Nat. Volatiles & Essent. Oils, 2021; 8(5): 12695-12702

A review of Brain oscillations associated with cognition and psychiatric disorders

Waleed Hassan Almalki[1], Amer Abdulrahman K Shalwala[2], Nouf Eid Nahi Alotibi[3], Salaman Abdullah Mohammed Alharthi[4], Ahmed Alshehri[5]

[1]Department of Pharmacology and Toxicology, College of Pharmacy, Umm Al-Qura University, Makkah, Saudi Arabia

[2]Maternity and Children Hospital, Pharmacy Department, TPN and Intravenous Preparation Unit, Ministry of Health, Makkah Saudi Arabia

[3]Ministry of Interior, Medical Services Department, Jeddah, Saudi Arabia

[4]King Abdul-Aziz Specialist Hospital, Pharmaceutical CARE Department, Ministry of Health, Taif, Saudi Arabia

[5]Department of Pharmacology & Toxicology, Faculty of Pharmacy, Northern Border University, Rafha, Saudi Arabia

Corresponding author: Waleed Hassan almalki. **Email id:** Whmalki@uqu.edu.sa

Abstract

Objective: The purpose of this study is to describe the causes, consequences, and dangers of concussion in sports.

Background: Concussion is a sports-related ailment that is most often linked with boxing, football, ice hockey, and martial arts. Additionally, new evidence indicates that concussions occur in a variety of sports. Concussion became a major topic of debate among the media, sports sponsors, sports medical experts, and players throughout the 1990s.

Description: Concussion is a kind of injury that may occur via a number of causes and has many signs and symptoms with other types of damage. A solid corpus of research from a variety of diverse fields is necessary for continued advances in congestion prevention and treatment approaches. It is important to focus research efforts both on prevention and management and to work closely on common goals for academics and clinicians.

Conclusions/Suggestions: The clinician is exclusively responsible for the wounded player's care until the scientific community is ready to make robust guidelines for the prevention and treatment of concussions. The improvements in the knowledge of concussions and how to manage athletes suffering from clogging separately are essential for sport medical practitioners.

Key Words: injury prevention, mild traumatic, head injury, brain injury,

1. Introduction

No other subject in sports has garnered as much interest and coverage as the diagnosis, treatment, and long-term consequences of traumatic brain concussion. Concussion is the most frequent kind. It is derived from the Latin word 'concutere,' which meaning to forcefully shake, resulting from severe brain damage (TBI). Light traumatic brain injury (mTBI), mild head injury, and minor head damage. All of these terms are interchangeable with concussion. A concussion is described as a temporary impairment of neurological function after a stressful event. It is a complicated pathophysiological process that is expected to affect about 1.7 million players in all types of sports in the United States of America each year [1, 2].

Athletes engage in a broad range of young, high school, college, professional, and recreational sports in today's competitive sports climate. While certain sports (for example, football) have maintained a steady level of participation, others have seen an increase in involvement. For younger players, sport offers an environment for physical, mental, and social development. Sports provide a chance for personal achievement and potential career for collegiate and professional players. Recreational athletes benefit from athletics as a means of maintaining a healthy lifestyle and alleviating the stresses of contemporary life. As sports programmes continue to grow in popularity, it is the sponsors' duty to provide an atmosphere that reduces the danger of harm [3-5].

Injuries may occur when you participate in sports. This danger arises as a consequence of the game's structure and the players' individual behaviours, both during and outside of their involvement. Acute traumatic injuries are more common in contact sports like football and ice hockey than in swimming and track and field. Due to the sport's emphasis on the head, boxing has a higher rate of head injuries than other sports. There is a distinct pattern of injury and particular kinds of injury in each sport. Concussions are a kind of injury that may occur when taking part in any sport or physical activity. This is the most frequent kind of acute brain injury seen in sports, with boxing, football, ice hockey, and martial arts being the most common. The incidence and severity of concussions in sports are affected by the game's characteristics, most notably the laws and regulations, the players' specialised physical activity, and the game's ambient circumstances, as is the case with other kinds of damage [6-8] (Figure1).

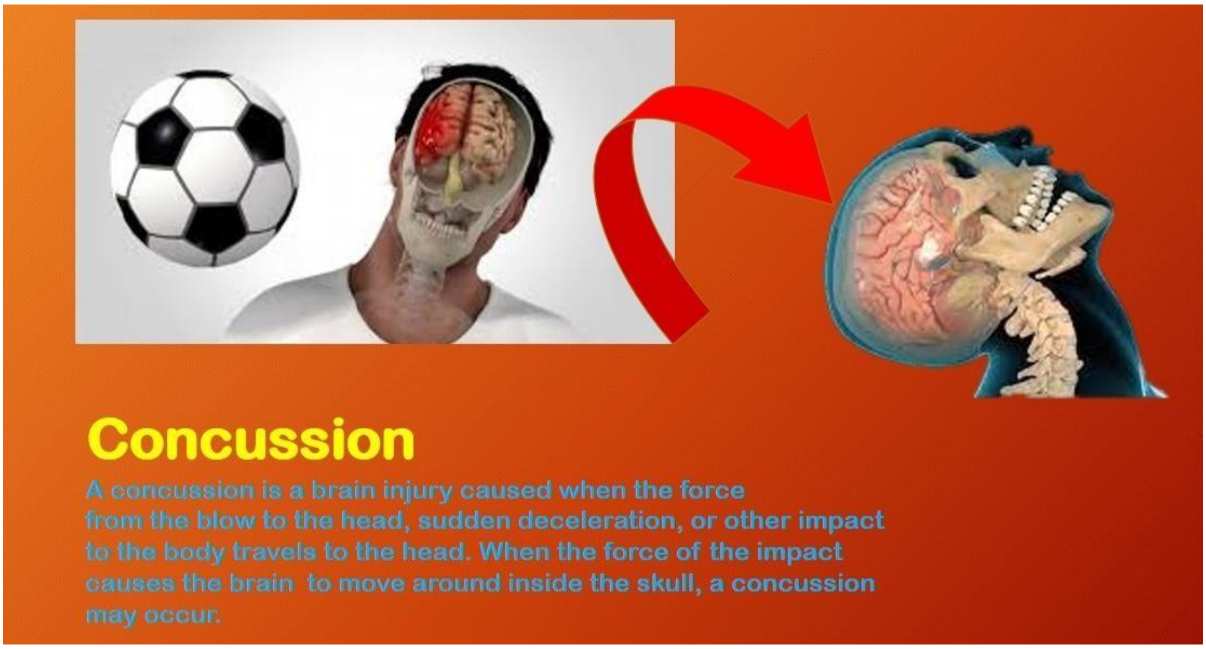

Figure 1: Concussion

2. Historical Perspective

Concussion has been characterised in a number of ways, focusing largely on the nature of the signs and symptoms present when the damage is present. The concussion is an instant and transient impaired neural function, like changed consciousness, visual or balanced problems and other indications and signals of interaction with brain stem. Concussion is a clinical disorder. The well-known "ding" sound associated with sports head injuries is included in this technique. Some authors say that a short or protracted loss of consciousness must be followed by cussion. A "mental change caused by trauma which may or may not lead to loss of consciousness" is called a "consciousness" [9]. When questioned, boxing, football, and ice hockey would most likely be associated with the general population and would not see the injury as an important matter for other sports. This notion is most likely because to the status of boxers, football and ice hockey [10]. Concussions occur in all sports, but at variable rates, according to current understanding of specialists in sport medicine. Competitive sports have traditionally been characterised by concussion. Gerberich et alresearch, from 1978 to 1982, was one of the earliest well-known studies in secondary football. There have been shocks that account for 20% of reported secondary school football wounds, and the history of commotion that led to loss of consciousness has been recorded for 14% of secondary soccer players investigated. The frequency of high school football, according to some writers, is 200 000 concussions per year. It is important to examine the time range for collecting the data for this paper [11]. In the early 1970s the main focus was blocking and tackling, with the head and face mask being the initial contact points.

The hazards associated with this approach were noted, and a first contact point for 1976 was banned by the Football rules committee of the Federation of State High-School Associations. A quantum leap forward of Rimel et al. and Barth et al. research in the early 1980s took place in the realm of concussion. In their investigation, the cognitive effects of the damage were found. There has been a lot of disagreement among neuroscientists over the subsequent decade on how to diagnose, categorise and treat congestion and the rules on return to sports following a congestion. Regardless of the sport, the relevance of commotion was recognised as medical specialists got a better knowledge of the natural history of the injury [12-14].

In 1994, the National Athletic Trainers' Association (NATA) Foundation for Research and Education sponsored the inaugural Mild Brain Injury Summit. The programmes were attended by professionals in neurosurgery, neuropsychology, neurology and sport medicine. The purpose of this study was to evaluate the existing data on the risk of sports congestion. The panellists discussed the idea of concussion and the multitude of programmes, as well as the present state of research and future research proposals, aimed at treating and managing concussions [15].

Many books, workshops and symposia have been the subject of Concussion in the last few years. The focus of the debate was on how the grading and management systems identified throughout the 1980s and beginning of the 1990s could be improved. Concussion diagnosis is one of medical or paramedical experts' most hard duties. The greatest challenge in terms of diagnosis is the wide array of possible indications and symptoms. For example, headache, dizziness, nausea or memory loss may suggest a commotion or other damage. The damage may lead or loss of awareness to temporary or permanent unconsciousness [16, 17].

3. Research Issues

As concussions became the 1990s"sports injury "problem," many researchers started concussion-related studies. As a result of the previous studies' results, it became clear that a number of alternative techniques for detecting concussions exist. According to some doctors, a concussion results in a loss of consciousness. Others classified an injury as a concussion only if memory difficulties occurred as a result of the damage. Still some doctors classified a relatively small head hit, often referred to as a "ding," as a concussion. The ambiguity around the concept caused complications for multicenter research projects. To ensure the uniformity of data from disparate sources, researchers' projects started to use the term mild traumatic brain injury (MTBI) interchangeably with concussion [18].

An injury that satisfies certain criteria for the existence of signs and symptoms and is therefore reportable for the study project is referred to as an MTBI. In general, the MTBI method to injury detection includes all of the previously mentioned concussion characteristics. Researchers and doctors may create a shared reference point for injury by defining an operational definition of a reportable MTBI [19].

4. Epidemiology Of Concussion

Concussion risk is linked to the amount of contact chances in a range of sports. Head-to-head collisions are frequent in football, for example. Many players on the field suffer a hit to the head on a regular basis. Other sports, such as ice hockey, anticipate head collisions but do not need them. Although falls on the court or collisions with barriers are possible in tennis and swimming, there is minimal risk of colliding. Collisions in a certain sport are characterised by the probability of clashing within that activity's environment. Collisions that happen during practise or a game are linked to a higher risk of concussion. To assess the risk of harm, you must first determine the probability of damage occurring. The number of times a player's head is struck during involvement is linked to the risk of concussion [20, 21]. These effects may be unintentional (accidental) and arise as a consequence of the game's design, or they could be intentional (eg, fighting). Game-related items such as sticks, surfaces, boundary barriers, or game operations equipment may cause head impacts. Collisions may be widespread and accepted as a natural element of the game, as in football, or they can be rare, as in tennis. The key thing to remember is that concussions may happen in any activity, regardless of its nature, and that they can have a long-term impact on the player. Given that high school football has the highest participation rate and is often linked to concussions, a count of head hits would assist put the risk of damage into context [22].

5. Pathophysiology

When neurological alterations occur as a result of head trauma, a number of neurochemical changes happen over hours as shown in animal studies. The release of excitatory, mainly glutamate, neurotransmitters that bind to N-methyl-D-aspartate receptors releases the extracellular space into the potassium and then causes an inflow of calcium into the cell. A brief hypermetabolic glycolytic state arises as membrane pumps try to restore equilibrium. It produces lactate that impairs neuronal function and decreases blood flow and glucose [23]. Calcium stays in mitochondria and can cause axonal damage. While the healing time generally is 7 to 10 days, the changed state of metabolism and decreased blood flow might take weeks to make the brain tissue more vulnerable to subsequent lesions. Migrain is also shown to produce the pathophysiologic process that causes cortical depression to spread following a head injury and may be the source of temporary global amnesia [24] (Figure 2).

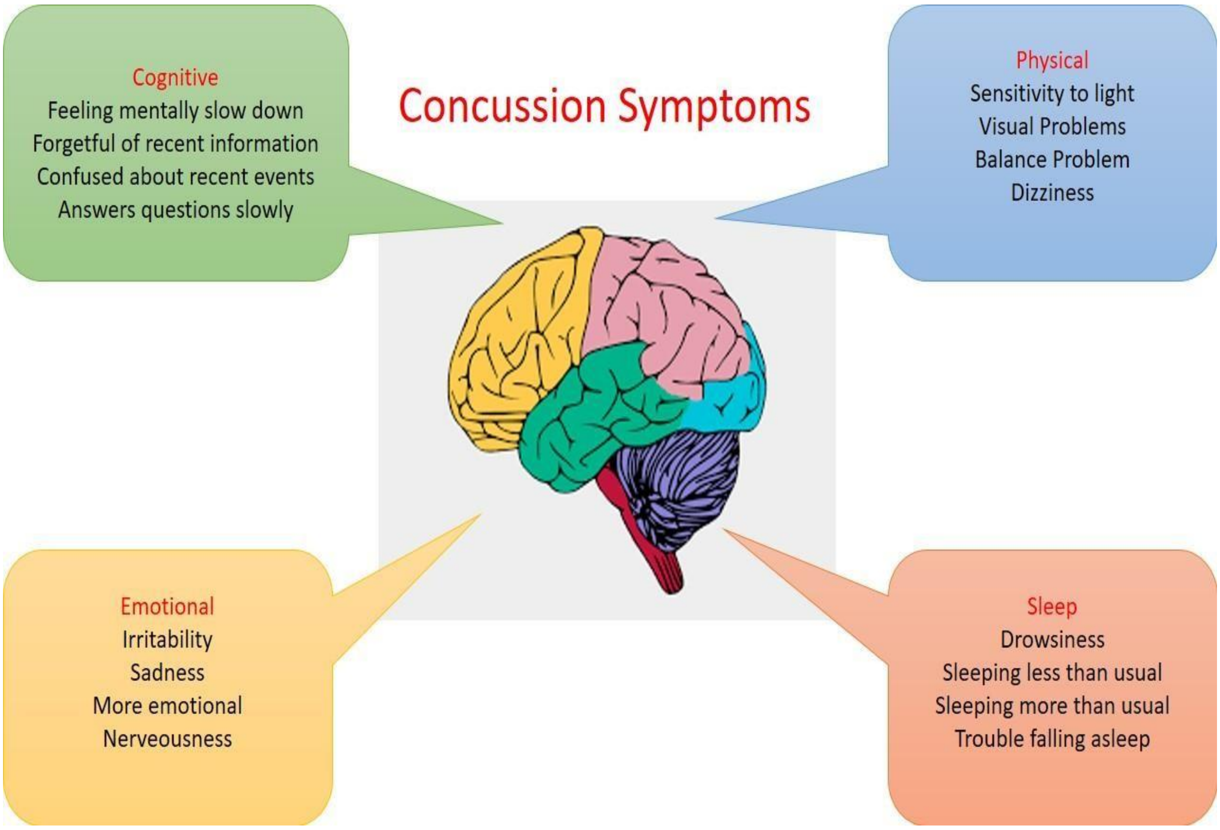

Figure 2: Concussion symptoms

6. Evaluation

The first question that a patient who has a head injury has is whether an epidural, subdural or parenchymal haemorrhage or increased intracranial pressure were triggered by a traumatic insult. In this assessment, consider if you have a competitor neck injury and hold the cervical spine immobilised. If a patient has lost heart or is suspected of a severe injury, the patient should be taken to the nearest emergency hospital and it is important to highlight that a catastrophic injury can occur even if no consciousness loss exists. Direct brain injury can result in a brief generalised cloned seizure and should be assessed immediately, while the acute seizures are favourable. In assessing the severity of traumatic breeding in persons with a congestive score of 13 to 15 on a 15-point scale, the Glasgow Coma Scale examines the visual, verbal and motor responses to stimuli [25-27].

Since there is minimal axonal damage lacking, brain imaging with CT and MRI scans generally contributes little to the assessment of congestion. The results are quite limited. Brain imaging. Diffusion tensor imagery is a form of imagery with magnet resonance used to evaluate the microstructural integrity of white matter. White matter lesions in minor traumatic brain wounds have been detected, however their utility in the clinic is still under discussion [28]. If a vertebral injury is suspected, a CT scan of the cervical spine should be done. If the findings of an exam are normal and no troubling symptoms, a written set of directives may be sent to a patient, including symptoms that need re-evaluation in the hospital. There is no evidence that the patient often wakes throughout the night following the comprehensive evaluation [29].

7. Pharmacoeconomics

The CDC estimates the annual incidence of mTBI at 1.1 million, including 300,000 concussions caused by sports. This equates to an annual expenditure of about $17 billion on concussion assessment and treatment. Due to the variability in illness evaluation and reporting, these estimates are likely to underestimate the true disease burden. Costs include direct assessment and treatment, as well as missed time at work or on the job [30, 31].

8. Treatment

In the majority of instances, concussion symptoms heal spontaneously - often within 7–10 days. Serial neurologic exams are critical for monitoring symptom remission and ruling out more severe damage. At the molecular and anatomical level, the mechanism of brain damage and its course remain ill-defined, impeding the development of medical/surgical interventions to expedite recovery. As our capacity to assess concussion has improved, so has the necessity for and duration of hospitalisation. Several overlapping and conflicting ideas about the appropriate procedures to return to play will be addressed in more depth later. Numerous studies have been conducted to determine the value of deliberate supervised rehabilitation after concussion [32, 33].

Trials conducted in the late 1970s demonstrated the importance of early ambulation, exercise, and education. Recently, there has been an increased emphasis on outpatient rehabilitation as hospital stays diminish. A randomised controlled study published in 2007 found that early active rehabilitation had no effect on post-concussive symptom resolution or life satisfaction after one year when compared to the control group. While determining the degree of damage, treatment is largely customised to the individual. The time period after the original injury remains a critical element in healing. There is a dearth of high-quality data on the pharmaceutical treatment of concussion-specific symptoms [34-36]. Antidepressants, particularly SSRIs and newer heterocyclics, are the most often recommended therapy for post-concussion syndrome. Trazodone may be an effective treatment option for insomnia, but its anticholinergic nature may restrict its usage. Although acetylcholinesterase inhibitors (physostigmine, donepezil) and choline precursors (lecithin, CDP-choline) have been demonstrated to enhance neuropsychological test performance, their effectiveness is limited by their short half-life, adverse effects, and method of administration [37-39].

9. Conclusion and Future Directions

Although neuropsychological testing is increasingly popular among sporting medicine practicers, due to a number of practical problems it is still not widely used in college and high school athletics. Evaluation of a whole athletic team needs time and effort, and because of lack of financial resources many organisations are reluctant to employ these tests.. In addition, no neuropsychological batteries specifically created for use with athletes before 1998 have been computerised. In a recent study, commercially available devices were used for a range of populations including elders (MicroCog) (D Powell, E Kaplan and D Whitla, Unpublished Observations, 1993). (Automated Neuropsychological

Assessment Metrics). An excellent example is the work of Kutner et al. who began analysing NFL football team New York Giants using a computerised evaluation technology in 1995. (The MicroCog condensed version) The development of immediate measurement and cognitive testing was dominated by athletes (IMPACT). This test battery has been developed to evaluate a range of neuropsychological features among sportsmen, including attention, sustained and selective attention, responsive times and a wide range of memory features. A microcomputer technician can finish the test battery with little supervision. Reaction speeds are measured for several of the different test modules during the following 0,001 second, enabling processing speed measurement when the player fatigues. There are presently three variations of the trial battery, and the stimulus randomly can be expanded to almost an infinite number. This part of the test battery was introduced in order to lessen the practical impacts of various paper and pencil techniques. For each module, interstimulus intervals may be adjusted easily and modules can be shown in full or individually.

In addition to these improvements in traditional neurological testing, the IMPACT battery also contains a previously publicised postconcussion scale provided through a microcomputer. All test data are kept to allow each athlete to compare their baseline findings with the postconsumption test results. We have just done an early investigation into reliability at a college in the US midwest (Lovell MR, Collins MW, Powell JW, unpublished observations). To evaluate the long-term reliability of the exam battery, university students took it four times (1, 2, 4, and 6 weeks). The average time difference in the reaction times was 0.10 seconds (standard deviation 0.54 s; standard error 0.06 s), showing relatively low variability for non-compared pupils. These outcomes will help in determining normal performance expectations between congested athletes, whose performance variability is expected to increase significantly. The National Collegiate Athletic Association and the National Academy of Neuropsychology are now carrying out IMPACT validation studies. We expect neurocognitive testing with such accessible, low-cost computerised tools will be extended to a far wider US population of over 1.1 million high school footballers who experience at least 40,000 cumulations per year beyond professional and university athletes. Furthermore, future results of our and other IMPACT studies might lead to a decrease in cumulative effects in the use of neuropsychological tests and a more accurate resolution of problems such as the excessive number of commotions. The achievement of these goals can help the safety and lifetime of athletes involved in contact sports.

Acknowledgement

The authors extend their appreciation to the Deputyship for Research & lnnovation, Ministry of education in Saudi Arabia for funding this research work through the project number 20-UQU-IF-P1-001.

Conflict of interest: There is no conflict of interest, the authors declare.

10. References

11. [1] Concussion: Physical Therapy Treatment After Mild Traumatic Brain Injury, The Journal of orthopaedic and sports physical therapy, 50 (2020) 178.

12. [2] O. Akhand, L.J. Balcer, S.L. Galetta, Assessment of vision in concussion, Current opinion in neurology, 32 (2019) 68-74.

13. [3] A.A. Almeida, M.T. Lorincz, A.N. Hashikawa, Recent Advances in Pediatric Concussion and Mild Traumatic Brain Injury, Pediatric clinics of North America, 65 (2018) 1151-1166.

14. [4] J. August, A. Torres, Prevention of Concussion, Seminars in pediatric neurology, 30 (2019) 99-106.

15. [5] K.S. Alharbi, N.K. Fuloria, S. Fuloria, S.B. Rahman, W.H. Al-Malki, M.A. Javed Shaikh, L. Thangavelu, S.K. Singh, V.S. Rama Raju Allam, N.K. Jha, D.K. Chellappan, K. Dua, G. Gupta, Nuclear factor-kappa B and its role in inflammatory lung disease, Chemico-biological interactions, 345 (2021) 109568.

16. [6] D.F. Aukerman, N.R. Phillips, C. Graham, Concussion Management in the Collegiate Athlete, Sports medicine and arthroscopy review, 24 (2016) 130-133.

17. [7] G.T. Baldwin, M.J. Breiding, R. Dawn Comstock, Epidemiology of sports concussion in the United States, Handbook of clinical neurology, 158 (2018) 63-74.

18. [8] S. Bonfanti, V. Duthon, J.L. Ziltener, J. Menetrey, [Sport-related concussion], Revue medicale suisse, 13 (2017) 1329-1332.

19. [9] K.V. Sathasivam, M. Haris, S. Fuloria, N.K. Fuloria, R. Malviya, V. Subramaniyan, Chemical Modification of Banana Trunk Fibers for the Production of Green Composites, Polymers, 13 (2021).

20. [10] H. Bramley, J. Hong, C. Zacko, C. Royer, M. Silvis, Mild Traumatic Brain Injury and Post-concussion Syndrome: Treatment and Related Sequela for Persistent Symptomatic Disease, Sports medicine and arthroscopy review, 24 (2016) 123-129.

21. [11] S.P. Broglio, Return to play following sports-related concussion, Handbook of clinical neurology, 158 (2018) 193-198.

22. [12] J. Brown, K. Knollman-Porter, Continuum of Care Following Sports-Related Concussion, American journal of speech-language pathology, 29 (2020) 1389-1403.

23. [13] T.A. Buckley, Concussion research: Moving beyond the natural history, Journal of sport and health science, 10 (2021) 111-112.

24. [14] K.M. Yap, M. Sekar, Y.S. Wu, S.H. Gan, N.N.I.M. Rani, L.J. Seow, V. Subramaniyan, N.K. Fuloria, S. Fuloria, P.T. Lum, Hesperidin and its aglycone hesperetin in breast cancer therapy: A review of recent developments and future prospects, Saudi journal of biological sciences, 28 (2021) 6730-6747.

25. [15] M. Choe, K.M. Barlow, Pediatric Traumatic Brain Injury and Concussion, Continuum (Minneapolis, Minn.), 24 (2018) 300-311.

26. [16] C.D. Chong, T.J. Schwedt, Research Imaging of Brain Structure and Function After Concussion, Headache, 58 (2018) 827-835.

27. [17] D. Comeau, N. Pfeifer, Diagnosis of Concussion on the Sidelines, Seminars in pediatric neurology, 30 (2019) 26-34.

28. [18] R.J. Echemendia, G.A. Gioia, The role of neuropsychologists in concussion evaluation and management, Handbook of clinical neurology, 158 (2018) 179-191.

29. [19] M. Eisenberg, R. Mannix, Acute concussion: making the diagnosis and state of the art management, Current opinion in pediatrics, 30 (2018) 344-349.

30. [20] C. Giza, T. Greco, M.L. Prins, Concussion: pathophysiology and clinical translation, Handbook of clinical neurology, 158 (2018) 51-61.

31. [21] A. Gregory, S. Poddar, Diagnosis and Sideline Management of Sport-Related Concussion, Clinics in sports medicine, 40 (2021) 53-63.

32. [22] M.N. Haider, L. Herget, R.D. Zafonte, A.G. Lamm, B.M. Wong, J.J. Leddy, Rehabilitation of Sport-Related Concussion, Clinics in sports medicine, 40 (2021) 93-109.

33. [23] A. Hodges, S. Ameringer, The symptom experience of adolescents with concussion, Journal for specialists in pediatric nursing : JSPN, 24 (2019) e12271.

34. [24] K.L. Hon, A.K.C. Leung, A.R. Torres, Concussion: A Global Perspective, Seminars in pediatric neurology, 30 (2019) 117-127.

35. [25] V. Hubertus, N. Marklund, P. Vajkoczy, Management of concussion in soccer, Acta neurochirurgica, 161 (2019) 425-433.

36. [26] W.T. Jackson, A.J. Starling, Concussion Evaluation and Management, The Medical clinics of North America, 103 (2019) 251-261.

37. [27] S. Jennings, M.W. Collins, A.M. Taylor, Neuropsychological Assessment of Sport-Related Concussion, Clinics in sports medicine, 40 (2021) 81-91.

38. [28] G. Jindal, R.R. Gadhia, P. Dubey, Neuroimaging in Sports-Related Concussion, Clinics in sports medicine, 40 (2021) 111-121.
39. [29] J.C. Jones, M.J. O'Brien, Medical Therapies for Concussion, Clinics in sports medicine, 40 (2021) 123-131.
40. [30] C. Kazl, A. Torres, Definition, Classification, and Epidemiology of Concussion, Seminars in pediatric neurology, 30 (2019) 9-13.
41. [31] H. Kerr, B. Bakken, G. House, Future Directions in Sports-Related Concussion Management, Clinics in sports medicine, 40 (2021) 199-211.
42. [32] Z.Y. Kerr, A. Chandran, A.K. Nedimyer, A. Arakkal, L.A. Pierpoint, S.L. Zuckerman, Concussion Incidence and Trends in 20 High School Sports, Pediatrics, 144 (2019).
43. [33] D. King, A. Collins-Yoder, Perioperative Considerations in Patients With Concussion, AANA journal, 87 (2019) 97-104.
44. [34] J. Kissick, N. Webborn, Concussion in Para Sport, Physical medicine and rehabilitation clinics of North America, 29 (2018) 299-311.
45. [35] C.L. Master, A.R. Mayer, D. Quinn, M.F. Grady, Concussion, Annals of internal medicine, 169 (2018) Itc1-itc16.
46. [36] T. McAllister, M. McCrea, Long-Term Cognitive and Neuropsychiatric Consequences of Repetitive Concussion and Head-Impact Exposure, Journal of athletic training, 52 (2017) 309-317.
47. [37] T.W. McAllister, R. Wall, Neuropsychiatry of sport-related concussion, Handbook of clinical neurology, 158 (2018) 153-162.
48. [38] M.A. McCrea, L.D. Nelson, K. Guskiewicz, Diagnosis and Management of Acute Concussion, Physical medicine and rehabilitation clinics of North America, 28 (2017) 271-286.
49. [39] N. McGrath, J. Eloi, The Role of Neuropsychology in the Evaluation of Concussion, Seminars in pediatric neurology, 30 (2019) 83-95.