoing losses that will require surgical intervention to control. Secondly, there are a host of complications that result, either directly or indirectly, from the MBT itself. These will be expanded upon later, but the major concern is the triad of hypothermia, acidosis and coagulopathy; also known as the trauma death triad. Finally, there is the logistical problem of sourcing enough blood product to match the transfusion required.

In trauma resuscitation, there is a distinction between volume loss and red cell mass loss. A healthy individual can tolerate up to 80% red cell loss if normovolaemia is maintained, but is compromised by loss of more than about 30% of their circulating volume. This is important from the motorsport perspective for two reasons. First, blood products are rarely kept on site for events due to the costs and logistics involved. Secondly, the primary concern for a major trauma victim at a motorsports event is adequate stabilisation of the patient and effective transport to definitive care. Therefore our main circulation target is the adequate restoration of circulating volume, rather than red cells. This may not mean restoration of a “normal” blood pressure, especially in the context of unsecured penetrating trunk trauma, where targeting a systolic pressure of 90mmHg is accepted practice backed by evidence².

The main complications of an MBT include:

- Hypothermia – often due to a combination of ongoing blood loss, patient exposure during assessment and resuscitation and the cold PRBC packs
- Acidosis – again, produced by a combination of hypovolaemic hypoperfusion causing a lactic acidosis and the citrate and lactate load of the PRBC packs
- Coagulopathy – a composite end-product of DIC from major trauma, major haemorrhage, acidosis, hypothermia (impairs platelet function), dilution of native clotting factors and a drop in platelet count. At present, the tendency is to back up transfusion of more than 6 units of PRBCs with a 1:1 ratio of FFP and a 2:1 ratio of PRBCs to platelets, though there is ongoing controversy over the coagulation benefit versus the blood product exposure risk and the volume overload potential. Streamlined MBT protocols are becoming more common in trauma units.
- Hyperkalaemia (raised serum potassium) – there is increased extracellular potassium (K⁺) in the PRBC packs for a variety of physiological reasons, which can result in a significant K⁺ load. Usually it does not cause a major problem, as long as the patient’s kidney function is relatively preserved.
- Sodium load – not usually a significant problem, unless the patient has disordered cardiac, liver or renal function
- Citrate toxicity – Citrate is used to prevent the packed red cell clotting together with the residual clotting factors, by binding the ionised calcium that is required as a co-factor in the coagulation cascade. It is usually not a problem unless more than 5 units of PRBCs are

given within 25 minutes (1 unit < 5 minutes), or there is impaired liver function. The effect is hypocalcaemic tetany and its various complications. The use of protocolised replacement with 10mls of 10% calcium gluconate remains controversial, but is practised.

- There are also the standard storage lesions (volume overload in addition to those listed above) and immune consequences (anaphylaxis, ABO incompatibility, TRALI and febrile non-haemolytic reaction) associated with any transfusion, though with a magnified potential in the MBT scenario.

Some of these problems have given rise to the resurrection of fresh whole blood transfusion. The strongest advocates and the largest volume of research is coming from the military, where fresh whole blood transfusion has a number of practical advantages, including the ability to store it relatively cheaply in the various healthy marines working nearby.

Anytime major trauma and haemorrhage are discussed, the issue of activated recombinant Factor VII (rFVIIa) is raised. Essentially, there is no role for Factor VIIa in macrovascular bleeding – a large hole in a significant blood vessel needs a surgeon, not a clotting factor. Additionally, Factor VIIa is largely ineffective where significant hypothermia, acidosis and coagulation defect persists, so correct all of these first. Factor VIIa is most useful for ongoing microvascular (capillary bed) bleeding or where damage control surgery has been completed and there is continued leak in the vicinity of the repaired wound. An industry-sponsored phase II trial of rFVIIa in MBT for major penetrating and blunt trauma failed to demonstrate a benefit over placebo. There were significant trial flaws, but the manufacturer has made no moves to repeat a better trial. At present, its only approved use is the control of significant bleeding in haemophiliacs, but its ‘off-label’ uses are recorded in Australia by the Haemostasis Registry group and includes use in major trauma.

In summary, a massive blood transfusion is a marker for significant injury, independantly produces morbidity and is largely the domain of trauma units rather than trackside operatives. Early transfer to a definitive trauma unit with a rapid door to theatre time for damage control surgery is the process most likely to simultaneously improve patient outcomes and reduce massive blood transfusion consequences.

References

1. Oh’s Intensive Care Medicine, 6th Ed. Pg 1005
2. Bickwell et al. “Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries” NEJM 1994: 331, 1105-9
3. Trauma.org



Recent race results

Formula 1

So Schuey returns, and posted a respectable 6th position in his Mercedes, though behind his younger team mate, Nico Rosberg. Bahrain also saw the return of the Lotus marque to F1.

1. Fernando Alonso - Ferrari 1:39:20.396 2. Felipe Massa - Ferrari +16.099 3. Lewis Hamilton - McLaren-Mercedes +23.182 4. Sebastian Vettel - Red Bull-Renault +38.713 5. Nico Rosberg - Mercedes +40.263 6. Michael Schumacher - Mercedes +44.180	7. Jenson Button - McLaren-Mercedes +45.260 8. Mark Webber - Red Bull-Renault +46.308 9. Vitantonio Liuzzi - Force India-Mercedes +53.089 10. Rubens Barrichello - Williams-Cosworth +1:02.400 11. Robert Kubica - Renault +1:09.093 12. Adrian Sutil - Force India-Mercedes +1:22.958	13. Jaime Alguersuari - Toro Rosso-Ferrari +1:32.656 14. Nico Hulkenberg - Williams-Cosworth 1 lap behind 15. Heikki Kovalainen - Lotus-Cosworth 1 lap behind 16. Sebastien Buemi - Toro Rosso-Ferrari 3 laps behind 17. Jarno Trulli - Lotus-Cosworth 3 laps behind Those not listed failed to finish
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Next race: Australian GP, Melbourne, 26th – 28th of March

World Rally Championship

Two events completed and Seb and Mikko are trading blows already. Mikko took Sweden and Loeb Mexico. Latvala and Sordo are continuing their support roles, with Sordo looking more and more confident in his own ability on an increasing variety of surfaces. Latvala needs to prove that he can be consistent. Having drawn the spotlight on himself last year, Ogier is lurking about the top positions early this year.

Mexico also saw Petter Solberg's return to the podium with a second place finish, ahead of Ogier in third.

The 2010 season separates the Super 2000s out of P-WRC and into their own category, with ten of the thirteen WRC rounds being contested by the powerful 1600cc turbo pocket racers. Ford and Skoda are represented, with Peugeot, MG, Proton and Abarth expected to get on board.

1. Sebastien Loeb 43 2. Mikko Hirvonen 37 3. Jari-Matti Latvala 25 4. Sebastien Ogier 25	5. Petter Solberg 20 6. Henning Solberg 16 7. Dani Sordo 12 8. Matthew Wilson 6	9. Federico Villagra 6 10. Mads Ostberg 4 11. Xavi Pons 4 12. Martin Prokop 2
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Next event: Jordan Rally, 1st – 3rd April

V8 Supercars

1. Jamie Whincup 771 2. Mark Winterbottom 714 3. James Courtney 696 4. Shane van Gisbergen 630	5. Lee Holdsworth 573 6. Craig Lowndes 552 7. Rick Kelly 530 8. Paul Dumbrell 489	9. Michael Caruso 462 10. Steven Johnson 455 11. Garth Tander 447 12. Will Davison 402
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Next round: Hamilton Island, 17th - 28th April

MotoGP

The first round of the MotoGP will be held on the 11th of April, in Qatar, on the Losail circuit

Intercontinental Rally Challenge

A series that resurrects some of the classic rally events such as Monte Carlo and Kenya and also attracts former rally legends and new competitors, often with more than 30 entrants per round. Skoda are leading the manufacturer's leaderboard, with Peugeot second, Ford third and Mitsubishi fourth. Subaru, Fiat, Citroen, Opel, Suzuki, Renault and Alfa Romeo are yet to post points.

1. Juho Hänninen 14	5. Jan Kopecky 9	9. Eduardo Scheer 3
2. Guy Wilks 11	6. Nicolas Vouilloz 6	10. Daniel Oliveira 2
3. Mikko Hirvonen 10	7. Bruno Magalhães 6	11. Jean-Sébastien Vigion 1
4. Kris Meeke 10	8. Stéphane Sarrazin 5	12. Marcos Tokarski 1

Next event: Argentina, 21st of March

Off-road racing (AORC)

The season opener will be the Pinjarra Engineering Hyden 450, held in WA near Hyden, between the 2nd - 4th of April.



FIA update

The FIA has produced a medical textbook, edited by Gary Hartstein, titled "Motorsport Medicine". It is a 250 page, two-part book. The first part details administrative and technical aspects of motorsport, while part two covers rescue and clinical aspects, with guidelines provided. Contributors include Charlie Whiting, Gerard Saillant and Terry Trammel. (Though not mentioned in the December press release, I believe David Vissenga was also involved.) The book has been nominated for a Safety Initiative award at the November Professional MotorSport World Expo. Where to obtain a copy, or how much it will retail for, is not detailed and, at present, it is not listed on Amazon.com

The award winner was an electronic marshalling system that is operated from race control and indicates track safety conditions using trackside and in-car lights. Intended for F1 for the moment, the press release did not mention the future role of trackside marshalls at F1 events.



Caught by the cameras



Another “longest jump” attempt with Monster Energy Drink’s Jonny Greaves powering his Pro 2WD Toyota off-road truck 301 feet between two dirt ramps in the Southern Californian desert, outside San Diego. Longest jump attempts seem to be threatening to be the next extreme sport!!

