Multidisciplinary Approach to Recovery from Concussions

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No disclosures

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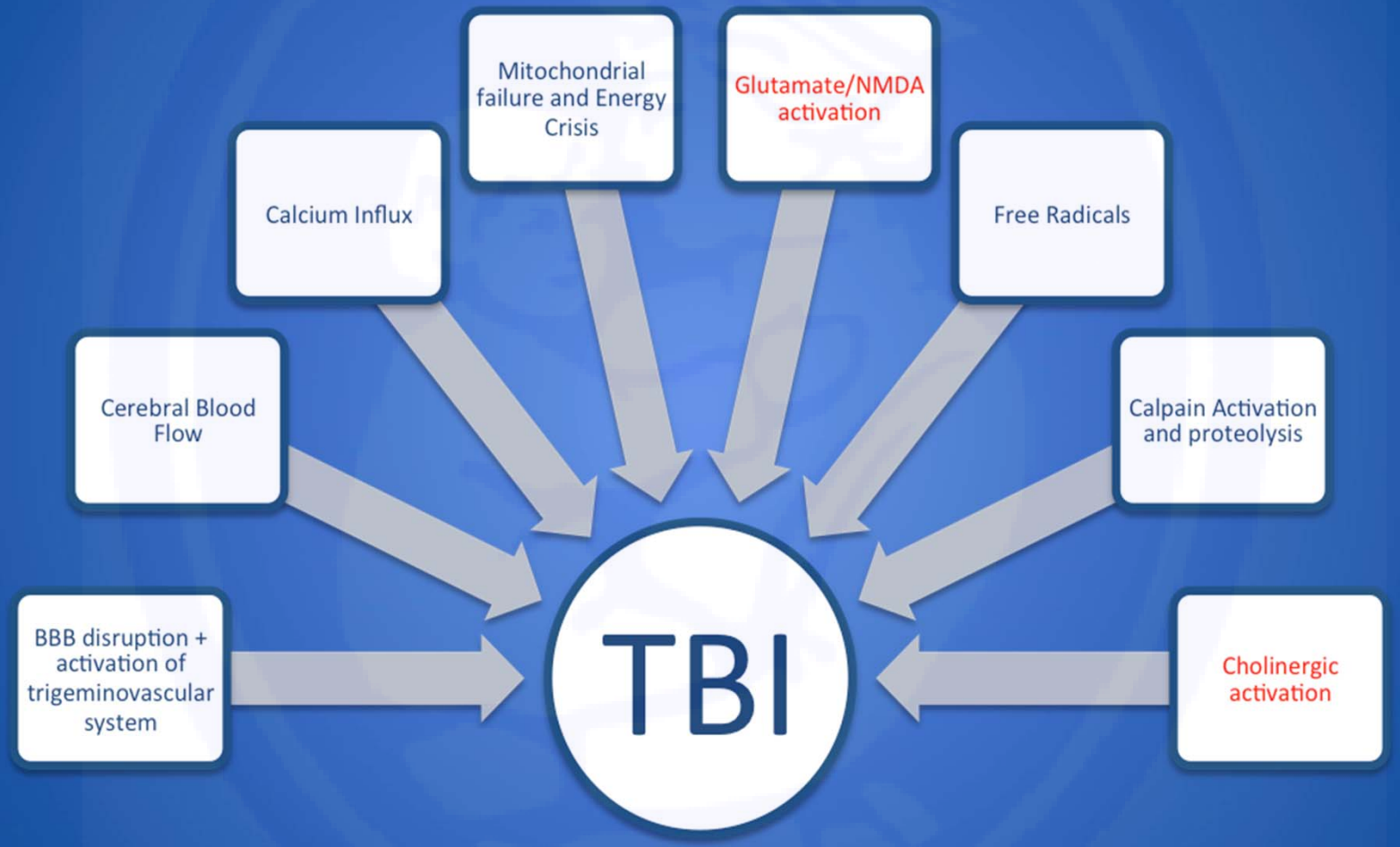
Objectives

- Review the Symptoms
- Identify Red Flags signaling emergency
- Post Concussion Symptoms
- Multidisciplinary approach to management
- Pharmacological Treatment
- Brief Review for Future Direction for Treatment and Research

E Toledo et al., Neuroscienceand Biobehavioral Reviews (2012)

Mechanism of Traumatic Brain Injury



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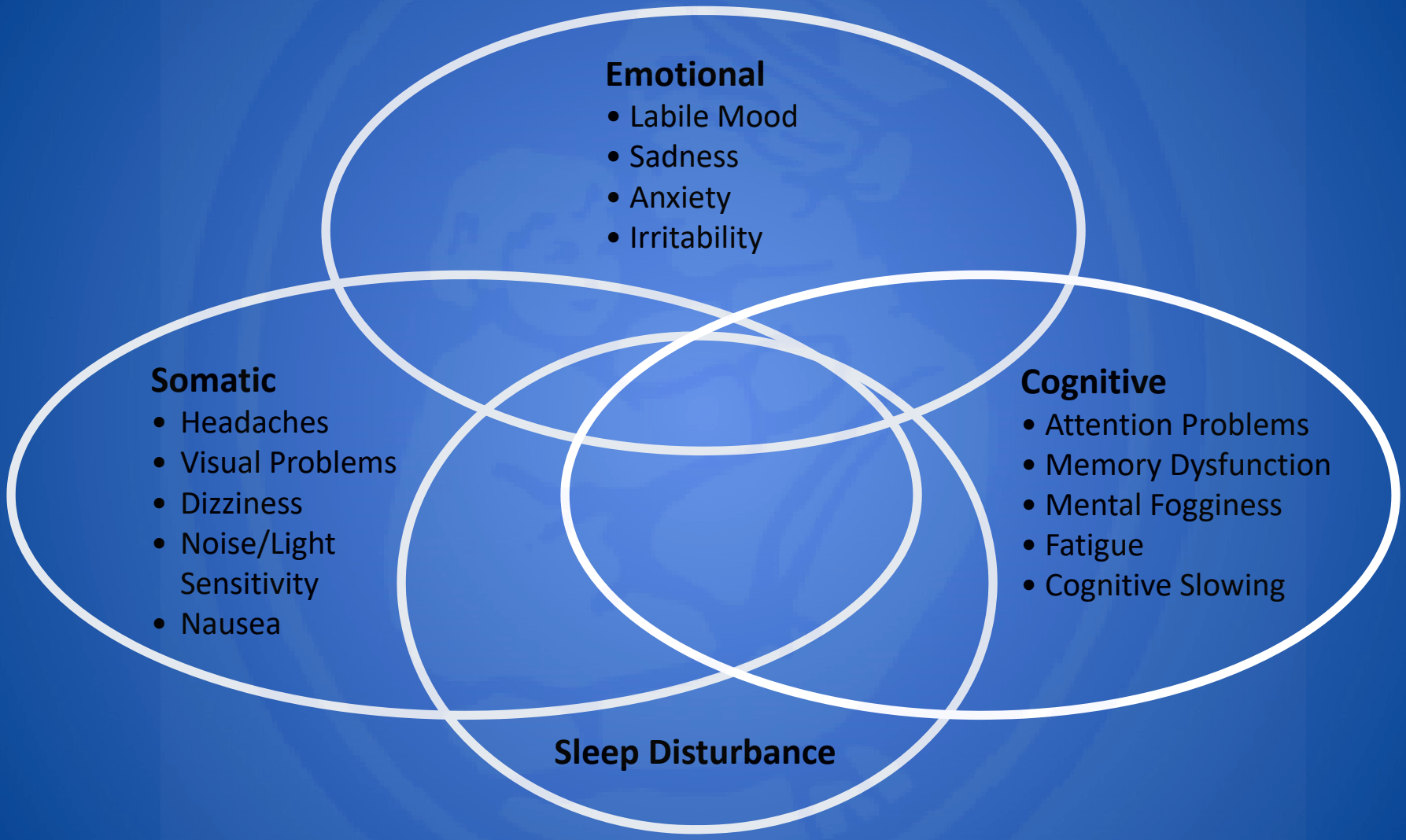
Pathogenesis

concussionblog.com

Symptom Clusters



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Red Flags

- Focal Neurological Signs
- Vomiting that persists
- Waking up at night with a headache
- Neck throbbing pain think dissection
- Headache that worsens with sneezing, coughing or change in position
- Seizure like symptoms
- Hallucination, suicidal ideation, severe depression


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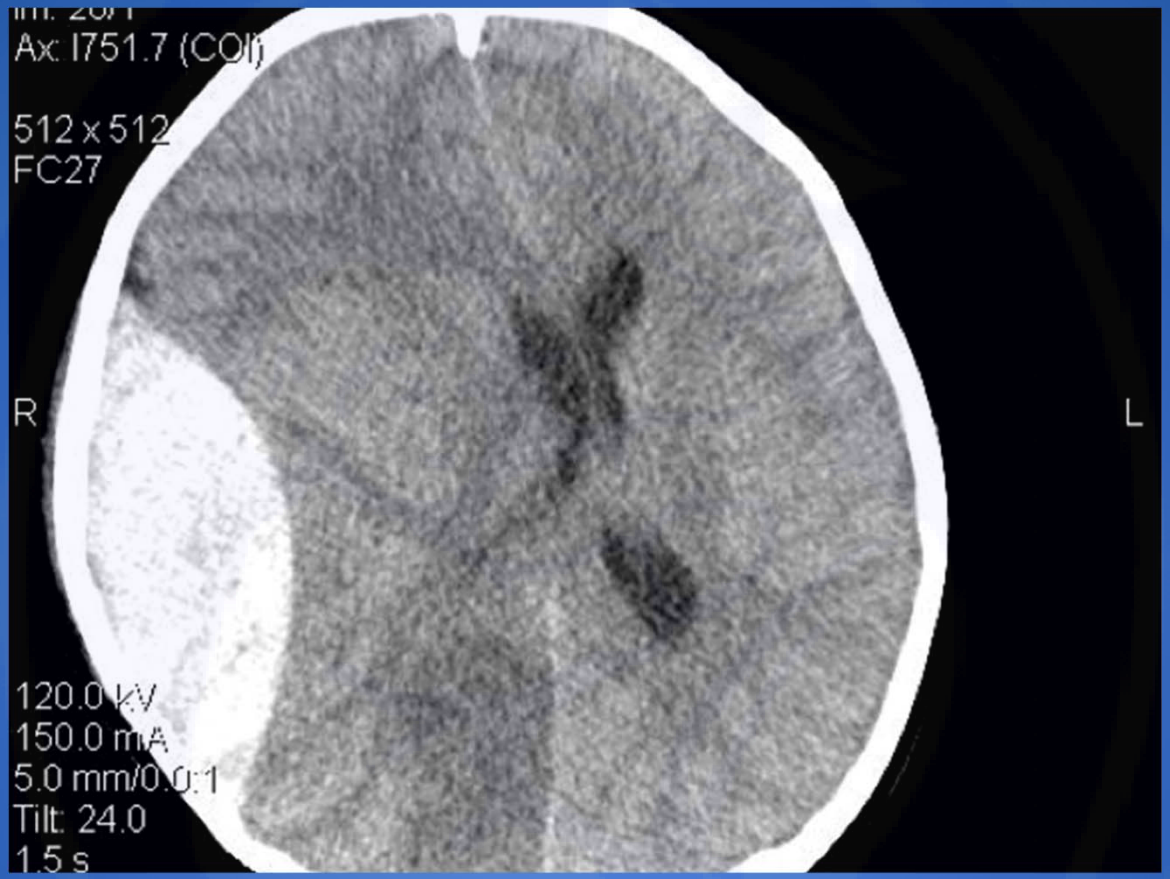

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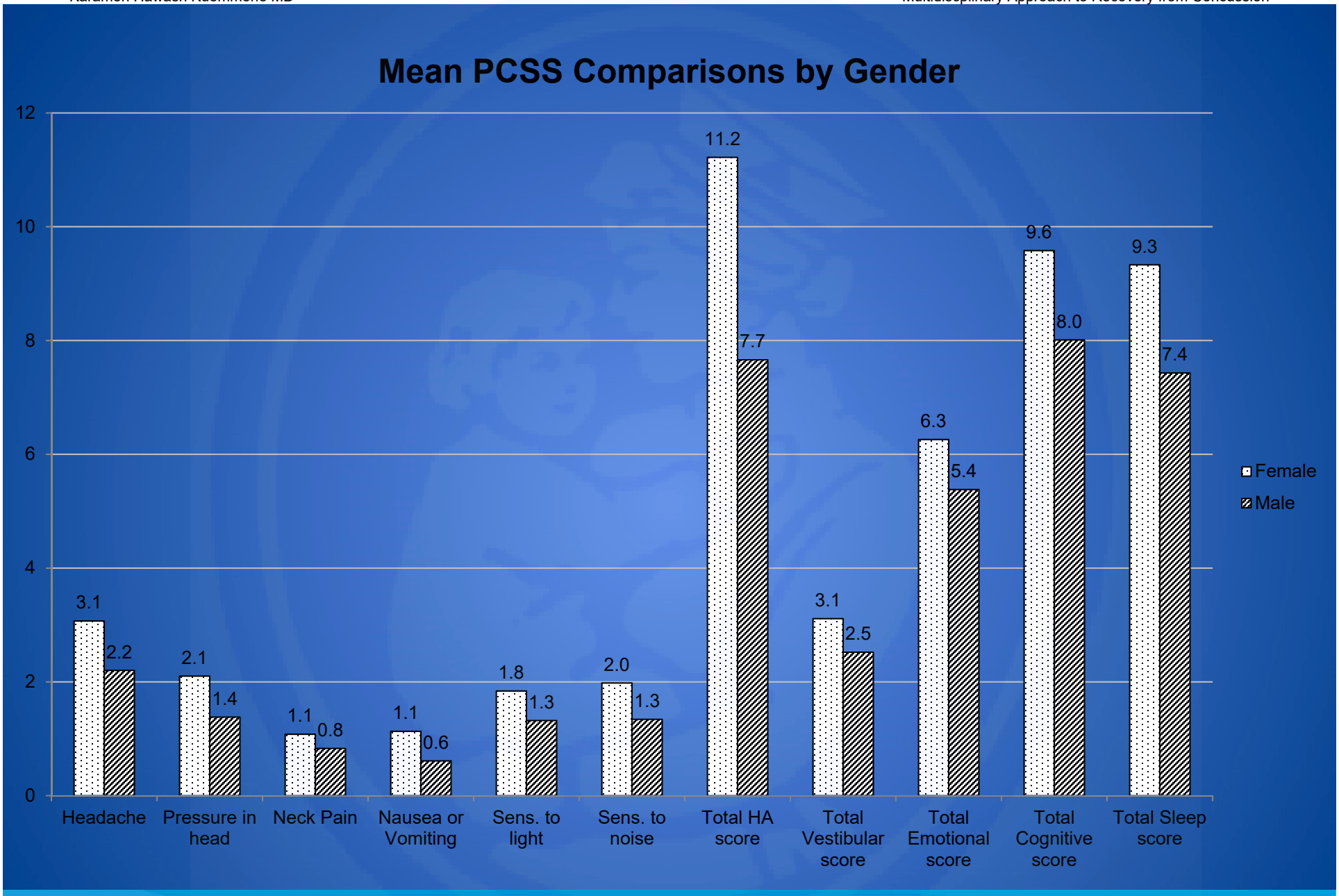

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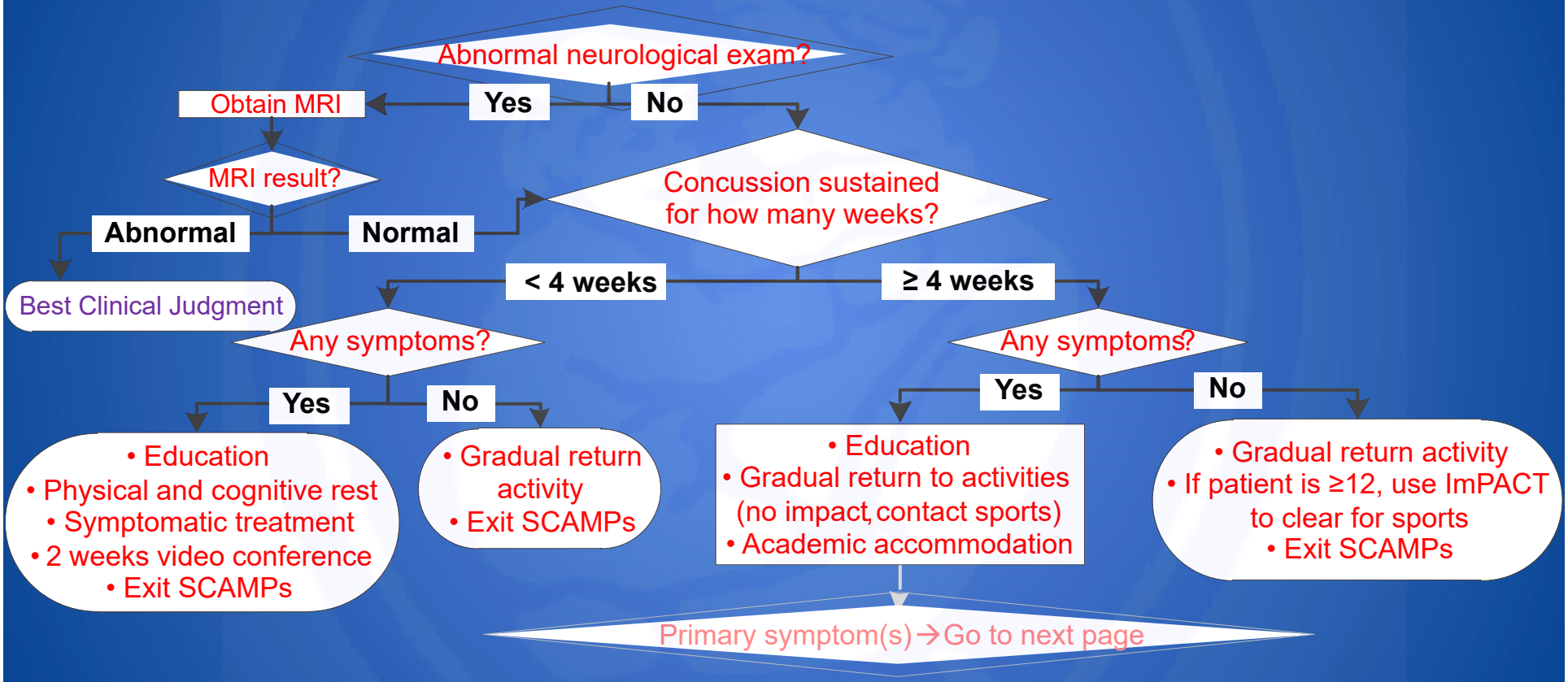
Management of Concussion

Concussion SCAMP Decision Support



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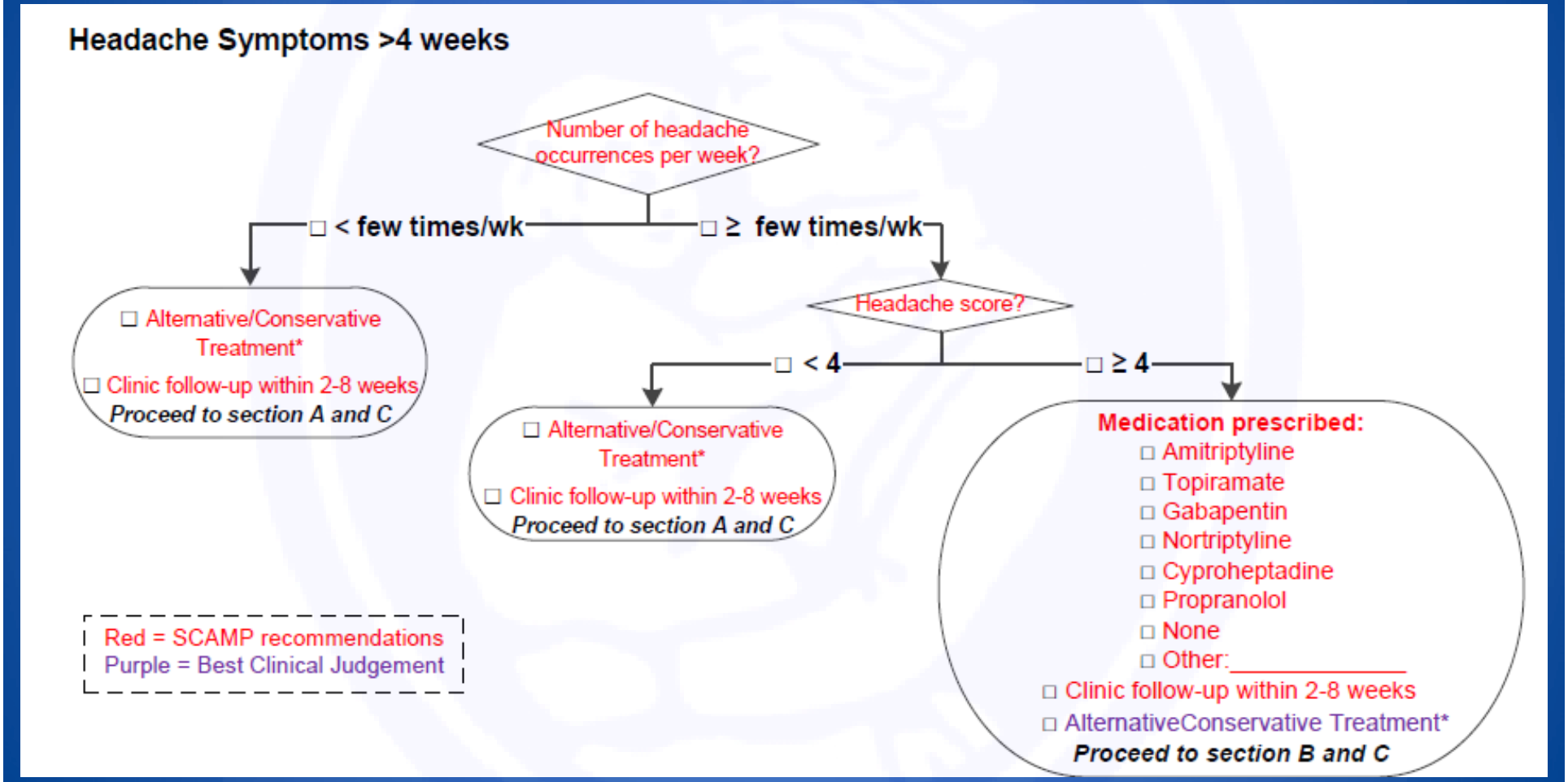
SCAMPS



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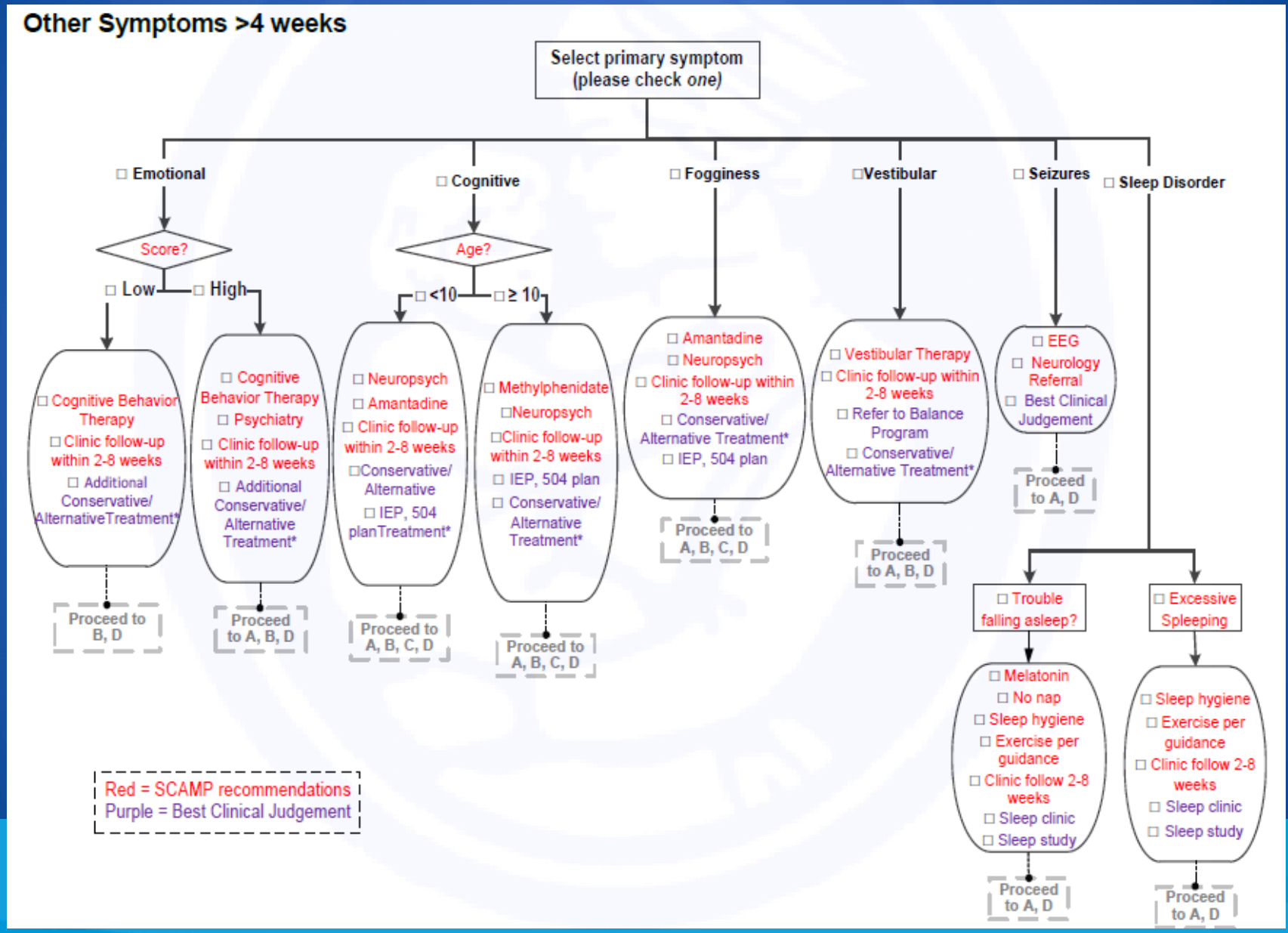
SCAMP



Multidisciplinary Approach

- Neuropsychology
- Otolaryngology
- Physical Therapy
- Sports Medicine
- Neurology
- Ophthalmology
- Optometry
- Educational specialist

Post-Traumatic Headache

International Classification of Headache Disorders 3rd edition

Acute (less than 3 months)	Persistent (more than 3 months)
Attributed to mild traumatic injury to the head or/ Moderate to Severe traumatic injury to the head	Attributed to mild traumatic injury to the head or/Moderate to Severe traumatic injury to the head
Attributed to WHIPLASH injury	Attributed to WHIPLASH injury
Attributed to Craniotomy	Attributed to Craniotomy

- Headache developed within 7 days of TBI
- No specific feature for post-traumatic headache (migraine/tension/cluster/cervicogenic)
- Isolated or part of a group of post concussion symptoms
- >3 month → Headaches + other symptoms = Post-Concussion Syndrome
- Pre-existing primary headache becomes chronic or worsened after head trauma, it is diagnosed as secondary post-traumatic headache

Post-Traumatic Headache: (no specific type)

	Tension	Migraine	Cervicogenic	Cluster
Quality	Bilateral, Moderate Dull, pressure or squeezing	Unilateral Severe Throbbing Nausea/Vomiting Photo-/phonophobia Sensory Vision	Unilateral Mild-severe Aching	Severe unilateral throbbing + autonomic activation: lacrimation, rhinorrhea
Location	Vary	Vary	Focal/neck	Retro-/peri-orbital
Triggers	Tension/reading Sustained poor posture	Exercise Lights and sounds	Neck movement/ history of whiplash	Alcohol

General Headaches Management

- Identify Headache type
- Educate and Manage Expectations
- Identify Headache Triggers and Relievers
- Review Sleep, Hydration, Diet, Exercise recommendations
- Avoid OTC medication overuse 1-3 times per week
- Educate about Relaxation Techniques, CBT and Coping Strategies

Medication-Overuse Headaches Management

E. Pinchefsky et al./Pediatric Neurology 52 (2015)

- Weaning or stopping of the overused abortive medications
- Starting preventative medications or other interventions once problem is identified
- Bridge therapy with a new acute medication (Indomethacin or Steroids)
- Establish treatment limits on use
- Patient education
- Consider steroid treatment or occipital block

Abortive Medications

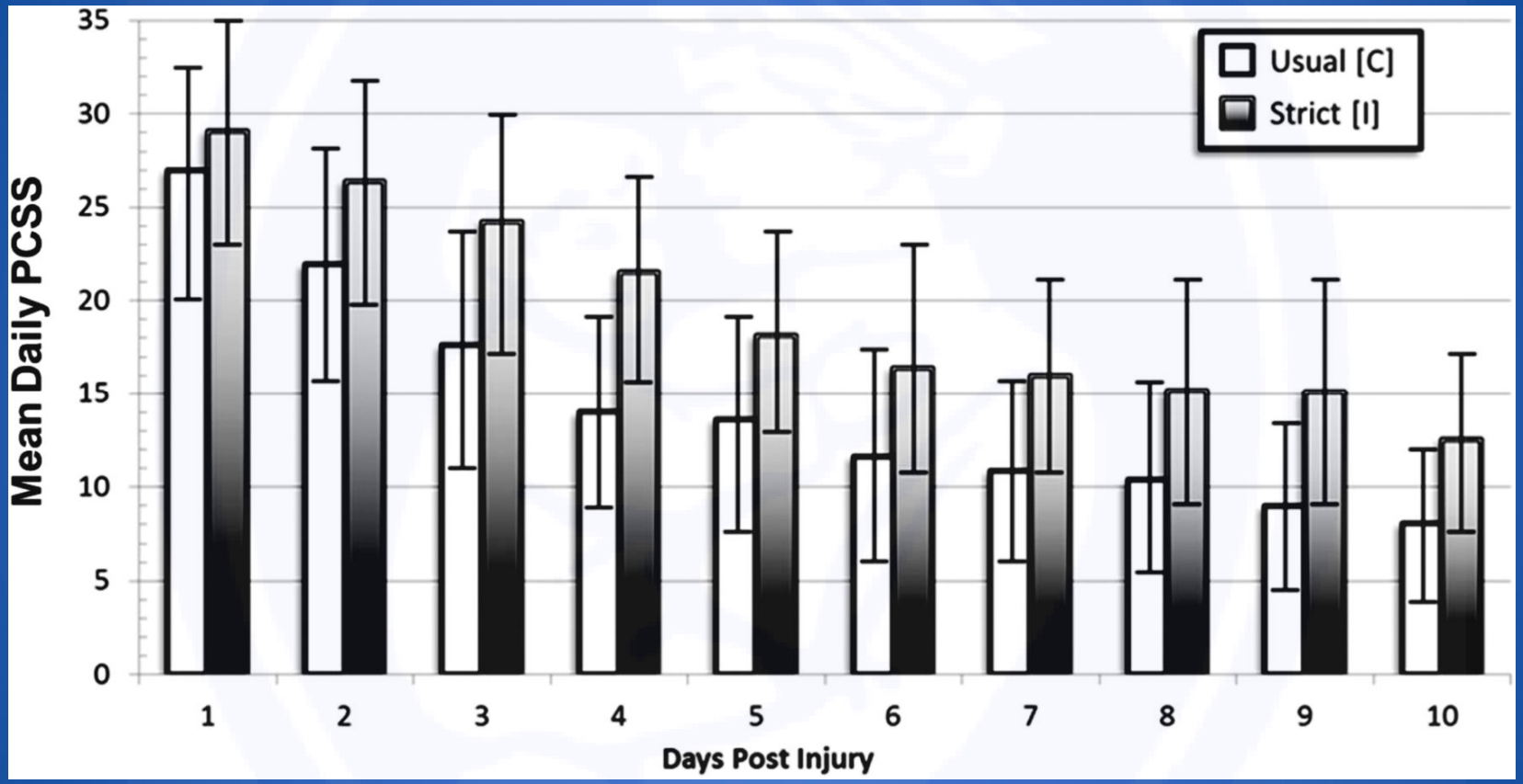
Different references

Medication	Side Effects
Acetaminophen	Liver Dysfunction
Ibuprofen	Gastritis, CI: Intracranial Hemorrhage
Naproxen	Gastritis, CI: ICH, Renal or Liver Disease
Ketorolac	GI bleeding, bronchospasm, CI: Asthma, ICH
Metoclopramide, prochlorperazine	Extrapyramidal signs, Sedation
Triptans	CI: ischemic heart disease, hypertension, basilar or hemiplegic migraine features S.E: numbness, tingling
Methyl prednisone	Gastritis, hypertension
Dihydroergotamine	Not w Triptans. CI: hypertension, hemiplegic migraine, pregnancy, CVS disease
OPIOIDS ⃠	MOH and dependence

Exercise

- 20 min 80% HR (5-6 ts/wk)
- Bed Rest harmful to mood, vestibular system and CVS
- All 5 studies (aerobic exercise): No adverse effect
- 2/5: Quick return to school and ↓ symptom duration

Mean PCSS with 95% Confidence Interval Over Time



Danny George Thomas et al. Pediatrics 2015;135:213-223

PEDIATRICS®

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Preventative Medications

- Start 2-4 weeks in the presence of persistent severe symptoms
- Start with a small dose and adjust according to response, side effects and efficacy
- Choose medication according to nature of symptoms, side effects profile and patient profile

Preventative Medications

Medication	
Amitriptyline & Nortriptyline: TCA	Sedation, appetite increase, mood changes, suicidal ideation, palpitation, dizziness (most studied with positive outcomes in small series). Nortriptyline: less sedating and less appetite increase
Cyproheptadine: Antihistamine	Suitable for children less than 10. Increases appetite and it is sedating
Gabapentin: AED	Mostly well tolerated but can cause dizziness and intense sedation (no studies)
Topiramate: AED	Word finding difficulties/cognitive side effects/paresthesia/Suitable in over weight patients with no cognitive concerns
Propranolol: Antihypertensive	CI: Asthma. Worsens depression and dizziness. Use with anxiety
Verapamil: Calcium channel blocker	Established migraine treatment
Valproic acid/Tegretol	No studies

Treatment

Occipital Nerve Blocks

Indicated when there is:

- Occipital cephalgias with or without occipital tenderness
- Cervicogenic headaches
- Localized Neck Tenderness
- 93% of pediatric patients reported significant improvement (Dubrovsky 2014 Headache)

Sleep

Sleep/Wake Disturbances

- 40%-60% of our concussion patients in the neurology clinic (30 d) present with trouble falling asleep or excessive sleepiness
- S/W d affect headaches, mood, fatigue, cognitive function especially executive function (prefrontal cortex benefits the most from sleep)

TREATMENT

- Sleep Hygiene
- Melatonin, Zinc, Magnesium
- Acupuncture, exercise, relaxation technique
- Pharmacological Management: TCA, Trazadone, Mirtazapine

Autonomic dysfunction

- Lightheadedness, fatigue, exercise-induced headache, impaired cardiovascular response to exercise
- Trauma to the cervical spinal cord and lower brainstem/whiplash
- Aerobic exercise

Balance

- Concussion can affect gait and worsen stressed gait
- Vision problems can alter gait
- Poor balance is a risk factor for repeated concussions especially in sports

How to test Gait

- Bess Testing
- Dynamic dual-task assessments can provide information about functional gait and recovery
- Instrumented gait tests in a balance center or athletic specialized facility is more sensitive than traditional testing
- It provides targets for improvement

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Traumatic Vestibular Pathology

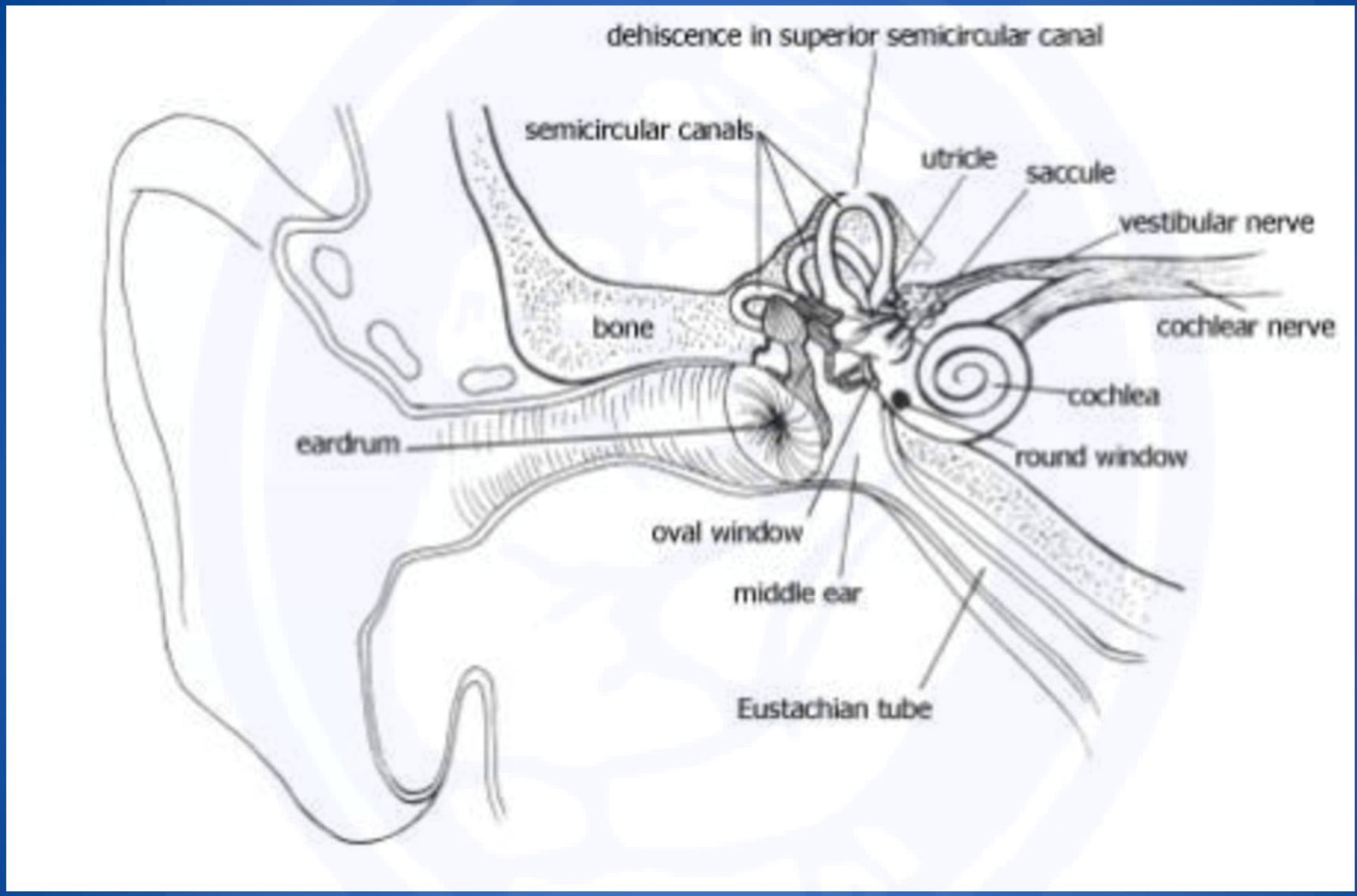
- Benign Paroxysmal Positional Vertigo (BPPV)
- Third window lesions
- Temporal bone fracture
- Labyrinthine concussion

Superior Semicirular Canal Dehiscence

- Dehiscence: Opening in the bone covering the SSC of the inner ear
- First decribed in 1998
- Dehiscence creates a 3rd opening in the inner ear (Oval window and round window)

Superior Semicircular Canal Dehiscence

- Vertigo
- Hearing loss
- Oscillopsia
- Hyperacusis



SSCD

- Diagnosis:
- CT imaging: Thin cuts through the inner ear (False positive)
- Vestibular Evoked Myogenic Potentials (VEMP)

Treatment

- Surgical correction: Middle cranial fossa approach
- Plugging the canal with fibrous tissue and small bone chips is most effective
- Risk: hearing loss in affected ear

Labyrinthine Concussion

- High frequency sensorineural hearing loss with or without vestibular symptoms following head trauma without a labyrinthine fracture
- Also Inner Ear Concussion and comotion labyrinthitis
- Expectant treatment
- Steroids are very controversial

Physical Therapy

- PT can be very helpful to patients who are slow to recover especially with dizziness, neck pain and headaches
- Vestibular and multimodal PT
- Shown to improve and fasten recovery

Return to activity

- Bed rest does not improve recovery.
- In some studies outcome worsened.
- In some studies after days of bed rest, headaches, restlessness and difficulty sleeping occur.

Cognitive Symptoms

- Symptoms

Inattention

Decreased Processing Speed

- Treatment

Amantadine: (Increases dopamine release and blocks its uptake, improve depression symptoms in rat models)

Stimulants

Omega 3 FA

Improve sleep and treat headaches

Neurolopsychology in Concussion

- Improves ability to diagnose
- Testing is important for clearance to return to play
- Empowering to patients especially if cognitive dysfunction is perceived but not real

Psychology

- Irritability
- Depression
- Anxiety
- Low self esteem
- Increased emotional burden because of missing school and sports
- Bullying
- Accusations of being a faker

Psychological/Emotional Symptoms

- Delayed Recovery
- Worsen headaches
- Worsen sleep
- Affect social adjustment

Coping Strategies

SE Woodrome et al. Journal of the international Neuropsychological Society (2011) 17, 317-326

Coping strategies Inventory	Subscales	Example items
Problem-focused engagement	Problem-solving	"I made a plan of action and followed it."
	Cognitive restructuring	"I convinced myself that things are not quite as bad as they seem."
Emotion-focused engagement	Express emotions	"I let out my feelings to reduce my stress."
	Social contact	"I found somebody who was a good listener."
Problem-focused disengagement	Problem avoidance	"I went along as if nothing were happening."
	Wishful thinking	"I hoped a miracle would happen."
Emotion-focused disengagement	Self-criticism	"I blamed myself."
	Social withdrawal	"I spent more time alone."

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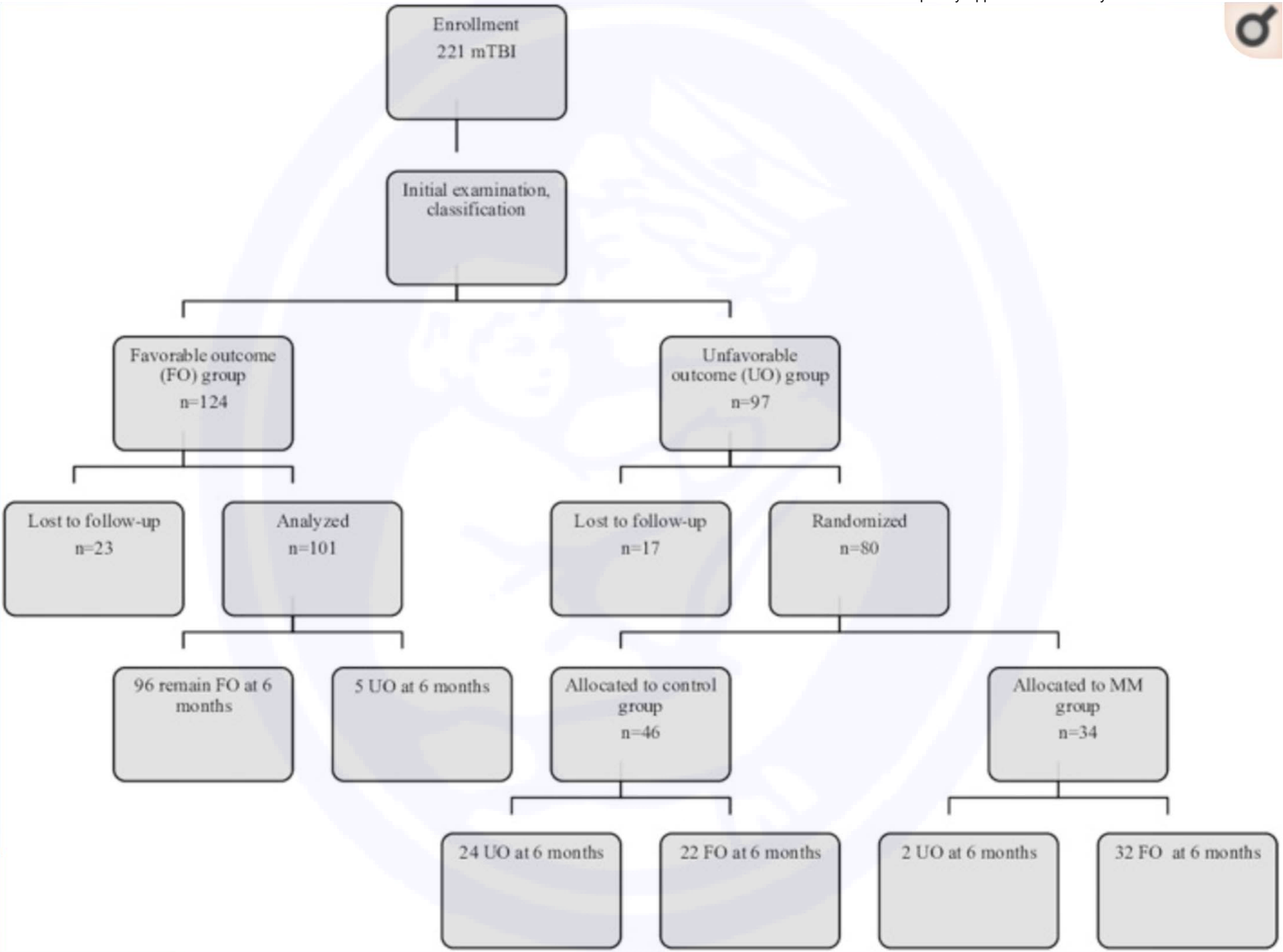
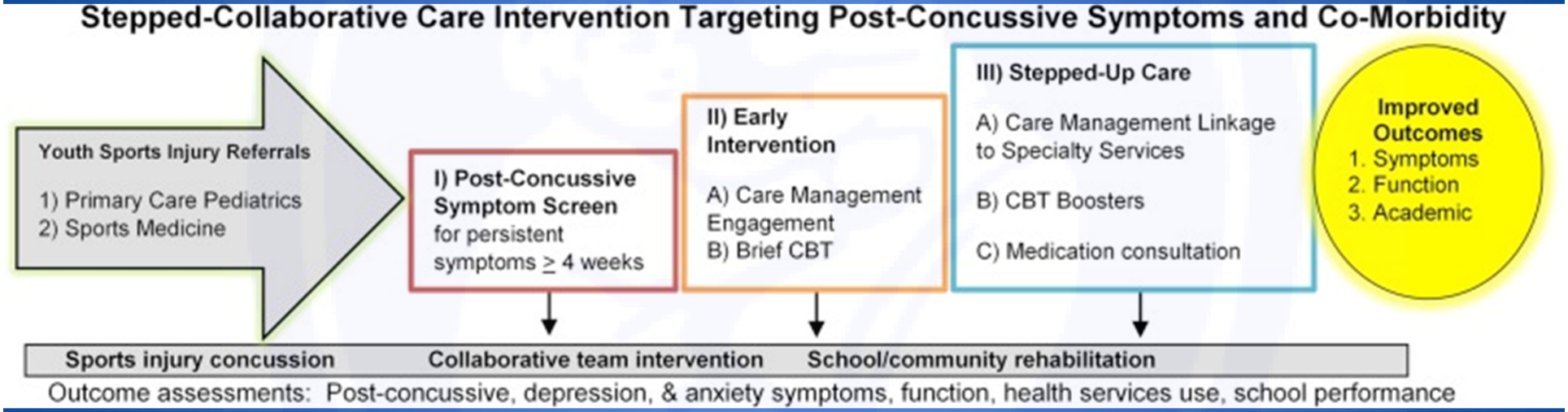
Cognitive Rehabilitation

- Multifactorial integrative model
- Identify appropriate patients
- Early Initiation of MM for high risk mTBI improve their outcomes.



McCarty et Al/ Trials 2019



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CBT

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CBT

- Pain management
- Problem-solving, mindfulness, challenging negative thinking
- Relaxation and imagery
- Emotion regulation
- Family communication skills, parent and child interaction
- Sleep hygiene
- Motivation, homework assignments

Memantamine
Mannix/Neuroscience(2019)

- NMDAR antagonist
- Suppress GSK β activation
- rTBI→damaged axons, cytoplasmic inclusion, swollen mitochondria, splitting myelin sheaths, decline in oligodendrocyte
- Memantamine protects against demyelination, oligodendrocyte loss and while matter loss
- Potential for rapid clinical translation in rmTBI

Neuroprotection

Glutamate Network Dysfunction Following TBI is studied well in CCI models and epilepsy

Glutamate and GABA Imbalance Following TBI

Guerriero et al.

Decrease Glutamate Acute Toxicity by:

- NMDA blockage
- Remove glutamate from the synapse by scavengers like pyruvate and oxaloacetate
- Up regulate glutamate transporters by: ? Ceftriaxone or Dehydroepiandrosterone
- Neuromodulation: anodal transcranial direct current stimulation → GABA reduction in motor cortex and improved memory (NOT TBI model)

96 Final Recommendations Comprise the Guidelines

BRAIN INJURY
http://informahealthcare.com/bij
ISSN: 0269-9052 (print), 1362-301X (electronic)
Brain Inj, Early Online: 1–13
© 2015 Informa UK Ltd. DOI: 10.3109/02699052.2015.1004755
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ORIGINAL ARTICLE

Updated clinical practice guidelines for concussion/mild traumatic brain injury and persistent symptoms

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Abstract

Objective: To introduce a set of revised guidelines for the management of mild traumatic brain injury (mTBI) and persistent symptoms following concussive injuries.
Quality of evidence: The Guidelines for Mild Traumatic Brain Injury and Persistent Symptoms were made available in March 2011 based on literature and information up to 2008. A search for new clinical practice guidelines addressing mTBI and a systematic review of the literature evaluating treatment of persistent symptoms was conducted. Healthcare professionals representing a range of disciplines from Canada and abroad attended a consensus conference to revise the original guidelines in light of new evidence.
Main message: A modified Delphi process was used to create 96 recommendations addressing the diagnosis and management of mTBI and persistent symptoms, including post-traumatic headache, sleep disturbances, mental health disorders, cognitive difficulties, vestibular and vision dysfunction, fatigue and return to activity/work/school. Numerous resources, tools and treatment algorithms were also included to aid implementation of the recommendations.
Conclusion: The revised clinical practice guideline reflects the most current evidence and is recommended for use by clinicians who provide care to people who experience PPCS following mTBI.

Keywords

Concussion, diagnosis, guideline recommendations, management, mild traumatic brain injury, persistent post-concussive symptoms

History

Received 14 July 2014
Revised 13 November 2014
Accepted 4 January 2015
Published online 14 April 2015

Introduction

Mild traumatic brain injury (mTBI) is a significant cause of morbidity, with many survivors of mTBI dealing with significant symptoms up to years beyond the usual recovery period of ~3 months [1–3]. As one of the most common neurological disorders, mTBI has an estimated annual incidence of 500/100 000 in the US [4]; a 2009 Canadian study suggested the annual incidence in Ontario (Canada) lies between 493–653/100 000, depending on whether the diagnosis was made by primary care providers or based upon a secondary review by an expert [5]. The actual incidence of mTBI is likely in excess of 600/100 000, as many persons who suffer a mTBI do not seek hospital-based care [6].

Various terms are used synonymously with mTBI including mild head injury, minor head trauma and concussion, which is defined as physiologic disruption of brain function resulting from traumatic force transmitted to the head [7].

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While the diagnosis of concussion is often related to a sport aetiology, any form of trauma may be the cause. In contrast, mTBI is defined by a Glasgow Coma Scale score [8] of 13–15 and limited post-traumatic amnesia, to permit differentiation from moderate and severe injuries. Nonetheless, the definitions overlap considerably and most would agree that concussion lies on the 'milder' end of the mTBI spectrum [9].

In most cases, patients who experience mTBI of any aetiology will recover fully, typically within days to several weeks. However, 10–15% of individuals with mTBI will continue to experience persisting symptoms even after 1 year [10, 11], which can include post-traumatic headache, sleep disturbance, disorders of balance, cognitive impairments, fatigue, dizziness and mood or affective disorders. The diagnosis of post-concussion syndrome has been surrounded by debate and controversy [12, 13], as there is significant symptom overlap with other diagnoses and complications of trauma, such as depression, anxiety and post-traumatic stress disorder. Regardless of formal diagnosis and course of recovery following mTBI, persistent symptoms following mTBI can cause functional limitations, heightened emotional distress and delayed return to activity, work or school [14, 15].

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