

Chapter 5

Medical Evidence in Non-Fatal Strangulation Cases

by William Green, M.D.

Strangulation is one of the most lethal forms of domestic violence. Minimal pressure on the neck can cause serious injury, and even in fatal cases of strangulation, it is possible there may be no external injuries at all. Health care providers working in the field of clinical forensic medicine commonly examine victims who were assaulted by strangulation. The strangled patient presents multiple challenges and questions. Are they medically stable or might they deteriorate? What evaluation is appropriate? What documentation is necessary, both medically and forensically? What was the intensity and duration of the assault? And how does the assault translate into the level of threat posed to the victim's life? This chapter discusses the medical evaluation of non-fatal strangulation patients.

A clarification of terms is important for the purposes of this discussion. The term “**forensic**,” refers to the interface between the law and medicine. “**Forensic pathology**” is the medical discipline that deals with the evaluation of *dead* victims. This differs from “**clinical forensic medicine**,” which is the medical discipline that deals with the evaluation and care (both medical and forensic) of *living* victims. Clinical forensic medicine includes attention to patient care needs, while forensic pathology does not.

CHALLENGES IN EVALUATING STRANGULATION CASES

In clinical forensic medicine, there are two sets of needs the medical professional must address. The first is the patient's needs. This includes any acute medical issues, emotional support, and crisis intervention. It may also include health issues and prevention strategies for STDs and unwanted pregnancy. Safety and social issues may also need to be addressed, such as risk-assessment, safety planning, and follow-up care.

Injuries sustained in a non-fatal strangulation evolve forensically, so a follow-up medical visit is imperative—both for victim care, as well as for the continuing documentation of evolving symptoms and physical findings for the criminal case.

The second area that must be addressed is the criminal justice needs, and this requires specialized training. A detailed assault history is necessary to determine the mechanism(s) of injury. The

proper collection of evidence (including DNA) and documentation of physical findings are necessary precursors to developing an expert medical opinion and later, expert testimony.

There are a number of medical and forensic issues that prove to be challenging in these types of cases. Medically, we are only now increasing our knowledge about level of risk associated with strangulation. It is not unusual for everyone involved in the case to under-appreciate the medical risk of strangulation. Patients may initially present with minimal or subtle injuries and symptoms. Consequently, this can result in limited medical evaluation and treatment, which may allow subsequent deterioration and a bad outcome for the victim. Forensic issues may include limited or poor documentation and little or no medical testing, therefore, no objective proof of injury.

BASIC PHYSIOLOGY TO UNDERSTAND

The brain needs a continuous supply of oxygen. Without it, brain cells quickly malfunction and die. And brain cells do not regenerate. There are two vital bodily systems that must work perfectly and in unison—the respiratory (breathing) system and the cardiovascular (blood flow) system. Multiple areas of vulnerability exist in both of these systems, and the compromise of a single area can rapidly produce a very bad outcome.

TERMS AND DEFINITIONS TO UNDERSTAND

- **Symptoms** are the things that the patient tells us; what the patient reports to the care provider. These things include medical history or complaints as well as the description of pertinent emotions (fear, panic, impending doom, etc.). Note that symptoms are inherently subjective.
- **Signs** are the things that are objective; they are the things the care provider sees, hears, and feels during the physical examination and includes lab reports and imaging studies (X-rays, CT scans, MRI scans, etc.).
- **Respiration** describes the delivery of oxygen into the blood. Air must pass through the mouth and nose into the upper air passages, the voice box (larynx), the wind pipe

(trachea), and finally into the lungs. Air must freely flow in and out of the lungs. The chest and the diaphragm muscle work together to create the “bellows” that moves the air (breathing).

- **Oxygenation** is when the lungs extract oxygen from the air and shift it into the blood.
- **Cardiovascular** refers to the system of heart and blood vessels that is responsible for pumping the oxygen-rich blood from the lungs, through the heart, into the carotid arteries in the neck, and up to the brain. After the oxygen is delivered to the brain cells, carbon dioxide and other waste products are transferred from the cells into the blood, and returned by the jugular veins in the neck to the lungs to be exhaled.
- **Asphyxia** occurs when brain cells are deprived of oxygen. This may result from compromise of respiration—the lungs being deprived of oxygen—or cardiovascular compromise—the brain being deprived of blood flow. Asphyxia may result from a combination of problems in both systems. Common clinical features—in other words, the symptoms and signs—of asphyxia from any cause, may include pain, anxiety, and altered level of consciousness. Unconsciousness may occur within 10–15 seconds of the application of pressure on the neck.
- **Strangulation** occurs when external pressure is applied to the neck until consciousness is altered. This does not necessarily mean the victim has become completely unconscious; it can mean just lightheadedness. There are two types of strangulation—manual and ligature. **Manual strangulation** can be accomplished with one hand, both hands, or another body part (e.g., knee or choke hold). **Ligature strangulation** is accomplished when a cord-like object is used to apply pressure to the neck.
- **Suffocation** is the process that halts or impedes respiration. Suffocation can include choking, smothering, and compressive asphyxia.
 - **Choking** is what happens when an object mechanically blocks the upper airway or windpipe (trachea). It’s when something gets in the airway and stops airflow *internally*. Choking can occur when food or some other object obstructs the airway. *Caution:* This term is often used inappropriately. Patients may use it to describe what happened when they were strangled.



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the investigation and prosecution of strangulation cases

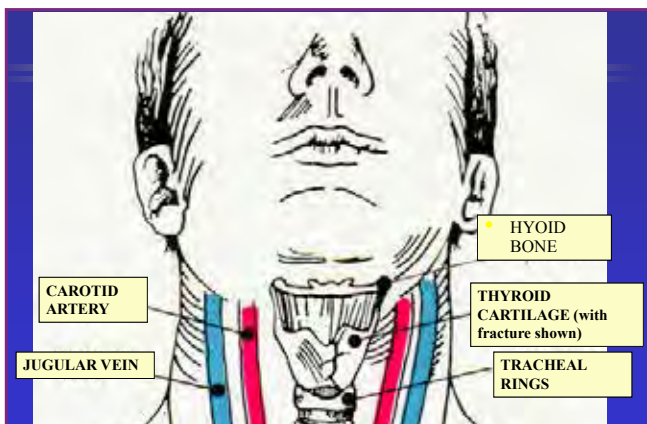
- **Smothering** is a mechanical obstruction of airflow into the nose and mouth (e.g., putting a pillow over the victim's nose and mouth).
- **Compressive asphyxia** occurs when an assailant puts his body weight on the victim, limiting the expansion of the lungs, which interferes with breathing.

PATHOPHYSIOLOGY

Pathophysiology is the study of the functional changes associated with disease or injury. Because two complex systems (respiratory and cardiovascular) are involved, functional vulnerabilities exist in many areas—singly or in combination. Functional changes may be temporary and resolve when the compromising force is removed. Examples include compression of the airway, the chest, a blood vessel, or a nerve. Forces may damage structures that will require treatment and/or time to heal. Examples include fractures, tears, ruptures, or crushing of airway or blood vessel structures. These injuries may pose an immediate threat to life. Bleeding and swelling deserve special emphasis. Even minimal force may cause bleeding and/or swelling in the injured tissue. Initially, both symptoms and signs may be mild or unrecognized. The great risk is that both bleeding and swelling can progress (often slowly) and not cause obvious problems until the airway is blocked or a vascular disaster occurs.

SPECIFIC FUNCTIONAL CHANGES IN STRANGULATION

Functional changes in a strangulation case may include damage to the voice box (larynx) and/or the hyoid bone. (*Note:* The hyoid bone is the only bone in the body that is not directly connected to any other bone; it aids in tongue movement and swallowing.) Bruising (contusion) and bleeding (hemorrhage) are common in strangulation cases, as well as swelling (edema). Swelling is



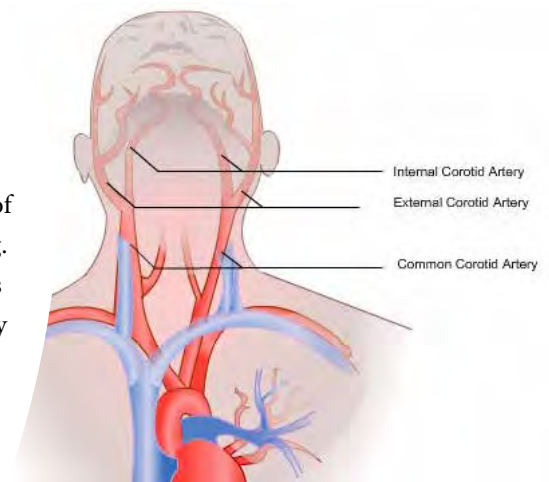
something that should be of grave concern given that it may not be apparent until hours after the strangulation occurs. These findings may develop with as little as 22 pounds of pressure to the neck. The temporary blockage or closing of the blood



vessels (occlusion) requires 33 pounds of pressure, and fracture of the hyoid bone requires 35–46 pounds of pressure.

Various combinations of functional changes may occur, leading to severe trauma to the upper airway. For example, the airflow can be compromised, the voice box fractured, and facial and neck swelling can be evident. Air can escape from the air passages and leak into the soft tissues (subcutaneous emphysema). These injuries can be very dangerous to a patient and may lead to death.

Damage to the carotid arteries may occur, which compromises the blood flow to the brain. The use of frontal force—anywhere from 5.5 to 22 pounds—may result in arteries being compressed against the neck bones. When a single carotid artery is compressed or blocked, there may be neurologic findings on the opposite side of the body. These findings include weakness, numbness, and tingling. When both carotid arteries are compressed or blocked, the result is rapid loss of consciousness. Any damage to the carotid arteries may result in compromised blood flow to the brain.



Delayed findings may include bleeding and internal artery damage (intimal tears). This is a very subtle diagnosis. Trauma may tear a small flap of tissue in the lining of the artery and as the body tries to heal it, a blood clot inside the artery may form and grow (thrombosis). Eventually, blood flow through the artery may decrease or even stop. These developing blood clots can break off and travel to the brain (embolization) and block a distant artery. Neurologic findings may develop from the areas deprived of blood flow. This resembles both the mechanism and clinical findings of a stroke.

If the return of blood from the brain is compromised (venous outflow obstruction), blood coming back to the heart begins to back up. This creates a situation called *stagnant hypoxia*. Blood is building up that does not have enough oxygen. Only 4.4 pounds of pressure on the jugular veins may cause this back up of oxygen-lacking blood. Altered consciousness results with only 15–30 seconds of sustained compression. Common clinical findings in this situation are tiny surface blood vessels that rupture from increased internal pressure. Those found on the face and other mucus membranes are known as *petechiae*. Others may be found in the white part of the eye (sclera), and are called *sub-conjunctival hematoma*. Further, ruptured blood vessels may occur internally, so they are not visible.

Some less-common medical problems that may result from strangulation include compression of the carotid body—an important neurologic structure in the neck that acts as a switching station for nervous impulses. Compression of the carotid body (sustained for 3–4 minutes) may stimulate the *carotid sinus reflex*, which results in a slowing of the pulse (bradycardia) and may lead to altered consciousness (lightheadedness or loss of consciousness). If pressure is sustained or the reflex response is severe, the situation may progress to cardiac arrest.

A rare problem is neck (cervical vertebrae) fractures, which are most commonly seen in long-drop hanging. Strangulation may also cause fluid overload in the lungs (pulmonary edema), a symptom that may not present for up to two weeks.

CLINICAL SYMPTOMS REPORTED BY STRANGLED PATIENTS

Neck and sore-throat pain is very common in victims of strangulation—it is reported in 60–70 percent of cases—and is usually related to direct trauma (blunt force). Injury to the voice box (larynx), swelling, and bleeding are also painful. Breathing changes or difficulty breathing is even more common, appearing in up to 85 percent of cases. One type of breathing abnormality, *psychogenic hyperventilation*, can be caused by anxiety. Fluid in the lungs, breathing problems, and worsening of other conditions such as asthma, may not be evident until days after an assault.

Voice changes, such as a hoarse or raspy voice, and the inability to speak are also common, reported by up to 50 percent of strangulation victims. Coughing may also be seen, due to injury, swelling, or bleeding in or near the voice box (larynx).



Practice Tip for First Responders and Healthcare Personnel: Document with voice recording both at time of initial consultation and follow-up appointments.

Swallowing abnormalities are common and occur in up to 44 percent of victims. Victims may have difficulty swallowing (dysphagia), painful swallowing (odynophagia), voice box (larynx) swelling and bleeding, and the swallowing tube (esophagus) may bleed and swell. These symptoms may be immediate or delayed.

Mental status and consciousness changes may include lightheadedness and dizziness, loss of memory, and loss of consciousness. Loss of memory may compromise the accuracy and credibility. It is important for healthcare providers to document the victim's level of certainty when documenting the patient's history of events.

Behavioral changes that may appear during or immediately after the assault include agitation, restlessness, and combativeness. Victims may be fearful (or frantic) because they do not have enough oxygen. Weeks to months after an assault, a victim may display impairment in memory and concentration, and may have problems sleeping. Mental health problems can include anxiety, depression, and dementia. The mental health and behavioral changes are most commonly due to the brain cells being deprived of oxygen. If the interruption is brief, the symptoms and signs are temporary and generally resolve. However, if the interruption of oxygen to the brain is longer, the findings may be permanent and will not resolve. When brain cells die (anoxic brain damage), the damage can be permanent and devastating.



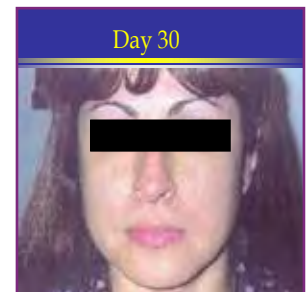
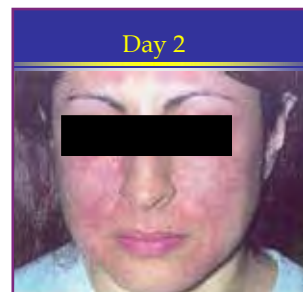
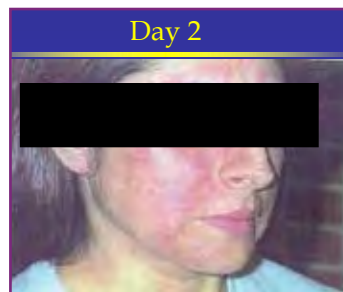
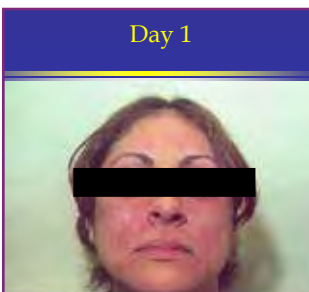
eyelid droop

Other neurologic signs and symptoms may include vision changes (dimming, blurring, decrease of peripheral vision, and seeing “stars” or “flashing lights”). Victims also may experience ringing in the ears (tinnitus), facial or eyelid droop (palsies), one-sided weakness (hemiplegia), incontinence (bladder or bowel), and miscarriage.



! Practice Tip for First Responders and Healthcare Personnel: You may have to ask questions about incontinence because victims may not readily share this information.

It is important to remember that symptoms are subjective; they are described by the patient. Documentation is essential, and it must be thorough and detailed. Multiple interviewers who take statements tend to provide objectivity when the descriptions are consistent. Over time, symptoms will change or even resolve, so recording the victim’s experience provides a degree of objectivity. Some symptoms may be non-specific and or have multiple causes—these must be thoroughly explored and recorded.



CLINICAL FINDINGS

In up to 50 percent of cases, there are no visible neck findings. In these situations, it is very dangerous to speculate about the seriousness of the event or try to predict the clinical outcome. Despite the lack of visible injury, the victim may experience pain (subjective discomfort described by the patient) or tenderness (discomfort with palpation).

- ! **Practice Tip for First Responders and Healthcare Personnel:** The lack of visible findings or minimal injuries does not exclude a potentially life-threatening condition.



petechiae over the eyelid

Visible injuries may include petechiae, which is the result of compression that impedes venous blood flow. As this internal pressure increases, small blood vessels near skin or mucous-membrane surfaces rupture, causing multiple, tiny (1–2 mm) red spots to appear. Petechiae are non-palpable, in other words, they are flat and cannot be felt when touched. The area is not tender and there is no discomfort when touched. Also, they do not blanch, in other words, they will not change color when pressed, unlike when you press on your fingernail.



petechiae

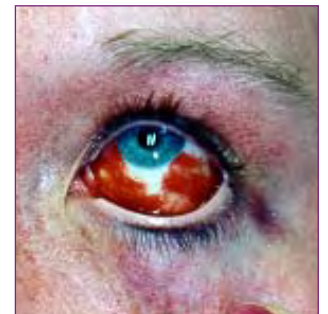
- ! **Practice Tip for First Responders and Healthcare Personnel:** The term “petechiae” is used inappropriately to describe direct blunt trauma findings, which should correctly be described as “micro hemorrhages.” Petechiae will remain for several days and may not resolve for up to two weeks.

Other visible findings include *sub-conjunctival hematoma*. This occurs when the compression impedes venous blood flow. As the internal pressure increases, small blood vessels on the surface of the eye (the sclera or white part) rupture and allow blood to pool. These “blood spots” (much larger than petechiae) can be very disturbing to the patient and those around her.

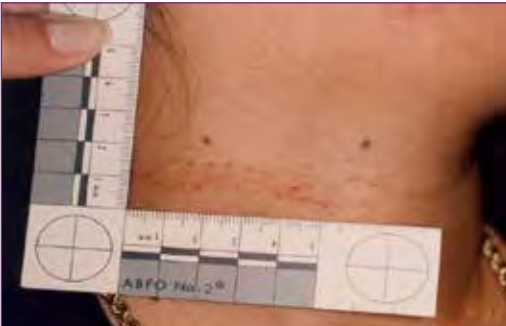


However, they are not dangerous and they do not impair vision. No treatment is required and they resolve within two weeks.

sub-conjunctival hematoma



- ! **Practice Tip for First Responders and Healthcare Personnel:** Use the forensic approach. Look for a patterning of findings. The appearance of the finding may give information about the cause or mechanism of injury.



It is important to understand the mechanism of injury. It allows the healthcare provider to compare and correlate the history of what happened to the physical findings. It provides for the assessment of consistency. The follow-up exam needs to include forensic imaging that can document emerging or evolving injuries. Further, it provides for a comparison and clarification of non-specific injuries (i.e., redness).

- ! **Practice Tip for First Responders and Healthcare Personnel:** Give patients a wig head on which they can demonstrate and describe what happened.



Findings can be caused by patients trying to save their own lives. For example, a victim scratching her neck to remove a ligature. Scratch marks may have small breaks that are caused when the fingernails move over the ligature. Marks on the bottom of the chin can represent a victim holding her chin down, trying to get the ligature or hands off of her neck.

CLINICAL MANAGEMENT OF THE MEDICAL EVALUATION

*self-inflicted
defensive "claw"
injuries*

First and foremost, the patient must be stabilized. Any patient who has altered mental status (unconscious, confused, combative, significantly intoxicated, etc.) or has severe symptoms should be considered a 911 emergency. All strangled patients, even those with minimal symptoms should have a medical evaluation by a healthcare provider experienced in evaluating and managing strangulation. This includes patients who say they are now "fine." At minimum, the medical



*abrasions under
chin due to
instinctual
chin lowering.*

evaluation should include a careful history and physical exam. Lab tests, imaging studies (X-ray, CT, MRI, etc.), specialty consultation, and observation are frequently needed to assess the risk and actual extent of injury. Forensic management may include using neck swabs to collect assailant touch DNA or saliva. The follow-up evaluation may also include exams and imaging studies.