TRAUMATIC BRAIN INJURY IN BOXING AND MIXED MARTIAL ARTS

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ACUTE TRAUMATIC BRAIN INJURY (ATBI)

- DIFFUSE BRAIN INJURY
  - Diffuse axonal injury (KO)
  - Cerebral concussion
  - Second Impact Syndrome
- FOCAL BRAIN INJURY
  - Subdural and epidural hemorrhage
  - Cerebral contusion
  - Other cerebral hemorrhages (rare)
COMMON SIGNS AND SYMPTOMS OF ATBI

- Cognitive features
  - Decreased speed of information processing
  - Confusion/ Disorientation
  - Amnesia/ Memory impairment
  - Impaired concentration
  - Loss of consciousness
- Behavioral features
  - Irritability/ Anxiety
  - Sleep disturbance
  - Fatigue/ Apathy/ Psychomotor retardation
  - Easily distracted
- Physical features
  - Headache/ Dizziness
  - Nausea
  - Impaired coordination/ ataxic gait
  - Visual disturbances
  - Vacant stare
  - Seizure
PATHOPHYSIOLOGY OF BRAIN INJURY IN BOXING

Three types of stresses to the brain.
1. Compressive
2. Stretching (tensile)
3. Shearing – the most dangerous
HEAD BLOWS

- Rotational (angular) acceleration – blows to the side of the head or to the chin that produce the greatest shearing forces causing direct neuronal and vascular damage, either focal or diffuse.
- Translational (linear) acceleration – jabs to the face that are less dangerous but still can account for coup – contrecoup injury to the brain.
- Impact deceleration – occurs when head strikes the mat after a KO and may cause an additional traumatic brain injury.
CONCUSSION

• A complex pathophysiologic process that affects the brain and is induced by traumatic biomechanical forces.
• Typically it is a rapid onset of short-lived impairment of neurological function that resolves spontaneously (although a small percentage will have prolonged post-concussion symptoms.
• It is difficult to diagnose during a boxing match because most concussions are not associated with LOC and, a fighter who gets KO’d may or may not be concussed.
• It is a clinical diagnosis as neuroimaging is usually wnl.
CONCUSSION (cont.)

- Neuropsychological /neurocognitive screening is becoming the standard of care for evaluating concussed athletes. ANAM, Cog Sport, Head Minder and ImPact are current screening tools.
- It is helpful to know the fighter’s pre-injury level of cognitive function to assess and document recovery.
- A graduated “return to play” protocol should be followed (3rd International Conference on Concussion in Sports) with the average recovery time being about one week.
- Role of trainers and managers in combat sports.
INDICATIONS FOR NEUROIMAGING

- Loss of consciousness (unless a “flash” knockout)
- Prolonged post concussion symptoms
- Abnormal ringside GCS

CT SCAN IS PERFECTLY ADEQUATE AS A POST-FIGHT MODALITY. MRI IS PREFERRED AS A PRE-FIGHT SCREENING TEST.
INDICATIONS FOR TRAUMA CENTER REFERRAL

• GCS < or = 13
• LOC with delayed recovery
• Persistent or focal neurologic deficits or symptoms
• Seizure
• Clinical suspicion of skull fracture
• Non-neurologic emergencies
SECOND IMPACT SYNDROME

• An exaggerated, often fatal (>50%) response to a second head injury while the athlete has not fully recovered from an earlier concussion.

• The diagnosis requires a witnessed first impact, ongoing symptoms of head trauma up to the time of the second impact, a witnessed second impact with subsequent rapid cerebral deterioration and neuropathologic or neuroimaging evidence of massive cerebral edema.

• There may be no or an insignificant amount of blood collection in the brain.
SECOND IMPACT SYNDROME (cont)

- Thought to be due to loss of vasomotor autoregulation leading to excessive hyperemia or cerebrovascular engorgement and eventual brain stem herniation.
- More often seen in youth football and can be a dramatic result of a minor injury.
- Management is generally medical and supportive in nature.
- Prevention is achieved by restricting the symptomatic boxer from participating in sparring or competition.
INTRACRANIAL HEMORRHAGE IN BOXING AND MMA

- Subdural – the most common
- Epidural – the most rapidly progressive
- Intraparenchymal – cerebral contusion
- Subarachnoid – very rare in combat sports
SUBDURAL HEMATOMA

- The leading cause of boxing fatalities
- Rupture of the bridging veins and/or cortical arteries
- Associated with prolonged periods of unconsciousness after a KO or delayed LOC/persistent symptoms from excessive head trauma. CHECK THE DRESSING ROOMS BEFORE LEAVING ANY BOXING VENUE!!!
- Requires immediate surgical evacuation of the blood if neurologic deficits or evidence of brainstem herniation is present.
EPIDURAL HEMATOMA

• Much less common in combat sports
• Rupture of the middle meningeal artery resulting from fracture of the overlying temporal bone.
• Typically, a lucid interval follows an initial period of unconsciousness and then rapidly deteriorates.
• Immediate surgical evacuation of blood is required.
CHRONIC TRAUMATIC BRAIN INJURY (CTBI)

• Dementia Pugilistica, “Punch Drunk” Syndrome
• The long-term cumulative neurologic consequence of repetitive blows to the head (not necessarily KO’s!)
• Estimated 15%-40% of professional boxers are affected. These numbers are decreasing and not seen in MMA.
• Advanced CTBI can resemble Parkinsons and/or Alzheimer's Dementia.
STAGES OF CTBI IN BOXERS

EARLY
• Dysarthria
• Mild incoordination or tremor
• Decreased attention span
• Emotional lability

MODERATE – progression of early symptoms
• Parkinsons-like movement and ataxic gait
• Memory and executive function deficits
• Inappropriate behavior
• Violent outbursts
DEMENTIA PUGILISTICA

• The late or severe stage of CTBI in boxers
• Prominent extrapyramidal or cerebellar symptoms
• Amnesia and frontal lobe dysfunction
• Psychomotor retardation
• Disinhibition, hypersexuality, psychosis
DIAGNOSIS OF CTBI

- Detailed physical exam
- Neuropsychological testing (pre-injury state is helpful)
- Cerebral atrophy on CT or MRI
- Possible roles for EEG, PET, SPECT scanning
- Autopsy findings of neurotoxic tau protein deposits in the brain
RISK FACTORS FOR CTBI

- Total number of fights (>150 bouts)
- Number of knockouts experienced
- Number of losses (not reliable)
- Duration of boxing career (>10 years)
- Fight frequency
- Age of retirement from boxing (>28 years old)
- Sparring exposure
- Poor performance or skills (“slugger vs boxer”)
- APOE e4 genotype
MANAGEMENT OF CTBI

• Supportive care
• Drugs for Parkinsons disease
• Drugs for Alzheimers disease
• Role of boxing medical community and RINGSIDE OFFICIALS, TRAINERS, ETC