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# Clinics in neurology and neurosurgery of sport: traumatic cerebral contusion

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This case highlights the difficulties encountered in managing a sports player with traumatic brain injury. Fortunately, most head injuries in sport are minor and recover completely. Although the consensus definition<sup>1</sup> of sports concussion emphasizes the lack of structural brain injury, this is not the case with more severe injuries.

The presence of acute abnormalities (eg, contusion, haemorrhage) on CT or MRI scans in such patients inherently pushes the nature and consequences of the injury higher up the spectrum of traumatic brain injury and standard sports concussion management guidelines may no longer apply.

The case described is one of mild TBI and not simple concussion. However, many elements of the management are common to both conditions, and for the sake of simplicity, we will accept, as have the faculty, that this is a case of concussion with a cerebral contusion.

## CASE STUDIES: FRONTAL CONTUSION

### Patient 1

A 26 year-old professional ice hockey player was celebrating his team's victory at a local nightclub. He was hit over the head with a beer bottle and lost consciousness for 3 minutes. In the emergency department, he had neurologically fully recovered. His scalp laceration was sutured and a CT scan of the brain was performed, revealing a small frontal contusion. There was no associated skull fracture and the CT scan was otherwise unremarkable. He was advised to rest for 6 weeks and then underwent formal neurological and neuropsychological testing, which were normal. Repeat CT scan of the brain showed complete resolution of the contusion (fig 1). What recommendations do you make, based on the following considerations?

- (1) Can he return to ice hockey?
1. If so, when?
2. Are there any extra precautions you would take when he returns to competition?
3. If he sustains a future concussion, would you manage him differently?

### Patient 2

An athlete with a similar history presents 12 months after injury with an MRI scan of the brain showing encephalomalacia in the right frontal lobe at the site of injury (figure 2). Does the presence of encephalomalacia alter your responses to the questions above?

## EXPERT COMMENTARY (DRS GEORGE AND HAMEL)

### Patient 1

#### Can he return to ice hockey?

Yes. The patient is asymptomatic, and the results of his neurological testing, neuropsychological testing CT scan are all normal. According to the literature return to play guidelines and recommendations,<sup>1-3</sup> this athlete presents all of the criteria to allow a return to ice hockey.

#### If so, when?

Because the clinical, neuropsychological and imaging tests are normal after 6 weeks of physical rest, the "return to play protocol"<sup>1</sup> can be considered; it will be a complementary rehabilitation time and may be achieved in 1 week.

#### Are there any extra precautions you would take when he returns to competition?

The first precaution or advice for this player is to avoid head-checking, which seems a usual (but stupid) procedure in ice-hockey.<sup>1</sup> Then, the player may need psychological support if initially his level of performance is not as good as before.

#### If he sustains a future concussion, would you manage him differently?

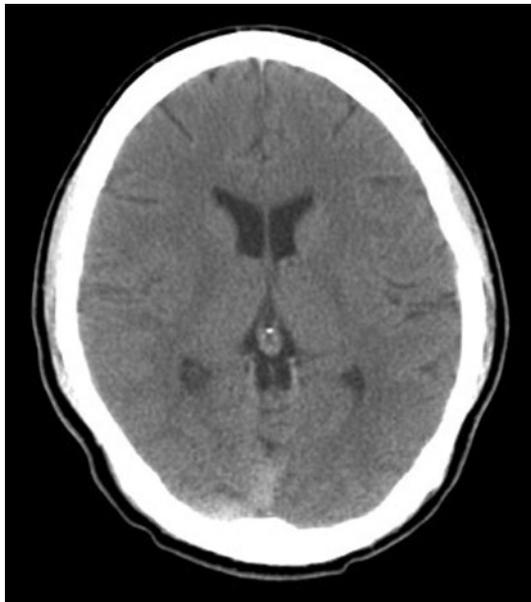
We consider that this patient has returned to normality, ie, without sequelae of the contusion. There is no reason to manage him differently from any other patient if he sustains a future concussion.

However, we must warn the patient of the risk of progressive neuropsychological dysfunction due to repeated concussions. The cumulative effect of repeated concussions is a matter of debate in the literature. Although short-term effects of two or three concussions are undetectable by neuropsychological testing,<sup>4,5</sup> the association between multiple concussions and late-life cognitive impairment is well known.<sup>6-8</sup> MRI is certainly the best method to identify small traumatic brain lesions leading to cognitive impairment. However there are no criteria (such as duration of playing in contact sports, number of concussions, severity of concussions) to define when MRI is advisable and which lesions raise the concern of late onset of encephalopathy.

### Patient 2

#### Does the presence of encephalomalacia alter your responses to the questions above?

We wonder why an MRI was performed 1 year after the injury. If it was carried out in association



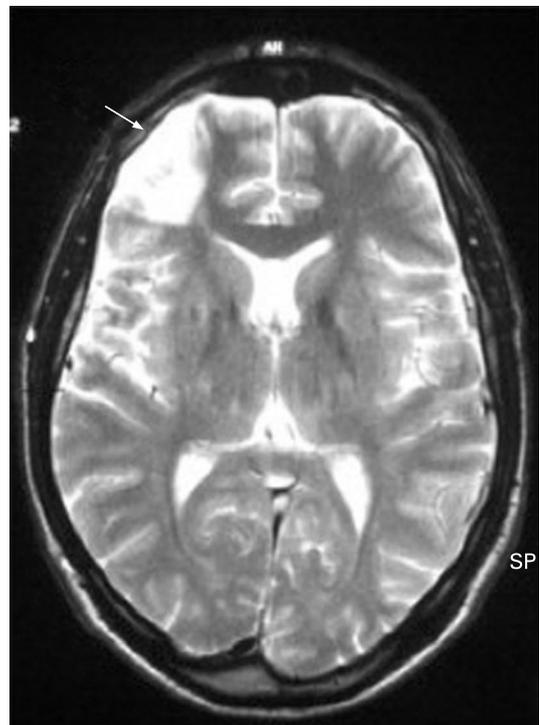
**Figure 1** Patient 1: repeat axial CT brain scan performed at 6 weeks after injury and reported as normal.

with clinical signs, especially cognitive dysfunction or seizure, we would not authorize the athlete to return to play. If all tests, including neuropsychological testing and postural testing, are normal, this brain lesion seen on MRI would not alter our responses regarding the first three questions. However, we might insist on assessing the individual risk of long-term neuropsychological impairment after repeated concussions. Therefore if this patient were to sustain a new concussion, we would recommend MRI scanning.

#### EXPERT COMMENTARY (DR DONALD MARION)

The concussion and cerebral contusion suffered by patient 1 has the following consequences: a lower threshold for seizures, which may occur spontaneously or after even mild head trauma, and prolonged neurological or cognitive deficits if he experiences more concussions. Prophylactic anticonvulsant therapy is not recommended because the side effects of anticonvulsant medications are a greater risk than is a spontaneous seizure. Multiple concussions, especially if they are sustained in a short period, are much more likely to cause prolonged or permanent neurological disability than a single concussion. At 2 days after injury, athletes with multiple previous concussions are 7.7 times more likely to have severe memory problems compared with athletes with no previous concussion.<sup>9</sup> Second impact syndrome is a rare but potentially lethal problem and has been implicated as the cause of sudden death in several high-school football players.

It is important to review these facts with the patient. Unfortunately, the question of who can safely return to play after a concussion has not been clearly resolved. Numerous protocols for evaluation of sports-related concussion have been developed and recommendations on return to play devised,<sup>10</sup> but an extensive search of the English-language literature reveals that there is only one truly evidence-based set of guidelines for mild TBI, and this does not contain any standards.<sup>11</sup> Despite this, several groups have devised concussion grading scales that can be used to evaluate the severity of a concussion and to develop guidelines for determining when an athlete should be allowed to return to play. The most widely adopted scales are



**Figure 2** Patient 2: axial T2-weighted MRI scan of the brain showing an area of high signal in right frontal region (white arrow) consistent with an area of post-traumatic encephalomalacia.

those developed by Kelly (Colorado Guidelines), Cantu and the American Academy of Neurology<sup>12-14</sup> (table 1).

Many athletic organizations at the high school, college and professional levels have also adopted neuropsychological testing as a means of objectively evaluating the cognitive and neuropsychological consequences of each concussion.<sup>15</sup> When compared with preseason scores, such tests can provide a powerful tool to determine who should return to play and who should retire from the sport. In 2004, the National Athletic Trainers' Association published a position statement that provides an excellent review of the contemporary diagnosis, treatment and return-to-play recommendations for athletes who have had a concussion.<sup>16</sup>

My practice would be to allow this player to return to ice hockey assuming I am convinced that he truly has normal neurological and cognitive abilities. I think that the 6-week period is sufficient time for him to have recovered and would allow him to return to play then. I would not recommend any specific precautions other than those recommended normally and I assume wearing a helmet is one of those usual precautions. If he were to sustain a future concussion he should be closely evaluated and I would abide by the recommendations as listed in the tables. The appearance of encephalomalacia on the MRI obtained at 1 year after injury would not change these recommendations.

#### EXPERT COMMENTARY (DR TURNER)

##### Patient 1

##### Can he return to ice hockey?

Yes. Once his symptoms and cognitive deficits have completely cleared at both rest and exercise he can return to sport by following a graduated exercise and training programme before resuming sport as recommended by the current Prague sports concussion guidelines.<sup>1</sup> This allows monitoring of any abnormal symptoms or signs that may only be provoked with exercise and

**Table 1** Definition of concussion grades I–III and recommendations for return to play based on these grades

Grade	Scale		
	Colorado <sup>12</sup>	Cantu <sup>13</sup>	American Academy of Neurology <sup>14</sup>
Definitions of grades			
I	Confusion, no LOC, PTA <30 minutes	PTA <30 minutes, no LOC	Transient confusion, symptoms <15 minutes, no LOC
II	LOC <5 minutes, confusion, PTA >30 minutes	LOC <5 minutes, PTA 30 minutes to 24 hr	No LOC, transient confusion, symptoms >15 minutes
III	LOC >5 minutes, PTA >24 hours	LOC >5 minutes, PTA >24 hours	Any LOC
Recommendations for return to play			
I	Return after 20 minutes if examination normal	Return the same day if normal at rest and exertion, and after 7 days if symptomatic	Return the same day if normal at rest and exertion
II	Return after 7 days if asymptomatic	Return after 2 weeks if asymptomatic at rest and exertion for 7 days	Return after 7 days if asymptomatic
III	Evaluation by neurologist or neurosurgeon, return after 2 weeks if asymptomatic and cleared by specialist	Return after 1 month if asymptomatic at rest and exertion for 7 days	Evaluation by neurologist or neurosurgeon; return after 2 weeks if neurologically cleared

LOC, loss of consciousness; PTA, post-traumatic amnesia.

must be medically supervised. There are a number of other anecdotal guidelines,<sup>12–14</sup> but I believe that the Prague guidelines are the most appropriate, given that they were developed by expert consensus.

#### If so, when?

When he is on a full training programme and free of symptoms as discussed above.

#### Are there any extra precautions you would take when he returns to competition?

Yes, ensure that he has a correctly fitted (and certified) hockey helmet with a full face mask.<sup>17 18</sup> I would also discuss with the coach and training staff about his tackling and body-checking technique to ensure he plays as safely as possible.

#### If he sustains a future concussion, would you manage him differently?

No., His postconcussion review would broadly follow the Prague guideline strategy and include repeat neuropsychological testing and an examination by a consultant neurologist. He would then follow the standard graduated exercise and training programme under medical supervision. I would repeat the CT scan before allowing him back onto the ice in competition.

#### Patient 2

##### Does the presence of encephalomalacia alter your responses to the questions above?

In principle it shouldn't change the management of the case but in practice it probably would, due to medicolegal and insurance concerns. These risks need to be discussed with the athlete concerned, his family, manager and team officials.

I would allow him to return to hockey assuming he is symptom-free, has been leading a normal sporting life in the past 12 months, and is not on any drugs or medications that potentially may be masking symptoms. He would need to have repeat neuropsychological testing and an examination by a consultant neurologist as part of the RTP strategy. The encephalomalacic area on his imaging would not change these recommendations nor would this make me alter his management if he sustained a further concussion.

#### EDITORIAL COMMENTARY

A cerebral contusion is a traumatic injury to the brain resulting in extravasation of red blood cells around small lacerated vessels in the neural parenchyma, or more simply put, are bruises of the brain.<sup>19</sup>

A cerebral contusion can demonstrate complete radiological resolution or a residual defect may remain, such as encephalomalacia. The significance of the contusion in this case is that, in addition to concussion management, the athlete is at an increased risk of seizures. Published studies suggest an approximately 5% risk of post-traumatic epilepsy in this setting.<sup>20 21</sup> Absolute risk of seizures in an individual athlete is impossible to quantify and therefore there are no evidence-based guidelines for return to sport specifically after a cerebral contusion.

The faculty has provided realistic responses to a common clinical scenario. For patient 1, all members of the faculty recommend returning to sport after 6 weeks, given that the player has shown normal neurological and cognitive abilities. For patient 2, a similar injury with demonstrated encephalomalacia, all members of the faculty agree that he may return to sport, but differ on management if this player with encephalomalacia sustains a future concussion. Dr Marion does not change his recommendation between patients 1 and 2, whereas Dr Turner will practise defensive medicine, advising annual neurological consultation and MRI, and Drs Hamel and George recommend repeating the MRI only if the player sustains future concussion. This difference of opinion highlights the difficulty faced on a daily basis by physicians treating sports concussion. The lack of evidence-based guidelines leaves the clinician to make a return to sport decision based on personal experience, anecdotal evidence or a "gut feeling" or to practise "defensive medicine".

It is worth emphasizing that current management of sports concussion has been the subject of recent international consensus meetings.<sup>1</sup> The Prague guidelines recommend that anecdotal injury severity grading systems (eg, AAN, Colorado) be abandoned in favour of individual recovery assessment. Furthermore, with regard to return to play, a key message from that Prague statement is that the athlete must return to normal at rest and after exercise, before he can return to sport. Return to normal includes the athlete being asymptomatic, with normal neurological examination and normal neuropsychological examination. A graded return to exercise is defined in the Prague statement as a stepwise symptom-limited programme. It should be stressed that this recommendation does not stipulate any defined time period before return to sport, but rather, that the time required will differ in each individual, based on the individual's clinical picture. Therefore, strict return to play guidelines that are popularized in many textbooks and journal publications should be abandoned in favour of an individualized stepwise programme.

**Competing interests:** None.

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