Sport-Related Structural Brain Injury Associated with Arachnoid Cysts: A Systematic Review and Quantitative Analysis

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Disclosures

• None
Background

- Sport-related concussion public health problem
  - Structural brain injury rare
- Arachnoid cysts are very common (0.7-1.7% population)
- Literature postulates those with arachnoid cysts are more prone to intracerebral injury after trauma
  - Vessels unsupported by cyst
  - Vessels decreased compliance
  - Slit-valve mechanism increases pressure within cyst
  - Associated skull thinning

Objective

• It is postulated that children with arachnoid cysts (AC) demonstrate higher rates of structural brain injury (subdural hematoma, hygroma, hemorrhage) after trauma, including while playing sports.

• Given the potential neurologic consequences of a structural brain injury requiring neurosurgical intervention, we performed a systematic review of pediatric sport-related structural-brain injury associated with AC with a corresponding quantitative analysis.
Methods

• PRISMA guidelines
• Four major electronic databases
• Systematically searched references
  — **Inclusion:** studies of sport-related structural injury associated with AC
  — **Exclusion:** if no structural injury described, no AC present, or injury occurred due to reason other than sports
• Included **41 studies = 49 cases** for review
• Studies spanned **1958-2015** with the median year of publication, 2003
• Descriptive statistics were summarized.
• Univariate logistic regression assessed for predictors of neurologic deficit, open craniotomy, and cysto-peritoneal shunt.
Results

- Forty-one studies reported 49 cases of sport-related structural brain associated with AC in children.
- Median age at presentation was 14 years.
- Soccer (27%) and football (12%) were the most common sports.

<table>
<thead>
<tr>
<th>Sport</th>
<th>Author, Year</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soccer</td>
<td>Oliver, 1958; Maeda, 1993; Kawanishi, 1999; Kawanishi, 1999; Chillala, 2001; Prabhu, 2002; Offiah, 2006; Domenicucci, 2009; Zeng, 2011; Isik, 2011; Maher, 2013; Edmondson, 2014; Takizawa, 2015</td>
<td>13 (27)</td>
</tr>
<tr>
<td>Football</td>
<td>Vigil, 1998; Donaldson, 2000; Gelabert, 2002; Bristol, 2007; Maher, 2013; Cress, 2013</td>
<td>6 (12)</td>
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<tr>
<td>Bicycle</td>
<td>Rogers, 1990; Donaldson, 2000; Blereau, 2013; Raveenthiran, 2014; Takizawa, 2015</td>
<td>5 (10)</td>
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<tr>
<td>Swimming/water sports</td>
<td>LaCour, 1978; Cullis, 1982; Rogers, 1990; Zhang, 2007</td>
<td>4 (8)</td>
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<tr>
<td>Martial arts</td>
<td>Weinberg, 1973; Yokoyama, 1988; Kertman, 2012</td>
<td>3 (6)</td>
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<td>Physical/weight training</td>
<td>Ochi, 1996; Mori, 2002</td>
<td>2 (4)</td>
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<tr>
<td>Boxing</td>
<td>Robles, 2006</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Dancing</td>
<td>McNeil, 1986</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Equestrian</td>
<td>Page, 1987</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Hockey</td>
<td>Ellis, 2015</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Roller-blading</td>
<td>Albuquerque, 1997</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Rugby</td>
<td>Varma, 1981</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Skateboarding</td>
<td>Varma, 1981</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Volleyball</td>
<td>Hamada, 2010</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Sport not specified</td>
<td>Pretorius, 2005; Tsitispoulous, 2008; Zeng, 2011; Zeng, 2013</td>
<td>4 (8)</td>
</tr>
</tbody>
</table>
Results

• Nearly all (90%) presented greater than 7 days after the injury.
  – Headache was the most common presenting symptom (98%), followed by nausea/vomiting (50%).
  – One-quarter presented with a neurologic deficit, most commonly hemiparesis.
• Subdural hematoma (72%) was the most common imaging finding.
• Nearly all (98%) were located in the middle fossa/sylvian fissure.
• The vast majority were treated surgically (94%)
  – Open craniotomy and burr holes were performed in 53% and 37% respectively.
  – Seven patients (14%) received a cysto-peritoneal shunt.
• No significant predictors were found for neurologic deficit or open craniotomy.
• The odds of receiving a cysto-peritoneal shunt decreased as age increased (p=0.004).
• All reported outcomes were good.
Conclusions

- Pediatric sport-related structural brain injuries associated with AC are rare.
- The majority of cases presented with chronic symptoms, most commonly headache, and recovery was good.
- Injuries occur in team/non-team and contact/non-contact sports.
- Most are treated with open craniotomy or burr hole.
- We did **not** find a contraindication to participate in sports in patients with an AC, although parents and children should be counseled appropriately.
- Further studies are necessary to evaluate AC characteristics that could pose a higher risk of adverse events after trauma.
Thank You