

Annals of Emergency Medicine

Welcome, Ms. Miller - Member of Journal of Emergency Medical Services (JEM)
[My Subscriptions](#) - [My Alerts](#) - [My Profile](#) - [Logout](#)

Search This Periodical

for

[Advanced Search](#) - [MEDLINE](#) - [My Recent Searches](#) - [My Saved Searches](#) - [Set](#)

JOURNAL HOME

CURRENT ISSUE

ARTICLES IN PRESS

WHAT'S COMING IN ANNALS

BROWSE ALL ISSUES

SEARCH THIS JOURNAL

SPECIAL TOPIC
COLLECTIONS

EDUCATIONAL RESOURCES

INSTRUCTIONS FOR
AUTHORS

JOURNAL INFORMATION

- Aims and Scope
- Editorial Board
- Permission to Reuse
- Info for Advertisers
- Contact Information
- Society Information
- Pricing Information
- Classified Ads

SUBSCRIBE TO JOURNAL

MY PDA

VISIT ACEP

JACEP 1972-1979

More periodicals:

FIND A PERIODICAL

GO TO PRODUCT CATALOG

Volume 32, Issue 1,
Pages 117-118 (July
1998)

Theodore C Chan, Gary M Vilke, Tom
Neuman and Jack Clausen

◀ previous 32 of 35 next ▶

FULL TEXT

CITATION ALERT

CITED BY

RELATED ARTICLES

EXPORT CITATION

EMAIL TO A COLLEAGUE

VIEW DRUG INFO

Article outline

- In reply:
- References
- Copyright

In reply:

 return to article outline

We thank Reay et al for their interest in the sudden deaths of physically restrained individuals in custody and appreciate the opportunity to discuss our study recently published in the *Annals* as well as prior work on the subject.¹

We agree sudden deaths of individuals in custody remains a complex issue and determining the cause of death in these cases is difficult. Our study focused on one issue: whether body position in the "hogtie" or "hobble" restraint position leads to respiratory dysfunction to the point that an individual is at risk for asphyxiation.

The study by Reay et al reported in 1988 that healthy volunteers placed in the prone hogtie restraint position had prolonged recovery times for oxygen saturation and heart rate after mild exercise; observations appropriately summarized by the limited claim that "the study found positional restraint to have measurable physiologic effects."² Unfortunately, others have interpreted reports in the literature as evidence the restraint position causes death from asphyxiation by impeding chest and abdominal movement.³⁻⁵

There were significant limitations to the 1988 study and we, therefore, concluded these findings needed confirmation. First, their study used cutaneous oximetry, an indirect measure of blood oxygenation, which is frequently inaccurate under conditions of exercise.^{5,7} Second, their study reported oxygen desaturations down to 85%, substantially lower than what would have been expected at such relatively

mild exercise levels in healthy subjects.^{8,9} Finally, a single outlier significantly skewed their data on oxygen saturation recovery: whereas the mean increase was 68%, the median difference was only 13% (less than 8 seconds, a finding that is of marginal clinical and physiologic significance).²

Our study used direct assessments of blood oxygenation from arterial blood gas analyses as well as cutaneous oximetry. None of these measures demonstrated evidence of hypoxia or desaturation when subjects were in the restraint position after exercise and, in fact, mean PaO_2 increased when compared with measurements in the sitting position before exercise.¹ In addition, direct measurements of PCO_2 showed no evidence of limitations of ventilation in the restraint position and, in fact, mean PCO_2 values were lower than at sitting rest. Finally, even though the levels of exercise were greater, we found no significant difference in heart rate recovery in the restraint position versus controls.¹

We did observe measurable physiologic effects on pulmonary mechanics when results in various body positions were compared, reflecting expected effects of posture on pulmonary physiology. Placing unrestrained subjects in the supine position resulted in lower values for FVC, FEV_1 , and maximal voluntary ventilation as compared with sitting, which were statistically significant. However, the clinical or forensic relevance of such physiologic effects requires thoughtful consideration unless, for example, one is prepared to recommend the sitting position during sleep to prevent asphyxiation.

Reay et al suggest our findings may not be applicable by citing the example of low blood morphine levels at times found in individuals who have died of opiate intoxication. Asphyxiation, however, is directly related to oxygenation and ventilation. Thus measuring these physiologic parameters gives a clear indication of respiratory function and concomitant risk of asphyxiation.

As our study focused on the impact of the restraint position on respiratory function, we made no comment on the issue of "restraint stress" other than to state that factors such as "drug use . . . physiological stress, hyperactivity, hyperthermia, catechol hyperstimulation, and trauma resulting from struggle may be more important factors in the deaths of these individuals."¹ To what extent any restraint causes increased physiologic stress and its contribution to custody death remains speculative.

We disagree with the suggestion made by Reay et al that only forensic pathologists have "insight into the spectrum of illness, injury, and death that occur . . . in the 'street'" and that these "are not well known to clinicians." As emergency physicians we confront these same issues in dealing with acutely ill patients, and believe our insight may be of value in understanding the factors and challenges associated with these deaths.

We agree additional studies should be conducted to further elucidate the pathophysiology behind these cases in the future. Improving the methods used by public safety officers and medical personnel for restraining violent individuals would be substantially expedited by the availability of scientific and clinical studies identifying the specific causes of mortality and morbidity during restraint. It would also be expedited by thoughtful and expert consideration of the results from such studies.

References

 [return to article outline](#)

1. Chan TC, Vilke GM, Neuman T, et al. Restraint position and positional asphyxia. *Ann Emerg Med.* 1997;30:578-586
2. Reay DT, Howard JD, Fligner CL, et al. *Effects of positional restraint on oxygen saturation and heart rate following exercise* [Special issue]. *Am J Forensic Med Pathol.* 1988;9:16-18
3. Reay DT, Fligner CL, Stilwell AD, et al. *Positional asphyxia during law enforcement transport* [Special issue]. *Am J Forensic Med Pathol.* 1992;13:90-95
4. O'Halloran RL, Lewman LV. *Restraint asphyxiation in excited delirium* [Special issue]. *Am J Forensic Med Pathol.* 1993;14:289
5. Stratton SJ, Rogers C, Green K. *Sudden death in individuals in hobble restraints during paramedic transport* [Special issue]. *Ann Emerg Med.* 1995;25:710-712
6. Barthelemy JC, Geyssant A, Riffat J, et al. *Accuracy of pulse oximetry during moderate exercise: A comparative study* [Special issue]. *Scand J Clin Lab Invest.* 1990;50:533-539
7. Norton LH, Squires B, Craig NP, et al. *Accuracy of pulse oximetry during exercise stress testing* [Special issue]. *Int J Sports Med.* 1992;13:523-527
8. Whipp BJ, Wasserman K. *Alveolar-arterial gas tension differences during graded exercise* [Special issue]. *J Appl Physiol.* 1969;27:361-365
9. Hammond MD, Gale GE, Kapitan KS, et al. *Pulmonary gas exchange in humans during exercise at sea level* [Special issue]. *J Appl Physiol.* 1986;60:1590-1598

CA

© 1998 American College of Emergency Physicians. Published by Elsevier Inc. All rights reserved.

[◀ previous](#) 32 of 35 [next ▶](#)