Cervical Spine Injuries in Fayed Resort: Shallow Water Accidents

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Abstract

Background Data: Shallow-water diving injuries have devastating consequences for patients and their families in terms of requiring intensive use of resources in both the acute and rehabilitative phases of injury. With the final clinical outcome often poor, the question is raised as to whether a target group can be identified for whom to implement a preventive program.

Purpose: Our aim is to evaluate the demographics, clinical features and outcomes of shallow-water diving injuries in Fayed resort.

Study Design: A descriptive analytic cross section prospective study involving 20 patients with diving accidents.

Patients and Methods: During the period from January 2011 to May 2014, 20 patients who presented with diving accidents from Fayed city were surgically treated in Suez Canal University Hospital in the Neurosurgery Department. Initial treatment was made according to Advanced Trauma Life Support guidelines, followed by neurological and radiological examination to determine the severity of the injury. Neurological classification was made according to the American Spinal Injury Association/International Medical Society of Paraplegia Impairment scale. Cervical traction was used in cases of subluxation. Surgery was performed in cases of spinal instability or cord compression.

Results: Neurologically, eight patients had complete ASIA, grade A, spinal cord injury, eight had incomplete spinal cord injury ASIA grade B (1 patient), grade C (3 patients), grade D (4 patients). The other 4 were normal ASIA, grade E. Five patients presented with teardrop fractures, five burst fractures, eight patients presented with flexion distraction injury including five with bilateral locked facets and three unilateral locked facets and two presented with fracture of the posterior elements. Surgical fusion was done in sixteen patients including anterior approach in fourteen patients and combined anterior and posterior approach in two patients. No neurological deterioration was recorded. Overall, 30% (6/20) patients improved neurologically during hospitalization with regard to the ASIA Impairment Scale.

Conclusion: A very specific patient profile was identified, and the severity of shallow-water diving injuries was confirmed. These data should be used to motivate further educational and preventive programs for reducing the incidence of diving-related injuries. (2014ESJ087)

Key Words: Central cord syndrome, cervical spine injuries, Water-activity-related injuries, diving accidents.
Introduction

Spine injuries are most commonly caused by motor vehicle accidents, falls, and violence. However, spine injuries can also result from accidents that occur during recreational activities. One group of these activities is performed in the water (sea, lakes, rivers, pools, etc.). Different kinds of aquatic spine injuries are secondary to diving, surfing, or waterskiing accidents.\textsuperscript{1,3,4,6–8, 14}

The most common spine injury associated with aquatic activities reported in the literature is caused by diving into shallow waters. Emergency physicians and spine surgeons who practice in beach areas have probably seen the uncommon case of patients who were playing or swimming in the see and then became quadriplegic after reckless diving in water thus presented with cervical spine injuries. There are few reports in the medical literature concerning spine injuries in shallow water.\textsuperscript{1,3}

Fayed city is one of the most important tourist cities in Egypt. It overlooks the Bitter Lakes that connects both ends of the Suez Canal beaches. It has dozens of private beaches and wonderful tourist villages. The depth of water in Fayed beaches is shallow even distance from the edge of the beach. Many platforms to jump extend distance into water in many of the city tourist villages.

The aim of this study was to analyze main features and outcomes of diving accidents, accepted in our service from Fayed resort in the last five years.

Patients and Methods

The aim of this study was to analyze main features and outcomes of diving accidents, accepted in our service from Fayed resort in the last five years. Items include age and gender, type and level of cervical lesion, associated injuries, neurological status on admission and discharge, treatment, length of hospitalization and complications during treatment, cervical deformity following the vertebral lesion, and rehabilitation.

During the period from January 2011 to May 2014, 20 patients who presented with cervical spine injuries secondary to diving accidents from Fayed city were surgically treated in Suez Canal University Hospital in the Neurosurgery Department. This study was undertaken in relation to diving accidents that took place in Fayed city, a tourist destination with shallow canal water and many platforms to jump in shallow water of the Suez Canal lakes close to the shore. Only patients who presented radiological findings of cervical spine fracture or dislocation or neurological deficit were included. The mechanism of accident was almost the same in every patient; they were jumping into the canal water. Most of them hit their head into the sand with compression cervical spine injury.

Initial treatment was made according to Advanced Trauma Life Support guidelines,\textsuperscript{10} followed by neurological and radiological examination to determine the severity of the injury. The mechanism of injury was established from clinical information and was correlated with data from imaging studies. Neurological classification was made according to the American Spinal Injury Association/International Medical Society of Paraplegia Impairment scale.\textsuperscript{9} (Table 1) Radiographs and computed tomographic scans were performed depending on the patient’s symptoms and clinical findings. Subaxial cervical spine fractures was done according to Allen mechanistic classification.\textsuperscript{2} Patients with neurological deficit or those who needed further evaluation to rule out ligament injury had magnetic resonance imaging. Patients with degenerative changes such as osteophytosis, disc collapse, calcification of posterior longitudinal ligament, and ligamentum flavum hypertrophy with or without secondary spinal stenosis were radiographically classified as having spondylosis. Patients who had neurological findings of spinal cord injury (SCI) were treated with National Acute Spinal Cord Injury Study III methylprednisolone protocol treatment.\textsuperscript{11} Cervical traction was used in cases of subluxation. Surgery was performed in cases of spinal instability or cord compression.

Results

All patients were men and local tourists. Their ages ranged from 15 to 34 years, with a mean age 24.3 years (Table 2). All spine injuries were located in the lower cervical spine; there were no injuries above third cervical vertebra.

Neurologically, eight patients had complete ASIA grade A spinal cord injury. Eight patients had incomplete spinal cord injury ASIA grade B (1 patient), grade C (3 patients), grade D (4 patients)
(those included central cord syndromes in 6 patients and Brown Sequard syndromes in 2 patients). Four patients were normal ASIA grade E. (Table 1) Four patients presented with associated injuries; two of them presented with a mild head injury with loss of consciousness, and another two presented with near drowning.

Radiographic studies and clinical information suggested different patterns and mechanism of injury including 14 (70%) patients with hyperflexion, four (20%) axial compression, and two (10%) with extension distraction. Five patients presented with teardrop fractures, five with burst fractures, eight patients presented with flexion distraction injury including five with bilateral locked facets and three unilateral locked facets and two presented with fracture of the posterior elements. Of special note is that two (10%) patients presented with initial radiographs without fracture or dislocation, all of whom had CCS (patients No 2 and 11 in table 2). Subaxial cervical spine fracture classification according to Allen mechanistic classification is presented in table 2.

Attempted closed cervical traction was tried in all the seventeen patient indicated for traction (all the patients in table 1 except patients No 9, 14 and 19). Complete reduction was achieved in fifteen patients and partial reduction was achieved in two patients. Surgical fusion was done in sixteen patients including anterior approach in fourteen patients and combined anterior and posterior approach in two patients.

Neurological Outcome:
No neurological deterioration was recorded. Overall, 30% (6/20) patients improved neurologically during follow up with regard to the ASIA Impairment Scale (AIS). All of which were initially incomplete lesions, and the improvement concerned both the neurological level and the AIS. (Table 1)

Table 1: The American Spinal Injury Association Impairment Scale

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A: complete</td>
<td></td>
</tr>
<tr>
<td>B: incomplete: sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5</td>
<td></td>
</tr>
<tr>
<td>C: incomplete: motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3 strength</td>
<td></td>
</tr>
<tr>
<td>D: incomplete: motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more strength</td>
<td></td>
</tr>
<tr>
<td>E: normal</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1.
**Table 2: Pre-operative Data of the Study Group**

<table>
<thead>
<tr>
<th>Patient No</th>
<th>Age/Sex</th>
<th>Allen Mechanistic Classification³</th>
<th>Description</th>
<th>Level</th>
<th>Neurology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15/M</td>
<td>FC5</td>
<td>Tear drop #</td>
<td>C4-5</td>
<td>Complete cord</td>
</tr>
<tr>
<td>2</td>
<td>21/M</td>
<td>FD2</td>
<td>bilateral Locked Facet</td>
<td>C4-5</td>
<td>Central cord syndrome</td>
</tr>
<tr>
<td>3</td>
<td>26/M</td>
<td>FC4</td>
<td>Tear drop #</td>
<td>C5</td>
<td>Complete cord</td>
</tr>
<tr>
<td>4</td>
<td>18/M</td>
<td>VC3</td>
<td>Burst #</td>
<td>C4</td>
<td>Central cord syndrome</td>
</tr>
<tr>
<td>5</td>
<td>29/M</td>
<td>FD3</td>
<td>bilateral Locked Facet</td>
<td>C6-7</td>
<td>Complete cord</td>
</tr>
<tr>
<td>6</td>
<td>31/M</td>
<td>FC5</td>
<td>Tear drop #</td>
<td>C5-6</td>
<td>Complete cord</td>
</tr>
<tr>
<td>7</td>
<td>27/M</td>
<td>FD3</td>
<td>bilateral Locked Facet</td>
<td>C5-6</td>
<td>Incomplete cord</td>
</tr>
<tr>
<td>8</td>
<td>23/M</td>
<td>VC3</td>
<td>Burst #</td>
<td>C5-6</td>
<td>Central cord syndrome</td>
</tr>
<tr>
<td>9</td>
<td>17/M</td>
<td>ED</td>
<td># posterior elements</td>
<td>C6</td>
<td>intact</td>
</tr>
<tr>
<td>10</td>
<td>19/M</td>
<td>FD3</td>
<td>bilateral Locked Facet</td>
<td>C5-6</td>
<td>Complete cord</td>
</tr>
<tr>
<td>11</td>
<td>27/M</td>
<td>FD2</td>
<td>Unilateral Locked Facet</td>
<td>C5-6</td>
<td>Central cord syndrome</td>
</tr>
<tr>
<td>12</td>
<td>32/M</td>
<td>FC5</td>
<td>Tear drop #</td>
<td>C4-5</td>
<td>Complete cord</td>
</tr>
<tr>
<td>13</td>
<td>17/M</td>
<td>FD2</td>
<td>Unilateral Locked Facet</td>
<td>C6-7</td>
<td>Central cord syndrome</td>
</tr>
<tr>
<td>14</td>
<td>24/M</td>
<td>VC2</td>
<td>Cupping of the Vertebral body</td>
<td>C4</td>
<td>intact</td>
</tr>
<tr>
<td>15</td>
<td>34/M</td>
<td>FC3</td>
<td>Burst #</td>
<td>C6</td>
<td>intact</td>
</tr>
<tr>
<td>16</td>
<td>21/M</td>
<td>FD3</td>
<td>bilateral Locked Facet</td>
<td>C5-6</td>
<td>Complete cord</td>
</tr>
<tr>
<td>17</td>
<td>22/M</td>
<td>FC4</td>
<td>Tear drop #</td>
<td>C5</td>
<td>Central cord syndrome</td>
</tr>
<tr>
<td>18</td>
<td>27/M</td>
<td>VC3</td>
<td>Burst #</td>
<td>C5</td>
<td>Central cord syndrome</td>
</tr>
<tr>
<td>19</td>
<td>30/M</td>
<td>ED</td>
<td># posterior elements</td>
<td>C7-1</td>
<td>Incomplete cord</td>
</tr>
<tr>
<td>20</td>
<td>25/M</td>
<td>FD3</td>
<td>bilateral Locked Facet</td>
<td>C5</td>
<td>Central cord syndrome</td>
</tr>
</tbody>
</table>

*Figures, tables, and other content have been adapted for natural reading, with appropriate adjustments to fit the format.*
Discussion

Spine trauma in shallow water Canal bathers is a special type of injury that occurs in the cervical spine. It occurs because of the combination of lack of experience in diving in shallow waters. Young patients present the most severe injuries and a diversity of types of lesions. The most common injury in these situations is complete cervical spine secondary to hyperflexion.

Every patient in this report was a male local tourist, probably with little or no experience of diving in the lake. This increases the risk of experiencing this type of injury. Reports of cervical spine injuries related to aquatic activities have been published previously; the most severe and devastating of these injuries is related to diving into shallow waters. Spine injuries caused by diving affect mostly young men, and almost 50% of these cases present with complete spinal cord injury.1,3 Forty percent of patients in our study suffered complete spinal cord injury.

In these diving-related accidents, patients usually hit their heads into the sand. For this reason, the spine injury occurs in the cervical spine. In the present series, the results show that all of patients were younger than 34 years. The posture of the head and neck at the time of the injury and the location and direction of the force vector will dictate the pattern of cervical spinal injury; the kinetic energy imparted predominantly dictates the magnitude of the injury.5 This statement applies in this case series as well. The main mechanism of injury in our series was hyperflexion (70%). This pattern of injury is explained by the fact that most of the patients hit the sea bottom with their vertex. The rest of the patients presented with vertical compression and extension distraction injuries. In a previous study, Cheng et al,6 reported an incidence of 78% of a hyperflexion injury mechanism in cervical injured patients secondary to head hitting the bottom of the sea.

This report presents and analyzes a series of patients who experienced a cause of spine injuries that has not previously been described commonly. Diving injuries occurred exclusively in the cervical spine because of the special characteristics of the previously described accident mechanism. The most devastating and severe injuries occurred in young patients. Young patients presented with tear drop fractures, burst fractures and locked facets.

Conclusion

A very specific patient profile was identified, and the severity of shallow-water diving injuries was confirmed. These data should be used to motivate further educational and preventive programs for reducing the incidence of diving-related injuries.

References

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الملخص العربي

إصابات الفقرات العنقية في منتجع فايد: حوادث المياه الضحلة

المقدمة: تمثل إصابات الغطس في المياه الضحلة مع إصابات الفقرات العنقية مشكلة كبيرة للمرضى و المجتمعي خصوصاً مع ضعف التحسن الأكلينيكي للإصابات العصبية الناتجة

الهدف: توضيح الخصائص الأكلينيكيه و النتائج الجراحية لإصابات الفقرات العنقية الناتجة عن الغطس في المياه الضحلة في مدينة فايد بالاسمتاليه


النتائج: عانت 8 مرضى من إصابة كاملة للحبل الشوكي و عليا 8 مرضى من اصابة جزئيه و 4 مرضى كانوا بل اصابات عصبية . تم إجراء التدخل الجراحي في 16 مريض لتثبيت الفقرات و قد تم تحسين الحالة العصبية في ستة مرضى

الاستنتاج: يجب البدء في برنامج توعيه لمنع حوادث الغطس و اصابة الفقرات العنقية الناتجة عنها

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