

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

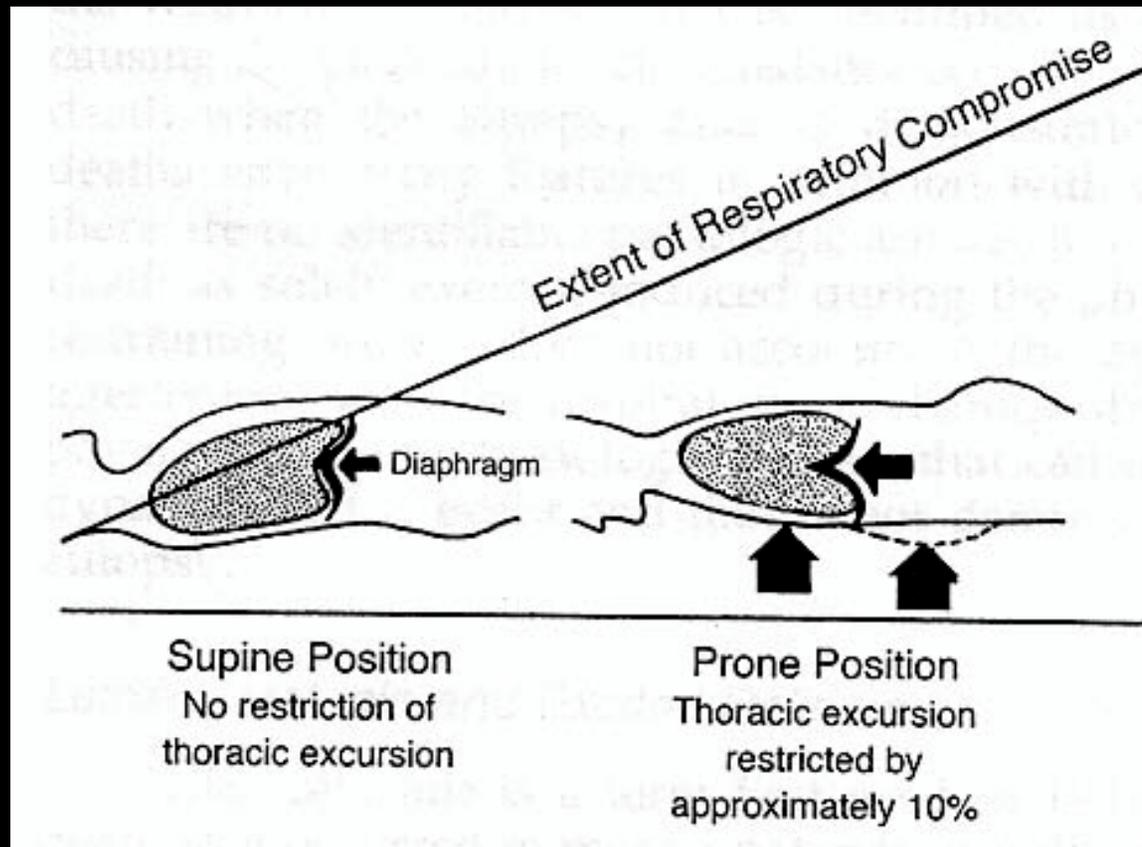
“POST HOC ERGO PROPTER HOC”

"after this, therefore because of this."

Positional Restraint and Asphyxia



Positional Asphyxia - Pump Failure



Respiratory Failure

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 et al: Effects of positional restraint on oxygen saturation and heart rate following exercise. Am J Forensic Med Pathol 1988; 9(1):16-18.

Original work

- Reay concluded that custody deaths are a result of adverse physiologic and respiratory effects of body position

Other caser 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

Physiologic Studies - UCSD

Annals of Emergency Medicine

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American College of
Emergency Physicians

ORIGINAL CONTRIBUTIONS

GENERAL CLINICAL INVESTIGATION

563 Prediction of Early Complications of Myocardial Infarction by Calculation of the ST-T Segment Product
W Schreiber, H Kitter, M Binder, B Hohler

571 ED Use of Rapid Lactate to Evaluate Myocardial Ischemia
NJ Schmiechen, C Han, DP Miltman

578 Restraint Position and Positional Asphyxia
T Neuman, JL Clausen

TOXICOLOGY

587 Prevention of Gastrointestinal Iron Toxicity by Orally Administered Premixed Deferoxime
HF Gomez, HH McClafferty, D Flory, J Brum

593 Intoxicated ED Patients: A 5-Year Retrospective Study of Mortality
P Davidson, J Kazior-McLain

598 Injuries Caused by Hazardous Materials: A Retrospective Study
GN Polyhronopoulos, MJ Castro, RH Gold

604 Regional Intravenous Infusion of Calcium Chloride for the Treatment of Acid Burns of the Upper Extremity

Restraint Position and Positional Asphyxia

Theodore C Chan, MD*

Gary M Vilke, MD*

Tom Neuman, MD*‡

Jack L Clausen, MD†‡

Study objective: To determine whether the "hobble" or "hog-tie" 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

Chan TC, Vilke GM, Neuman T Clausen J: Restraint position and positional asphyxia. *Ann Emerg Med* 1997;578-86.

Physiology Studies - UCSD

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

Schmidt P, Snowden T: The effects of positional restraint on heart rate and oxygen saturation. J Emerg Med 1999, 17(5): 777-82.

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”

Reay DT: Death in custody. Clinics Laboratory Medicine 1998; 18(1):1-22.

Weight Force during Restraint?

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

Subject's chest fully extended.

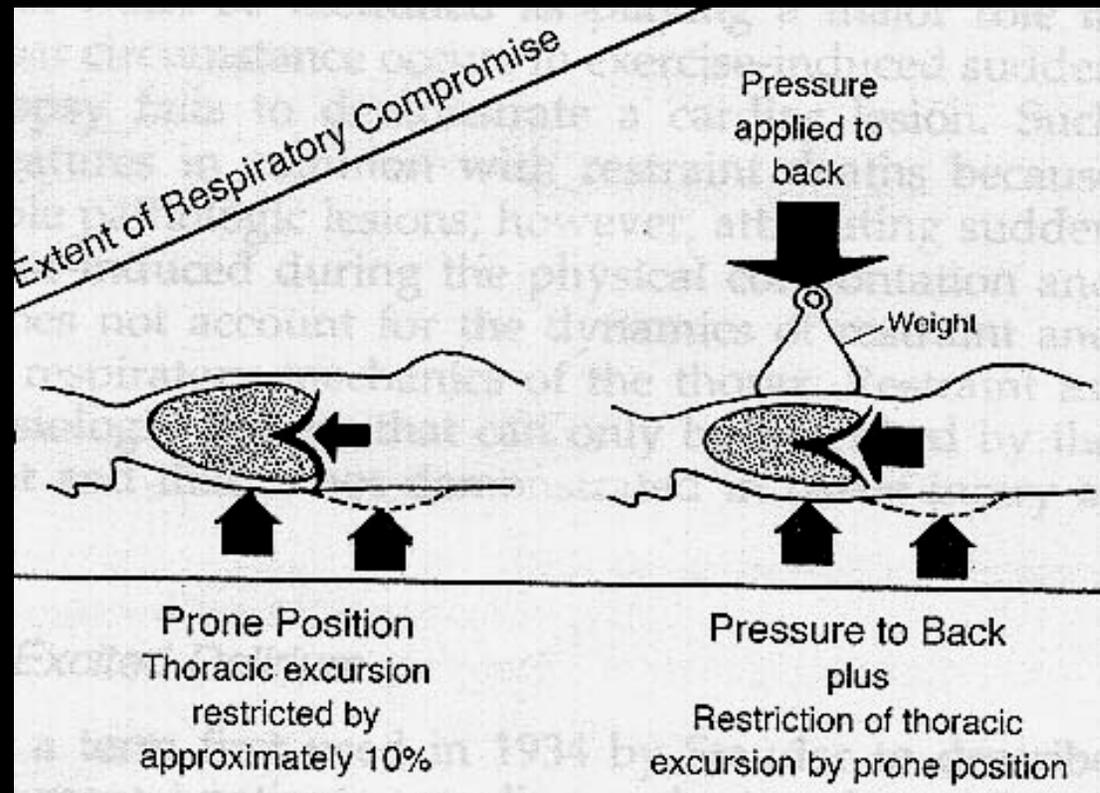


Breathing becomes labored due to pressure being exerted on subject's back.



Officer subdues violent suspect.

Weight Force during Restraint?



Physiologic Study Weight Force

Chan TC, Neuman T, Clausen J, Eisele J,
Vilke GM: Weight force during prone
restraint and respiratory function. Am J
Forensic Med Pathol 2004;25:185-9.

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

Chan TC, Neuman T, Clausen J, Eisele J, Vilke GM:
Weight force during prone restraint and respiratory
function. Am J Forensic Med Pathol 2004;25:185-9.

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.

Chan TC, Neuman T, Clausen J, Eisele J, Vilke GM: Weight force during prone restraint and respiratory function. Am J Forensic Med Pathol 2004;25:185-9.

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

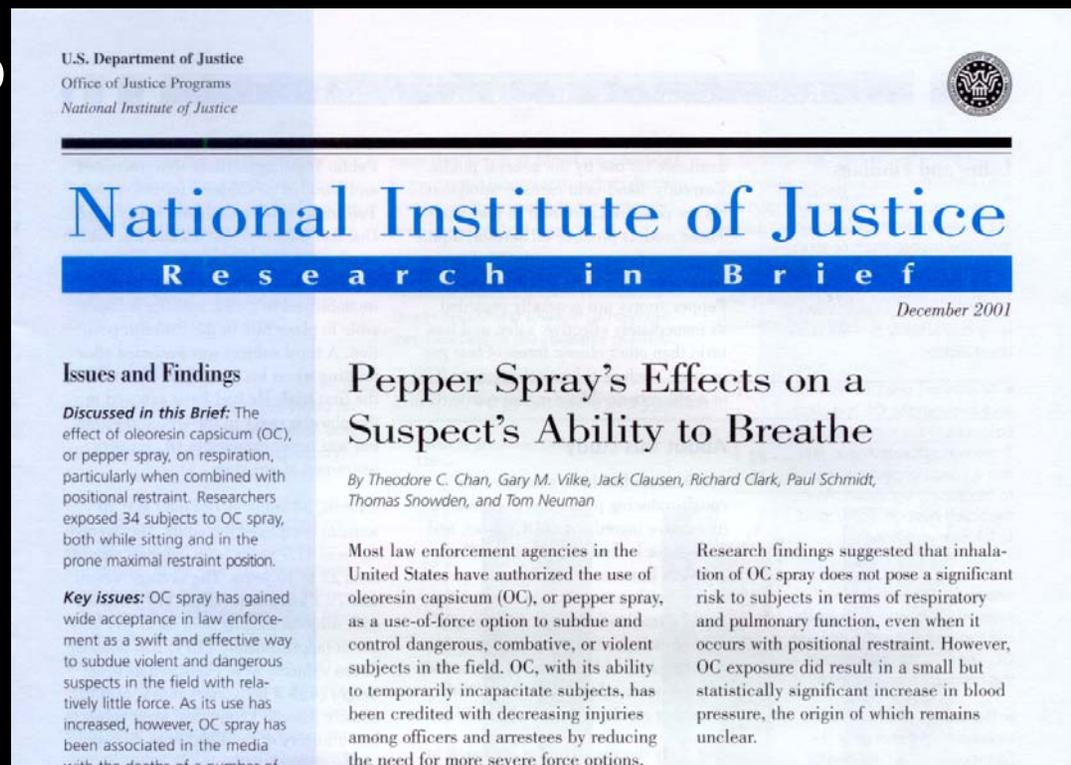
OC spray

- 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



NIJ funded UCSD study

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

