Atlanto-Occipital Dislocation in Side Impact

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Case Occupant

- Driver
- 51-year-old female
- 165 cm (5’5”), 101 kg (222 lb)
- 3-point belt worn
- Driver airbag not deployed
Case Occupant History

- GCS 15 at scene
- GCS 15 when admitted on 4th floor
- Moved to SICU due to change in respiratory status (Day 2)
- Move to NICU post-operatively (Day 3)
Case Occupant Injuries

**CASE NO.: 13-02**
**CASE VEHICLE: 1997**
**TYPE: Oldsmobile Achieva**

**OCCUPANT: Driver:**
**STATURE: 165 cm**
**MASS: 101 kg**
**RESTRANTS: 3-point belt worn**
**SEVERITY: **
**MAIS - 4 : ISS - 36**

- Hemorrhage: subarachnoid within the basal cisterns (3)
- Contusion: cervical spinal cord with quadruparesis and subluxation of C1 and C2 (4)
- Intimal tear; no disruption, bilateral cervical vertebral arteries (2)
- Laceration: grade I, liver
- Hemorrhage: left conjunctiva
- Laceration: 6 cm left cheek
- Injury NFS: left external carotid artery (2)
- Contusion: left lung
- Dislocation: Atlanto-occipital joint (2)
- Fractures, left 1st to 5th posterior left ribs and 1st and 2nd anterior right ribs with hemithorax
The case vehicle was stopped at the controlled intersection in the left-turn lane of a off-ramp from a divided highway and four-lane divided roadway.
Vehicle two was traveling east in the outside lane approaching the intersection. As the driver of the case vehicle began a left turn, vehicle two entered the intersection and struck the case vehicle on the left-side doors.
The impact caused the case vehicle to rotate counterclockwise. The case vehicle came to rest with its rear wheels on the gore of the median, facing south west.
Vehicle two rotated slightly counterclockwise and came to rest facing east in the inside lane.
Path of Case Vehicle
Path of Vehicle Two
09 o'clock PDOF
CDC 09-LZAW-4
1997 Oldsmobile Achieva 4 door

21 mph ?V
Missing Vehicle
Algorithm
1997 Oldsmobile Achieva 4 door

Crashed Vehicle

Exemplar Vehicle
Crashed & Exemplar Oldsmobile Achieva
1997 Oldsmobile Achieva 4 door
1997 Oldsmobile Achieva 4 door – Interior

48 cm estimated B-pillar intrusion
46 cm estimated door intrusion
1997 Oldsmobile Achieva 4 door – Interior
1997 Oldsmobile Achieva 4 door
1997 Oldsmobile Achieva 4 door

Shoulder belt cut with scissors and seat belt cutter
Vehicle Two 1998 Dodge Dakota Club Cab 4x4

Probable source of C-spine injury and facial laceration
Exemplar 1997 Oldsmobile Achieva with Mock-up of a Dodge Dakota

A subarachnoid brain hemorrhage within the basil cisterns, a dislocation of the atlanto-occipital joint, a contusion of the cervical spinal cord with a subluxation of C1 and C2, with resulting motor deficit, an intimal tear without disruption of the bilateral cervical vertebral arteries and an injury to the left external carotid artery were probably caused by the left shoulder being loaded in and down by the intruding door as it was loaded by V2 and the trapping of the driver's head by the hood/grille of V2, which resulted in a distraction of the head-neck complex.
1997 Oldsmobile Achieva 4 door

Probable source of left rib fractures and left lung contusion
Case Occupant

Possible source of liver laceration
Atlanto-Occipital Injuries: Clinical Case Perspective and Review
Mechanism of Injury

- **Tension-Extension**
  - Most Common
  - Injury to Tectorial Membrane
  - Airbag injury most common
  - Supported by high incidence of facial lacerations and mandibular fractures
Exemplar 1997 Oldsmobile Achieva with Mock-up of a Dodge Dakota
Exemplar 1997 Oldsmobile Achieva with Mock-up of a Dodge Dakota
Intraoperative Findings

- Complete ligamentous disruption at Oc-C1
- Small Epidural Hematoma
- No evidence of fracture
Mechanism of Injury

- Hyperflexion
  - More unusual
  - Associated with posterior element fractures
Mechanism of Injury

- Rotation/Lateral Flexion
  - Very rare
  - Alar Ligaments very strong in adults
  - Usually results in occipital condyle fractures
Clinical Presentation

- Few specific symptoms
- Diagnosis based on constellation of
  - Associated Injuries
    - Facial abrasions/lacerations
    - Mandibular fractures
  - Radiological features
  - High index of suspicion in the proper situations
Clinical Presentation

- Major Head Injury
  - Traumatic contusions
  - Posterior Fossa SAH
  - Intraventricular hemorrhage
Clinical Presentation

- Cardiorespiratory Abnormalities
- Cranial Nerve Palsies
  - Sixth most common
  - Lower Cranial Nerve Palsies
Clinical Presentation

- Asymmetric Motor Deficits
  - Hemiparesis and Decerebration
  - Spinal cord Injury from Subluxation
    - Direct SCI
    - Hematoma
  - Vascular Injury leading to Brainstem Infarction
Radiology

- Frank skeletal dislocation or severe malalignment rare
- Swelling of the retropharyngeal space
- Associated cervical fractures
- Diagnosis is often delayed for days
Referenced Research Papers

- Kaufman et al: Occipital Condyle-Superior facet of atlas (Longitudinal AOD)
- Dublin et al: Atlas arch-Post mandibular cortex
- Wholey et al: Tip of Odontoid-Basion ➔ >5mm abnormal
Radiology

• Powers Ratio
  ➔ BC/OA
    ♦ (Basion- Post arch/Ophisthion-Ant arch)
    ♦ Normal 0.77+/-.09
    ♦ <0.9-normal; >1.0 OAD
    ♦ 0.9-1.0; Gray Area (7% of normal, none in AOD)
    ♦ Useful if abnormal, indicates need for neck stabilization
Radiology

- None of these measurements are completely reliable
- CT scan is conclusive
- CT indicated if
  - High clinical suspicion
  - Retropharyngeal Swelling
Radiology

- MRI
  - Details ligamentous injury
  - Highlights associated spinal cord injury
  - Useful to diagnose associated hematoma
Treatment

- Immediate: Cervical Immobilization: Collar/Halo
- Traction Dangerous: Can worsen Deficits
- Definitive Treatment
  - Halo Immobilization
  - Internal Fixation (Occiput to Upper Cervical Spine)
Case Occupant Outcome

- Currently lives independently, on disability
- Residual right hemiparesis, mild
- Left 6\textsuperscript{th} nerve palsy
Summary

- OAD is a rare but often lethal injury
- Diagnosis requires a high degree of suspicion
- Hitherto most commonly described from hyperextension injuries from airbag deployment
- Based on this case, clinical suspicion should be widened to side impact injury
Thank You for your attention