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PRACTICE MAKES PERFECT

The FIA has developed a portable medical extrication vehicle for closed cars to help teams practice worldwide



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Following the tragic passing of two drivers from major championships in recent weeks - Jules Bianchi and Justin Wilson - it is more important than ever that we continue to research and develop ways to improve safety and medical care across motor sport. In this issue of AUTO+Medical we take a look at two of our latest projects.

The first is the development of a new extrication simulator for closed car championships. It is a portable and low-cost piece of equipment designed to help extrication teams practice their duties and hone the craft. The second is an ongoing study to learn more about the nature of vision and how it affects a driver's ability to race safely.

These projects are examples of the different ways we are trying to improve our sport and we believe they will be of great importance for the development of motor sport medicine.

Elsewhere in this issue we speak with Dr Michael Scholz, the Medical Chairman of the DMSB and CMO of the German GP, whose keen eye for preparation and communication makes his interview a fascinating read.

Our scientific study examines one of the most important issues in the sport – driver concussion.

I hope you enjoy the latest issue.

Professor Gérard Saillant
 FIA Institute President
 FIA Medical Commission President

LETTERS

In this section, we print the best letters and emails received from readers around the world. We welcome comments on articles as well as suggestions for future content or insight into an area of motor sport medicine you feel would be relevant. If you wish to send in a letter or email, please direct it to: medical@fiainstitute.com

Dear Editor,

I was curious what the process for submitting articles for publication in AUTO+Medical. I am working on a paper regarding "track noise levels" that includes some original research I did at the Circuit of the Americas last year. Let me know if you think that is a topic you would be interested in reviewing for publication and how it should be submitted.

Best regards,

John P. Sabra, MD
 CMO-Circuit of the Americas
 Assistant Professor- Dell Medical School
 Department of Surgery and Trauma
 Austin, Texas

Editor: We would be delighted to receive your article for publication.

All articles should be relevant to Motor Sport Medicine and follow the accepted guidelines for any medical articles submitted for publication, be they an overview of a topic or original research being presented; briefly they should include Title, Authors, Images and references.

You should also confirm that the submission is not subject to copyright elsewhere and is an original work. Authors are accountable for all aspects of the work and should ensure that it is accurate and representative.

Dear Editor,

On behalf of the Board of Directors and the Curriculum Committee of the International Council of Motorsport Sciences (ICMS), we would like to invite motor sport medicine professionals to join us at the ICMS Annual Congress. This year's congress will be held from December 9-11, 2015 in Indianapolis, in conjunction with the Performance Racing Industry (PRI) Trade Show that draws over 45,000 participants from around the world.

Twenty-six ICMS Congresses (annual general meeting + scientific sessions) have been held since 1988. They have served as a site and environment for discussion, collaboration and vetting of thoughts and ideas related to the world of motorsport medicine and safety. Previous congresses have been held in Canada, Italy, England, Mexico and France as well as the United States

Sincerely,

Hugh Scully, MD, MSc, FRCS(C), FACS.
 Chairman Emeritus; Chair, Curriculum Committee
 Toronto, Canada

Rob Seal, MD, FRCP(C)
 Chair, Education Committee
 Edmonton, Canada

Editor: This is a great event for medical professionals. For those that are unable to attend we'll be reporting on the highlights in a future issue.

STAR LETTER

Dear Editor,

First of all, I would like to thank you for the excellent idea of creating the AUTO+ Medical journal. Even though I am a junior doctor in motor sport, I think I share the same feelings and challenges as every one of us. We all are people with oil running through our veins and we live for our work in motor racing with a great passion.

Luckily, we have got used to fewer and fewer lethal incidents due to the improvements in safety and security items, and the training and professionalisation of teams throughout motor sport. However, we can't forget that our pilots risk their lives everyday and they put their health in our hands.

Ways of communicating between each other such as this journal, or the biannual FIA meeting, helps us to share and improve our weak points or doubts, and keeps us from thinking that we are the only ones with these problems.

I enjoyed Dr. Steve Olvey's article about the traumatic brain injury (see AUTO+ Medical #4) and was able to speak thoroughly with Professor Hutchinson in Doha about the same matter.

This type of lesson and its management are extremely difficult in our world, not only because it is difficult to prove whether the pilot is completely out of risk and can drive again, but also because of the the high pressure the pilot, team and medical team all have to get along with it.

I encourage the whole medical community to discuss and try to reach a protocol about this important matter. I look forward to the next journal and congratulate you again for the initiative, the quality and the variety of the articles.

Yours,

Dr. Anna Carreras Castañer
 Trauma and Orthopedic Surgeon, Hospital Quiron Teknon (Barcelona)

Member of Barcelona-Catalunya Circuit Medical Team

GLOBAL NEWS

QATAR TO HOST REGIONAL MEDICAL SEMINAR

The Qatar Motor and Motorcycle Federation will host the 2015 FIA Middle East and North Africa (MENA) Medical Seminar on 7-8 October in Doha, where the focus will be on rallying and off-road events.

Chief Medical Officers (CMOs) and their deputies from the region will meet to partake in theoretical discussions and practical exercises.

The delegates will discuss general topics such as organisational structures, training and selection of staff, as well as covering areas specific to rallying and off-road racing including logistical issues, spectator safety, accident management and how to overcome weather related problems.

Throughout the various interactive sessions, footage from real life incidents will be played to trigger points of discussion.

During the practical exercises those in attendance will participate in workshops covering a wide range of issues from extrication and resuscitation to practicing responses to incidents with multiple casualties and/or technical difficulties.

Leading figures from the motor sport medical community will be speaking at the event, including German Grand Prix CMO Dr Michael Scholz, FIA WRC Permanent Medical Delegate Jean Duby, and Bahrain Motor Federation CMO Dr Amjad Obeid.



Rallying events, such as the 2015 Qatar International Rally, will be a focus of the seminar



F1 TECHNOLOGY MIGHT HELP PEOPLE LIVE LONGER

The McLaren Formula One team is confident that it can adapt its technology from Formula One to help people live longer and it is developing a range of wearable tech to help it do so.

Geoff McGrath, the team's Vice President of Applied Technologies, wants to measure people in the same way that the team measures the cars driven by Jenson Button and Fernando Alonso.

Speaking at the Wired Health 2015 event, McGrath said: "If we can measure the health of an engine then why can't we measure the well-being of a machine or the person operating that machine - that is our philosophy.

"As we do in Formula One, we can feed intelligence into a model and aim for the predictive intelligence. We will then use simulations so that we can start to support our decision-making capabilities and understand how the product is being operated."

In the same way as the cars can relay information being sent through thousands of sensors in real time, Applied Technologies is

gauging the human body and developing the ability to monitor it via sensors.

McGrath explained: "After working with the England Rugby team and analysing their performance, we formed a strategic alliance with the largest pharmaceutical company in the world, Glaxosmithkline.

"Working on mobility and diseases such as Parkinson's and ALS, clinical trials took place with our team putting simple sensors and microchips on their bodies and we found the optimum position on the body to understand the context of whether somebody is walking, sitting, sleeping, etc.

"We then used deep learning techniques to try and spot tiny anomalies which would provide a pre-systematic warning if someone was trending towards a problem. It's not pure medical science but it is great bio-mechanic insight that an intervention or a check-up may be necessary."

McLaren plans to have its first wearable technology on sale by 2016.

'RACE WITH RESTRAINT' DEBUTS

The Motorsport Safety Foundation (MSF), a US organisation established to help improve safety standards, introduced its 'Race with Restraint' initiative at the 24 Hours of LeMons at Autobahn Country Club in Illinois providing grassroots racers with high-end safety equipment for rent at low prices.

Hiring out HANS devices and helmets to drivers for just \$30 a day each, MSF provided the gear to competitors for a much lower cost than buying the equipment outright.

Scot Elkins, MSF CEO, underlined the fact that hiring a helmet and a HANS device, "for \$60 a day total, a driver got \$1,600 worth of safety equipment."

The initiative aims to provide affordable safety equipment to competitors at grassroots levels, where the majority of the drivers' budgets are preoccupied with buying and tuning their cars.

Elkins says that due to the success of the concept, they intend to take it to national level, with plans to have up to 20 stalls at various race tracks around the USA.

MSF chose the 24 Hours of LeMons to debut the programme as, in Elkin's mind, it epitomised the grassroots level of the sport. The series is an ultra-low budget category that restricts competitors to the use of cars that cost no more than \$500.

"This type of racing works perfectly for us because these guys only participate two or three times a year and it doesn't justify them to go out and spend a lot of money on safety equipment," he said.





JUSTIN WILSON 1978-2015

The global racing community has been mourning the loss of British driver Justin Wilson, who passed away after suffering a head injury when he was struck by debris from a crashed car during an IndyCar race at Pocono Raceway on Sunday 23 August.

The nose section of Sage Karam's car hit Wilson on the helmet after the American driver had crashed on lap 180 of the 200-lap race. IndyCar medical staff were on the scene within moments, with Wilson quickly extricated from his car and airlifted to the Lehigh Valley Health Network Cedar Crest Hospital in Allentown, Pennsylvania, where he arrived in a critical condition. But he did not regain consciousness and IndyCar officials announced he had died on the evening of Monday 24 August.

A statement released on behalf of Wilson's family said: "Justin was a loving father and devoted husband, as well as a highly competitive racing driver who was respected by his peers.

"The family would like to thank the staff at the Lehigh Valley Health Network Cedar Crest Hospital, Pocono

Raceway, Andretti Autosport, and the Verizon IndyCar Series as well as the entire racing community for the amazing outpouring of support from fans around the world."

Wilson spent the majority of his career racing in open-wheel championships in America, after winning a number of titles on the European scene during his junior career. He won the inaugural Formula Palmer Audi title in 1998 and drove on the Formula One support bill for three seasons in Formula 3000, winning the championship in 2001.

He made his F1 debut for Minardi in 2003 and contested 11 races with the Italian squad before completing the final five rounds of the year with Jaguar. He switched to Champ Car in 2004 and took four victories over four seasons, finishing as series runner up in 2006 and 2007.

After Champ Car merged with IndyCar in 2008, Wilson went on to make 120 IndyCar starts and claimed four victories. He is survived by his wife, Julia, and two daughters, aged five and seven.

ASN'S START USING FIA MOTOR SPORT ACCIDENT DATABASE

FIA National Sporting Authorities (ASNs) have started to use a new database that collates data from racing accidents the world over.

In May, individual usernames and passwords were sent to a correspondent at every ASN to permit access to the portal and data entry.

The idea behind the initiative is to have a database of accidents

that can be analysed with the aim of informing future research and safety innovations.

The full launch follows an initial two-year trial of the system. With a larger amount of data at its disposal, the FIA can identify where to focus research and development projects to improve safety across a wide spectrum of motor sport disciplines.

FIA President Jean Todt said: "The introduction of the database will open up an opportunity for the world of motorsport to provide detailed information on any serious accidents that occur.

"A significant number of the major safety improvements made throughout motorsport have been predicated by fatal or serious accidents.

"It is difficult to talk about a particular occurrence or a change in safety procedures and technology from a hypothetical point of view. It is an easier task to develop procedures and technology based on actual data."

While stressing that it is unrealistic to prevent accidents from occurring altogether, President Todt remains confident that with the assistance of the database being open to other nations, the safety risks when incidents do happen are minimised.

"You cannot remove accidents from motorsport," he explained. "But the primary goal of the FIA is to minimise, as much as we possibly can, the harm that occurs when they do happen."



National Sporting Authorities will enter data from serious accidents across the world

FIA SPORT CONFERENCE PLENARY DISCUSSES MOTOR SPORT MEDICINE

Some of the leading practitioners in the field of motor sport medicine gathered to discuss medical issues at the FIA Sport Conference in Mexico in July.

The panel touched on a wide range of subjects, highlighting how research and communication continue to improve standards in motor sport.

Prof. Gérard Saillant, President of the FIA Institute and FIA Medical Commission, spoke about how current initiatives focused on research can have a positive effect: "The FIA database and the accident data recorders are fantastic improvements to try to collect all the accidents in the world and learn what is the mechanical aspect and what is the medical consequence [of these events]".

Dr Steve Olvey, a Founding Fellow of the FIA Institute and former medical director at IndyCar, highlighted how communication has and continues to improve medical practices: "In 1990 we began to see doctors speaking with engineers and with time we knew we had the same goals in mind and we began to understand each others' language."

He believes that this sharing of ideas and information marked an important point in the history of safety development and gave an example of how it had an impact on racing. "The crash that Alex Zanardi had in Germany in 2001, [was] until that time considered non-survivable."

Zanardi lost his legs in the

crash, but lived and Dr Olvey said that this would not have been possible without the communication between engineers, organisers and doctors and the subsequent improvements they led to.

He stated that the future progress of motor sport medicine relies upon continued cooperation and learning between these parties.

Dr Manuela Alberro, the WRC Medical Delegate in Mexico and Argentina, spoke of the logistical medical challenges specific to rallying and how she and her team tackle them.

"Obviously the environment of the WRC is extremely challenging not just because of the geographical situation but often because the rally control is a long way away from the point of the accident and it can even be hundreds of kilometres sometimes.

"We have a very large number of vehicles that we call 'medical intervention cars' and they have state of the art medical equipment. They are located around the course so that they can guarantee medical care in a maximum of 10 minutes. This means that on average we have 12 to 15 medical vehicles for rallies."

The panel also included leading safety experts such as NASCAR Safety Director Thomas Gideon, Formula One Race Director and Safety Delegate Charlie Whiting and COO of the Motorsport Safety Foundation, Scot Elkins.

Dr Steve Olvey



Dr Manuela Alberro



Prof. Gérard Saillant



NASCAR DRIVERS EDUCATE THEMSELVES ON SAFETY

NASCAR drivers have been taking the opportunity to educate themselves on the safety procedures and policies in place at NASCAR events.

In the wake of Kyle Busch's February crash at the Daytona International Speedway in which the Joe Gibbs driver broke his leg and ankle, a handful of drivers from the series gathered a week later to learn more about the specific mechanisms in place in the event of an accident.

Senior competitors, such as current Sprint Cup champion Kevin Harvick, learnt not only what

happens in a medical situation trackside, but also who is involved in providing a duty of care to those who are injured. NASCAR utilises a travelling team of medical, safety and trackside coordinators, but also makes use of each of the track's medical teams and the teams work together to implement procedures well in advance of each race.

Harvick admitted that he felt more comfortable with the systems in place once he had taken the time to avail himself of it, commenting: "Once they explained the process,

and how the doctors were chosen, [it] was definitely kind of eye-opening as to how much money and time was spent to make sure they had the right people at every race track, and, really, the longevity of the staff and some of the people who have been a part of our community for such a long time.

"Some of it is just now knowing about it and I don't think anybody is saying that it can't always be better. But I feel pretty confident in what the process is and in the medical staff that we have at the tracks."

FEATURES

PRACTICE MAKES PERFECT

To help extrication teams hone their skills, the FIA has developed a portable and cost-efficient medical extrication vehicle for closed car championships.





“ THE DRIVING PRINCIPLE BEHIND IT IS TO HAVE A CAR THAT IS COMPLETELY REPRESENTATIVE OF A REAL RACING CAR ”

fitted with seats (that are optional), a steering wheel, a tunnel, a console, pedal box, footrest, gearstick and a handbrake – all of which are used to simulate realistic extrication scenarios that the teams could face.

“It is made out of the proper steel that you would normally find on the roll cage. Actually, it is stronger than on the race cars because you want the extrication team to be able to cut through the strongest materials.”

One of the key specifications of the project was that it helps provide the most realistic training scenarios possible for the teams to practice with, so the car has been designed to be compliant with real-life safety standards and technical regulations.

“The driving principle behind it is to have a car that is completely representative of a real racing car, be it a rally car or closed circuit car,” says Mekies.

When folded, the entire unit can fit into a square box, around 1.5m across and 0.5m high. It also weighs just 80kg with the steering wheel, console and bodywork. This makes it easy to transport around the world for use at specific events and for delivery to customers.

Mekies stresses how important it is to have a finished product that is transportable, as he

Simulating realistic scenarios in which extrication teams can practice is expensive and logistically challenging. But the FIA hopes to have solved this issue with the development of a reusable and portable medical extrication car.

An exact replica of the roll cage and interior of a modern closed car, the unit has been designed to be an easily transportable and cost-effective device for National Sporting Authorities (ASNs) and other stakeholders to use when training their personnel.

“It is very much a project driven by the FIA Medical Commission,” says FIA Safety Director Laurent Mekies. “Professor Saillant [Commission President] had this idea in his mind for quite a while, so we worked with doctors and the Chief Medical Officers of the medical commissions to produce a practical solution.”

Extricating a driver safely following a serious

accident is a crucial aspect of motor sport medicine, especially in closed-cockpit cars where the driver might remain trapped for an extended period of time. Practicing for these scenarios is essential and so with the ultimate aim of the project to improve the training that extrication teams receive, the car has been built to be as realistic to work on as possible.

“It is an exact replica of a current racing or rally car,” says Mekies. “It’s just a roll cage, but it includes the key elements of the cockpit environment. There are also some very basic bodywork panels that have been incorporated. At the end of the day, the conditions that the extrication teams face are representative of what can happen at the race track or stage.”

The car uses replaceable steel tubes that can be cut during training exercises and subsequently switched at a very low cost. It is



and his colleagues intend for the car to be as convenient to use as possible. "It has to be able to be shipped very easily around the world. In the past you would spend more in shipping the car because of volume and weight. But this only weighs around 95kg in total with everything attached."

As well as providing a realistic training simulation and transportable equipment, the FIA wants to make the car cost-effective to use over and over again.

"A big advantage of this car is that the extrication teams, including fire forces, can come and cut half of the roll cage off and replace it for a very cheap price, which you couldn't do on a real car."

Mekies sees no reason why this will not help improve the overall training that extrication teams receive, reflecting on past projects that have had similar success.

"If you look at how key the open cockpit extrication car was and how it helped train teams all over the world, then I think you could expect the same success with the closed car."

Developed in 2013, the F1 extrication simulator has proved to be a very useful tool for training teams who would not otherwise have had access to such equipment. By giving these personnel access to a replica of the cockpit, they could train in the specifics of extrication, practicing the safe removal of a driver with real

“ A BIG ADVANTAGE OF THIS CAR IS THAT THE EXTRICATION TEAMS CAN CUT HALF THE ROLL-CAGE AND REPLACE IT FOR A VERY CHEAP PRICE. ”



harnesses, steering wheels, cameras, seats and other paraphernalia to contend with.

First used for training at the 2014 Abu Dhabi Grand Prix, the F1 simulator was hailed as a success by the organisers and has since been distributed to other venues in order for their teams to practice with.

This success is what the FIA wants to replicate with the closed extrication car and Mekies is confident it will achieve that.

"I think it will be a great step forward for safety. The side benefits are that you can roll it, and put it upside down to simulate real life rally or circuit accidents. It enables you to simulate a variety of possible outcomes."

Showcased at the FIA Sport Conference in Mexico in July, the extrication car is expected to be unveiled at a variety of events in the near future. Ensuring that the equipment is kept in the public domain, Mekies would like to see it transported around the world to various seminars and conferences, thus further promoting itself as a safety product.

"I think that the National Sporting Authorities would probably like to have use of one to train their teams and I think there are many ways in which the FIA can help," says Mekies.

"Like I said we can ship our car to all of the seminars to help train people. Those with bigger needs will be buying them as there are different monetary mechanisms that the ASNs can utilise in the name of safety. I'm sure that some of them might want to explore that and create a finance deal for buying the car."

Currently only one extrication car has been produced, but the feedback Mekies and his colleagues have received has made them confident that they will be producing a lot more in the near future.

DR MICHAEL SCHOLZ

Chief Medical Officer, German Grand Prix; Medical Chairman, Deutscher Motor Sport Bund

Dr Michael Scholz has been involved in motor sport medicine since 1996, when he started working as a trackside physician at the Motorsport Arena Oschersleben. He has since gone on to work across a large range of racing disciplines, including sports cars, superbikes, touring cars and Formula One. He is currently Medical Chairman of Germany's National Sporting Authority and CMO of the German Grand Prix.

AUTO+ Medical: How did you first become involved in motor sport?

Michael Scholz: I first became involved during the mid-nineties thanks to construction of the third permanent circuit in Germany near my hometown. However, it was difficult at first to get involved as a huge number of my colleagues were also interested in doing so. But, due to fortuitous circumstances, I got a chance. I met a paramedic who worked at the circuit in my hospital and was working with me in the operation theatre. He was the one who connected me with the Chief Medical Officer of the Motorsport Arena in Oschersleben.

A+M: How did you come to be Medical Chairman of the DMSB and CMO of the German GP?

MS: I started out working as a doctor all around the circuit: in the pit lane, on foot, in a trackside ambulance, as part of the medical team and in the medical car. This gave me an in-depth knowledge of many of the areas of the specific issues we face at motor races. At the circuit in Oschersleben a wide range of international races took place, and over the course of one of these events there was a vacant space related to the position of the

CMO. It happened on a Saturday and the Race Directors had to react to this situation immediately. As a result of the circumstances and after discussions with senior management, I was appointed CMO for that weekend. Everything went really well and as a consequence I was appointed as CMO for the rest of the season.

Due to a huge number of high-level national and international motor sport events at the circuit, I came into the focus of the ASN officials. We met and discussed ideas and ways to implement them. From there I had more and more involvement and ultimately progressed to the role of Medical Chairman of the DMSB.

Furthermore, as the result of the high frequency of FIA events in Germany, the ASN got a number of positive Medical Reports from the FIA Medical Delegates. I presume these positive reports were one piece in the decision making of the ASN to approve me as CMO of the German GP.

I would like to mention that my mentor in numerous matters was the current FFSA Medical Commission President and permanent Medical Delegate for the FIA World Endurance Championship and FIA World Touring Car Championship, Dr Alain



Chantegret. He is a good friend and most things I know I learned from him.

A+M: As CMO of the German GP, what are your day-to-day activities on a race weekend?

MS: The work starts on Monday. I check all of the medical equipment, the track and the emergency routes, the way to the hospitals, the duty roster and the best place for the individuals related to their medical skills. I get in touch with the hospitals and the police department to clarify details and methods of communication. Wednesday is the time for the official hospital visit if necessary, Thursday for all extrication exercises and medical scenarios. Friday morning the medical briefing takes place with a warm welcome for the FIA Medical

Delegate and the F1 Medical Rescue Coordinator and afterwards the show begins. Now is the time your system has to run smoothly.

It is absolutely crucial to start planning as early as possible for a GP in order to be well prepared. Consequently your medical team is aware of its responsibilities, is well trained and the atmosphere is relaxed yet focused. No less important is prior communication with the hospitals and the clarification of procedures and communication channels with all involved. From my point of view these

“ MARK WEBBER’S RED BULL LOST A TYRE AND IT HIT A CAMERAMAN IN THE PIT LANE.”



The pitlane during the 2013 German GP

are the basic principles of creating an efficient system, especially in the instance of serious accidents. If all is prepared well then anything that happens feels like it has been planned for and you can start the event with a sense of well-being. Day-to-day I believe that the daily update of information is a crucial part of my role. We must ensure the capabilities and contact details for the hospitals, people in charge and the different teams and personnel are correct. I make sure I inform the team of all changes and that I have explained all the relevant issues and instructions regarding ERS, self protection, extrication, scenario management etc. Another issue is dealing with complex paperwork and data access. I try to provide the FIA Medical Delegate and Medical Rescue Coordinator with all needs. And last but not least, it is crucial to clarify beforehand with all other services and via a common briefing the operating principles on scene at an accident.

A+M: Can you give an example of an incident you have responded to?

MS: One remarkable incident occurred during the German GP at the Nürburgring in 2013. After changing tyres in the race, Mark Webber’s Red Bull lost one of them and it hit a cameraman in the pit lane. He was seriously injured in the incident, which poses several challenges to overcome such as traffic, a large number of people, noise, limitation of space, access and transport methods. Consequently if we needed an ambulance in the pit lane, the Race Director had to deploy the Safety Car. The solution was a cooperation between the medical pit lane team and a team that was sent by the Medical Centre and came from the other side across the garage. It was necessary to take

immediate action, to inform security to get them access, for the racing team to arrange the way of transport across the garage, and then to inform the FIA Medical Delegate and the Race Director what was going on and how much time it would take. The result of this was that we found a fast way to transport the patient without barriers to the Medical Centre, with no consequences for the proceeding of the race. It was also important we communicated with the hospital to arrange all details and to update the clinical team accurately. To achieve objectives like this you have to clarify procedures beforehand, and you need good command structure and communication as well as clear operating principles in race control, with the teams around the circuit and with the medical centre, and reliable structures and people in the hospitals.

A+M: You’ve worked across many different motor sport disciplines, which ones pose the biggest medical challenges and why?

MS: All disciplines of motor sport pose different challenges. In motorcycling we see a whole range of accidents and injuries. In historic racing we are faced with an imbalance between the high speed of the cars, their safety features and the mostly elderly drivers. But for me ensuring the medical care at a rally is the biggest challenge. Firstly we have two passengers in a rally car. Furthermore we often have to go long distances to reach the car after an accident. Special circumstances are caused by the different terrain, environment and the potentially difficult positions of the car. Good cooperation and interaction of extrication, rescue and medical teams are essential if we are to be effective. The methods of transport

and communication are further issues as well as the big task to ensure spectator safety.

A+M: What changes would you like to see to motorsport medical standards / procedures / policies?

MS: Firstly it would be great to have a universal approach to medicine in motor sport and see programmes designed to improve the quality of medical service. Therefore it is necessary to reflect on the cultural and political environment, the economic basis, the focus of motor sport disciplines, and the experiences of the medical team in the region. We are working on a new basic medical course as well as a guide for electronic devices. To create sustainability we like to build regional networks to train colleagues and teams directly. Other points are regional and international networks to illustrate problems and solutions, to share experiences and to highlight different ways of thinking. Data access after accidents is on our focus as well. The medical car crew can use a tablet with an electronic accident protocol. This protocol is linked with the medical centre and we have the option to provide the emergency unit in the hospital with the relevant data too.

A+M: During your career in motorsport medicine, what have been your greatest achievements and what have been your biggest challenges?

MS: When I started to deal with motorsport medicine I saw a good running system. As I have mentioned I was in touch with several different series, hence I got different influences and ideas related to possible changes to improve some parts, especially issues like interaction, tasks and education. We launched several pilot projects, like

education programmes for the special medical teams such as the extrication team and the team in the medical centre. The concept of the medical car, the medical expertise of the crew, as well as the training, were completely redefined. The idea was born to offer an education concept for all medical staff at the circuit to create an approach for this special environment. The feedback was really good and we discovered resources and potential for improvement by making interactive training scenarios with all other services.

To establish all of these ideas and programmes and to have motivated and professional colleagues and team members behind me are my greatest achievements. One more is the really great collaboration between the different ASNs and medical teams in Austria and the Netherlands. I was aware that it would be a long-term goal and this was the biggest challenge as well - at the beginning we only had the support of some circuits, so we worked enthusiastically but without real economic resources. It was a long process and as a consequence of positive feedback from the participants, as well as the drivers after some big accidents, we could move forward. Now we have a well-defined structure, cooperation with the DMSB Academy and the status as an FIA Institute Medical Regional Training Provider.

A+M: Are you working on any interesting medical research projects at the moment?

MS: There are two main issues of interest at the moment. The first is the status and development of extrication procedures, especially in closed cars. With such vehicles there is a compromise of safety of the driver and limitation of space - to work with the classic KED system or similar devices is more



“ IT IS ABSOLUTELY CRUCIAL TO START PLANNING AS EARLY AS POSSIBLE FOR A GRAND PRIX. ”

and more difficult. Modifications like hatch-roof, removable parts of the seat and movable seat are helpful. Another approach is the development of new devices, so we have focused on research aspects like how stable is a fracture of the spine after the first impact, how intensive is the manipulative treatment by using the classical KED, what forces are affecting the patient, does it make sense to continue to use these devices or will it be better to look for other solutions with new and smaller ones, especially in closed cars? The second area of research is the field of stress-level monitoring and data access. This

topic includes quite a number of interesting aspects such as data access immediately after an accident occurs, evaluation of performance data, particularly related to long distance races, as well as performance and safety aspects relating to the best time for driver changes and so on.

A+M: What would you like to achieve in the rest of your motorsport career?

MS: My national focus is to stabilise the existing structures and promote further development to ensure progress. I would like to step up cooperation between the circuits and the hospitals as I think such cooperation will give our colleagues in hospitals interesting educational opportunities, as well as give our medical teams similar chances to learn. My international focus is to launch and establish regional education to improve the level of medical service in general, whilst considering economic resources and experiences. An important goal must be to offer a good quality of medical service not just at high-level motor sport events, but also for grassroots races. I would appreciate regional and international networks - because of the opportunity they present to effectively share experiences and ideas, different points of view and thinking - to be updated. In general I would like to achieve a closer link to the technical and safety personnel in terms of safety and rescue as it is important that we give manufacturers feedback after serious accidents on how improvements could be made regarding safety as well as feedback to the drivers and teams in terms of understanding rescue procedures. The overall goal of all we do must be to achieve the best outcome for the driver in the event of a serious accident.

RACING RE-VISION

Through a series of simulator tests, the FIA Institute is examining how impaired vision affects driving standards in racing.

In an effort to learn precisely how a driver's vision affects their ability to race safely, the FIA Institute is undertaking a programme testing the nature of eyesight in motor sport.

"The aim is to better understand what aspect of vision is the most important for drivers", says Julien Adrian, who is leading the project for Streetlab Vision, the company instructed by the FIA Institute to perform these tests in partnership with the Institut de la Vision.

As simplistic as it might seem to say that good vision is an important part of safety, deciphering exactly which aspects of vision are most important and how they effect a driver's performance can help to develop safety features, regulations and tests.

"We're trying to find out what are the most important parts of vision in terms of safety. We are collecting data on the aspects of vision used when racing and also trying to determine limits and rules for licensing drivers to race," explains Adrian.

Together with French simulator manufacturer Oktal, Adrian and his team have created a platform through which they are testing

eight racing drivers' abilities with artificially altered vision. Using a simulator with screens that provide a 100-degree field of vision and glasses with vision-altering filters, they are assessing drivers' ability to identify, process and react to danger when their vision is obscured.

Before they begin the experiments, the drivers are tested to determine their capabilities with unimpeded sight, thus setting a standard against which to measure the subsequent tests.

They are then given a pair of glasses that completely blocks vision from one of their eyes and are tested against their initial run.

"The first objective of this test is simply to discover if it is possible to drive a race car with only one eye. Then we assess the level to which they can drive with that impediment".

While the premise of these initial tests is fairly straightforward, the project has not been without its issues. Adrian reports that some of the 'more experienced' drivers have suffered from motion sickness from using the simulators, "but it is not a problem for the younger drivers," he says. "We went to the FFSA (Fédération Française du Sport Automobile) to use their young academy drivers to test the simulators and everything was OK, the simulator was very good."

After the primary set of tests, the drivers are set a series of tasks on the simulator with varying artificial visual impairments. The purpose of these tests is to identify how much vision from each eye is necessary to race and how it affects the drivers' abilities.

"There are three separate scenarios. For the



first, we put an obstruction in the way of the car and see how they react, if they can escape it.

"The second scenario is in three separate parts. In the first part we have an object approach the car from the periphery of the screen and record if and how quickly the driver avoids it with perfect vision. Next, we place a filter on their right eye and have an obstacle approach from the left, again recording how well they do. The final part of this section is

covering the driver's left eye and having an obstruction approach from the left."

This process is repeated 10 to 15 times for each participant, with steadily decreasing levels of vision in each eye, until ultimately vision from either the left or right is completely obscured. These tests should help to identify if it is possible for a driver to race safely with just one eye and exactly how that ailment affects their ability.



“ WE’RE TRYING TO FIND OUT WHAT ARE THE MOST IMPORTANT PARTS OF VISION IN TERMS OF SAFETY. ”

The next phase of the tests will focus on endurance driving. For a long-distance races such as the Le Mans 24 Hours, a driver's vision can be affected by the long stints behind the wheel, changing light and lack of sleep. The researchers will look at exactly how eyesight is affected and how long it takes to deteriorate in these circumstances, creating a platform from which guidelines and potential safety features can be developed.

"We have the drivers testing until October-November time," says Adrian, "so once all the tests have been conducted and the data collated, we hope to present our findings to the FIA Institute by the end of 2015."

INSIDE THE FORMULA E MEDICAL CAR

Formula E Incident Commander Jonathan Webber and Dr Gareth Davies take us inside the Formula E medical car at the London ePrix and the specialist equipment at their disposal.

1 THE BMW I3

"It's a totally electric car provided by BMW which obviously fits in with the series. What's interesting about Formula E is that the medical car is not just a medical car, it is an incident vehicle so it carries equipment to enable the medical crew and the safety teams to help the drivers and to protect themselves and carry all of the additional safety equipment."
Jonathan Webber

2 THE TEAM

"The four-strong team that rides in the medical car consists of a doctor, paramedic, incident commander and a battery specialist from Williams whose job it is to help manage any battery-related issues they might have at the scene of an incident. "The occupants all wear open face helmets and electrically insulating gloves with leather outer protectors and standard footwear."
Jonathan Webber



3 RESPIRATORS

"These are standard respirators with filters and bilateral filters. If there was a battery fire, it's not actually a smoke and flame fire that you might be used to seeing with a race car. A battery fire is actually known as thermal runaway, where there's a chemical exchange taking place in the battery, where the battery overheats and releases a very toxic fume. If we go to a driver who is injured in a car with a battery fire, or indeed in the pit lane or in the garage, then we have to be able to protect ourselves from the fumes that come out. The occupants of the medical car have been face-fitted for these respirators."
Jonathan Webber

4 OXYGEN

"There is oxygen, which is fairly standard medical car equipment. There is also a cylinder with a standard mask and high-flow oxygen and with this you can treat anybody with breathing difficulties."
Jonathan Webber

5 THE 'HOOK'

"The idea of the hook is that if you touch a car that is electrically live, because it is direct current, then muscular contraction occurs meaning you end up almost being glued to the car and you can't release. If somebody tries to touch you or pull you away then they will also get electrocuted. So the insulated hook is designed to give you a reach so there will be no transfer of the electricity moving down. The small portable one is carried in the medical car and there are much longer hooks available in the other rescue resources."

Dr Gareth Davies

6 MATS

"The electrical mats are of the minimum of class zero-electrical conductivity, there's a drape mat that goes over the top of the car covering the monocoque and driver's shroud area. There are two floor mats for the doctor, paramedic and rescue staff to stand on so that the car and the floor are insulated in order that there isn't any electrical contact. It's quite basic but it's very critical in terms of such an unusual and potentially catastrophic situation."

Jonathan Webber

7 DRUGS

"In here again is a pretty comprehensive selection of medications, so quite an array of different drugs that are anaesthetic agents. Some of these drugs help stimulate the heart beat and control your heart rate, some of them are for anti-sickness, some of them are for sedation - and these ones are also to support circulation so it's quite a comprehensive selection."

Dr Gareth Davies

8 INTUBATION KIT

"In this particular pack we have just about everything that you have in an emergency department in a hospital so it allows us to address problems with breathing and you can be intubated."

"This particular pack is used if the patient has got a serious head injury. We use the equipment in here, plus some drugs, to anaesthetise the patient and we can pass a tube down into the lungs, and then using this device we can take over the breathing of the patient. That's connected to oxygen so we can make sure the patient is breathing properly."

Dr Gareth Davies

9 BANDAGES

"Here we've got bandages. These are the same sort of bandages that the military use that are impregnated with special chemicals to make the blood clot to put around a limb if there is major haemorrhage from a blood vessel that has been torn."

Dr Gareth Davies

10 WATERJEL PACKS

"One of the major issues we have to be careful of is the small battery, the 12v that sits underneath the driver seat. At a couple of races we've been too, that 12v battery has become a problem and could short circuit or explode, so we have to be able to deal with the potential for burns very quickly. In the medical car we carry a water gel critical-burn kit, which enables us to quickly smother the injured person in water gel material, which is a special material that aids cooling, but also is recommended to help with burn injuries. That's kept in the medical car and all of the medical units and ambulances around the circuit."

Dr Gareth Davies



THE ROAD BACK:

ANDREAS MIKKELSEN

World Rally Championship star Andreas Mikkelsen looks back at his accident during the 2012 Intercontinental Rally Challenge's Circuit of Ireland Rally and gives his thoughts on concussion and safety.

Following a heavy front-on collision during the 2012 Circuit of Ireland Rally, Norway's Andreas Mikkelsen found he was able to continue the event, eventually finishing second. It was not until afterwards that he realised he did not remember any of the stages following the accident and was later diagnosed with concussion, spending the night in hospital. He spoke to AUTO+ Medical about his experience and his thoughts on rally safety.

Question: What do you remember about the accident?

Andreas Mikkelsen: I don't remember too much, I remember starting the stage and losing control of the car because it started to rain. I remember the impact after that, that's all. The next thing I recall was being at the stage finish. Basically I was knocked out for like 15 seconds and then the stage finished.

Q: Did you have medical attention after you were knocked out?

AM: Well no, not really. Because we had to get to the next stage and at that time it was so important for me to get points from that rally so I was just trying to focus on finishing and I had two or three stages to go. After that crash I finished that stage, but I didn't know exactly which country I was in! I knew I was in a rally because I was sitting in a rally car, but I was sitting there wondering where I was.

Q: But you managed to finish the stage without any further incident?

AM: Yeah, we finished that stage and I also finished the next two stages and we finished the rally. Of course I went to the hospital after that but I just tried to finish the rally. I was knocked out for a little bit, but I felt fine and just suffered the memory loss.

Q: At the time you didn't realise that this was a concussion?

AM: Well of course I had hit my head, I didn't feel 100 per cent but I felt well enough just to finish the rally, take it carefully and seek medical help after that.

Q: So what do you remember of the post-race events?

AM: At first we went to the finish ramp and then I went to the prize-giving, and because I felt my eardrums weren't right, my hearing was really strange, I went to the hospital after the prize-giving and stayed there overnight. They kept me in for observation and they took some scans and all that, nothing was really wrong, just a normal concussion.

Q: Looking back on it now, if there had been a doctor examining you straight after the incident, do you think you should have been allowed to carry on?

AM: Probably not. I mean it is hard to say





when you are not qualified, when you are just driving a car in a stage and I mean crashes happen so often in a rally. So it's really hard to control but for me I didn't even tell my co-driver that I didn't know which country I was in, because if I told him then I probably would have had to stop and it was really important for me to get those points. It is probably not really correct what I did, but yeah, that's the way I chose to be. But looking back now, doing the rest of the rally in not 100 per cent condition is probably not the correct choice.

Q: What advice would you give to other drivers who have suffered a suspected concussion during a race or rally?

AM: Luckily in my case there was nothing really wrong, except for the loss of memory and the fact that there is concussion, but you know I waited a long time to check it out. I finished and went through all the usual post-

rally procedures and then decided to check it out just to be sure. It is definitely better be safe than sorry, so I should not have waited so long to check it out.

Q: So have you suffered any other concussions since that accident?

AM: No, I have stayed out of trouble after that. I have had accidents but nothing where I have been knocked out or feel really dizzy afterwards.

Q: Did that crash change the way you think or your approach?

AM: Not really, I think that we're in really safe cars and you see also the accidents we have now, like I have just had in Finland [Mikkelsen's event ended early when he rolled his Volkswagen after taking a bend too quickly]. You see what the cars look like and yet we're just walking around. We've come a long way

safety wise. Of course it'll never be perfect but it is hard to make the sport 100 per cent safe and I don't think that is really possible. With my concussion, I remember talking to the rally radio after just finishing that stage and they could clearly see I was out of it because I was strange in that interview, I didn't really know what was going on. Maybe in future we should have a doctor at each stage end, maybe that can solve things a bit? As a young rally driver you want to compete no matter what, so maybe it is best that you do not make the decision. With my accident I was fighting for first position, and after that stage I remember my co-driver saying that 'it is over now because we have lost 40 seconds' and I was a little bit angry with him as I couldn't understand why he said that we have lost time because I didn't remember I had crashed! I said 'what are you talking about', I just couldn't remember.

Q: How do you and your fellow drivers feel about the current levels of safety in rallying?

AM: It's different from rally to rally I have to say. In some rallies it is much better than in others, but the real safety issue, which I believe all the drivers think, is that we are coming into certain rallies like Poland where if you make one slight mistake you hit a lot of people. So we need to make sure they are standing in the secure areas and to control the spectators in the correct way. That is where rallying needs to improve. There was a moment when I went off in Poland, I went off the road and I almost hit three spectators. I drove over some chairs and luckily people were not in them, so that was a really close one. Basically I'm not too worried about our safety but all the spectators and how they are controlled, this needs to be looked at even more.

SCIENCE

CONCUSSION IN MOTOR SPORT

The diagnosis and treatment of concussions are issues that have been widely debated throughout the sporting world. Dr Peter Hutchinson and Dr Steve Olvey explore the subject in relation to motor sport.

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BACKGROUND

One of the most challenging aspects of medicine in motor sport is the evaluation of drivers with suspected concussion and mild traumatic brain injury.

This applies both to establishing the initial diagnosis and decision-making in terms of return to both practice and competitive driving.

Definitions of concussion vary and include mechanistic, pathophysiological and clinical criteria. The classical definition of concussion is a “traumatically induced, usually transient, disturbance of brain function that involves complex pathophysiological processes.” Such processes are thought to include derangements in the metabolism of neurotransmitters.

In practice, patients with concussion experience a period of confusion, headache, nausea or vomiting, or visual disturbance of variable duration. Loss of consciousness is not required for a diagnosis of concussion, and concussion can be sustained with no period of retrograde or post-traumatic amnesia.

In pathophysiological terms, there is a continuum of diffuse brain injury, which extends from the mild end of the spectrum, of which concussion is a subset, to more severe diffuse injuries. Rotational forces leading to transient distortion of intracerebral tissues seem an important element of the injury mechanism that explains why concussion may occur with rotational injuries even where there is no impact to the head. Imaging is usually normal in patients with concussion.

In terms of prognosis, symptoms resolve in 80% of patients in 7-10 days.

MANAGEMENT

OVERVIEW OF MANAGEMENT

The first stage in the management of patients with concussion is to establish the diagnosis from the history, examination findings and the potential application of assessment tests. The second stage is to remove the participant from the action and monitor for deterioration. Referral to an emergency

“ ONE OF THE MOST CHALLENGING ASPECTS OF MEDICINE IN MOTOR SPORT IS THE EVALUATION OF DRIVERS WITH SUSPECTED CONCUSSION AND MILD TRAUMATIC BRAIN INJURY.”

department may be required and imaging performed as indicated from guidelines e.g. the UK NICE head injury guidelines (1). In terms of acute imaging, CT is the investigation of choice but with MRI being increasingly applied, including classic structural MRI and newer sequencing techniques such as diffusion MR and spectroscopy. In patients with a mild head injury and a normal CT scan, 25% have an abnormal MRI scan. The third stage is the decision to return to participation.

HISTORY

The history should include past medical history including previous history of head injury and neurological symptoms. The circumstances of the impact should be explored: whether there was a precipitating



medical event; whether there is retrograde and / or post-traumatic amnesia; whether there was loss of consciousness; and initial and on-going symptoms. Relevant symptoms include headache, nausea, vomiting, dizziness, visual disturbance, speech disturbance, hearing disturbance, memory and concentration impairment.

EXAMINATION FINDINGS

Examination findings should include standard and neurological observations (including pulse, blood pressure, pupil reactivity), assessment of the three parts of the Glasgow Coma Score and a neurological examination of both the cranial nerves and peripheral nervous system. The scalp and face should be examined for bruising and swelling. The

helmet should also be examined for signs of impact damage. Examination of the cervical spine should also be performed in patients with a suspected head injury.

ASSESSMENT TOOLS

Several tools are available for the sideline assessment of sports concussion, each with its own sensitivity and specificity. The time to administer these tests is of importance which varies from less than one to 10 minutes, rendering many impractical for on-field or track use. They may aid decision making but overall the clinical experience of the healthcare professional remains paramount.

The ImpACT test (2) is regarded as the gold standard for rapid neuro-psychiatric testing. It has a long period of administration (40

minutes) and requires a certified examiner, but has the advantage of no learning, normalisation to baseline indicative of healing, and is repeatable. The King-Devik test and SCAT tests 2 and 3 have the advantage of rapid administration, are sensitive without requiring a baseline and can be administered by a non-certified examiner.

SCAT3 (3) assesses the Glasgow Coma Score, orientation, patient reported concussive symptoms (including headaches, dizziness, visual disturbance, slowed thought processes), cognition, a rudimentary neck examination and balance and coordination.

Given the advantages and disadvantages of these tests, a combination of testing is one option using ImPACT for baseline testing and to signal recovery and return to competition, and the SCAT3 or King-Devik for initial diagnosis and removal from competition.

Overall neurocognitive testing, whether by paper or automated test protocols, has been shown to be more valid, effective, and reliable than imaging for diagnosing and managing most concussed sportspeople.

However, consideration needs to be given to the practicalities of introducing these tests across all types of motor sport in terms of high level professional driving compared to amateur competition.

SUSPICION OF MORE SEVERE INJURY

If more severe injury is suspected, the patient should be referred to an emergency department for further assessment and imaging. Indicators of more severe injury are GCS <14 immediately, GCS <15 by two hours after injury, deteriorating mental state, potential spinal injury and neurological signs on examination.

INDICATION FOR CT SCAN

Guidance for the indications for CT scanning is available from the UK NICE head injury guidelines. For adults who have sustained a head injury and have any of the risk factors, a CT head scan should be performed within one hour of the risk factor being identified (table 1).

ON-GOING MANAGEMENT

On-going management of concussion requires firstly early recognition of the condition, secondly rest until cerebral recovery and thirdly graduated return to cognitive and physical activity. While formalised protocols exist, a personalised approach is needed, based on the participant, the level of performance, and the rules and practicalities of the sport.

If symptoms such as excessive tiredness or

“ PATIENTS WITH SYMPTOMS LASTING MORE THAN ONE-THREE WEEKS SHOULD BE REFERRED TO SPECIALIST SERVICES FOR CLINICAL ASSESSMENT ”

headache return on increasing exertion, then extension of the period of rest and reduction in level of activity are recommended. Participants, managers, and family members need to know that important symptoms can be present even when the patient seems “normal.”

Patients with symptoms lasting more than one-three weeks should be referred to specialist services for clinical assessment and, if needed, formal neuropsychological input and consideration for more advanced imaging (MRI scan).

The long-term prognosis for concussion is generally good, with most patients recovering completely given time. However, certain patients may develop the post-concussion syndrome of persistent symptoms that can last weeks or months but even this is self-limiting in most patients. The post-concussion syndrome is often associated with minor head injuries and comprises a number of symptoms including physical (headache,

TABLE 1

| | |
|--|--|
| INDICATIONS FOR CT SCANNING TO BE PERFORMED WITHIN ONE HOUR OF THE RISK FACTOR BEING IDENTIFIED (4) | GCS less than 13 on initial assessment in the emergency department |
| | GCS less than 15 at 2 hours after the injury on assessment in the emergency department |
| | Suspected open or depressed skull fracture |
| | Any sign of basal skull fracture (haemotympanum, ‘panda’ eyes, cerebrospinal fluid leakage from the ear or nose, Battle’s sign). |
| | Post-traumatic seizure |
| | Focal neurological deficit |
| | More than one episode of vomiting |



Driver's helmets should be examined for signs of impact damage



blurring of vision, dizziness, tinnitus, poor balance and fatigue), psychological (impairment of memory, concentration and executive function), psychiatric (frustration, anxiety and depression) and social (job loss, divorce). Treatment is generally supportive and includes medication, e.g. analgesics for headache (of variable efficacy) and antidepressants, and therapy, e.g. cognitive behavioral therapy.

Patients with ongoing symptoms including fatigue and depression should also be assessed for pituitary dysfunction. Our own series show at 6 months, 12% incidence of

“THE SECOND IMPACT SYNDROME IS A RARE BUT VERY SERIOUS CONDITION THAT CAN OCCUR FOLLOWING A SECOND TRAUMATIC BRAIN INJURY.”

TABLE 2 GRADUATED RETURN TO PLAY PROTOCOL

| REHABILITATION STAGE | FUNCTIONAL EXERCISE AT EACH STAGE OF REHABILITATION | OBJECTIVE OF EACH STAGE |
|--------------------------------------|---|---|
| 1 NO ACTIVITY | Symptom limited physical and cognitive rest | Recovery |
| 2 LIGHT AEROBIC EXERCISE | Walking, swimming or stationary cycling keeping intensity <70% maximum permitted heart rate No resistance training | Increase HR |
| 3 SPORT-SPECIFIC EXERCISE | Skating drills in ice hockey, running drills in soccer. No head impact activities | Add movement |
| 4 NON-CONTACT TRAINING DRILLS | Progression to more complex training drills, eg, passing drills in football and ice hockey May start progressive resistance training | Exercise, coordination and cognitive load |
| 5 FULL-CONTACT PRACTICE | Following medical clearance participate in normal training activities | Restore confidence and assess functional skills by coaching staff |
| 6 RETURN TO PLAY | Normal game play | |

anterior pituitary dysfunction in symptomatic patients attending a neurotrauma clinic. Hypogonadic hypopituitarism is most frequent finding.

Also for patients with ongoing symptoms, Headway (5), the brain injury association, provides excellent practical advice for recovery after brain injury.

RETURN TO “PLAY”

The decision to return to sport, including competitive motor sport, is often difficult. The over-riding factor is clinical recovery but for more severe injuries with CT scan abnormalities, the risk of post-traumatic seizure also needs to be considered. Motor sport differs from other sports, notably pitch sports, where return to play may be possible after assessment. Australian rules and rugby allow rolling substitutions to enable players to be assessed pitch-side.

It is essential that people with symptoms and signs of concussion should not continue or return to sport until the symptoms resolve. Early return to play with symptoms and

slowed protective reactions risks further injury and exacerbation of concussive symptoms.

Specific to motor sport is whether to return the same day at the same meeting, or the next meeting. Drivers who are diagnosed with concussion should absolutely not return to driving the same day nor during the same race meeting. Drivers should also not drive themselves home on the public roads after a concussion sustained during a race.

Guidance exists in terms of return to play from the International Conference on Concussion in Sport (6) which was initially aimed at pitch sports but can be sensibly applied to motor sport (table 2). This advises a stepwise progression. The competitor should continue to proceed to the next level if asymptomatic at the current level. Generally, each step should take 24 hours so that a competitor would take approximately one week to proceed through the full rehabilitation protocol once they are asymptomatic at rest and with provocative exercise. If any post concussion symptoms



occur while in the stepwise program then they should drop back to the previous asymptomatic level and try to progress again after a further 24 hour period of rest passes.

For patients with more severe injury (particular in the presence of CT abnormality) the risk of seizure needs to be considered and should be less than 2% per annum to be considered fit to return to competition, this is the baseline rate of seizure risk in the general population. Head injury is a risk factor for seizures and TBI is a prevalent cause of acquired epilepsy in the general population, particularly amongst young adults. Post-traumatic seizures have profound implications for patients' quality of life and socioeconomic status, e.g. driving, employment, and can onset suddenly several years after a latent period without seizures. Population studies can assist in determining the risk of seizure and decision making but cannot be absolute in determining the risk for

an individual, and expert opinion is recommended.

SECOND IMPACT SYNDROME

The second impact syndrome is a rare but very serious condition that can occur following a second traumatic brain injury. It is more common in children and young adults and characterised by aggressive brain swelling possibly of vascular origin. The second impact may be minor but is usually followed by rapid collapse (within a minute), intractable brain swelling and a mortality of 50%. Urgent treatment is required.

ASSESSMENT OF OUTCOME FOLLOWING TRAUMATIC BRAIN INJURY

There are various methods by which outcome may be assessed following the diagnosis of traumatic brain injury. These include the Glasgow Outcome Score, the Extended Glasgow Outcome Score, Quality of life

“THE PROBLEM OF ACCURATELY DIAGNOSING CONCUSSION AND SUBSEQUENT DECISION REPRESENTS A MAJOR ON-GOING CHALLENGE FOR MOTOR SPORT MEDICINE.”

questionnaires (SF-36, QOLIBRI) and more formal neuropsychological assessment.

CONCLUSION

The problem of accurately diagnosing concussion and subsequent decision represents a major on-going challenge for motor sport medicine. The key points in the management of competitors with concussion and mild traumatic brain injury are firstly to exclude severe intracranial injury, secondly to monitor recovery with appropriate return to play, and thirdly ensure that patients are counseled about the need for gradual

resumption of activity, with specialist assessment of persisting symptoms.

SUMMARY OF RECOMMENDATIONS

The diagnosis of concussion should be based on the history and examination findings.

Assessment tools are an adjunct. The SCAT or King-Devik tests may be applied to assist in the initial diagnosis and removal from competition. ImPACT may be applied for baseline testing and to signal recovery and return to competition.

Patients with a diagnosis of concussion should not compete again in the meeting.

A graduated return to driving should be implemented. This may require specialist assessment by a doctor experienced in the management of traumatic brain injury.

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+ SURVEY ON CONCUSSION

An important survey on concussion for motor sport medical professionals

“Many of you involved in motor sport have to deal with competitors who are involved in accidents, relying on your skills and experience in dealing with trauma to provide a high standard of care. More difficult for the majority of us is the driver with no physical injuries but exhibiting the symptoms of concussion.

“Not only challenging to diagnose trackside, we are also faced with the decision of should we allow a competitor to continue? Do they need to go to hospital? Do they need imaging?

“If we do send a competitor to hospital and they send them back to the track, what do we do then?

“Some of us have the benefit of being able to refer competitors with concussion to leading experts in this specialty in motor sport, but not all of us have an experienced motor sport expert in neurosurgery available to us.

“Professor Peter Hutchinson, along with Professor Steve Olvey, both leading experts in concussion and both with vast experience in motor Sport as well as being Chief Medical Officers have written the comprehensive review in this issue of AUTO+Medical on the subject which we think will be valuable to all of you involved in the sport.

“In an effort to find out more about how we all deal with concussion and get more information on the subject we have included a survey, which we urge you all to complete. This is entirely confidential and can be completed online.

[Click here to take the survey](#)

“We look forward to hearing any comments you may have.”

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Dr Pedro Esteban
(FIA Medical Delegate,
World Rallycross
Championship)

Dr Jean Duby
(FIA Medical Delegate,
World Rally
Championship)

Dr Kelvin Chew
(Chief Medical Officer,
Singapore GP)

Dr Jean-Charles Piette
(FIA Medical Delegate,
Formula One)