MORE THAN A CONCUSSION: EXTRAORDINARY RETURN TO PLAY IMPLICATIONS

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I have no financial disclosures.
14 y/o male presented to Sports Medicine clinic 2 weeks post non-helmeted, head to head collision in flag football scrimmage

+LOC for 1-5 minutes and post-traumatic amnesia x 48-72 hours

Air-lifted to nearest hospital and admitted x 3 days

No admission GCS, but reportedly 14 on admission to PICU

MRI showed SAH involving corpus collosum and right parietal region + questionable right frontal calvarium hairline fracture

Evaluated by Neurosurgery and recommended for non-surgical management
Case History

- Re-taken to ER on the way home 2/2 increased confusion and headaches
- Repeat CT scan stable
- Patient denied any TBI related symptoms
- Patient did not have any seizures or seizure-like activity
- Patient’s reported reason for visit was school required evaluation for athletic clearance given football season was beginning
- **Patient had already been cleared by outside neurosurgeon for exercise progression**
Case History (continued)

- Past Medical History
  - Denied migraines, prior concussion, ADHD, or learning disorders

- Past Surgical History
  - None

- Social History
  - Lived with parents
  - Denied tobacco/ETOH/illicit drug usage
  - Current B-average high school student

- Functional History
  - Doing all ADL’s and school activity w/o reported issues
  - Balance and vision issues with low to moderate level activity

- Denied Drug Allergies, current medications, or family history

- 14 Point ROS was negative
Physical Examination

- HEENT/neck: CN 2-12 intact, no head lesions; no lid lacerations or facial bruising
- Neck: full pain-free range of motion in all planes; nontender midline
- Psych: appropriate mood and affect
- MSK: 5/5 strength bilateral upper and lower extremity
- Skin: no obvious abrasions
- Psych: appropriate mood; alert, awake; oriented fully
- Neuro: sensation intact bilateral upper and lower extremity; + Hoffman test RUE, neg babsinki bilateral; Neg rhomberg ; AAOx4
- Difficulty with dynamic balance and tandem gait as evidence by a Balance Error Scoring System (BESS) test score of 15
- Rapid alternating movements intact bilat heel-to-shin but slowing UE; slowed right side finger-to-nose
- VOMS testing positive for horizontal nystagmus, vertical lag with VOR, and accommodation abnormality
Neuropsychology Evaluation

- Neuropsychological evaluation revealed no reported symptoms
- ImPACT testing
  - Decreased Visual Memory
  - Decreased Verbal Memory (based off perceived ability)
  - Decreased efficiency with the testing
  - Decreased reaction time
- Paper and Pencil testing
  - Significantly decreased visual spatial abilities
  - Significantly decreased visual scanning
  - Decreased ability to shift and maintain problem solving abilities
Case History
Physical Examination
Differential Diagnosis
Work Up
Final Working Diagnosis
Treatment
Outcome and Return to Play
Discussion Points

Differential Diagnosis

- Mild Traumatic Brain Injury
- Moderate Traumatic Brain Injury
- Severe Traumatic Brain Injury
- Acute Psychiatric Disorder
- Epileptiform Disorder
- Hydrocephalus
Case History

Physical Examination

Differential Diagnosis

Work Up

Final Working Diagnosis

Treatment

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Discussion Points

Final Working Diagnosis

- Moderate Traumatic Brain Injury Secondary to Traumatic Subarachnoid Hemorrhage
- Cognitive Impairment
- Balance Impairment
- Visual/Motor Discoordination
Management

- Referral to Optometry
- Referral to Vestibulo-ocular Physical Therapy Specialist
- Patient was not cleared for contact activity at time of evaluation
- Academic accommodations
- Patient was not allowed to lift weights until cleared to do so at least 6 months post injury
- Education to patient, family, and athletic trainers on current data related to this topic and the fact there is no clear protocol for return to play. Discouraged return to contact sport.
2.5 month period of Vestibular and Ocular Physical Therapy
   - Habituation exercises
   - Buffalo Concussion Treadmill Testing for exertion
   - Balance (static and dynamic; varying base of support; stable and unstable ground)
   - VOR training for gaze stabilization

Over time, ImPACT scores and clinical examination normalized
Patient never went to Optometry referral
Continued in school throughout his rehab process without any reported major issues
Gradually began lifting weights 6-7 months post injury
Evaluation 10 months post injury
   - Normal clinical exam except brief saccadic event with downward gaze
### Progression Evaluated Through IMPACT Testing

<table>
<thead>
<tr>
<th>Exam Type</th>
<th>Baseline</th>
<th>Post-Injury 1</th>
<th>Post-Injury 2</th>
<th>Post-Injury 3</th>
<th>Post-Injury 4</th>
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<tbody>
<tr>
<td>Date Tested</td>
<td>09/31/2017</td>
<td>07/02/2018</td>
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<td>Last Concussion</td>
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<td>2.1</td>
<td>3.2.3</td>
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</table>

### Composite Scores

<table>
<thead>
<tr>
<th>Score Type</th>
<th>Baseline</th>
<th>Post-Injury 1</th>
<th>Post-Injury 2</th>
<th>Post-Injury 3</th>
<th>Post-Injury 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory composite (verbal)</td>
<td>76</td>
<td>82</td>
<td>84</td>
<td>80</td>
<td>88</td>
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<tr>
<td>Memory composite (visual)</td>
<td>67</td>
<td>61</td>
<td>76</td>
<td>75</td>
<td>82</td>
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<tr>
<td>Visual motor speed composite</td>
<td>37.72</td>
<td>44.08</td>
<td>41.65</td>
<td>43.43</td>
<td>43.88</td>
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<td>Reaction time composite</td>
<td>0.77</td>
<td>0.7</td>
<td>0.67</td>
<td>0.67</td>
<td>0.61</td>
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<tr>
<td>Impulse control composite</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>3</td>
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<tr>
<td>Total Symptom Score</td>
<td>0</td>
<td>8</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Cognitive Efficiency Index: 0.22, 0.18, 0.33, 0.28, 0.35
Return to Play

- Encouraged evaluation with Sports Optometry to optimize mild ocular involvement through vision therapy at last visit
- Patient ran track starting 8 months after his injury and was successful
  - Qualified for the state meet in the 4x100 relay
- Cleared at 10 months post injury for full contact progression with his athletic training staff
- Currently involved in spring practice and planning to participate in spring game later this month
ACSM recommends
- 3-6 months minimum for RTP if skull fracture
- Repeat scan prior to RTP if bleed
  - CAVIAT: (Tamraz 2003) residual hemosiderin can be detected on scans for years after insult

One year minimum after craniotomy prior to contact RTP

Cantu 1996 guidelines for immediate retirement from Contact Sports
- Persistent concussion symptoms
- Permanent CNS dysfunction
- Hydrocephalus
- Spontaneous SAH
- Symptomatic painful/neurological abnormalities of the foramen magnum
Expert opinion
- One year
- Discourage collision sport involvement

In the presence of mTBI, isolated SAH does not appear to worsen outcomes

Use of diffusion-weighted imaging
- Good imaging detail but limited access and cost prohibitive
Case History

Physical Examination

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Discussion Points

Figure 1 Considerations for concussed athletes leading to medical care or return to sport (RTS)

Concussion event → See team ATC/MD

Symptoms and signs resolve/RTS < 2 weeks?

Yes

No

Which symptoms persist?

Behavioral

Cognitive/academic

Vestibular/neuroophthalmological

Somatic (e.g., headache, disordered sleep)

Seek specialist care

Continued desire to play?

Yes

No

Proceed to retirement discussion (6)

Return to athletics via established RTS/RTL guidelines (80-90% of athletes)

Voluntary hiatus from sport

Symptoms resolve in timely and satisfactory manner (and continued desire to play)?

Yes

No

Proceed to retirement discussion (1)

Return to athletics via established RTS guidelines

Voluntary hiatus from sport

The circled numbers included in the boxes at many of the endpoints correspond to the patient case numbers described in the prior section. LOC = loss of consciousness; RTL = return to learn; SRC = sports-related concussion.

Neurology 2018 (Davis-Hayes)
Return to play decisions for contact sports after brain bleeds are made on a case by case basis.

Educate your patient on the risks of return to contact sport after a brain bleed.

Listen to your patient and their desires in life and sport.

Always evaluate every situation on your own.

Utilize your colleagues in other fields of medicine:
- Neuropsychology
- Physical Therapy
- Optometry
References

- Robert Cantu. Head Injuries in Sport. BJSM, 1996 (30);289-96.
- Hou DJ et al. Diffusion-weighted magnetic resonance imaging improves prediction in adult traumatic brain injury. Neurotrauma 207; 24(10); 1558-69.


https://www.google.com/search?q=concussion+in+sport&source=lnms&tbm=isch&sa=X&ved=0ahUKEwipoejm1MDhAhURpFkKHVsCOcQ_AUIDygC&biw=1563&bih=909#imgrc=t9aRtGbEuQb4oM:

https://www.google.com/search?q=subarachnoid+hemorrhage&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi7hK2M1sDhAhVr1IkKHWliAEAQ_AUIDiygB&biw=1368&bih=802#imgrc=4LGNww7k--6ZeM:
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