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# CONCUSSION: A REVIEW OF EPIDEMIOLOGY, PRESENTATION AND TREATMENT.

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## ABSTRACT:

A direct impact on the head can cause a Mild Traumatic Brain Injury or Concussion. It is a neuronal brain injury with or without loss of consciousness. Each year, approximately 69 million people are estimated to suffer from Concussion. Around 80-90% of these Concussion cases resolve within a week. The most commonly reported post-concussion symptoms include headache, cognitive changes, sleep disturbances, and depression. Essential in the approach to patients with concussion includes a detailed history taking and physical examination. Imaging modalities like Magnetic Resonance Images (MRI) of the brain may not show any significant changes; therefore more sensitive tests, like Functional MRI (fMRI), Diffusion Tensor Imaging (DTI), Magnetic Resonance Spectroscopy (MRS) and Positive Emission Tomography (PET) can be used. The treatment approach depends on the underlying cause and presentation. Patients should be encouraged to resume physical activity as soon as possible. Symptoms like headache can be treated with Analgesics. Sleep disturbances should be handled with proper sleep routine and drugs including Zolpidem. Cognitive disturbances can be improved with drugs and Cognitive Behavioral Therapy. In all patients, follow-up and counseling are always required. We discuss the epidemiology, symptoms, and treatment approach of mild traumatic brain injury in the world and Pakistan.

**Key words:** Concussion; Mild traumatic brain injury; Post-concussion symptoms

## Introduction

Concussion or 'Mild Traumatic Brain Injury' (mTBI) is a form of brain injury caused by a direct impact on the head, or by any other trauma that causes rapid back and forth movement of the Skull and underlying Brain. American Academy of Neurology defines Concussion as 'A Clinical syndrome characterized by immediate and transient alteration in brain function, including alteration of mental status or level of consciousness, that results from mechanical force or trauma' <sup>(1)</sup>

As a pathological phenomenon, Concussion reflects in the form of a functional disturbance rather than pure structural damage. It presents with mild neurological symptoms with or without any loss of consciousness. <sup>(2)</sup> Usually, 80-90% of these concussive neurological symptoms resolve within a week, but rarely, can last up to months. <sup>(3)</sup> Cases that develop persistent symptoms usually have associated red flags like head injury, pre-existing psychological diseases, old age and female sex. <sup>(4)</sup> Patients who undergo Repetitive Traumatic Brain Injury can also develop long-term effects like Chronic

Traumatic Encephalopathy (CTE), Alzheimer's disease, Epilepsy, and increased mortality. <sup>(5)</sup>

### Incidence of Concussion Globally

Traumatic Brain Injury (TBI) is a leading cause of morbidity and mortality. It is also a major health burden to the Economy and Quality of a person's life. Studies have reported the incidence of all-severity Traumatic brain injury is nearly 70 million people per annum, out of which 56 million cases are of mild Traumatic Brain Injury. <sup>(6)</sup> The incidence rate of Traumatic Brain Injury in various regions of the world is summarized in Table 1. <sup>(6)</sup>

### Incidence of Concussion in Pakistan

Most cases of traumatic brain injury (TBI) are mild and not associated with any loss of consciousness. These factors result in TBI being largely underreported with very few visits to healthcare professionals in the country. Studies on the epidemiology of traumatic brain injury have been conducted in Pakistan. A surveillance study conducted by Pakistan National Emergency

Department Surveillance Study (Pak-NEDS) collected data from the Emergency Department of various hospitals. During the 4 month study, more than 250,000 cases presenting as a possible case TBI were included, out of which 12,125 had the true nature of Traumatic Brain Injury. Most of these patients were males, less than 25 years of age, and arrived by ambulances. Around two-third cases of Traumatic Brain Injuries were unintentional and one-third intentional. Although most of the patients were managed by medical officers and resident physicians, the Glasgow Coma Scale (GCS) for severity of the injury was only reported in 9% of patients.<sup>(7)</sup> A one year study conducted in Jinnah Post-Graduate Medical Center (JPMC) in Karachi reported 1,59,600 cases of Head Injury. The study also reported the majority of patients being male and age between 20-39 years of age. The death rate of patients with Head Injuries was reported to be 40%.<sup>(8)</sup> Another study conducted in Emergency Departments of tertiary care hospital for 1 year found 1,378 cases of Traumatic Brain Injury. The patients were mostly young with a male to female ratio of 3:1. The study reported Road Traffic Accidents (RTA) while riding motorbike being the cause of the majority of cases, yet the use of proper safety equipment including helmets' use is limited needs to be addressed.<sup>(9)</sup>

### Approach to a patient with Concussion

Patients visiting the emergency department or hospital after mild traumatic brain injury may present with somatic, cognitive, or affective symptoms.<sup>(10, 11)</sup>

Somatic symptoms	Cognitive symptoms	Affective symptoms
Headache, Sleep disruptions, Dizziness, Nausea, Visual disturbances, Photophobia, Phonophobia.	Attention and Memory loss, Slow processing speed, Difficulty multitasking, Increased distractibility, Losing one's train of thought, and Foggy feeling.	Increased irritability, Emotional lability, Anxiety, and Depression

### Mechanism of Injury

After proper First-Aid management, the patient should be evaluated thoroughly. Essential for further management is to establish the mechanism of injury, precise location, direction, and force of trauma. These factors determine the further management.

### History and Physical Examination

Various assessment tools have been developed to assess the severity of Concussion and its prognosis. One of the widely used standard questionnaires is the Sports Concussion Assessment Tool -5 (SCAT5). Included in the questionnaire is a combination of field examinations focusing on Red flag symptoms, Glasgow Coma Scale, Spine stability, Cognitive Screening, Short

term memory, Neurological Screening, and Decision making.<sup>(12)</sup> Being a clinical diagnosis, a detailed clinical examination is essential to establish proper care for the patient which might involve a multidisciplinary team consisting of Emergency Department physicians, Neurologists, Neurosurgeons, Physical Medicine and Rehabilitation physicians and Neuropsychologists.<sup>(13)</sup> Special consideration must be paid to Neurocognitive screening or Neuropsychological evaluation, Balance assessment, Vestibular and Ocular screening, and Cervical Spine examination.

### Investigations

A wide range of advanced neurological imaging techniques are required to assess the severity of trauma. Traditional imaging like CT scan and MRI, usually don't show any pathologies and are indicated only if there is a prolonged loss of consciousness, focal deficit or worsening symptoms to rule out Skull fractures or intracranial bleeding.<sup>(14)</sup> Imaging techniques including functional MRI (fMRI), Diffusion Tensor Imaging (DTI), Magnetic Resonance Spectroscopy (MRS), and Positive Emission Tomography ((PET) are more sensitive in the evaluation of Concussion. The use and properties of these tests in Concussion imaging are compared in Table 2.<sup>(15)</sup>

### Post-concussion Symptoms

Following a mild Traumatic Brain Injury, there can be various physical, emotional, and cognitive symptoms. The constellation of these symptoms is referred to as Post Concussive Symptoms. These include Headache, Anxiety, Insomnia, Cognitive changes, Depression, Decreased Concentration, Fatigability, Poor judgment, Visual disturbances, Dizziness and increased sensitivity of noise.<sup>(4)</sup> Depending on the severity of brain injury, these symptoms can resolve within months. Whereas individuals who had severe brain injury, can develop life-long symptoms or permanent disability.<sup>(4)</sup>

### Head ache

Head ache is the most common symptom occurring after a traumatic brain injury. Cervical pain is also present in 60% of the cases.<sup>(16)</sup> Post-traumatic headache can begin at the time of injury or later. Any headache occurring proximate to the time of injury is termed as an Acute post-traumatic headache. Headache lasting for 2 months is classified as Acute, whereas those lasting more than 2 months are Chronic. The headaches are heterogeneous in nature with a combination of both tension-type and migraine-like attacks. The underlying pathophysiology of these post-traumatic headaches is not completely understood.<sup>(16)</sup> Present literature studying the nature of

headaches occurring after trauma reported Tension-type headache symptoms in two-third of the cases and migraine-like in the remaining one-third. <sup>(17)</sup>

### **Sleep Disturbance**

Sleep problems after mild TBI can occur in as much as 80% of the patients. Brain regions regulating attention, alertness, and sleep regulation are particularly prone to injury. The symptoms occurring after injury can include insomnia, hypersomnia, obstructive sleep apnea, dizziness, difficulty falling asleep, fatigue, or low energy. <sup>(18)</sup> A positive correlation is reported between sleep disturbances and psychiatric symptoms, patients presenting with severe sleep disturbances are found to have severe psychiatric symptoms as well. <sup>(18)</sup>

### **Cognitive Changes**

Cognitive changes are common and have been reported by numerous studies post-concussion. A significant reduction in information processing speed and executive function is seen in patients. <sup>(19-21)</sup> An Emergency Department prospective study, following patients with mTBI reported 33% of patients being functionally impaired at 3 months, 22.4% of these patients were functionally impaired even after 12 months post-injury. <sup>(22)</sup>

### **Depression**

Varying symptoms like continuous headaches, Sleep disturbances and Cognitive disorders make patients prone to developing depression. Patients with a history of mTBI are 3 times more likely than the general population to develop depression. <sup>(23)</sup> It has been reported that 30-40% of patients of mTBI develop depression. <sup>(24, 25)</sup> Patients with underlying psychiatric disorders and mood disorders are more severely affected. A study reported patients suffering from PTSD being 23 times more likely to develop depression, compared to the general population. <sup>(26)</sup> A strong positive correlation of depression is found with other post-concussive symptoms like headaches. <sup>(27)</sup>

### **Management of Concussion**

#### **Physical Activity**

In the past, patients with mTBI were advised to have complete physical and cognitive rest. An exacerbation of injury with daily activity was suspected. However, recent studies have shown that restoring physical activities early is beneficial in avoiding persistent post-concussive symptoms. Patients should be motivated to resume exercise, as much as tolerated, after 1-2 days of the injury. <sup>(28, 29)</sup>

### **Cognitive Disturbances**

Treatment of Cognitive impairment includes using both pharmacologic and non-pharmacologic approach. Interventions like diet and lifestyle changes, cognitive rehabilitation, and medications such as NMDA antagonists, Catecholamine augmenting agents have proven beneficial. <sup>(30)</sup> A multicenter study showed restoring physical activity early results in a lower risk of developing Cognitive symptoms compared to those patients who had no physical activity after the event. <sup>(31)</sup>

### **Post-traumatic Symptoms & Headaches**

Treating symptoms like headache is essential in the management of mTBI. Analgesics are initially employed in the treatment, with other possible options like Triptans. Symptoms like Nausea can be treated with Metoclopramide or Prochlorperazine. Patients with concomitant insomnia are advised to take Tricyclic antidepressants, Topiramate, Amitriptyline or Nortriptyline. Patients suffering from refractory chronic migraine headache have shown modest beneficial results with the use of Botulinum toxin A Injections to reduce the number of headache days in a month. <sup>(32)</sup> Preventive medicines for headache are advised for patients with persistent symptoms for more than 2 weeks. Efficacy of Nerve blocks in management of both migraine and tension-type headaches have been reported. <sup>(33-36)</sup>

### **Sleep Disturbances**

Sleep disturbances can be resolved by identifying the sleep influencing factors including pain, depression, anxiety, and sleep hygiene. It is necessary to review caffeine and any other medicines that can interfere with the patient's sleep. Sleep questionnaires are typically employed to evaluate the underlying cause. The drugs that can be used include Melatonin and Amitriptyline, particularly in the setting of a background headache, to treat delayed sleep phase syndrome. <sup>(37-40)</sup> In short term management, Zolpidem and Zopiclone can be used. If the disturbances are long, Cognitive behavioral therapy is proven more beneficial than chronic use of pharmacotherapy. <sup>(41)</sup>

### **Psychiatric Disturbances**

A multidisciplinary team with a psychiatrist is employed to manage the common psychiatric manifestations like anxiety and depression in patients. Drugs like Sertraline have shown advantages in improving cognition and alertness whereas methylphenidate improves depressive symptoms. <sup>(42, 43)</sup> Behavioral therapies, including Cognitive Behavioral Therapy, are proven beneficial in post-concussive anxiety. <sup>(44)</sup>

## Conclusion

The occurrence of Traumatic Brain Injury is common globally, including Pakistan. A thorough history and physical examination are required in the Emergency Department. Although the majority of patients might not report any symptoms initially, follow-up of these patients to evaluate their mental health and cognitive function is essential to prevent any long-term complications. In Pakistan, the common population developing mTBI are young males, mostly after Road Traffic Accidents. This population at risk should be approached to teach and implement the use of safety equipment like helmets to reduce the future incidence of Traumatic Brain Injuries and resulting complications.

**Table-1**

Countries	No. of countries	Population	TBI cases total	TBI Incidence/100,000
Low to middle income countries	50	6,160,384,080	49,954,794	811
High income countries	16	1,188,267,169	17,903,925	1507
African Region	20	990,267,592	7,934,534	801
Latin America	6	634,315,984	5,765,538	909
Regions of America-US/Canada	1	357,270,594	4,640,418	1299
European region	18	916,755,857	5,814,715	897
South East Asia Region	6	1,928,530,522	9,278,934	1012
Eastern Mediterranean region	8	648,060,427	18,279,321	948
Western Pacific Region	7	1,873,450,273	17,312,953	924
Global	66	7,348,651,249	69,026,412	939

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**Table -2**

Imaging Modality	What it measures	Potential advantages	Potential Disadvantages
DTI (Diffusion Tensor Imaging)	Speed and directionality of water diffusion	Surrogate measure for imaging white matter integrity and connectivity	<ul style="list-style-type: none"> <li>No metallic implants or penetrating objects</li> <li>Take longer (30-90 minutes)</li> <li>Require patients to remain motionless</li> <li>Post imaging data processing is required</li> </ul>
fMRI (Functional Magnetic Resonance Imaging)	BOLD signal, a marker of increased oxygen delivery presumably to areas of neural activation	Images of real time cerebral function to specific cognitive or motor tasks	<ul style="list-style-type: none"> <li>Same as DTI</li> <li>Requires intact neurovascular coupling</li> <li>Patients must actually perform task during scan</li> </ul>
MRS (Magnetic Resonance spectroscopy)	Spectroscopic pattern of cerebrovascular metabolites	Imaged functional activation of neural structures	<ul style="list-style-type: none"> <li>Same as DTI</li> </ul>
PET (Positron Emission Tomography)	Positron emitted from injected radioisotope for fluoro-deoxyglucose PET measures cerebral glucose uptake	<ul style="list-style-type: none"> <li>Images functional cerebral metabolism</li> <li>Capable of measuring quantitative rates of cerebral glucose</li> </ul>	<ul style="list-style-type: none"> <li>Injected radioisotope</li> <li>Takes longer (30-60 minutes)</li> <li>Requires arterial sampling</li> <li>Requires PET scanner</li> </ul>

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**Sidra Saleem;** concept, data collection, data analysis, manuscript writing, manuscript review

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**Mohammad Wasay;** concept, data analysis, manuscript writing, manuscript review