

Selected Pages from  
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Only the pages from this chapter that offer information relative to investigation of "Restraint Asphyxia" cases were scanned for inclusion within this PDF: pages 229-244 and 273-275; as well as all pages identifying the references cited within this chapter (275-277).

The black and white photos on these pages were not redacted from the scanned pages. However, several unnumbered pages were found within this chapter, containing *Color Figure* photos. Those pages were *not* scanned into the PDF: Color Figures 2.6, 3.13, 4.9, 4.6, 5.7, 6.8, 6.11(a,b,c), 7.15, 8.11, 8.24, 9.11, 9.19, 13.6, 13.7, 16.1, and 19.2.

When scanning these pages to RTF files, the yellow highlighting was ignored! Thus, this PDF does not contain the yellow highlight found within the *jpg* page scans found on <http://www.charlydmiller.com/LIB/forensicpathasphyxia.html>

For the purpose of clarification, I occasionally *inserted* text on some RTF pages, prior to creating this PDF. ALL inserted text appears between brackets ([ ]) in **dark blue font color**.

# Asphyxia

# 8

Asphyxial deaths are caused by the failure of cells to receive or utilize oxygen. The deprivation of oxygen can be partial (hypoxia) or total (anoxia). The classical signs of asphyxia are visceral congestion, petechiae, cyanosis, and fluidity of blood. These are nonspecific, however, and can occur in deaths from other causes. Visceral congestion is due to obstructed venous return and capillovenous congestion. The latter is a result of the susceptibility of these vessels to hypoxia, with resultant dilatation of the vessels and stasis of blood.

**Petechiae** are pinpoint hemorrhages produced by rupture of small vessels, predominantly small venules. Rupture appears to be mechanical in etiology and is caused by sudden over distention and rupture of the vessels following abrupt increases in intravascular pressure.<sup>1,2</sup> These are most common in the visceral pleura and epicardium. In asphyxial deaths from strangulation, petechiae are classically seen in the conjunctivae and sclerae. Petechiae, as nonspecific markers,<sup>1,2</sup> may be seen in the conjunctivae and sclerae in association with many different conditions, not all fatal, and not just in asphyxial deaths. They are routinely seen in the reflected scalp in all types of death and are of no diagnostic significance in this area. Petechiae of the epiglottis are also of no significance. Gordon and Mansfield documented development of epicardial petechiae after death.<sup>2</sup>

Petechiae can develop after death in dependent areas of the body e.g., an arm hanging over the side of a bed. Here, gravity causes increased intravascular congestion and pressure with resultant mechanical rupture of small vessels. If the petechiae become larger or confluent, they are called ecchymoses.

Cyanosis is, of course, nonspecific and caused by an increase in the amount of reduced hemoglobin. It does not become observable until at least 5 g of reduced hemoglobin is present. Postmortem fluidity of blood is not characteristic of asphyxia or any cause of death, but rather the result of a high rate of fibrinolysis that occurs in rapid deaths, possibly by high agonal levels of catecholamines.<sup>3</sup>

Asphyxial deaths can be loosely grouped into three categories:

1. Suffocation
2. Strangulation
3. Chemical asphyxia

These deaths might be accidental, suicidal or homicidal in manner. Compared with other causes of homicide, homicides via asphyxia are relatively uncommon in the U.S. They predominantly involve strangulation — manual and ligature strangulation. In the last ten years, murders ascribed to strangulation have averaged 286 a year, with a range of 366 to 211. There seems to have been a gradual decrease in the number of such cases over the years. Murders caused by "asphyxiation" (no further description but excluding strangulation) have averaged 107 a year, with this number being fairly constant over the ten-year period.<sup>4</sup>

## Suffocation

In deaths from suffocation, there is failure of oxygen to reach the blood. There are six general forms of suffocation:

1. Entrapment/environmental suffocation
2. Smothering
3. Choking
4. Mechanical asphyxia
5. Mechanical asphyxia combined with smothering
6. Suffocating gases

### Entrapment / Environmental Suffocation

In suffocation by entrapment or environmental hazard, asphyxia is caused by inadequate oxygen in the environment. These deaths are almost exclusively accidental in nature. In **entrapment**, individuals find themselves trapped in an air-tight or relatively air-tight enclosure. Initially, there is sufficient oxygen to breathe. However, as respiration continues, they exhaust the oxygen and asphyxiate. The best example of this is a child trapped in a discarded refrigerator. Fortunately, this specific form of death by entrapment is becoming rare, as modern refrigerators do not have a latch system of locking and can be pushed open from the interior. Suicide and homicide by entrapment are rare, but do occur.

In **environmental suffocation**, an individual inadvertently enters an area where there is gross deficiency of oxygen. This deficiency is not due to displacement of the oxygen by suffocating gases, which will be discussed in another section, but rather that the oxygen has been depleted by some mechanism. Thus, the authors reported two deaths caused by lack of oxygen in an underground chamber.<sup>5</sup> The normal percentage by volume of oxygen in the atmosphere is 20.946%. In this particular case, the percentage by volume was 9.6%. This lethal atmosphere was caused by fungus-like organisms and

low forms of plant life present on the vault walls and in the sediment on the floor. The metabolic processes of the fungi and plant life resulted in depletion of oxygen by these organisms, with production of carbon dioxide. Thus, carbon dioxide, which is normally 0.033% in air, in this case, was 7.0%. The increased quantity of carbon dioxide, however, was insufficient in itself to have caused death by displacement of oxygen. It was the absolute lack of oxygen that caused death. At oxygen concentrations of 10 to 15%, there is impairment in judgment and coordination. Loss of consciousness occurs at 8 to 10%; death at 8% and less. At oxygen concentrations of 4 to 6%, there is loss of consciousness in 40 sec and death within a few min.

In deaths due to entrapment or environmental suffocation, the cause of death cannot be determined by autopsy alone, because there are no specific findings. *All that one finds is nonspecific acute visceral congestion.* It is only by an analysis of the circumstances leading up to and surrounding death, and the exclusion of other causes, that one can make a determination as to the cause of death.

### **Smothering**

Asphyxia by smothering is caused by the mechanical obstruction or occlusion of the external airways, i.e., the nose and mouth. Deaths such as these are usually either homicide or suicide, very rarely accident (Figure 8.1).

The most common form of suicidal smothering is the placing of a plastic bag over an individual's head (Figure 8.1 A). If it is heavy plastic, it may be secured at the neck. More commonly, suicides employ the thin, filmy plastic bag used by dry cleaners. Here, there is often no necessity to secure the bag at the neck, because it clings to the face, occluding the airways. These filmy plastic bags also account for the rare accidental deaths by smothering when these bags are used to cover a mattress or pillow in a crib of a young child. The child becomes enmeshed in the bag and smothers. In all the deaths that the authors have seen in which plastic bags have been placed over the head, there have been no specific autopsy findings. Petechiae of the face, sclerae, and conjunctivae were virtually always absent. Petechiae of the epicardium or pleural surfaces of the lung were sometimes present, but these are so nonspecific that the authors do not give any weight to them. If an individual commits suicide by use of a plastic bag and the bag is removed prior to notification of the authorities, a medical examiner cannot determine the cause of death by the autopsy.

There are occasional allegations of infants smothering in their cribs because of heavy blankets or bedding placed over them. The authors feel that these cases are examples of sudden infant death syndrome (SIDS) and that it is just coincidental that they are found covered by bed clothes. One can pile a number of blankets on an infant without causing any respiratory difficulty.



**Figure 8.1** (A) Suicide of elderly female who secured plastic bag over head with tie around neck. (B) Accidental smothering in mentally retarded, 43-year-old male who wrapped face in duct tape. Deceased had performed this act before.

Occasionally, an alcoholic is found face down on a pillow, dead. Circumferential oral and nasal pallor is noted and death is attributed to smothering. This pallor, however, can be caused post mortem by passive pressure of the dependent head on the pillow. Thus, the diagnosis cannot be made on this "evidence." The authors have grave reservations about this diagnosis. An individual would have to be in an alcoholic coma to smother this way. Alcoholic coma, however, puts them in grave danger of death anyway and this is more likely the cause of death, rather than the alleged suffocation.

Accidental smotherings can occur with defective cribs. Here, an infant is trapped either between a too-small mattress and the frame of the crib, or between a defective crib and mattress, with the face wedged against the mattress (Figure 8.2). The child is unable to move and smothers.

Gags obstructing the nose and mouth can cause death by smothering. Such deaths, though unintentional, are still homicides if the victims die during the commission of a crime. Typically, a gag is placed around the face obstructing the mouth and nose (Figure 8.3). Victims are usually elderly individuals who are either unable to struggle sufficiently to move the gag or who are unusually susceptible to the anoxia by virtue of natural disease. Mucus and fluids may accumulate in the nasal cavities and airways, contributing to asphyxia. In the elderly, there may be congestion of the face with



**Figure 8.2** A 9-month-old child who slipped between frame and mattress of defective crib. Face wedged against mattress.



**Figure 8.3** A 75-year-old woman, victim of robbery. Asphyxiated from towel secured over mouth and nose.

scattered fine petechiae of the sclerae, conjunctivae, and skin of the face. This has not been the case in young individuals in whom petechiae are usually absent. It is the discovery of the gag obstructing the airways that makes the diagnosis, not alleged signs of asphyxia.

In homicide by smothering, the implements used are usually pillows, bedding, and the hands. Infants may be placed in plastic bags. The victims tend to be very young, very old, debilitated, or incapacitated by restraints, disease or drugs. It is extremely difficult to smother adults in full control of their faculties.

When a pillow is used, it is placed over the face and pushed down. This causes obstruction of the nose and mouth, asphyxia, and death. There are usually no marks on the face. The face is not congested and there are no petechiae of the sclerae or conjunctivae (Figure 8.4). Abrasion injuries of the face will occur only if the victim puts up a vigorous resistance. In a review of 15 smothering deaths involving children below the age of 2 years, of the 13 who could be evaluated for the presence of petechiae, only one had findings. This child had a single petechia of the conjunctiva and a single area of scleral hemorrhage. Because of the circumstances of this case, there was the possibility that the child might also have been choked. Pushing the face into the bedding will accomplish the same end as using a pillow.

Smothering can also be accomplished using the hands. The nose is pinched off with one hand, while the other hand is used to push the jaw closed. In small children, one hand can accomplish both these tasks. In infants and adults unable to put up any effective resistance, an autopsy will fail to disclose any injury due to this process. In adults, even those who can muster only a minimal struggle, there may be abrasions on the nose or chin from the fingernails, and contusions of the lips from pressure of the palm (Figure 8.5).

The sequence of physiological events in smothering is:

- Bradycardia (decrease in heart rate)
- Decrease in respiration to agonal gasps with eventual cessation of respiration
- Slowing and finally flattening of the electroencephalogram (EEG)

The heart will continue to beat even after flattening of the EEG. In infants, bradycardia has been observed to start 30 sec after the initiation of smothering, and flattening of the EEG at 90 sec.<sup>6</sup> If, after cessation of respiration, the pillow or hand is removed from the face, respiration will not usually restart spontaneously. The individual must be resuscitated. Violent struggles with increased utilization of oxygen can speed up this sequence of events, just as natural disease could make the individual more susceptible to the effects of hypoxia.



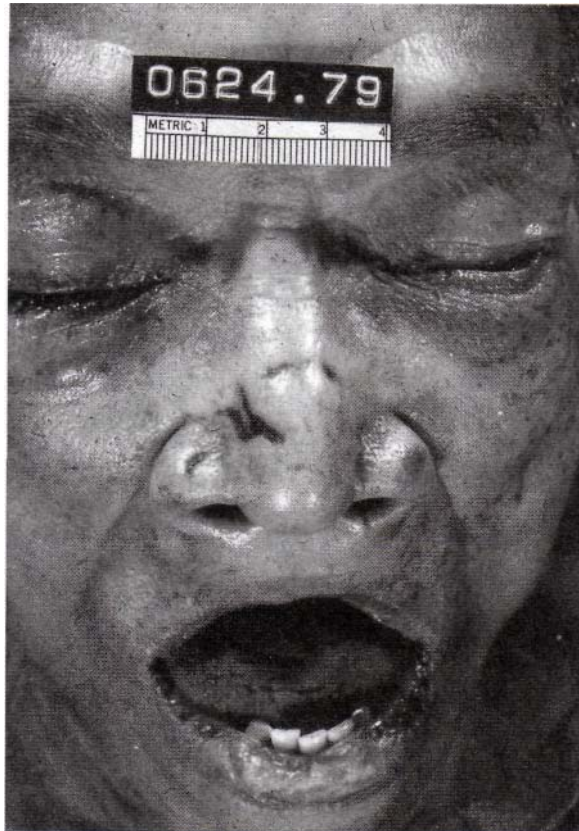


**Figure 8.4** A 2-month-old infant smothered by parent. No petechiae of sclerae, conjunctivae, or face.

### **Choking**

In choking, asphyxia is caused by obstruction within the air passages. The manner of death can be natural, homicide, or accident. Natural deaths are seen in individuals with acute fulminating epiglottitis, where there is obstruction of the airway by the inflamed epiglottis and adjacent soft tissue. Such individuals represent medical emergencies and can die literally in front of a physician. The individual develops a sore throat, hoarseness, respiratory difficulty, inability to speak and then suddenly collapses as the airway is completely obstructed. Inhalation of steam can cause a similar picture, with a markedly edematous, beefy-red mucosa in the larynx with obstruction (Figure 8.6).





**Figure 8.5** Elderly female smothered with hand. Fingernail marks on nose.



**Figure 8.6** Massive laryngeal edema caused by inhalation of steam.

Homicidal deaths by choking are relatively uncommon. In infants, one occasionally sees a newborn murdered by stuffing toilet paper into its mouth. Figure 8.7A illustrates the case of an infant killed by her father by ramming



**Figure 8.7** (A) Pacifier rammed into mouth by father (*continued*).

a pacifier into her mouth. In adults, individuals sometimes die during a robbery or burglary when a cloth or sock is rammed into the mouth to silence the individual. This is often done in conjunction with gagging (Figure 8.7B). This method of gagging individuals is shown quite frequently on television without any harmful consequences, but, unfortunately, in real life, the cloth can work its way backward, completely obstructing the posterior pharynx and causing the individual to asphyxiate.

Most choking deaths are accidental in manner. In 1997, there were approximately 3300 deaths ascribed to unintentional inhalation of food or other objects, resulting in obstruction of the respiratory passages.<sup>7</sup> In children, choking usually involves aspiration of a small object into the larynx with occlusion of the airway, e.g., a small rubber ball or a balloon (Figure 8.8). Deaths have occurred in classrooms, where children have choked on the top of ballpoint pens they were biting on.

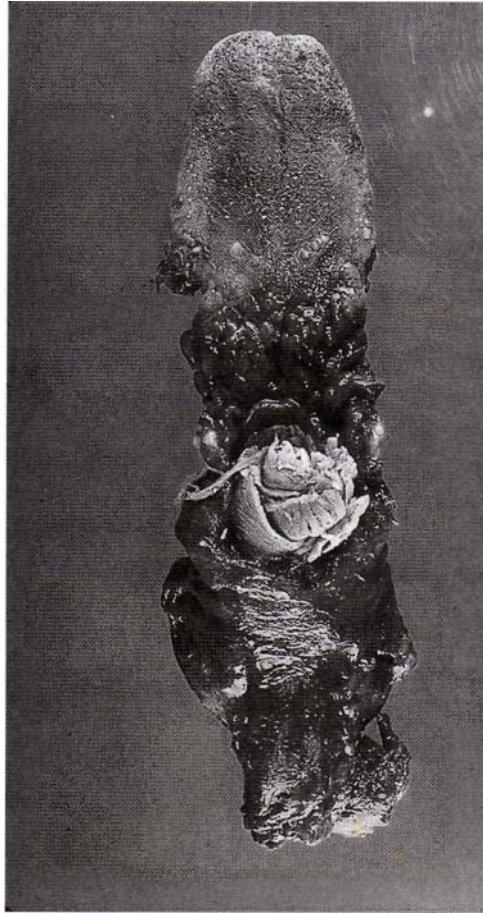
In adults, choking virtually always involves food (Figure 8.9). Here, it is commonly associated with acute alcohol intoxication, bad-fitting dentures, neurological injury, or senility. The piece of food will wedge in the laryngopharynx and larynx, completely obstructing the airway. Such deaths have



**Figure 8.7** (continued) (B) Choked on gag that was secured by a bandana.



**Figure 8.8** A 2-year-old choked to death on a wine cork.



**Figure 8.9** A 39-year-old male choked on a ham sandwich.

acquired the name of "cafe coronary." The individual is eating, suddenly stops talking, stands up, and collapses. Cardiopulmonary resuscitation is begun in the belief that the individual has suffered a heart attack. In fact, he has choked on food and his airway is completely occluded. Thus, cardiopulmonary resuscitation is ineffective. If the individuals giving mouth-to-mouth resuscitation are observant, they will see that the chest is not rising when they blow into the airway, which indicates obstruction.

Coughing during a collapse suspected of being caused by choking rules out this diagnosis as one must have an open airway to cough. Coughing involves the inspiration of 2 to 2.5 liters of air, followed by closing off of the epiglottis and the vocal cords, contraction of the abdominal muscles to force up the diaphragm, while, at the same time, the expiratory muscles contract. The epiglottis and vocal cords open up and the air is then expelled out of

the lungs, under pressure, usually carrying with it any foreign material present in the bronchi and trachea.<sup>8</sup> The expelled air can reach velocities of 75 to 100 miles per hour.

Occasionally, choking deaths occur when an individual falls into finely ground material, such as cornmeal or sawdust. There is involuntary inhalation and the airway is completely occluded by this material.

The finding of small amounts of food material in the airway at autopsy does not indicate that the individual choked to death. Approximately 20-25% of all individuals aspirate food agonally, independent of the cause of death.<sup>9</sup> One can attribute a death to aspiration only if the airway from the larynx down is completely occluded by food. Death caused by massive aspiration of food is rarely seen in a medical examiner's office. It is most common in comatose patients who have impaired functioning of the central nervous system.

The diagnosis of choking death is made at autopsy when the airway is found occluded. If the individual had an occluded airway and the object or food was removed during resuscitation, the only way to make the diagnosis would be by history. There are no specific autopsy findings indicative of choking except for occlusion of the airway.

Some medical personnel will ascribe a death to choking even though the airway was never completely occluded. They suggest that laryngospasm is the cause of death. There is, however, no objective evidence that this can occur. If laryngospasm did occur, one would expect relaxation of the larynx as the victim became agonal. This, in turn, would lead to opening up of the airway and recovery. Others hypothesize that a fatal "vagal reaction" or "reflex cardiac death," mediated through the parasympathetic nervous system, occurred through hypersensitivity of the larynx to aspirated food. Again, there is just no objective proof that this entity exists.

### **Mechanical Asphyxia**

In mechanical asphyxia, pressure on the outside of the body prevents respiration. Mechanical asphyxia is almost always accidental in manner. **[When not associated with Restraint actively being applied.]** It can be subdivided into three types:

1. Traumatic asphyxia (a term often used interchangeably with mechanical asphyxia)
2. Positional asphyxia
3. Riot-crush or "human pile" deaths

### ***Traumatic Asphyxia***

Traumatic asphyxia occurs when a heavy weight presses down on an individual's chest or upper abdomen, making respiration impossible. One common form of



traumatic asphyxia is individuals under a car, repairing it, when the jack slips and the vehicle falls on top of them (Figure 8.10). At autopsy, there is congestion of the head, neck, and upper trunk with numerous petechiae in these areas, the sclerae, the conjunctivae and the periorbital skin. Retinal hemorrhages may also be present. Internally, there is often no evidence of trauma in spite of the heavy weight on the chest. Individuals who survive an episode of traumatic asphyxia usually make an uneventful recovery, though occasionally there is some permanent visual impairment due to retinal hemorrhage. One individual who survived described a severe crushing pain and suffusion of his face followed by immediate unconsciousness.<sup>10</sup> Rarely, traumatic asphyxia is homicidal. Thus, in one instance, an individual was knocked to the ground and a refrigerator and stereo were piled on top of him. An occasionally encountered form of accidental traumatic asphyxia involves individuals buried in cave-ins with their heads above the ground.

The most unusual case of traumatic asphyxia seen by the authors was that of a 5-month-old infant killed by a python. The snake wrapped itself around the baby, tightening its coils whenever the child exhaled. At autopsy, the only marks on the child were teeth marks on the face where the snake had tried to swallow the child whole (his head was too big for the snake's mouth) (Figure 8.11). There were no petechiae, hemorrhage, or bruising.

### ***Positional asphyxia***

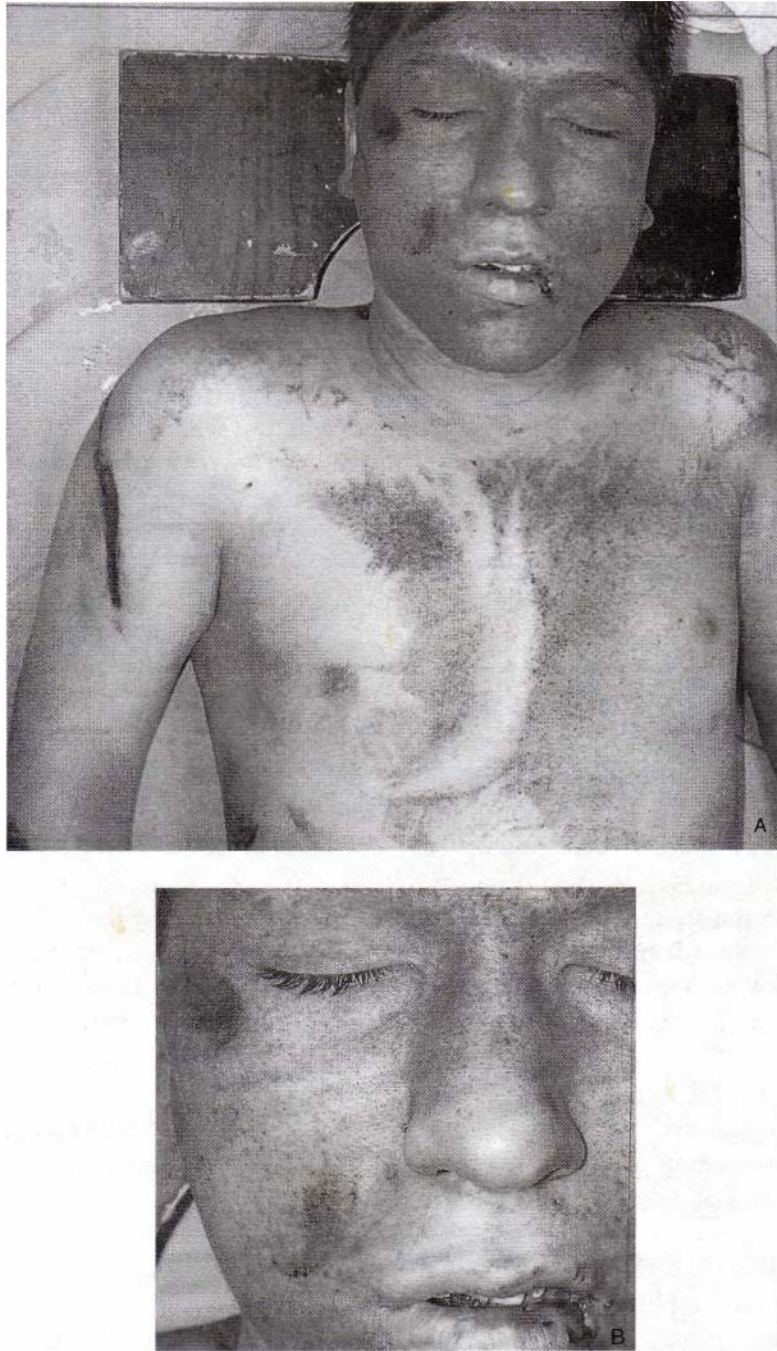
Positional asphyxia [**when not associated with Restraint being actively applied**] is virtually always an accident and is associated with alcohol or drug intoxication. In this entity, individuals become trapped in restricted spaces, where, because of the position of their bodies, they cannot move out of that area or position. This results in restriction of their ability to breathe, followed by death (Figure 8.12). There is usually marked congestion, cyanosis, and petechiae. Positional asphyxia might occur if individuals fall down a well and are wedged between the walls. Every time they exhale, they slip farther and farther down the well, preventing inhalation.

### ***Riot-crush***

Riot-crush, as the name implies, occurs in riots, when the chest is compressed by stampeding people piling on top of each other. Respiratory movements are, thus, prohibited by this human pile.

### ***Traumatic Asphyxia Combined with Smothering***

Traumatic asphyxia combined with smothering is a combination of both these entities. It can be accidental or homicidal. An accidental form is overlay, where an infant is placed in bed for the night with either an adult or a larger child. Subsequently, the infant is found dead. During the night, the other individual rolled onto the infant, killing it by a combination of



**Figure 8.10** Traumatic asphyxia. (A) Deceased pinned under overturned vehicle. (B) Marked congestion of face with petechiae.





**Figure 8.11** A 5-month-old infant killed by python. No petechiae, hemorrhage, or bruising of body. Puncture marks on face have a semicircular configuration and are caused by the needle-like teeth of the python.

smothering and traumatic asphyxia. If the circumstances surrounding the child's death are not known, such a case is often ascribed to SIDS. In fact, an autopsy cannot differentiate between the two. Other deaths in this category are individuals buried in cave-ins, grain, or sand, etc. The physical findings at autopsy are generally nil. Rarely, a few fine petechiae of the facial skin, but not of the sclerae or conjunctivae, will be found.

**Burking** is a combination of suffocation and traumatic asphyxia developed (or at least perfected) by the "resurrectionists" Burke and Hare in the early 19th century.<sup>11</sup> These men made their living by digging up bodies from graveyards and supplying them to medical schools for dissection. They



**Figure 8.12** Positional asphyxia in acutely intoxicated individual.

decided, however, to eliminate the chore of digging up bodies and go straight to the source. Victims, usually intoxicated, were brought to the ground, whereupon Burke knelt or sat on their chests, expelling the air and interfering with inspiratory efforts. He then put one hand over the victim's nose and mouth and used the other hand to press the lower jaw towards the upper. Visible injuries were virtually nonexistent. The two now had a fresh body for the schools. **[“Burking” is a form of Restraint Asphyxia.]**

### **Suffocating Gases**

Deaths from suffocating gases are caused, not by the toxic nature of the gases, but rather by displacement of oxygen from the atmosphere. Carbon dioxide and methane are the two most commonly encountered suffocating gases. Both are essentially nontoxic and odorless. Both are found in sewers and mines. Methane is the principal constituent (94-96%) of natural gas that is used for cooking. It is odorless; the smell we detect from natural gas is an added ingredient to make leaks detectable. Reduction of atmospheric oxygen to less than 25% of normal (5-6% by volume of oxygen) by displacement of oxygen by inert gases, such as carbon dioxide and methane, produces unconsciousness in seconds and death in a matter of minutes. Determination of the cause of death in such cases is by knowledge of the circumstances surrounding the death. There are no specific findings at autopsy. Toxicological analysis of the blood is of no help in the case of carbon dioxide, because it

**[This PDF now skips to pages 273-275 (“Crucifixion” and “Deaths from Choke or Carotid Holds” information), followed by all pages identifying the references cited within Forensic Pathology 2e (2001), Chapter 8.]**

with a simple noose around the neck, there may be elaborate binding with multiple turns of the rope around the body, or the hands bound either in front of or behind the body. Analysis of the binding will reveal that the individual was capable of binding himself. He is not completely suspended; his feet are on the ground. Thus, he can relieve the pressure of the noose just by standing a little straighter. In some instances, rather than a noose, a ligature or some other device capable of applying pressure to the neck is used. There is always some self-rescue device so that the individual can relieve pressure before losing consciousness. Unfortunately, because of equipment failure, a flaw in design or construction of the device, or loss of control by the individual, accidental deaths occur.

### ***Crucifixion [a form of “Restraint Asphyxia”!]***

One unusual, historical, form of asphyxia was crucifixion.<sup>37</sup> The victim was typically nailed to a cross with nails driven through the wrists into the crossbar and through the feet into the upright post. Death was caused by shock, both hypovolemic and secondary to the pain of nailing, plus dehydration and asphyxia. The weight of the body on the outstretched arms would interfere with exhalation by maintaining the intercostal muscles in an inhalation state. Exhalation would then become primarily diaphragmatic. Over a prolonged time, this would lead to impaired respiration and asphyxia.

### ***Death Caused by Upside-Down Suspension***

If an individual is suspended upside down for a long enough period of time death can result. The mechanisms of death might be either acute cardiac or respiratory failure or a combination of both. The length of time it takes for death to occur depends on the health of the individual. It could range from a few hours to a day, perhaps somewhat longer.

### ***Deaths from Choke or Carotid Holds [Both of which can cause Restraint Asphyxia due to different mechanisms.]***

Neck holds are used by law enforcement agencies to subdue violent individuals. Rarely, one will encounter a death alleged to have occurred due to application of either a choke hold or a carotid sleeper hold.<sup>38,41</sup> These terms are often used interchangeably, but, in fact, refer to two different holds whose purpose is to produce transient cerebral ischemia and unconsciousness. Neither involves use of a mechanical implement. **[This statement is false.]** Rather, the arm and forearm are used to compress the neck, producing cerebral ischemia and unconsciousness. **[A physical form of restraint.]** Occasionally, a baton, large metal flashlight, or some other device **[thus, constituting use of a “mechanical implement” for restraint]**, will be used to compress the neck. The authors have seen a number of deaths involving use of such instruments. In such cases, there is usually extensive hemorrhage in the neck and fractures of the hyoid or larynx.

With choke (bar arm) holds, the forearm is placed straight across the front of the neck. The free hand grips the wrist, pulling it back, collapsing the airway and displacing the tongue rearward, which occludes the hypopharynx. Incapacitation is caused by collapse of the airway and the carotid arteries with resultant decrease in the supply of oxygen to the brain. Compression of the carotid arteries is the prime mechanism for loss of consciousness. If too much force is used, there could be fracture of the larynx or hyoid. In two cases reported by Reay and Eisele and in a case seen by the authors, there were unilateral fractures of the greater cornu of the thyroid cartilage.<sup>38</sup> Both of Reay and Eisele's cases had fractures on the left side of the neck, the right forearm was across the neck and the left hand was used to pull it backward. Thus, pressure was eccentrically transferred to the neck, predominantly to the left side. In the case seen by the authors, the left forearm was across the neck and the fractures were on the right side of the neck. The authors' case also had a fracture of the hyoid bone on the same side. Following loss of consciousness, the chokehold is released and the victim should regain consciousness within 30 sec. There should be no permanent *sequelae*. Obviously, if the choke hold is maintained for too long, death will ensue, and one now has a case of manual strangulation.

In the carotid sleeper hold, symmetrical force is applied by the forearm and upper arm to the front of the neck such that there is compression of only the carotid arteries and jugular veins and not the trachea. The arm is placed about the neck with the antecubital fossa or crook of the arm centered at the midline of the neck. The free hand grips the wrist of the other arm and pulls it backward, creating a pincher effect. This produces transient cerebral ischemia. The carotid sleeper hold impedes blood flow in the carotid arteries by pressure exerted on both sides of the neck by the pincher effect of the arm and forearm. If properly applied, the compression of the carotid arteries will cause loss of consciousness in approximately 10-15 sec. On relaxation of the hold, cerebral blood flow will be restored and consciousness will return in approximately 10-20 sec, without any serious side effects. **[This statement is entirely theoretical. There is no guarantee that consciousness will return after interrupting carotid blood flow and asphyxiating the brain into unconsciousness!]** Experiments by Reay and Holloway demonstrated that, during application of the carotid sleeper hold, blood flow is decreased an average of 85% to the head.<sup>39</sup> The range in five subjects was 82 to 96%. The time to minimum blood flow averaged 6 sec (range 3.2 to 7.2 sec).

In theory, the carotid sleeper hold will cause rapid unconsciousness without injury to the individual. Unfortunately, in violently struggling individuals, a carotid sleeper hold can easily and unintentionally be converted into a choke hold, as the individual twists and turns to break the hold.

Maintenance of the pressure in a carotid sleeper hold, after loss of consciousness, becomes manual strangulation and, if continued long enough, will cause death. One would not expect trauma to the structures of the neck

in such an instance. The compression of the carotid arteries, with resultant decreased cerebral blood flow, can theoretically precipitate a stroke in an individual with atherosclerotic disease of the carotid or cerebral vasculature. The pressure can cause dislodgment of atherosclerotic material with a stroke caused by an embolus. Blood flow to the brain is from both the carotid and the vertebral arteries. If the vertebral arteries have impaired blood flow due to atherosclerosis, then occlusion of the carotid arteries can threaten an already compromised circulation, resulting in thrombosis or stroke **[or death]**.

Both choke and carotid sleeper holds are safe if properly used, though the latter is the safer of the two. In weighing how much force is acceptable in a situation, one must realize that any action involving force always has the potential of producing severe injury and death.

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