

Head Injury

Contributors

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Overview

Head and neck injuries are common sports-related injuries amongst elite athletes and the general population. Sports Related Concussion (SRC) is the most common of these and a growing global public health concern. The fifth Concussion Consensus Conference in Berlin (2016) defined SRC as 'a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces' (1). The pathophysiology of concussion is not completely understood but has been characterised as force delivered to the brain causing disruptive stretching of neuronal cell membranes and axons resulting in a complex cascade of ionic, metabolic and pathophysiological events (2).

Building a picture of the burden of disease is difficult with SRC due to wide varying definitions accepted in global clinical practice, the lack of consistent sports injury surveillance in many healthcare systems as well as concerns around under reporting in some sporting settings. A recent report combining data from Emergency Department visits, outpatient clinics and high school epidemiological surveillance systems estimated 1.0 - 1.8 million SRCs per year in the 0–18 years age range (3). UK data suggests that SRC incidence at UK Emergency Departments (ED) was comparatively lower at 0.6% of all ED attendances, compared to 2-4.6% in a US context (4).

Case Study

Jack is a 15-year-old male schoolboy rugby player. While making a last-ditch tackle in a rugby game, he fails to position his head correctly and his head makes contact with the opposition player's knee. He immediately falls to the ground with his hands raised above his head, but doesn't lose consciousness. On witnessing this, his coach (a trained first aider) recognises one of the more common observable signs of a concussion (tonic posturing) and removes him permanently from the game. He attends A&E later that evening with his mother where he is discharged with head injury advice. His local GP (who has an interest in Sports & Exercise Medicine) advises him to follow the standard Graduated Return to Play Protocol for an under 18 year old. Jack recovers fully and is fit to return to rugby at 23 days.

Pathophysiology

The pathophysiology of SRC is poorly understood, however dominant theories suggest that the force delivered to the brain causes disruptive stretching of neural axons and cell membranes, causing a cascade of complex metabolic, ionic and pathophysiological events (2). Initial research suggests that the resultant stress applied to nerve cells leads to shifts in intracellular ion concentrations, mitochondrial dysfunction and inappropriate release of neurotransmitters. This culminates in an increased glucose utilisation in neural cells, combined with a decrease in resting cerebral blood flow which creates a mismatch (2).

Aetiology

Theorised mechanisms are multifactorial and complex. The most recent Consensus Statement on Concussion (2016) defined one of the key clinical features as "SRC may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head" (1).

Clinical Features

The suspected diagnosis of SRC can include one or more of the following clinical domains:

1	Symptoms: somatic (e.g. headache), cognitive (e.g. feeling like in a fog) and/or emotional symptoms (e.g. lability) The most common observed symptom was headache (5).
2	Observable/ Physical signs: Loss of consciousness or responsiveness Lying motionless on ground / Slow to get up Tonic posturing Unsteady on feet /Balance problems or falling over / Incoordination Grabbing / Clutching of head Dazed Blank or vacant look Confused / Not aware of plays or events Balance impairment (e.g. gait unsteadiness) Note: Loss of consciousness is typically only observed in <10% of cases of SRC in rugby union players.
3	Behavioural changes (e.g. irritability)
4	Cognitive impairment (e.g. slowed reaction times)
5	Sleep/wake disturbance (e.g. somnolence, drowsiness)

Clinical Assessment

Thorough clinical history, neurological examination and utilisation of the SCAT5 tool are important elements of both the initial and subsequent assessments (6). Advanced neuroimaging, fluid biomarkers and genetic testing are important research tools, but require further validation to determine their ultimate clinical utility in evaluation of SRC.

Management Options

If one symptom or one observable signs in any one or more of the clinical domains are present, an SRC should be suspected and a ‘Recognise and Remove’ policy enforced (1,7).

In practice, basic management of SRC should be a holistic approach, incorporating basic first aid principles. The ‘Headcase’ approach for SRC management promoted by England Rugby suggests this process should include the basic principles below:

- Maintaining a safe approach
- Do not move the player until safe to do so
- Basic application of first aid such as management of airway breathing and circulation
- Assessment for spinal injury
- If a neck injury is suspected, keep headgear in place unless appropriately trained
- If the player is demonstrating any immediate danger signs, dial 999 and call an ambulance (8)

NB. SCAT5 is a standardised tool for evaluating concussions and is designed for use by clinicians, specifically for athletes ages 13 years and older. Children aged 12 years or younger should be evaluated using the Child SCAT5. For non-clinicians there is a Concussion Recognition Tool 5 (CRT5).

Primary management involves following a prescribed Graduated Return to Play Protocol, prescribed by a Sports Medicine Physician and individualised to the patient and to the sport.

Consensus guidelines for adult athletes endorse 24–48 hours of symptom-limited cognitive and physical rest followed by a gradual increase in activity, staying below symptom-exacerbation thresholds. Each stage of the GRTP Protocol must last at least 24 hours (1,9). Athletes younger than 18 years should have an extended GRTP compared to adults and a minimum of 48 hours between each activity stage is recommended. Therefore the minimum GRTP is 23 days (6).

Stage	Rehabilitation stage	Exercise allowed	Objective
1	Minimum rest period	Complete body and brain rest without symptoms	Recovery
2a	Symptom limited activity	If symptoms are still present at 24 hours, then players are advised to move from the initial period of rest, to stage 2a of performing symptom limited activities such as going for a walk. A player should remain at 2a until they are completely symptom free. Whilst aiming to return to all normal activities (other than sport), they should keep all activities to below a level that makes their symptoms worse.	Recovery
2b	Light aerobic exercise	Light jogging for 10-15 minutes, swimming or stationary cycling at low to moderate intensity. No resistance training. Symptom-free during full 24-hour period	Increase heart rate
3	Sport-specific exercise	Running drills. No head impact activities	Add movement
4	Non-contact/contested training drills	Progression to more complex training drills, e.g. passing drills. May start progressive resistance training	Exercise, coordination, and cognitive load
5	Full contact/contested practice	Normal training activities	Restore confidence and assess functional skills by coaching staff
6	Return to play	Player rehabilitated	Fully recovered

NB. This is a generic example of GRTP for contact sports but may need modification to take account of the athlete’s routine activities (e.g. in gymnastics may not need the full contact practice and would need further adaption).

Athletes may need specialist input to their GRTP protocol if:

- Second concussion within a 12-month period
- History of multiple concussions (>3)
- Unusual presentations (e.g. associated migraines or prominent balance issues)
- Recovery that takes longer than 10 days

Athletes who return to sport prior to full recovery are at increased risk of repeat concussion (10). Some research has demonstrated that athletes who return to sport after SRC following standard return to sport protocols had an increased rate of musculoskeletal injury (3). Cases of documented ‘Second Impact Syndrome’ in the literature are both rare and controversial. It is considered by some to be a potentially life-threatening complication of reinjury during the initial postinjury time period that is not fully understood and appears primarily limited to paediatric and adolescent athletes (11).

Prevention

While it is impossible to eliminate all concussion in sport, concussion-prevention strategies can reduce the number and severity of concussions in many sports.

Structured education programmes with athletes that promote recognition of symptoms, optimal technique and return to play protocols have been shown to have a positive effect. Policy change and law adaption trials are currently ongoing to seek to reduce overall injury burden, though results have to date have been mixed (12). More research is needed to assess which laws amendments may best mitigate the risk of SRC and protect the overall health of athletes across the sporting world.

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