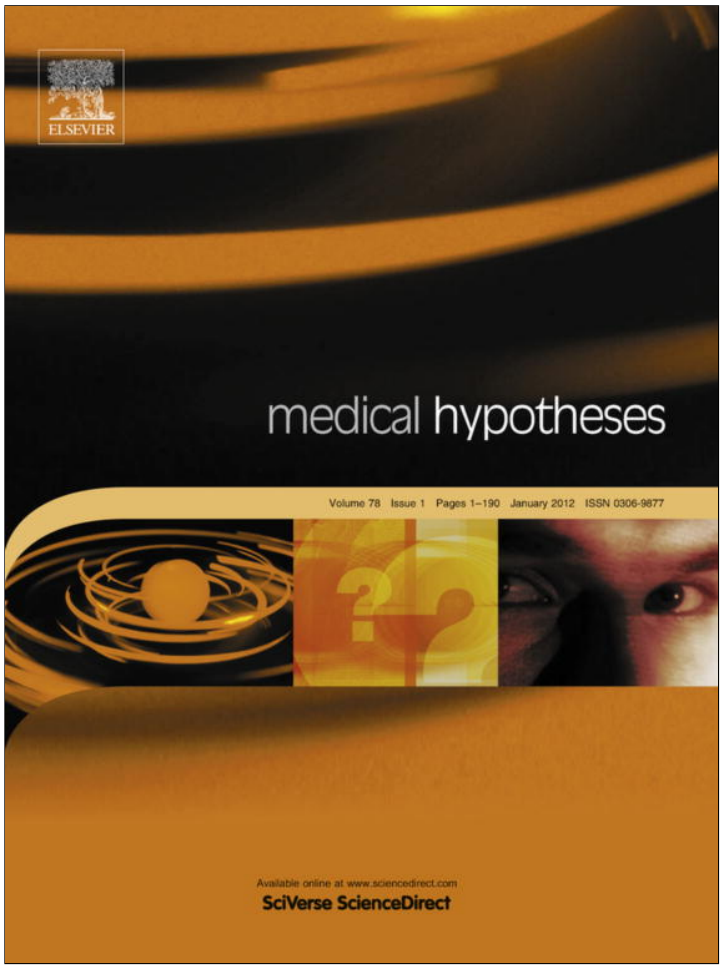

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Vomiting as a reliable sign of concussion ☆

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ABSTRACT

Concussion is the most common type of traumatic brain injury, with headache being the most frequent symptom of mild traumatic brain injury (MTBI) (including dizziness, vomiting, nausea, lack of motor coordination or difficulty balancing). Concussion may be caused by a blow to the head, or by acceleration forces without a direct impact. Often, MTBI occurs as the result of a sports injury. Loss of consciousness is always present, unlike vomiting. Therefore, we hypothesize vomiting to be considered as a cardinal sign of concussion. Stimulation of vomiting centres finally triggers vomiting. Professional boxers and mixed martial arts competitions reluctantly agree with stringent rules and protective clothing. We discuss the issue of further protection for those engaged in these and other sports.

Introduction

Concussion is the most common type of traumatic brain injury (TBI) that manifests with a variety of symptoms [1]. The forces involved, disrupt cellular processes in the brain and symptoms usually subside within days or weeks. Concussion is often defined as a head injury with a temporary loss of brain function coupled with a variety of symptoms.

Headache is the most common mild traumatic brain injury (MTBI) symptom [2]. Other symptoms include dizziness, vomiting, nausea (a sensation of restlessness and discomfort with an involuntary urge to vomit) [3], and lack of motor coordination or difficulty balancing. Visual and auditory symptoms are likely to be reported, as well [4]. Symptoms' severity decreases and their nature tends to change over time. Psychological signs and symptoms generally do not occur immediately after the injury, so, we address to those as 'late symptoms'. Commonly, early after concussion occur nausea and drowsiness, but usually do not last, while headache and dizziness occur immediately after the injury and are long lasting [5].

Common causes of MTBI include sports injuries, vehicle accidents, and falls; the latter two are the most common among adults. Concussion may be caused with or without a direct impact to the head. Competing in the mixed martial art (MMA), stand of traumatic brain injury is a constant, occupation-related risk [6]. Different techniques are combined in combat according to MMA. The use of both, striking and grappling techniques are allowed, while standing and while down-casted on the ground. Such competitions allow competing of martial artists of different backgrounds. Participants in sports that involve combating are at risk for sustaining concussions [7,8]. According to Zazryn et al., 25% of professional boxing participants were injured, 89.8% of the injuries were to the head, neck and face with 15.9% concussions [9,10]. The incidence of concussion for amateur boxers was 4.0–6.5% [11].

Herein, concussion is regarded as the fugacious and rapidly revocable state of neuronal dysfunction associated with a loss of consciousness instantly following the head injury [7,8,12–14].

Hypothesis

Considering the neurophysiology of vomiting [15], concussion strikes an eye [16]. Theoretically, any part of the brain can be damaged during fight [17].

Among many symptoms pointing out MTBI, vomiting arises as one of the most distinct [18]. Persistence or worsening of symptoms may indicate a more severe injury what requires a more in-depth evaluation [19]. Patients with a concussion often have no neurologic signs but antegrade amnesia [20].

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Definitions of MTBI have been inconsistent in the past, but the World Health Organization's International Statistical Classification of Diseases and Related Health Problems (ICD-10) provided a consistent, authoritative definition across specialties. In 1993, the American Congress of Rehabilitation Medicine defined MTBI as 30 min or fewer of loss of consciousness (LOC), less than a day of post-traumatic amnesia (PTA), and a Glasgow coma scale (GCS) score of at least 13. In 1994, the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders defined MTBI using PTA and LOC Other definitions of MTBI incorporate focal neurological deficit and altered mental status, in addition to PTA and GCS.

Therefore, we hypothesize vomiting to be considered as an unmistakable, confident and completely reliable sign of concussion among certain athletes that are not equipped with protective headgear. Due to its impressiveness it doesn't rely on anamnestical data and its documenting isn't susceptible to subjective speculation.

Discussion

Approximately 3% of TBIs result from sport activities [1]. Boxing becomes stigmatized as facilitator of TBI [6,21,22]. Professional boxing matches among male boxers are fraught with high injury rate [23,24]. The difference in concussion rates between professional and amateur boxing may be due to differences in safety gear [25,26].

Despite uninterrupted researches, contributing biomechanical factors mediating MTBI remain unclear, pursuant to the difficulties in finding out impact events in the field [27].

Analysis of boxing was interesting to help explain the peculiarities in the clinical overview of brain injuries in martial arts. A longer term goal of such an enquiry should be to study the effectiveness of protective headgear and gloves in boxing [28,29]. Boxing gloves and headgear are currently required in amateur boxing to prevent a head injury [30], and improvements in the effectiveness of protective equipment in boxing are required [25,31]. The effectiveness of boxing safety equipment has been addressed in Denmark [29,32]. No decrease in injuries was found with an increase in gloves thickness, unlimited hand-wrap and use of helmets for heavier boxers [28]. The lack of other data on this topic leaves boxing officials, athletes and trainers uncertain as to what specific safety equipment is most effective and what areas of improved safety needed additional study. Both, rotational and translational alternations were considered to be determined concussion risks in these calculations [14].

Rigorous rule sets for MMA fights have been setting up [33,34]. State athletic and boxing commissions across the United States have played a central role imposing the safety rules, since they watch over MMA in similar ways as boxing [35]. Events of lesser significance usually use less rigorous rules because they have more inexperienced fighters that are looking forward to gaining experience and exposure that could eventually result in recruiting into one of the larger, better waged promotions. Japan and Europe lack rigorous control over MMA competitions, so these organizations have the greater lack of limits in rules [36]. Usually, a reasonable rule set with some organization-specific feature has been set up and is broadly used. Rule changes in greater extent are implausible, allowing for fighters in one group to transit to others easily [35].

Boxers frequently develop subdural hematomas and brain-injury deaths [37]. Chronic encephalopathy of boxers is generic to fighters themselves [21,6,28].

The vomiting canters receive afferent signals from at least four major sources: the chemoreceptor trigger zone (area postrema), visceral afferent impulses with signals from the gastrointestinal organs and other peripheral trigger areas [38]. Equally important afferents come from various other centres in the brain [39]. It is most likely that connections of the area postrema with the solitary tract nucleus induce vomiting and nausea [40].

Electrical stimulation of joint vomiting centres induces vomiting [41,42], while destruction of the vomiting canters inhibits it [39]. Area postrema's function in chemoreception has been researched [43]. It is trigger zone consisting of a layer of specialized ependymal cells [44]. Unlike most of ependymal cells, specialized ependymal cells of the area postrema form a lining of single epithelial cells in the vacancies of the nervous system [45]. Area postrema is located rostral to the inferior tip of the fourth ventricle's caudal floor. It is believed that ependyma and tanycytes can engage in transport of chemicals in and out of the cerebrospinal fluid, thus liquid milieu [46,47]. The area postrema is believed to be a circumventricular organ meaning, it does not contain tight junctions, what enables detection of toxins in the blood flow and its acting as a vomit-inducing centre [43,48,49]. Asides of lacking tight junctions, it is a densely vascularised structure. Its significance in the various systems' autonomic supervision manifests in observing the cardiovascular and the systems controlling food intake and metabolism.

The trigger zones function as the emetic chemoreceptor for the vomiting centres – chemical abnormalities in the body are sensed by these centres, which then send excitatory signs to the vomiting centres [43].

Neural and humoral deposits of pathways lead to activation of canters in the brain that launch and control vomiting. Paradigm of brain centres as commander in chief of vomiting, the prime mover of the decisive pronouncement is almost undoubtedly made too simple and dented in some particulars, but helps to explain much about vomiting [42,46].

Observation of condition for worsening (worsening headache, nausea or sleepiness) is an important part of treatment. Physicians recommend that those suffering from concussion return if they display worsening symptoms, like altered mental status what should alert the [2,50]. Athletes are typically followed closely by team trainers after competitions. [51–53]. Others, however, may not have access to this level of health care. Recommendation for those suffering from concussion exists that they return for further consultations and care if the symptoms worsen.

Conclusion

Following our belief's explanation based on the listed literature, vomiting following boxing matches is often the aftermath of mild head injury. Among many potential symptoms that are gladly to be connected with concussion, vomiting is, probably, most impressive. Concussion is pretty likely to be expected after MMA fights, because of absence of demands of wearing protective headgear. Possible, widely apprehensible causes of vomiting are likely to be suspected in the absence of other signs of concussion. Ignoring all those, we strongly believe concussion is likely to manifest with vomiting, so, our entire paper is oriented in that direction. Asides of purely generic explanation of vomiting physiology in injured brains, we stressed out the importance of wearing of protective gear in combats, clearly distinguishing amateur and professional boxers. However, MMA competitions have emerged out of professional boxing in its striving to get rid of rigorous and sometimes limiting rules and protective gear. Thus, it is dubious how justifiable and recommendable would be advising tightening the rules or impelling helmet wearing liability.

Conflict of interest statement

None declared.

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