



D37 Positional Asphyxia

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Learning Overview: After attending this presentation, attendees will: (1) review the musculoskeletal mechanics of breathing, (2) examine known mechanisms of positional asphyxia, (3) review two cases involving different mechanisms of positional asphyxia, and (4) gain a broader perspective on the biomechanics of death not otherwise associated with penetrating injuries or other mechanisms that disrupt human ventilation.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing new insights into death caused by positional asphyxia, specifically those attributable to accidental external ventilation restrictions.

Living organisms energized by oxidative phosphorylation of Adenosine Triphosphate (ATP) require oxygen (O₂) for cellular (internal) respiration. O₂ is provided by circulating blood that exchanges cellular by-products (Carbon Dioxide (CO₂)) with O₂-rich air in the lungs. Breathing (external respiration) involves active cyclic muscle-force generated, O₂-rich atmospheric air induction into the lungs followed by passive exhalation of CO₂-rich gas. The lungs are incapable of self-movement and rely on volume changes of the upper chest cavity for CO₂ and O₂ transport. Contraction of the diaphragm and intercostal muscles pull the ribs superiorly and anteriorly, thereby increasing chest cavity volume. This expanding lung volume creates a negative internal pressure resulting in air inhalation. Exhalation is a passive process whereby these muscles relax, the ribs move inferiorly and posteriorly, the volume of the chest cavity decreases, and gas in the lungs is expelled. Sustenance of adequate cellular respiration requires removal of CO₂ and delivery of O₂, which requires movement of a specific volume of air in the respiratory system. This volume must also include sufficient additional to compensate for the “dead air space” in the mouth and trachea. Air in this dead air space does not participate in effective exchange of CO₂ and O₂.

Positional asphyxiation occurs when expansion or relaxation of the ribs cannot occur to a sufficient extent to provide adequate gas exchange. Positional asphyxia may occur with flexed or extended torsos such that adequate musculoskeletal chest movement is prohibited or when immovable external objects obstruct such movements. Positional asphyxia has occurred in industrial accidents, infants belted in some automotive child seat designs, and prisoner restraint. The following describes instances of positional asphyxia for which inhalation or exhalation was inhibited.

Case 1: An 18-wheel truck carrying coil sheet steel, estimated weight approximately 38,000 pounds, struck the rear of a second 18-wheel truck. Delta-V of this collision was approximately 35mph–40mph. Intrusion of the bullet tractor into the target trailer crushed the bullet tractor and limited space forward of the bullet tractor driver. Restraints securing the coiled steel cargo failed and, upon impact, this cargo translated forward and deformed the back of the bullet tractor cab. The back of the cab behind the driver pressed the driver’s seat forward into the area already compacted by impact of the bullet tractor with the target trailer. Although the driver of the bullet tractor sustained no rib fractures, the combined forward and rearward intrusion of the cab flexed his hips and knees toward his chest. This position, in conjunction with the driver’s surfeit of adipose tissue, restricted adequate ventilation of the driver. Eyewitness reports indicated that shortly after the collision, the driver was alert and urgently requested extrication. Unfortunately, the necessary equipment did not arrive in time. The victim expired on the scene *in situ*. Positional asphyxia occurred due to the inability to adequately inhale.

Case 2: A young man was reaching over the third-row seat of a Honda® Odyssey® minivan. Unable to reach the item of interest, he rose from the seat, turned 180°, placed his knees on the seat, leaned over the seat back, bending forward at the waist. The seat rotated toward the back bumper of the van, resulting in pinning the man upside down with the top of the back seat pressed against the inferior aspect of his ribs. The victim was unable to right himself and simultaneously rotate the seat to the normal position. The position of the seat against the ribs partially inhibited diaphragmatic relaxation and inferior rib movement. Adequate gas volume exhalation did not occur. First responders did not arrive in time, and the man expired on the scene due to positional asphyxia believed attributable to the inability to adequately exhale.

Asphyxiation, Accidental Death, Biomechanics of Breathing