



Pathology & Biology Section – 2004

G44 Compressional Asphyxia Due to a Crowd Stampede: The E2 Nightclub Disaster

Adrienne Segovia, MD, Mitra B. Kalelkar, MD, Aldo J. Fusaro, DO, Scott Denton, MD, Edmund R. Donoghue, MD, Kendall V. Crowns, MD, Eupil Choi, MD, J. Lawrence Cogan, MD, Ronald Knoblock, MD, Cyndi D. Gardner, MD, and Barry D. Lifschultz, MD, Cook County Medical Examiners Office, 2121 West Harrison Street, Chicago, IL 60612*

After attending this presentation, attendees will be able to recognize the findings in cases of compressional asphyxia, understand the proposed pathophysiologic mechanism for their development, and become acquainted with models of crowd panic behavior.

This presentation will impact the forensic community and/or humanity by recognizing the findings in cases of compressional asphyxia in your daily forensic pathology practice, understand the proposed pathophysiologic mechanism for asphyxial deaths, and become acquainted with models of crowd panic behavior.

We present 21 deaths due to compressional asphyxia that occurred in a Chicago nightclub stairwell in February, 2003. For reasons that remain unclear approximately 500 persons fled down a long narrow 28 step stairwell. The alleged trigger for the event was an altercation between two women on the dance floor, and the use of pepper spray to control the situation.

The victims ranged in age from 19 to 43 years. Nine were male and twelve were female. At autopsy external evidence of injury, when present, consisted of abrasions and contusions. Petechial hemorrhages of the sclera and conjunctiva, face and neck region were present in 17 of the 21 victims. The remaining five showed scleral and conjunctival congestion without petechiae. Petechiae were also present on the shoulders and the mid back. Petechial hemorrhages of the larynx, oral mucosa, pleura, epicardium, epiglottis and scalp were also present in the majority of the victims. One victim had bite marks of the lips and two had bite marks of the tongue. When present, muscle hemorrhage involved the temporalis and sternocleidomastoid muscles. Hemorrhage was also present in the soft tissues overlying the thyroid. The only bony injury present was a fracture the right second rib anteriorly. Petechial hemorrhages were not identified in the lower extremities of any of the victims. Hyperaeration of the lungs was present in four of the 21 victims. Toxicology studies revealed the presence of alcohol and the presence of an antidepressant in one victim.

Asphyxia due to crowd compression was first described by Ollivier d'Angers in 1837. Ollivier reported that twenty-three persons died when they were compressed by a crowd of approximately 300,000 exiting the Champ de Mars in Paris following a re-enactment of the storming of the citadel of Antwerp. Ollivier used the term 'masque echymotique' to describe the physical findings consisting of subconjunctival hemorrhage, craniocervical cyanosis and cerebral vascular congestion. In 1900, Perthes described the clinical syndrome and included mental dullness, hyperpyrexia, tachypnea, hemoptysis and "contusion pneumonia" to the complex of findings. Since then the syndrome has been further defined and can include neurological complications, ophthalmic complications, petechiae of the mucosal membranes, epistaxis, hematemesis, microscopic hematuria and albuminuria. Associated traumatic injuries have been described. Of these, thoracic injuries are most common and include rib fractures, hemothorax, pneumothorax, pulmonary contusions, cardiac contusion, and clavicle fractures. Fractures the upper extremities, pelvis, lower extremities and spine are the second most commonly associated traumatic injury. More severe, crushing injuries may produce lacerations of the liver, rupture of the diaphragm, as well as injury to the small bowel and colon.

The majority of the victims demonstrated the classic findings of asphyxia by compression - petechial hemorrhages in the absence of associated fatal internal traumatic injuries. The etiology for the development of the classical findings is unclear. A "fear response" leading to closure of the glottis and contraction of the abdominal muscles was proposed in 1905 by Lejars. The work of Williams et. al., in 1968 supported this. Their study monitored blood flow and intrathoracic pressure in anesthetized dogs. They reported that blood flow through the jugular vein and carotid artery decreased with thoracic compression. To simulate closure of the glottis, Williams and co-workers occluded the endotracheal tubes of the dogs, which resulted in an increase in pressure of the jugular vein and the development of the classic findings. The classic findings, however, have been documented in situations when the glottis was not closed; for example, in entrapped victims who were screaming. Nontraumatic/compressional mechanisms can produce the classic findings such as paroxysmal coughing, which can only occur when the glottis is open. Closure of the glottis may be responsible for the hyperaeration of the lungs seen in some of the victims, but not necessarily in the development of subconjunctival, scleral or facial petechiae. The absence of petechial hemorrhages in the lower extremities has been shown to be the result of collapse of the inferior vena cava, which occurs with increasing levels of thoracoabdominal pressure. This protects the veins of the lower extremities.

The twenty-one deaths described above occurred when the crowd panicked and rushed into one of two available stairwells. The term panic will be used here to describe flight from a perceived danger. For panic to



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develop a specific threat to physical survival having immediate effects must exist. The behavior of panicking individuals in a crowd has been studied. Panicked flight is directed towards escaping imminent danger. The convergence of fleeing persons in a collective panic frequently occurs because individuals flee in one direction assuming that escape is possible in that direction while ignoring other exits. This behavior is called "herding." Herding behavior occurs when the crowd moves in the same direction and other exits are not efficiently used. Models show that this behavior pattern frustrates escape. Individual behavior occurs when each person finds an exit only by accident and is similarly ineffective in effecting escape. Models show that escape is best accomplished when there is a mixture of individual and herding behavior. Individual behavior allows some to detect the exit, while herding allows successful solutions to be imitated by others.

A review of the literature found few case reports which described compressional asphyxia caused by crowds, and also lacked traumatic injuries and presented the autopsy findings. Several articles emphasized the management of patients, discussed the implications for disaster planning, and emphasized that morbidity and mortality were the result of associated internal injuries. Little mention has been given to the duration of the compression, which we believe contributes significantly to mortality.

In summary, we describe twenty-one deaths from compressional asphyxia due to a crowd stampede. The majority demonstrated the classic findings first described in 1837 by Ollivier. Mortality resulted from chest compression inhibiting respiratory movement and was related to the duration and the amount of weight rather than internal or related traumatic injuries.

Compressional Asphyxia, Crowd Stampede, Petechiae