Use of Force Continuum: Medical Aspects

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Disclosures

- No corporate funding or financial investments in any of the companies whose equipment will be discussed.
Objectives

- Discuss medical related issues
  - Restraint position and asphyxia
  - OC spray
  - Conductive Electrical Devices
Death in custody

- Deaths have been associated with use of force techniques
- Deaths will continue to be associated with use of force techniques

“POST HOC ERGO PROPTER HOC”
"after this, therefore because of this."
Positional Restraint and Asphyxia
Positional Asphyxia - Pump Failure

- Supine Position: No restriction of thoracic excursion
- Prone Position: Thoracic excursion restricted by approximately 10%

Extent of Respiratory Compromise

Diaphragm
Respiratory Failure

Lung Failure
- gas exchange failure
- hypoxemia

Pump Failure
- ventilatory failure
- hypercapnia

Airway Obstruction
- hypoxemia & hypercapnea
Original work

Theory of Positional Asphyxia in custody restraint based primarily on the work of Reay et al in 1988

Crossover study of 10 healthy individuals
- exercised on ski machine to HR 120
- measured recovery times for HR and O2 sat to baseline in first the sitting then hogtie positions
- prolonged recovery for HR and O2 sat in hogtie position
  - mean O2 sat recovery time increased 20”
  - mean HR recovery time increased 24”

Reay concluded that custody deaths are a result of adverse physiologic and respiratory effects of body position.
Other case reports and series

1985 Wetli & Fishbain: 7 cases of custody death, 4 associated with hogtie position

1992 Reay: 3 cases of positional asphyxia in individuals placed in prone restraint position in back of patrol cars

1993 O’Halloran and Lewman: 11 cases of sudden death in subjects in prone position (9 of them hogtied)

1998 Hick, et al: 5 cases of restraint-associated deaths resulting in profound acidosis suggesting acidosis exacerbated by hypoventilation as a result of body position
Case Report

1995 Stratton et al: Two cases of unexpected death in restrained individuals during ambulance transport

Conclude death caused by positional asphyxia from restraint for excited delirium
Case report similarities

Cases involved agitated, psychotic individuals in a state of “excited delirium” usually from recreational drug use (cocaine, methamphetamines, ETOH)

Most cases involved traumatic struggle before and during apprehension

No clear evidence of any other specific cause of death on autopsy – diagnosis of positional asphyxia
Autopsy

Pathologists base diagnosis of positional asphyxia on temporal relationship of restraint to sudden death and lack of other obvious cause of death on autopsy.

*Similar Sudden In-Custody Deaths reported in prone, supine and sitting restraint positions*
Restraint Position and Positional Asphyxia

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Study objective: To determine whether the “hobble” or “hoggie” restraint position results in clinically relevant respiratory dysfunction.

Methods: This was an experimental, crossover, controlled trial at a university-based pulmonary function laboratory involving 15 healthy men ages 18 through 40 years. Subjects were excluded for a positive urine toxicology screen, body mass index (BMI) greater than 30 kg/m², or abnormal screening pulmonary function testing (PFT). Forced vital capacity (FVC), forced expiratory volume in 1 second (FEV₁), and maximal voluntary ventilation (MVV) were obtained with subjects in the sitting, supine, prone, and restraint positions. After a 4-minute exercise period, subjects rested in the sitting position while pulse, oxygen saturation, and arterial blood gases were monitored. The subjects repeated the exercise, then were placed in the restraint position with similar monitoring.
Physiology Studies - UCSD

1995 study funded by grant from the County of San Diego

Randomized cross-over controlled trial in 15 healthy subjects

**Phase 1:** PFTs (pulmonary function testing) in different positions: sitting, supine, prone, hogtie restraint

**Phase 2:** Serial ECG, oximetry, *arterial blood gases*, and PFTs during 4’ stationary bicycle exercise followed by 15’ in the sitting and hogtie restraint

In healthy subjects, the restraint position resulted in a restrictive pulmonary function pattern but did not result in clinically relevant changes in oxygenation or ventilation.

We found no evidence to support the theory of positional asphyxia as a result of hogtie restraint body position.
Subsequent studies

Randomized cross-over controlled trial of 18 healthy subjects

Phase 1: Exercised on bicycle up to HR 120 bpm, then measured HR and oximetry in the sitting and hogtie positions. No difference in HR recovery and no evidence of hypoxia.

Phase 2: Simulated vigorous pursuit and struggle (ran 250m), followed by wrestling for 1’, then rest in sitting or restrained position (lateral). No physiologic differences or hypoxia noted in recovery.

Physiologic studies

- No study, including the original Reay study, has shown that the prone restraint position results in hypoxia.
Change in position

“The hogtied prone position should be viewed as not producing significant physiologic respiratory compromise, and it does not produce any serious or life-threatening respiratory effects”

Weight Force during Restraint?

Officer Subduing a Violent Suspect and How It Can Interfere With Breathing

Subject's chest fully extended.

Breathing becomes labored due to pressure being exerted on subject's back.

Officer subdues violent suspect.
Weight Force during Restraint?

Prone Position
Thoracic excursion restricted by approximately 10%

Pressure to Back plus
Restriction of thoracic excursion by prone position
Physiologic Study
Weight Force

Weight Force Study

- 10 subjects placed in sitting, PMRP, PMRP with 25 lbs on back, and with 50 lbs on back for 5 minutes
- PFTs, oxygen saturation, etCO2 measured

Outcomes

Conclusion: Weight force of 25 and 50 lbs on the back does not result in evidence of hypoxia or hypoventilatory respiratory compromise in our healthy subjects.

Weight Force

- Recent UCSD/SDSU study looking at weights up to 225 lbs on back in prone position
  - PFT decreases to 85% (71.6-97.5% of predicted)
  - No associated hypoxia
OC spray

- Inhalation can result in gagging, sob, cough, inability to vocalize
- Symptoms transient (15-30’)
- Respiratory symptoms have led some to suggest role in SDIC syndrome

- AI claims over 90 deaths following OC spray use in 1990s
- Granfield: 30 deaths following OC
- O’Halloran: 21 SDIC, 10 of which involved OC.
- Pollanan: 21 deaths, 4 of which occurred after OC exposure
Similar deaths with OC spray

Cases involved agitated, psychotic individuals in a state of “excited delirium” usually from recreational drug use (cocaine, methamphetamines, ETOH)

Most cases involved traumatic struggle before and during apprehension
OC spray

- Few studies on OC spray as opposed to capsaicin
  - California AG report on 23,000 uses: No fatalities
  - Watson: 908 OC exposures, 10% required medical care, <1% resp sx, no fatalities
  - 2-year joint study of FBI & Army: No long-term health effects seen with OC spray exposure

- Very few studies on respiratory effects of OC spray inhalation in humans
NIJ funded UCSD study

Crossover controlled trial of 35 volunteers to following:

a. Placebo spray followed by sitting position
b. Placebo spray followed by restraint position
c. OC spray followed by sitting position
d. OC spray followed by restraint position
Conclusions:

- OC exposure did not result in any evidence of hypoxia, hypoventilation, or respiratory compromise.
- OC did not result in any further change in pulmonary function (FVC, FEV1) in either sitting or restraint positions as seen in the original UCSD restraint study.