
DEATH IN CUSTODY

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The sudden and unexpected death of a person while under arrest or in police custody is a source of community concern. Unsubstantiated facts and rumors surrounding a death in custody have always possessed the potential for controversy, and major disturbances have erupted because of alleged police misconduct. Bereaved family, friends, and communities in general are all deeply concerned whenever such a death takes place.

Searching questions are frequently asked about such a death, including the following: Was unnecessary force used by the police in arresting the person? Was the person physically abused during transport or during interrogation after having been placed in custody? Such questions relate to possible acts of unlawful violence on the part of law enforcement personnel and raise the question of police misconduct. Equally disturbing questions can be posed concerning neglectful behavior on the part of law enforcement personnel, including the following: Was serious and obvious illness in the person ignored or overlooked by the police? Were legitimate complaints minimized or disregarded? Was needed medical attention given? Did someone fail to recognize the potential suicide or fail to heed a suicidal threat? What steps were taken to prevent the occurrence of such an incident? Did the authorities make their rounds sufficiently frequently? Was every reasonable means taken to protect the safety and welfare of the suspect or prisoner from any form of self-directed violence?

We must recognize that misconduct by law enforcement does occur, and that it is the province of the medical examiner or coroner to thoroughly investigate the entire course of events from the moment the

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police first have contact with a suspect until the time when death occurs. It is mandatory that any death that occurs while a person is in the control of law enforcement officials be promptly, thoroughly, and objectively investigated by the local medicolegal official, whether a medical examiner or coroner. As in all sudden, unexpected, unusual, or suspicious deaths, a competent medicolegal investigation of any death occurring in custody or in confinement is necessary to establish the cause and manner of the unforeseen death and to determine irrefutable facts that characterize and illuminate the events surrounding the death. Three major purposes are served by such an investigation: (1) rumors and speculation are put to rest; (2) wrongdoing by law enforcement is recognized for what it is; and (3) information may be developed that identifies situations and procedures that require correction or improvement.

THE INVESTIGATION

Scene and Circumstance

As in any death investigation, the circumstances of the death should be clearly established. Particular attention must be given to any altercation or interaction with law enforcement personnel or anyone else. The medical examiner or coroner should, if at all possible, be notified of the death when it occurs and make every attempt to examine the body at the scene.²⁰ This provides a unique opportunity to make a preliminary assessment about what might have happened, and it establishes communication with the agency in charge of the investigation. This becomes invaluable in synthesizing events surrounding the death and is particularly useful when trying to establish cause of death. If a scene response is not possible, the medical examiner or coroner must have access to investigative information, including photographs, to establish the position of the body when found, the time the body was found, and when the victim was last seen alive. This is particularly true if the body is found in a jail cell. Equally importantly, when death occurs during the process of arrest, it is critical that a minute-by-minute reconstruction of events be developed. This means that detailed statements of the participants must be obtained, and that a detailed sequential reconstruction of events must occur. This process should be done as quickly as possible, because delay will only distort events, and time has a way of molding perceptions of what may have transpired.

Autopsy

Few investigations in forensic pathology come under as much scrutiny as a death in custody. It behooves the pathologist charged with performing the autopsy to institute those procedures ordinarily reserved for deaths of homicidal violence. Even though the death may appear to

be uncomplicated, such as a suicidal hanging, too often there are community suspicions that something sinister has happened and that someone in the ranks of law enforcement is responsible for the death. Consequently, the pathologist responsible for the autopsy must implement such procedures ordinarily reserved for homicidal deaths, to include the collection of trace evidence such as fingernail clippings, hair, and fibers; swabs for sexual activity; preservation of clothing; and complete and detailed photographs of any anatomic findings demonstrated at autopsy. There are never too many photographs. Consideration should likewise be given to the use of a video camera to record the entire procedure. On occasion it may be necessary to preserve critical specimens such as the larynx for future reference. Furthermore, it may be necessary to request consultation with physicians in other disciplines such as neuropathology. The most important feature of this aspect of the investigation, namely the autopsy, is to establish as precisely as possible any anatomic injury or natural disease that may have been responsible for or, at least contributed to, the death. There may be instances in which the anatomic findings are so definitive—for example, rupture of an acute myocardial infarct—that the investigation rapidly comes to a close, but this is most unusual. Ordinarily, with the autopsy the investigation is just beginning, and many hours will be spent reviewing reports of investigation before the certifier of death, whether medical examiner or coroner, has sufficient information to render a final opinion.

Concomitant with the autopsy findings, a complete toxicologic examination is required. Alcohol and street drugs, such as cocaine and methamphetamine, are common companions in victims who die in custody. Equally important are therapeutic drugs such as lithium and phenytoin, which may be present in subtherapeutic amounts and which may provide insight into the behavior of the victim, particularly if there is a history of manic-depressive psychosis or seizures. Unrecognized diabetic ketoacidosis can be responsible for sudden death. Vitreous and urine glucose/ketones may provide the first indication that such is the case.

INSTITUTIONAL AND RESTRAINT DEATHS

There are clear differences between investigating a death in which (1) the victim has been found dead, usually in an institution or jail, and in which (2) the victim dies during or immediately after a struggle during which physical restraint has been used by the police. In an institutional death in which the prisoner or inmate is found dead, there is a different emphasis and direction in the investigation, in contrast to the death of a suspect who is wrestled to the ground and then is discovered to be lifeless. Each has its unique problems worthy of separate discussion.

Institutional Deaths

Few case studies of jail deaths have been done in a fashion that permits a comparison of data from different parts of the country. The earliest study performed in the Cleveland metropolitan area, by Adelson et al² in 1968, examined over 12 years the cause and manner of death of 91 prisoners who were found dead in jail. Of those 91 prisoners, 64% died as a result of natural disease and 25% as the result of suicidal acts. The remaining 11% died of injury that was either accidentally sustained or in which circumstances were not determined. In a more comprehensive study, Copeland⁹ in 1984 examined the deaths occurring in metropolitan Miami of inmates in detention over 27 years. In his series, 55.5% were the result of natural disease and 20.9% the result of suicidal acts. In 1988 Frost and Hanzlick¹² examined 53 deaths over 12 years and found that 57% were attributed to natural causes and 26% to suicidal acts. The balance of the deaths in these studies was the result of homicidal or unintentional lethal violence. In all studies, arteriosclerotic vascular disease and seizures were responsible for most of the natural deaths. Hanging by ligature accounted for almost all of the suicides, most of which occurred early during the period of the prisoner's incarceration. Additionally, natural deaths occurred in an older-age group, whereas suicides occurred at a younger age. A most interesting finding in the Cleveland study, which was performed at a time when alcoholism was viewed as a criminal offense, was that two thirds of all sudden and unexpected deaths were the direct result of the sequelae of alcoholism either in its acute or chronic form. No recent studies have examined the character of sudden death in custody and confinement, particularly in view of the fact that alcoholism is no longer viewed as a crime, but as a medical condition that is treated, accordingly, in a proper medical or substance abuse and alcohol facility.

The Investigation

When a prisoner or inmate is found dead in confinement, the usual response by security personnel is to sound the alarm for immediate medical aid. It may be the policy of the institution that all security personnel are adequately trained in cardiopulmonary resuscitation and to immediately render aid. Although such aid may be given, recognition has to be given to the panic of the event, and to the injuries discovered at autopsy that may have been inflicted by resuscitation. Sometimes there may be reluctance of security personnel to render aid, and they may elect to wait for an emergency response by medically trained personnel. In both instances, the record should reflect what course of action was taken and who did what and when. As is the usual course of events with any emergency response, the victim is likely to be transported from the scene of death to a medical facility to receive definitive and appropriate care.

Emergency life-saving resuscitative procedures can produce injuries

that must be recognized at the time of autopsy examination. Similarly, how the body was handled and whether any injuries can or did result from such handling should be established. Of particular note is the hanging suicide and the manner in which a body is removed from a ligature. Skull fractures and scalp lacerations can be produced when the body is cut down and allowed to drop to the floor. Hence it is important that the circumstances and method surrounding body removal be known. Additionally, intubation, particularly by paramedical personnel, can produce injuries to the mucosal lining of the larynx that can be misinterpreted at autopsy as evidence of neck compression (Fig. 1). It behooves the medical examiner or coroner to obtain as much information as possible about the discovery of the body, attempts at resuscitation, any therapeutic procedures that were undertaken, and the handling of the body, whether in the hospital, emergency room, cell, or institutional dormitory.

As previously stated, opportunity to visit the scene where the incident occurred is of great value to the medical examiner or coroner. In addition to the actual site of death, the institution where the death occurred will generally have a log of the inmate's activity, as well as a record of activity of those responsible for supervising the inmates of the

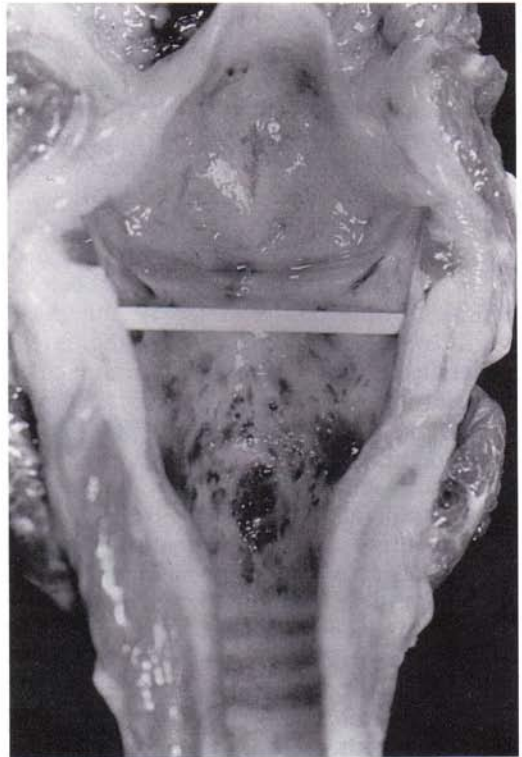


Figure 1. Mucosal hemorrhages produced by on-scene intubation by paramedics. The victim died of gunshot wounds.

institution. These records may be of some importance to those responsible for reviewing procedures or assessing liability, but generally they have limited value to the person responsible for certifying death.

The record of investigation must clearly reflect, in as much detail as possible, what happened. In some jurisdictions, the medical examiner or coroner may have an investigative unit separate from law enforcement to conduct a separate investigation. This is unusual, and most medical examiner or coroner agencies rely on law enforcement personnel to conduct the investigation, which obviously has the potential for concealing what might have transpired, but this may be all that is available. If investigative reports are not accessible, then the medical examiner or coroner is left with only the results of the autopsy and toxicologic examination on which to base an opinion of cause and manner of death. Occasionally, this may be all that is necessary—particularly if an overwhelming natural disease is present—but this rarely is the case.

Although it may appear that the investigation of natural death is straightforward, the person responsible for establishing cause of death should be circumspect during the death investigation. The cause of death may be convincingly established during the autopsy examination, but related issues may be difficult to assess and, furthermore, have significant civil liability. Even in situations in which the prisoner or inmate has been carefully monitored, there is always the concern that someone failed to heed the complaints of the inmate or failed to recognize someone who was seriously ill. It may be difficult to answer such questions based on the autopsy findings. Nevertheless, the examiner should be prepared to handle such questions. Regardless, you can be assured that there are many experts willing to step forward and offer opinions on the most meager of findings.

Although inmates who die from clearly identified natural disease may cause some concern, inmates who die by their own hand create major concern. Jail suicides have been studied in detail, and a well-defined profile has emerged of the person who takes his or her life while in detention.^{16, 30, 33} Hanging is the method of choice. This is understandable because the common and ordinary means that exist in the community, namely firearms and medication, are not readily available to the person in detention. Strips of fabric from clothing or bedding, belts, or shoelaces may furnish the means with which the desperate person can end his or her life.

Jail suicides, like natural deaths, always raise significant questions. Because these are violent deaths, a probing for a more sinister reason for the death occurs. The medical examiner or coroner must be wary and circumspect as the death investigation commences. An on-scene presence serves many purposes, most particularly the opportunity to examine the body at the scene (Fig. 2). At the scene the examiner has the opportunity to become informed of the vigilance of the caretakers or guards, the overall condition of the facility, and the spatial relationships at the site where death occurred. Because the majority of deaths

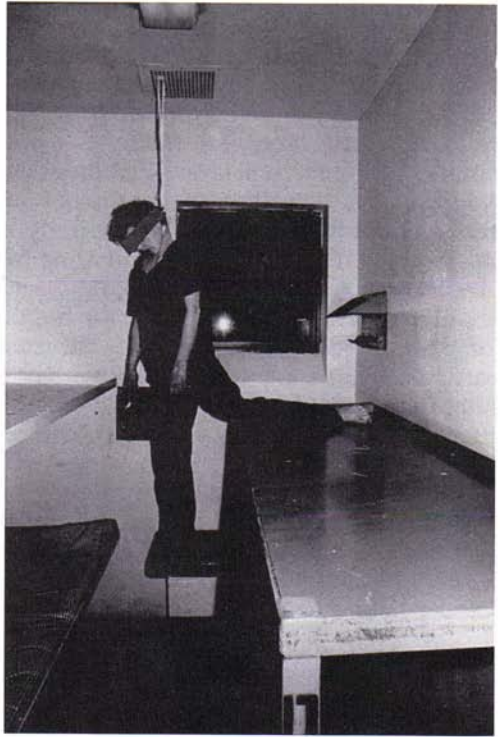


Figure 2. A typical jail death scene with victim using strips of cloth torn from a towel to hang herself.

are the result of hanging, the opportunity to reconstruct the method and means of self-destruction is also available.

One of the more frequent allegations in suicidal hanging deaths in custody and confinement is that guard(s) or caretaker(s) inflicted fatal injuries to the inmate, and that the ligature was fashioned to conceal lethally inflicted injuries, most notably manual strangulation. Although this may seem to be an untenable allegation, it is an allegation that can be difficult to contradict and must be taken seriously by anybody responsible for the investigation. Consequently, the autopsy should be approached much as a homicide investigation, because failure to collect specimens and to take detailed photographs of any injuries and to give appropriate attention to the ligature can only raise questions concerning the adequacy of the postmortem investigation.

The performance of the autopsy should present no particular problems for the experienced pathologist, but as in any asphyxial death, attention must be given to the performance of a careful neck dissection to assess the character of the injury present and, more importantly, to exclude other injuries commonly associated with manual strangulation or choking. Because the autopsy findings in hanging victims show some variation in their presentation at autopsy, it is worthwhile to review the

spectrum of these findings. Luke et al²³ studied hanging victims in a number of circumstances and described laryngeal fractures in about a third of the cases examined. More recent studies have shown a higher incidence than originally reported.⁵ The important point of both of these studies is that laryngeal fractures do occur and are not a point of differentiating manual strangulation or choking from a suicidal hanging. Additionally, petechiae of the bulbar and palpebral conjunctivae are variable and may be absent if the body is completely suspended. Petechiae offer little help in discriminating between a more nefarious act of murder and a self-induced hanging.

It is necessary to emphasize the importance of a complete evaluation for prior sexual activity during the examination of the body. This is particularly true for female victims, because there is the unspoken assumption that a female prisoner is vulnerable to sexual assault by male guards while in custody. Swabs should be taken of all body orifices and preserved for DNA analysis, along with the usual microscopic and chemical evaluation for the presence of semen. There is always an element of suspicion of sexual activity because the death occurred in confinement. In the male victim who is found hanging, some urethral seminal discharge can occur after death and is not a reflection of sexual activity before death.

Release of Information

One of the more difficult determinations for any medical examiner or coroner is the release of information concerning a death in confinement. My experience is to release as much information as possible, because to withhold information only creates an atmosphere of suspicion. If the cause of death is clearly established, it serves no purpose to conceal that information from the public. It may be prudent, however, to avoid releasing details concerning the death. This information may be a mix of hearsay and fact, and it may place other agencies in a difficult position to explain events, particularly during the early phase of the investigation. It may be necessary to answer queries by stating that other studies are being conducted and to specify these studies and why they are being performed. Once an atmosphere of withholding information about the death is created, it becomes difficult to generate a sense of truthfulness and to remove the suspicion of "cover-up."

Death on the Street

Of all the deaths that a medical examiner or coroner is charged with investigating, the most difficult and complex are deaths that occur on the street while a suspect is being detained or placed under arrest. The level of violence surrounding the event can be extraordinary and may be witnessed by a variety of individuals, including friends and relatives of the deceased. There have been occasions on which the entire confrontation has been recorded by a hidden camera of an amateur photogra-

pher. There is no question that such events frequently attract local and sometimes national attention and can cause police agencies to come under intense scrutiny. When such a death occurs, there is frequently a sense of community outrage about the conduct of the police, and occasionally criminal charges have been filed against law enforcement personnel involved. Such is the atmosphere that the medical examiner or coroner may face and in which a death investigation may be conducted. The police seek exoneration of their acts, while family and friends of the victim seek retribution for the death.

The Investigation. As previously stated, if there is a scene of death, the death investigator, whether medical examiner or coroner, should respond to the scene. Generally there will be no physical evidence at the scene to aid in the investigation, but the real value is the opportunity to develop a sense of what happened. It provides an opportunity to see the physical surroundings and terrain, establish the jurisdiction of the investigation, learn what method of physical restraint was used, and assess the overall level of violence that occurred. This awareness of the dynamics of the event can prove invaluable during the examination of the body. It directs attention to critical areas of the body that require a detailed examination, to either identify the nature and extent of injury or, equally importantly, to demonstrate the absence of injury.

Restraint Deaths

The types of physical restraint involved in police encounters that are generally identified as causing death include neck holds and mechanical restriction of respiration. Because each of these maneuvers may be responsible for death, each will be examined separately.

Neck Holds

Neck holds are a common method of restraint used by most police agencies throughout the United States. For many years the use of all neck holds was generally viewed as an acceptable, nondeadly maneuver that could be used in any confrontation. Generally, the choke hold, a type of neck hold, is viewed as inherently dangerous, because it is designed to obstruct the airway and to virtually strangle a person into submission or unconsciousness. The neck hold called the "carotid sleeper" or "lateral vascular neck restraint" is designed to obstruct the carotid arteries in the neck and cause momentary unconsciousness.⁶ Personnel who teach defensive tactics use the carotid neck hold as the primary hold to be used if the situation warrants its use. Those who are versed in martial arts can attest to the effectiveness of carotid compression. Physiologic studies performed in our laboratory have shown that carotid blood flow is significantly reduced in about 7 to 10 seconds when the hold is correctly applied.²⁹ This means that an officer can quickly gain control of his opponent during the period of temporary

unconsciousness. The difficulty of quickly and appropriately positioning the arm and forearm to occlude the carotid arteries in a violently struggling person may not always be easy.²⁸ What may be intended as a carotid submission hold can easily become a combination carotid submission and choke hold with devastating fatal consequences.

Autopsy Evidence of Neck Compression

Whenever there has been a fatal confrontation with the police, the pathologist is obliged to carefully examine the neck for signs of compression. Before the neck organs, soft tissue, and muscles of the neck are examined, it is particularly important that evidence of venous constriction of the vessels draining the head be evaluated. Because the jugular venous return of the head is a low pressure system, generally not exceeding 5 mm Hg, little pressure is required to occlude the veins and cause a back pressure to develop and extend to smaller vessels, namely venules, throughout the structures of the head including the eyes.¹⁷ If this back pressure is sustained, small vessels distal to the compromising stricture rupture and produce typical petechiae in the conjunctivae, buccal mucosa, and sometimes even the skin. The importance of petechiae is that they reflect increased pressure in the cervical venous system caused by constriction of veins, produced by compression of the neck. Petechiae can be produced by vigorous chest compression of resuscitation. This results from a retrograde venous pulse pressure from the chest into the venous system of the head. Nevertheless, the finding of petechiae is important, and it may be the first physically evident sign on the body to indicate neck compression.

The examination of the neck must include a meticulous surface examination to detect any contusion or abrasion. These findings may be subtle, meager, or sometimes nonexistent, but it is exceedingly important that the examination is detailed and even aided by a hand lens or a dissecting microscope. The absence of injury must be clearly noted.

As with the external surface examination, the underlying soft tissue, muscle, and neck organs must be examined in a methodic fashion, which has been appropriately described as a layered dissection of the neck.⁴¹ This examination must focus on the presence of hemorrhages in the soft tissue and muscles of the neck and, in particular, their character and distribution. It is unlikely that resuscitation ever accounts for hemorrhages in these areas. There may be the occasional instance in which hemorrhages in the submandibular gland result from the rearward thrust of the head during intubation or mouth-to-mouth breathing, but this area is located some distance from the major laryngeal structures that are directly affected by neck hold compression.

The most important examination of all neck structures is the laryngeal examination. Because the larynx constitutes the most rigid structure of the upper airway, pressure applied to the neck commonly results in fractures of the larynx or its appendages. Although the larynx is composed of three anatomic supporting cartilages—namely, the hyoid, thy-

roid, and cricoid cartilages—ossification begins early in life, but fusion of the cornu to the central body of the hyoid occurs much later and gives it rigidity and susceptibility to fracture when stressed.²⁶ It is imperative that these anatomic structures be meticulously examined to establish whether sufficient force has been applied to the neck to produce fractures. In some instances, the larynx may retain its cartilaginous character and remain pliable and less likely to fracture, but even in these instances there can be fracture of the cartilage with hemorrhage. A fracture to the larynx is good anatomic evidence that force has been applied to the neck.

In addition to injuries to the skeleton of the larynx, neck compression can produce scattered petechiae and flame-shaped hemorrhages of the laryngeal mucosa that can be randomly distributed over the surface. Even if the hyoid, thyroid, and cricoid structures are intact, such hemorrhages can occur and be the only evidence of neck compression.

Interpretation of Autopsy Findings

Once injuries have been identified to the neck, it then becomes the responsibility of the examining pathologist to offer a reasonable and reasoned interpretation of the findings. If there are fractures to the larynx—that is, the thyroid, hyoid, or cricoid, alone or in combination—the reasonable conclusion is that pressure was applied to the neck, usually in a constricting fashion. The author has yet to see such fractures induced by clumsy or difficult intubation during resuscitation. Isolated fractures can result from a blunt impact delivered to the neck with a nightstick, a kick with a shod foot, or even a karate chop. In such instances, however, the overlying skin will ordinarily show an abrasion or contusion as evidence of impact. It would be very unusual to produce bilateral fractures by such a mechanism.

In addition to fractures, hemorrhages of the soft tissue and muscle are the expected findings if neck constriction has occurred. In the absence of fractures, but with the presence of soft-tissue, laryngeal mucosal, and cervical strap muscle hemorrhages, and petechiae in the conjunctivae, neck constriction must be strongly considered, particularly if corroborated by events reconstructed through independent witness statements. As previously noted, confounding issues surface when there has been vigorous resuscitation. Intubation can produce hemorrhages (including petechiae) of the laryngeal mucosa, and vigorous chest compression can produce conjunctival petechiae. When this happens, caution must be used in offering a definitive pathologic diagnosis. The only hope in resolving such issues is to carefully examine the witnesses' statements of events, and to assess whether the narrative of events corroborates the anatomic findings. If there is a major contradiction, an assessment must be made of the reliability of the witnesses and whether the injuries present at autopsy could have been therapeutically induced. It is important that the autopsy findings be studied in the light of the record of events that is available.

Neck Holds and Death

Although constriction of the structures of the neck, in particular the carotid arteries, can cause unconsciousness very quickly, it does not mean that death immediately follows. There are instances in which death has occurred very quickly following the application of a neck hold, but to explain such a death requires the existence of a reflex neurologic mechanism such as the carotid sinus pathway. This mechanism is discussed in greater detail later. The most common pathway responsible for a neck hold death, however, is one of asphyxia, which is mediated by the lack of cerebral oxygenation because of restriction of the cerebral arterial blood flow or collapse of the airway.

How long does it take before there is hypoxic brain injury leading to death? The answer must be assessed in light of what we know about the survival times of victims who have sustained a cardiac arrest and have been resuscitated. There is sufficient clinical experience to assess how long cerebral circulation may cease to function, because of cardiac arrest or ventricular fibrillation, with survival and minimal residual neurologic effects.³² This clinical experience indicates that the limit for *occasional* recovery of function appears to be between 10 and 20 minutes. This is the reason for rapid institution of cardiopulmonary resuscitation, which is designed to reduce the amount of time the brain is without oxygenated blood. This critical time is important in evaluating deaths in which neck holds have been used. Furthermore, experimental animal data indicate that, with obstructive asphyxia, a similar 3-to-5-minute interval is required for cardiac standstill to occur. Death is not instantaneous.³⁷ Recognition must be given to the physical exertion associated with a violent struggle and the resulting fatigue and increased oxygen demands of the body, which may influence and shorten this interval. In evaluating deaths in which the neck hold is thought to have played a role, it is important that these references of time be kept in mind, particularly during the reconstruction of events surrounding the death.

Carotid Sinus Stimulation and Sudden Death

Sudden death may result from carotid sinus stimulation. This reflex neural pathway through the vagus nerve can cause bradycardia and cardiac standstill, and it may account for some deaths that occur rapidly following application of a neck hold. The sensitive carotid sinus syndrome is a well-recognized but uncommon clinical condition.⁸ Reportedly, some individuals chosen at random can be induced by neck massage into a bradycardia.⁴ This study suggests that a carotid sinus massage can create a reflex rhythm disturbance in a variety of persons who are not identified as "sensitive" to neck compression. This has significance in understanding deaths that have occurred during the application of a neck hold with immediate collapse and in which no significant pathologic findings are present at autopsy. Conceivably, even

though there may be airway and carotid artery constriction during the application of a neck hold, it does not preclude initiating the carotid sinus reflex and its attendant cardiac rhythm disturbance.

Restraint Asphyxia

In addition to neck holds, the other major consideration in evaluating deaths that occur during a physical confrontation with the police is the take-down of the victim, usually accomplished prior to the process of handcuffing, and the ultimate position of the victim after that restraint is accomplished. Because the event is so violent and dynamic, different aspects of the restraining process can be identified in evaluating deaths of this type.

Respiration depends on an intact airway, pulmonary parenchyma capable of adequate gas exchange, and the mechanical bellows action of the muscular and bony structures of the thorax. The coordinated activity of respiration is mediated by an intact nervous system. Obstruction of the airway by neck holds has been discussed previously, and diseased pulmonary tissue is a subject with which most pathologists are familiar. *Restraint asphyxia* describes interference with the bellows action of the chest that prevents an effective gas exchange from occurring and creates a condition of hypoxia that, if prolonged, can result in death.

Restraint asphyxia is a general term that encompasses all three components of the take-down and restraining process. These components include compression, restriction, and position. Each of these is likely to play a role during the restraining process, but it is difficult to assign a percentage value to each component.

Compression and restriction of the chest occur when the suspect is forced to the ground during an attempt to control the suspect. Usually this situation involves several law enforcement individuals who grapple with a suspect. Finally, resistance is overcome and the suspect is forced to the ground, where the police have the physical advantage and the opportunity to handcuff. During this process, compression and restriction of the thorax will occur if knees and feet are used to hold the suspect down (Fig. 3). Depending on the intensity of the struggle, it may take several minutes before the suspect is controlled by handcuffs, whether or not the feet are bound to the handcuffs in a hog-tied fashion. This process can be inherently dangerous, because compression and restriction of chest excursions create a pathologic condition akin to what is known as "traumatic asphyxia." In its most exaggerated form, this condition occurs when a victim is "pinned" by the collapse of a jack stand beneath an automobile, or in other situations in which a person's chest is compressed and immobilized, usually by a collapsing object.

There is a third component, namely the position of the victim, that must be evaluated whenever a person is placed face down and handcuffed, with leg restraints, whether or not hog-tied. Studies performed in our laboratory using oxygen saturation as an index to measure the effects of the face-down hog-tied position following exercise in volunteer

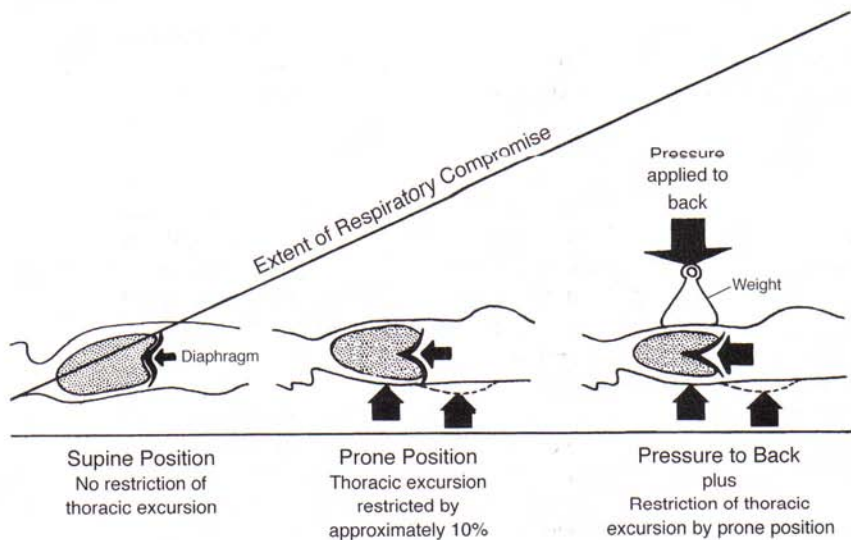


Figure 3. Restriction and compression of thoracic movement with weight placed on back in prone position. Abundant abdominal panniculus further impedes thoracic expansion by moving abdominal contents against diaphragm.

subjects showed a delayed recovery in oxygen saturation with the prone hog-tied position.³¹ We concluded that such a prone hog-tied position promoted a delay in respiratory recovery. This was viewed as potentially harmful because it interfered with respiratory recovery. More recent studies using arterial blood gas determinations refute our earlier work regarding the hog-tied prone body position. These studies show that although body position does not influence the respiratory recovery, there is an average reduction of respiratory excursion by 10% to 12%.²⁴ Hence in normal individuals, the hog-tied prone position should be viewed as not producing significant physiologic respiratory compromise, and it does not produce any serious or life-threatening respiratory effects. In some individuals, however, particularly those with an abundant abdominal panniculus, the upward movement of abdominal viscera against the diaphragm interferes with respiration and creates a situation of continued respiratory embarrassment. Similarly, if the chest is deformed by scoliosis or there is significant intrinsic pulmonary disease, the resting position of the victim must be viewed as interfering with respiration.

All three elements—compression, constriction, and position—need to be recognized in evaluating a death when a suspect is restrained face-down in the context of a violent struggle. When death appears to be the result of the take-down and struggle, with a number of people exerting pressure at various sites on the body, restraint asphyxia must be seriously considered in evaluating the death. The final resting position of

the victim must likewise be considered, as should body habitus and any unusual physical deformity, such as kyphoscoliosis.

Diagnosis. In contrast to the anatomic findings encountered when neck holds have been used, findings to support the diagnosis of restraint asphyxia can be meager to nonexistent. This can result when the force applied is not concentrated in one area to allow for well-developed bruising patterns to become manifest. Petechiae of the face and eyes can be expected if the compression of the chest is prolonged and severe; however, this finding may also result from neck compression. Vigorous cardiopulmonary resuscitation can generate enough retrograde venous pressure to produce petechiae. Fluidity of blood as evidence of asphyxia is an unreliable finding and should be relegated to the realm of useless information.¹

There are no typical pathologic findings that allow for a diagnosis of restraint asphyxia. The only source that provides the necessary information for this diagnosis is the historical record of events surrounding the physical struggle, take-down, restraint, and death. Because restraint asphyxia is a pathophysiologic process with few anatomic markers, the medical examiner or coroner must rely on events as described to understand and explain the death. The difficulty occurs when assessing the credibility of those persons who were witnesses to or participants in the restraining maneuver. The critical issues to be established are who did what and for how long. Equally important is a clear description of the behavior of the victim during the confrontation. Did the victim vocalize breathing difficulties or manifest signs and symptoms of distress with cyanosis or chest pain, or did the struggle end abruptly with the officers involved interpreting this as a sign that the victim "gave up"? After the struggle ceased and the victim was restrained, did the officers check the condition of the victim, or did they move away to recover their own composure and only later check the victim? These questions must be answered to create a timeline of events surrounding the death. Only after this information is established can the certifier of death make a judgment and render a statement of cause of death.

Catecholamine Rush

There is little doubt that where there is violent activity, abundant release of adrenal catecholamines occurs. The fight-or-flight response initiated by a violent physical confrontation and mediated by the adrenal medulla induces a pronounced output of noradrenalin/adrenalin, which are known to sensitize the heart and promote rhythm disturbances.⁷ Additionally, psychological stress has been shown to promote cardiac rhythm disturbances.²¹ These pathways play a major role in causing death in persons who find themselves in a perilous circumstance and suddenly "drop dead," with no clearly defined anatomic lesion to account for death. When there has been intense physical combat and the victim has been violently thrown to the ground, restrained with chest compression and restriction, and in some instances hog-tied to secure the

hands and feet, it is difficult to attribute death solely to a catecholamine response or a psychological stress-induced cardiac dysrhythmia. If death occurs when there has been respiratory compromise leading to hypoxia, the restraint maneuver must be identified as playing a major role in causing death. A similar circumstance occurs in exercise-induced sudden death when the autopsy fails to demonstrate a cardiac lesion. Such deaths have many features in common with restraint deaths because there are no identifiable pathologic lesions; however, attributing sudden death as solely exercise-induced during the physical confrontation and restraining process does not account for the dynamics of restraint and interference with the respiratory mechanics of the thorax. Restraint asphyxia is a pathophysiologic process that can only be described by the dynamics of the event and that is not demonstrated in tissue injury at autopsy.

Lethal Catatonia and Excited Delirium

Lethal catatonia is a term first used in 1934 by Stauder to describe death that occurred in mental patients, usually psychotic, who exhibited psychomotor excitement for several days to weeks with alteration in autonomic functions including fever, profuse perspiration, tachycardia, refusal to eat or drink, progression to rapid weight loss, dehydration, and death.³⁴ Autopsy examination failed to reveal any anatomic cause of death. The term *lethal catatonia* was created to describe these deaths. Other descriptive labels have been used and include "acute catatonic excitement," "psychotic exhaustion syndrome," and "malignant catatonia." More recently, "acute exhaustive mania," which appears to be similar to "lethal catatonia," has been suggested to explain sudden death occurring when an extremely agitated or psychotic person, in a drug-induced state or otherwise, manifests violent behavior and dies.¹⁹ Similarly, the neuroleptic malignant syndrome resulting from the withdrawal of antipsychotic/neuroleptic agents has many features in common with lethal catatonia. Some authors speculate that malignant catatonia and neuroleptic malignant syndrome are caused by hypodopaminergic states and are variants of the same process¹⁰ (EF Torrey, personal communication). In either instance, these two conditions have well-described clinical features that cannot easily be modified to explain sudden death, particularly when the victim is restrained with an element of respiratory compromise.

Cocaine-induced "excited delirium" is an acute drug reaction, first described as occurring in cocaine body packers by Wetli and Mittleman in 1981. These authors subsequently reported seven deaths in cocaine users who demonstrated bizarre and violent behavior.⁴⁰ Five of the victims required forcible restraint before death. The method of restraint is not clearly described and the restraint maneuvers not detailed. Nevertheless, a profile of the victim emerged, consisting of marked agitation, paranoia, and aggression characterized as "excited delirium" with unexpected strength and hyperthermia.³⁸ The amount of cocaine in the blood

at autopsy was lower than what is commonly seen in fatal cocaine overdoses. The consequence of these observations is that "excited delirium" has become a defined pathologic entity induced by cocaine and other stimulant drugs and which involves the dopamine system with central dopamine receptor blockade or neurotransmitter deficiency.³⁹ Because of these effects, akinesia of respiratory muscles has been postulated and may be the neurophysiologic pathway leading to death.¹⁸ If indeed this pathway affecting respiratory muscles exists, then any compromise of respiration, including position, may ultimately prove fatal. The consequence of "excited delirium" is that the victim may be particularly vulnerable to restraint-induced sudden death. This appears to be the condition reflected in the report of O'Halloran and Lewman,²⁶ which describes sudden death in 11 men restrained in a prone position by police officers during a state of "excited delirium."

Restraint, Natural Disease, and Drugs

To identify cause of death in situations in which there has been a violent confrontation with the police and in which the autopsy demonstrates significant natural disease and/or large amounts of drugs is one of the more taxing issues that the medical examiner or coroner faces. The restraint maneuver is unlikely to be *solely* responsible for the death if there is significant natural disease or drugs present. If there is every indication that restraint has played a major role in the death, it must be identified as such. It is virtually impossible to assign a degree or percentage of responsibility that restraint may have played in producing death. We may be able to distinguish various factors in a death and not be able to separate them. Consider the obese man with advanced coronary artery disease who is party to a violent confrontation in which he struggles desperately to evade the police, is finally handcuffed and shackled in a prone position, and then states that he cannot breathe. The autopsy demonstrates cardiomegaly with moderate focal coronary arteriosclerosis of sufficient severity to explain death under other circumstances. A dilemma exists that is not easily reconciled. Should the death be wholly and completely attributed to the natural disease process, or should the physical restraint be viewed as contributing to death? In this instance, the legal principle that you "take your victim as you find him or her" requires identifying the restraint process as playing a role in the death and therefore placing some responsibility on the police. The degree of responsibility is probably best left in a legal forum.

Similarly, the same circumstance arises when the autopsy demonstrates significant amounts of drugs in body fluids that under other conditions would be sufficient to explain death. This is particularly true for cocaine and amphetamine, where the amounts of drug present in the blood could be recognized as sufficient to cause death. Stimulants such as cocaine, however, appear to lower the threshold for death to occur during restraint. Animal studies shed some light on the role of cocaine in restraint; animals that receive high doses of cocaine and

are restrained are more susceptible to sudden death as compared to unrestrained control animals.²⁷ This experimental observation emphasizes the susceptibility of a person to sudden death during restraint if a stimulant such as cocaine is present. Whether that susceptibility is mediated by catecholamine is not established; however, deaths have been reported in persons with acute cocaine psychosis in association with face-down restraint, which probably includes chest compression and restriction.²⁶ The question is how much of a contribution did the restraint make to the death. Certainly the medical examiner or coroner can avoid any potential controversy and completely exonerate the police by summarily dismissing the restraint as insignificant and assigning full responsibility to the presence of drugs. I do not know how such dilemmas can be resolved, but the role of restraint and circumstances of the event should at least be recognized in an attempt to better understand and describe death in such circumstances.

Certification of Death

Obviously, the certification of death flows from the determination of the cause of death. The difficulties often encountered in establishing cause of death have already been discussed.²² If the natural disease process is overwhelming and the restraint maneuver is judged negligible after careful review of statements and the report of investigation, then an appropriate certification of the manner of death is natural causes. Similarly, if the autopsy findings demonstrate significant injury that can be attributed to the restraint process, such as injuries to the larynx, and reports of investigation show that significant force was used, including a neck hold, the death should be classified as non-natural and violent in character.

In assessing the death and establishing a manner of death, other considerations need to be evaluated, namely the inherent character of the injury or action that is viewed as responsible for the death. If the action by a person(s) is of such a nature as to be inherently dangerous and alone can cause death, and death results from that activity, then the death is appropriately classified as homicide. Because neck holds by their nature obstruct cerebral circulation or the airway or both, in addition to the potential of triggering a reflex parasympathetic cardiac standstill, they are inherently lethal. If death results following their use, then the death should be classified as homicide. Thus, in addition to viewing the death in the broadest sense of dying "at the hands of another," it is important to establish what the hands are doing to cause death. Similarly, if significant chest compression has occurred during the restraining process, particularly for an extended time, then such compression, sometimes referred to as "traumatic" asphyxia, is inherently lethal. If it is established that such a sequence of events occurred during the restraining process, a homicide classification is warranted.

The two examples cited, namely neck holds and chest compression, are more readily recognized as inherently capable of causing death. In

most restraint deaths, however, it is not easy to clearly identify the lethality of other activity that may play a dominant role in producing death. In the process of restraint—which involves placing a suspect in the face-down position—there are various components of this process that, because of the dynamics of the event, can be distinguished but not necessarily separated. If the chest compression and restriction are transitory (it is frequently difficult to establish specific times), then there should not be an inherent danger to life. Similarly, the prone position is a neutral position, largely tolerated by most persons even after vigorous exercise.²³ The situation is significantly altered when the condition of the victim creates a risk of sudden death. These conditions include intoxication by stimulant drugs such as cocaine and amphetamines, acute psychotic behavior (drug-induced or otherwise), physical exhaustion, obesity (particularly with a large abdominal panniculus), and the presence of significant cardiovascular or respiratory disease. Hence it is not only the transient restraint maneuver but also the condition of the suspect that creates the potential for a fatal outcome.

When certifying death in which restraint is identified in whole or in part as causing death, and the inherent character of the restraint used is not viewed as lethal in its application, then an accidental classification is appropriate. Some would disagree and use the broad definition of homicide in such circumstance as death occurring at the hands of another.¹⁵ Others would attribute death wholly to one of the many risk factors present in the victim, such as acute drug psychosis or exhaustive mania or others as discussed previously. Obviously, there are different ways of evaluating and certifying such deaths, which highlights the absence of any clear standard for assigning cause and manner of death occurring during a violent confrontation with the police.

PEPPER SPRAY AND CUSTODY DEATH

Oleoresin capsicum (OC) is an extract of pepper plants of the genus *Capsicum*. This extract is used as the active component of OC spray. OC is a complex mixture of capsaicinoids, 80% to 90% of it being capsaicin and dihydrocapsaicin, the most potent of the homologues in this mixture. OC is used as the principal active ingredient in pepper spray.¹⁴ Exposure to OC occurs through skin and eye contact and inhalation. When OC comes in contact with the skin, erythema and pain are produced. There are no reported instances of a chemical burn produced by OC, although OC enhances an allergic dermatitis. In the eyes, OC spray produces stinging, lacrimation, and photophobia. It decreases superficial sensitivity of the cornea and makes the eye vulnerable to abrasion. The respiratory effects are most pronounced. The nasal mucosa responds to OC with rhinorrhea, and low doses of capsaicin stimulate the cough reflex. Additionally, bronchospasm has been shown to occur in about a third of normal persons within seconds of exposure to OC.³⁵ Asthmatics are more sensitive to the bronchoconstrictive effects of capsaicin; an

acute asthmatic attack can be induced by exposure. In 1995, Steffee et al³⁵ reported two deaths in custody where OC had been used. In one death attributed to heart disease OC had been used, but the death was viewed as coincidental with the use of OC and not the consequence of OC. In the other death, OC exposure was identified as causing bronchospasm in a person with florid follicular bronchiolitis/bronchitis. In-custody death and OC has been reviewed by Granfield, Onnen, and Petty,¹³ who studied 30 deaths in an attempt to identify the role of OC as a causative agent. In all instances, death could be attributed to other causes, and none were identified as the result of OC. The use of OC has come under criticism in California by the American Civil Liberties Union, who identified 26 deaths thought to have resulted from pepper spray.³ Although pepper spray may have been used in each instance, the role of OC remains unclear. Pepper spray is widely used by law enforcement agencies, and at this time there is no convincing evidence to indicate that it is inherently lethal or dangerous.

SUMMARY

Death in custody is the most demanding investigation that a medical examiner or coroner can perform. The investigation requires attention to detail at the time of scene investigation and autopsy examination, as well as a careful assessment of the toxicologic results and circumstances of the death. Synthesis of the many facts that are developed during the investigation should allow the medical examiner or coroner to establish a reasonable cause of death. There can be legitimate points of disagreement of interpretation because the conclusions so frequently are predicated on physiologic processes and not on anatomic findings. It is incumbent on the medical examiner and coroner responsible for investigating deaths of these types to utilize all the information generated during the investigation and to identify an appropriate cause of death.

ACKNOWLEDGEMENTS

The author wishes to acknowledge Pat Luckman for preparation of the manuscript, Dr. James Luke for his advice and review, and the Scientific Illustration Division of the Armed Forces Institute of Pathology for preparing Figure 3.

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