Chronic traumatic encephalopathy: Rugby’s call for clarity, data and leadership in the concussion debate

Jon S Patricios,1,2,3 Simon Kemp4

**AMERICAN FOOTBALL FIRST...**
After US District Judge Judy Brody recently ruled that the consolidated multidistrict concussion litigation cases against the National Football League (NFL) in the USA were to be transferred to a labour arbitrator, the NFL agreed to a $765 million settlement. More than 4000 current and ex-NFL players, the plaintiffs in this case, allege that the NFL has misrepresented the long-term health dangers associated with on-field head injuries.1 Either way, the debate about the potential long-term consequences of concussion will play out in the American media for a number of years to come, ensuring that the term chronic traumatic encephalopathy (CTE), a progressive neurodegenerative condition that is thought to occur as a consequence of repetitive mild traumatic brain injury, not only remains part of our clinical lexicon, but is also embedded in social media postings (‘#CTE’ on Twitter, ‘Heads Up! CTE’ on Facebook, 1740 YouTube videos, and 740 000 Google references)2–3 where the messaging today is simple and consistent: ‘contact sport damaged my brain and it didn’t have to happen’.

**... ICE HOCKEY FOLLOWS...**
Recently, the National Hockey League (NHL) has been sued by the family of a former NHL player in what has been described as ‘an explosive wrongful death lawsuit’ that allegedly resulted from a lethal combination of recurrent head injuries, in-game fighting, over-prescribed painkillers and CTE. American Football and Ice Hockey are not the only sports to be associated with CTE.4 Boxing was implicated in the very first medical descriptions of dementia pugilistica in prize-fighters in 1928,5 while in soccer, the possibility of significant brain injury as
a result of repeated heading of the ball has again been reopened in the context of the CTE debate.\textsuperscript{6}

\section*{WILL RUGBY UNION?}
Rugby Union (hereafter just ‘Rugby’) is a collision team sport played by men, women, boys and girls in more than 100 countries across five continents. The seven-a-side version of the game will return to the Olympic Games in Rio in 2016 and is anticipated to be the catalyst for a further expansion of the game around the world. The game’s origin is attributed to a young schoolboy at Rugby School in England who, while playing soccer “with fine disregard for the rules”, first took the ball in his arms and ran with it, thus originating the distinctive feature of the Rugby game.\textsuperscript{7, 8} While running with and passing the ball are key features of the game, the contest for possession which is embedded in the game’s charter\textsuperscript{9} is most clearly seen in the frequent contact events that characterise the modern game. Forceful tackling of the ball carrier by the tackler or tacklers, aiming to drive him/her backwards is an integral part of the game (http://www.sportsconcussion.co.za/sportconcussion/video-channel/#featured-yt-vids-page) with in excess of 200 tackles being seen each game. Although tackling that involves contact above the shoulders of the ball carrier is not allowed under the Laws of the Game, the head and brain are certainly not immune to trauma.\textsuperscript{9, 10} Inadvertent head-to-head impacts occur, as do head collisions with the ground and opposition feet, hips and knees, accounting for a large proportion of concussions seen in Rugby.

As sports medicine doctors who care for Rugby players from the age of six onwards through to international professional players, the exponential growth in CTE dialogue is both engrossing and concerning.

Rugby is a sport that consists of static and dynamic phases requiring strength, speed and guile in different measure according to position. The game encourages players of a range of sizes, shapes and skill levels to participate which few other sports can match. Its inherent physicality together with its core values of respect, self-discipline and fair play are key elements of the game’s attraction to players, coaches, spectators, broadcasters and sponsors. The health benefits of regular sports participation, when society is becoming increasingly sedentary, are seen as increasingly important in optimising health and wellness. Rugby has an excellent record in this regard.\textsuperscript{11}

In all the cases of CTE described so far, only two cases, who also participated in other contact sports, have been associated with Rugby.\textsuperscript{12, 13} Admittedly North America doesn’t have a strong Rugby base, but it surely is only a matter of time before a stronger association is claimed and the conclusion suggested that participating in non-helmeted, tackling sports may have an adverse long-lasting effect on the brain. Already there is ongoing discussion about the possible link between Rugby and Amyotrophic Lateral Sclerosis (ALS) in two retired South African international Rugby players.\textsuperscript{14, 15} Concern about risk of sports injury is known to be a key factor in the recruitment and retention of players into a sport with parental perceptions of risk an increasingly critical factor in age-group sport. It appears that the current CTE debate in North America has been picked up by parents with real concerns expressed about the effect on American Football and Ice Hockey participation.

\section*{RUGBY’S RECORD ON RISK MANAGEMENT}
Rugby has never shied away from addressing player safety issues including head injury and concussion. The sport has increasingly adopted a mature risk management approach where discussion of risk perception drawing on epidemiological evidence has driven appropriate risk mitigation initiatives.\textsuperscript{16} Communication throughout the process to the whole game is standard practice. The game’s approach to concussion risk management has followed these principles. The International Rugby Board (IRB) has been a sponsoring attendee at the last two concussion in Sport Consensus Meetings, adopting widely implemented international concussion consensus protocols at all levels of the game, and the IRB has a proven track record of implementing sport-specific national and local safety programmes.\textsuperscript{17} A unique ‘brain bin’ known as the Pitch side Suspected Concussion Assessment (PSCA) is beingtrialled around the world to facilitate the immediate evaluation of elite players suspected of having suffered a concussion during a match, and new age-specific concussion return-to-play guidelines are currently being drafted.

The typical risk management approach relies on an informed whole sport perception of risk driven by data. To date, Rugby has been able to base its risk management approach on appropriate data sets and in cases where these have needed enhancing, such as catastrophic cervical injury, Rugby has moved swiftly to ensure that data are collected.

Our concern is that, till date, the enormous public interest in CTE appears to have been escalated by its high social network visibility, increased public awareness and high-profile law suits, rather than sound science. We believe that this enhanced awareness may impact on participation rates in Rugby Union in spite of an absence of evidence of established risks. Indeed, if the risk is ultimately found to be acceptable, reduced participation rates may actually have an adverse effect on participants’ overall health. Equally, we recognise the need to robustly and honestly challenge ourselves as Rugby doctors, with questions pertaining specifically to our collision sport. This includes assessing the extent to which the clinical features attributed to CTE such as irritability, impulsivity, aggression, depression, short-term memory loss and heightened suicidality proposed to begin 8–10 years after experiencing repetitive mild traumatic brain injury are prevalent in retired Rugby players.\textsuperscript{17}

Do we have a sense that one of the legacies of over 100 years of Rugby is a cohort of neurologically compromised and psychologically affected retired players?

More specifically, since the introduction of professionalism in 1995 (and the accompanying increased playing schedule and intensity at all levels of the game), do we feel that the prevalence of symptoms associated with CTE and psychological conditions has increased?

Our experiences suggest that neither is true.

\section*{CLINICAL AND COMMERCIAL CONFOUNDERS TO CONSIDER}
The strong possibility that confounding variables that are recognised in (but are not unique to) the NHL and NFL playing populations and that might contribute to CTE risk should be acknowledged. These include vices associated with many professional sportsmen—the physical and psychological effects of performance-enhancing drugs and the misuse of social drugs including alcohol, as well as the psychological effects of retirement on once-prominent and well-rewarded sportsmen. The incidence and prevalence of CTE in the general and retired sporting population is still unknown, and our understanding that individual susceptibility is influenced by genetics, comorbidities, neuroplasticity and cognitive reserve is still evolving.\textsuperscript{18–20} There is convincing
evidence that previous concussion may increase susceptibility to future concussive injury,21 but a literature review looking at the long-term neurocognitive effects of a number of contact sports concluded that adverse long-term neurocognitive effects of concussive injury have been demonstrated empirically in professional boxers only.22

In the absence of sufficient current and historical game analysis, head and helmet impact force data comparing helmeted with non-helmeted sports, it is hard to know how or if acute and cumulative concussive injury in Rugby differs from that seen in the NFL and NHL and what, if any, are the clinical consequences of such differences.

EMPHASISING EPIDEMIOLOGY

When the term CTE was first coined in 2002 by Dr Bennet Omalu, an African pathologist working out of Pittsburgh, the initial reaction of the NFL was hostile. Perhaps they perceived that the ethos and possibly the commercial interests of the game were being threatened. Since then, Dr Omalu’s work and interaction (http://www.youtube.com/watch?v=pOKvhcB6wQ) with his medical colleagues as well as the publications from the Center for the Study of Traumatic Encephalopathy in Boston have refined the description of the histopathological features describing a predictable pattern of hyperphosphorylated tau protein deposition in the brain, and an associated accumulation of other abnormally aggregated proteins including TAR DNA-binding protein, t amyloid β protein and α-synuclein.18

Recent suggestions that advanced imaging techniques may reveal encephalopathic changes in the living brain may be the first steps towards a viable premorbid clinical and research tool.23 Far more ominous is the apparent tendency to be drawing clinical conclusions (and staking large law suits!) on postmortem histological evidence that cannot, by definition, infer causality or enable us to move past step one of van Mechelen’s widely cited and accepted injury sequence prevention and intervention model, namely identifying the extent of the problem.24

With respect to the long-term consequences of the head trauma in our sport, we believe that we are starting to experience a cultural shift away from a risk-based model to one where public opinion driven by media reports based on powerful but limited epidemiological data and understanding may be not only fuelling adverse behaviours and compensatory neurosis but also promoting symptoms and anxiety in previously asymptomatic athletes.

CALL TO CONSOLIDATE

Rugby cannot side step this issue; it has an obligation to provide clear leadership around the risk of participation in the sport. Our call is for a unified, considered, consistent and unemotive message from all stakeholders in collision sports to define our current understanding of the possible neurocognitive effects of our sports that addresses the following:

1. The extent to which sportsmen involved in principally helmeted collision sports may suffer structural changes in their brains that manifests later in life with neurological and psychological symptoms.
2. What the incidence or prevalence of this condition in the general population as well as specific sporting populations is.
3. What other medical and lifestyle factors contribute to the development of this condition.
4. How the risk of an individual developing this condition through participation in contact sports such as Rugby Union compares to other uncommon but highly adverse life events such as sudden cardiac death.
5. How can the adverse health effects of non-participation in sport be factored into any risk-based decision-making about participation?
6. To what extent can appropriate acute medical management of head injuries accompanied by suitable return-to-play guidelines decrease the chance of long-term sequelae?
7. How can we work to ensure that best-practice acute concussion management is actually being delivered through a coordinated effort from a number of groups? This must be a priority in sports injury management across collision sports.
8. How can we best counsel athletes suffering from recurrent concussions (three or more) or whose recovery from the acute episode becomes more prolonged so as to diminish the possibility of longer term effects?
9. How can we encourage sporting codes to urgently initiate validated consensus-based epidemiological surveys to help ascertain the incidence of neurocognitive and psychological disorders in retired sportsmen as compared with the general population, allowing comparison between sports?
10. How can we encourage athletes previously involved in collision sports to donate their brains after death for the benefit of research without bias?
11. How can we ensure that sports head injury policy should be reviewed regularly based on scientific progress?

As physicians and scientists, we need to reclaim clinical decision making from the realm of media-driven and often frenzied public opinion and help guide administrative decisions in sport for the immediate and long-term benefit of the athlete.

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