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Pathology of Non-Fatal Asphyxia and the Risk of Fatal Outcome in the Context of Intimate Partner Violence

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Abstract

The victims of intimate partner violence are subjected to emotional, physical and/or sexual abuse. The physical abuse often includes episodes of mechanical asphyxia and its most frequent mechanisms: throttling and strangulation. Non-fatal asphyxia situations have signs, symptoms and short-term or long-term consequences whose severity varies according to the intensity, duration and number of episodes.

The extensive study of bibliographic contents available at the PubMed platform, which resulted from a search with the terms "intimate partner violence", "domestic violence", "strangulation", "brain injury", "PTSD", "non-fatal lesions", "asphyxia", "forensic", "neck compression", "fatal lesions", "prevention", "violence against women" and "crime", as well as the study of the books "Forensic Pathology", "Medicolegal Investigation of Death", "Medicina legal y toxicologia" and "Odontologia legal & antropologia forense" allowed to gather the most recent information on asphyxia in an intimate partner violence context.

The typical signs of mechanical asphyxia are abrasions and contusions on the neck, which may or may not be visible, and the most common symptoms are neck pain, swallowing difficulties and sore throat. Among the several consequences, there is the possibility of developing brain injuries that might work to signal a non-fatal intimate partner violence situation or that lead to the victim's death. The occurrence of asphyxia increases the victim's likelihood of being murdered in the context of that intimate relationship.

Given the severity of this public health issue, it becomes imperative to identify the victims of asphyxia in order to ensure the provision of healthcare and the application of measures of protection and prevention that are adequate to victims and survivors.

Keywords: Intimate Partner Violence; Domestic Violence; Asphyxia; Strangulation; Brain Injury; PTSD; Choking; Forensic; Neck Compression; Violence Against Women

Introduction

The World Health Organization (WHO) defines intimate partner violence (IPV) as a serious public health issue that affects thousands of people in the world. It is an on-going type of violence that persists in time, causing immediate and later consequences, both short-term and long-term [1-3].

The prevalence rates vary between communities, countries and regions and despite all the efforts, this type of violence continues to increase. The victims are mostly heterosexual women; the aggressors are either their partners or ex-partners; and the most common place of abuse is the residence that they share [3-7] (Table 1). The incidence rates are difficult to define, as they depend on the number of reports and documentation of the injuries characteristic of interpersonal violence. New studies also point to an increase in the incidence and severity of physical violence by an intimate partner associated with the coronavirus disease 2019 (COVID-19) when compared to previous years [8-10].

The focus of this review is the analysis of partner violence in intimate relationship and the influence of lethal and non-lethal asphyxiation violence on the body and psychology of the victims. The extensive study of publications on the subject allowed to gather information that clarifies the topic and reinforce the need to develop protective and preventive measures specific to this type of abuse.

The injuries caused in an IPV context are found more often on the face, head and neck [11,12]. Neck injuries can be a sign of physical abuse by way of mechanical asphyxia. Mechanical asphyxia does not always cause visible injuries, but when they exist, they point to an austere form of abuse whose frequency, intensity and seriousness tend to increase over time. The risk of homicide in these interpersonal relationships is high, as demonstrated by recent studies. Non-fatal asphyxia is a known risk factor for murder inflicted by the aggressor in the relationship, whether by asphyxia or other mechanism, such as stabbing or use of firearms [13-17].

Region	Prevalence (95% confidence interval), %
Asia Pacific, High Income	28.45 (20.6 to 36.3)
Asia, Central	22.89 (15.8 to 30.0)
Asia, East	16.30 (8.9 to 23.7)
Asia, South	41.73 (36.3 to 47.2)
Asia, South-East	27.99 (23.7 to 32.2)
Australasia	28.29 (22.7 to 33.9)
Caribbean	27.09 (20.8 to 33.3)
Europe, Central	27.85 (22.7 to 33.0)
Europe, Eastern	26.13 (20.6 to 31.6)
Europe, Western	19.30 (15.9 to 22.7)
Latin America, Andean	40.63 (34.8 to 46.5)
Latin America, Central	29.51 (24.6 to 34.4)
Latin America, Southern	23.68 (12.8 to 34.5)
Latin America, Tropical	27.43 (20.7 to 34.2)
North Africa/Middle East	35.38 (30.4 to 40.3)
North America, High Income	21.32 (16.2 to 26.4)
Oceania	35.27 (23.8 to 46.7)
Sub-Saharan Africa, Central	65.64 (53.6 to 77.7)
Sub-Saharan Africa, East	38.83 (34.6 to 43.1)
Sub-Saharan Africa, Southern	29.67 (24.3 to 35.1)
Sub-Saharan Africa, West	41.75 (32.9 to 50.6)

Table 1: Prevalence of intimate partner violence by Global Burden of Disease (GBD) region [3]

Statistics of the WHO show that 38% of female homicides are committed by intimate partners [1].

Even if the victim survives the physical abuse, the consequences may persist and affect her in the future at a physical, psychological, emotional and social level. The serious consequences of intimate partner violence require the implementation of primary and secondary measures of prevention. The intervention not only assists victims and survivors, but it is also believed to benefit future generations, in that, when we reduce the risk factors associated with the children who grow up in these environments, we also reduce their risk of becoming victims or aggressors in their future interpersonal relationships [18-32].

Methodology

This literature review results from an extensive study of bibliographic contents available at the PubMed platform, obtained from a search with the terms "intimate partner violence", "domestic violence", "strangulation", "brain injury", "PTSD", "non-fatal lesions", "asphyxia", "forensic", "neck compression", "fatal lesions", "prevention", "violence against women" and "crime". In a first phase, the articles were selected by reading their abstracts and, in a second phase, by reading them in full. In order to obtain the largest possible amount of heterogeneous information about the topic, no time restrictions were applied in the bibliographic research. However, only the most recent studies with more probative value were used as reference in the results of incidence and in the statistical data presented in this article. The bibliographic references of the World Health Organization (WHO) and of the Victim Support Association (APAV) were researched specifically on Google with the terms "WHO intimate partner violence" and "APAV domestic violence statistics".

The reading of the books "Forensic Pathology", "Medicolegal Investigation of Death", "Medicina legal y toxicologia" and "Odontologia legal & antropologia forense" was particularly useful to study the asphyxia mechanisms and the pathophysiology.

After selecting the articles and book chapters, the gathered information was organized by contents to enable a complete and clear approach to the topic. The gathered and organized information was then combined and contextualized in the form of a literature review, enabling the transfer of knowledge and conclusions about the studied topic.

Non-fatal asphyxia in the context of intimate partner violence

The term "asphyxia" is used to describe a pathophysiological state characterized by the suppression of breathing in the presence of blood flow or, in a broader sense, to the compromising of one of the following: the absorption of oxygen from the air, its transport from the lungs to the tissues, its release from oxyhaemoglobin to the target tissues or its absorption or use by those tissues.

The study of mechanical asphyxias is particularly relevant in the context of forensic medicine, with these being recognized as frequent in crime situations. Mechanical asphyxias can occur by way of smothering mechanisms, external neck compression, aspiration of liquids to the respiratory system and biomechanical musculorespiratory changes. Of all these, asphyxia by external compression of the neck by throttling or strangulation are the most common in the context of intimate partner violence. The mechanical asphyxia of IPV victims seems to be the reflex of an impulsive attitude caused by the need to immobilize the victim or control her defense movements; hence, in most cases, neck constriction is manual or achieved with an object present in the conflict setting. However, in some IPV situations there might be an initial intention of committing murder [33-36].

The incidence rates of this type of practices are difficult to define, as they depend on the number of reported situations and on the documentation of the visible aspects of mechanical asphyxia. The analysis of data published in scientific studies allows us to define mechanical asphyxia as an event of abuse that is relatively common in IPV circumstances. In the study of Glass et al. (2008) [15], 27% of the sample of survivors suffered aggression by strangulation, whereas 43% of the homicides occurred through this means. As for Wilbur et al. (2001) [13], 68% of the IPV victims who took part in their study reported having been subjected to asphyxia. Still in this study, Wilbur and his colleagues assessed the frequency of different mechanisms of mechanical asphyxia by external

compression of the neck in the studied sample. The results show that the most frequent mechanism is throttling with both hands (in 43% of the respondents), followed by the combined mechanism of one hand, two hands and strangulation with other means (31%). One-handed throttling was reported in 11% of the situations, and in 2% of such situations the victims confirmed the use of a rope or belt as a means of strangulation. In the same study, one of the inquired victims reported attempted hanging by her partner. The authors concluded that most of these abuses occur in a common residence (78% of cases) and that, on average, victims experienced asphyxia 5.3 times during their relationship (87%). Non-fatal asphyxia proved to be frequently associated with other types of psychological, physical and sexual abuse [13-16,35].

The occurrence of aggression by asphyxia appears to be related to the likelihood of homicide in the same context of interpersonal relationship. In this regard, it seems that the existence of injuries caused by non-fatal asphyxia is a risk factor for a later aggression that proves fatal for IPV victims [11-13,34]. According to Glass et al. (2008), the existence of non-fatal asphyxia injuries in a victim increases six times her likelihood of suffering attempted murder and seven times the likelihood of death by homicide in the same IPV context [15].

Pathophysiology, asphyxia mechanisms and anatomopathological signs

From a pathophysiological point of view, asphyxia can be described as a process of insufficient exchange of respiratory gases. The decreased blood flow leads to a reduction in the quantity of oxygen (O_2) available in the organism. The organs that are more affected by the suppression of breathing are the brain and heart. In these conditions, the anaerobic metabolism is used to produce energy, resulting in the production of lactic acid and consequent tissue acidosis. An insufficient elimination of carbon dioxide (CO_2) might occur at the same time, leading to respiratory acidosis. Thus, the definition of asphyxia comprehends a reduction of oxygen availability (O_2), an increase in the levels of carbon dioxide's partial pressure (PCO_2) and a reduction of the pH levels in the organism. Critical levels of ischemia and cellular hypoxia result in the interruption of the energy metabolism, a decreased brain function and, eventually, neuronal necrosis.

On the other hand, the process of asphyxia by external compression of the neck often incapacitates or kills the victims not because of compression of the airways and resulting block of the air flow, but because of compression of the carotid arteries and resulting block of oxygenated blood flow to the brain. This process encompasses four different phases of variable duration: the anaesthetic phase, the convulsive phase, the agony phase and the terminal phase. In the first phase (anaesthetic), the victim goes through tinnitus, photopsia, pain, headaches and loss of consciousness. The convulsive phase is similar to an epileptic crisis, starting with tonic seizures followed by clonic seizures. In the agony phase, it is possible to observe some involuntary movements, either automatic or reflexive; the heart has isolated and spaced contractions and there is incontinence due to a relaxation of the sphincters. Finally, in the terminal phase there is cardiorespiratory arrest, areflexia, pupil dilatation and death [34,35] (Table 2).

Phases of mechanical asphyxia	
Anaesthetic phase	Tinnitus, photopsia, pain, headaches and loss of consciousness
Convulsive phase	Its characteristics are similar to those of an epileptic crisis, accompanied by seizures
Agony phase	Involuntary movements, heart with isolated and spaced contractions and relaxation of sphincters
Terminal phase	Cardiorespiratory arrest, areflexia, pupil dilatation and death

Table 2: Phases of mechanical asphyxia [34]

Throttling proved to be the most common mechanism of asphyxia in intimate partner violence. It consists of an asphyxia process achieved by compressing the neck with the hands, with a part of the limbs (forearm, elbow, leg or foot) or by way of a technique known as "chokehold". The necessary time to reach the terminal phase is superior to that of strangulation. For this asphyxia mechanism, the most typical injuries found in the victim's neck are contusions, as a consequence of the pressure exerted by the aggressor's fingers. The mark of the thumb is often the most visible. These injuries might constitute useful evidence to identify the author of the crime, despite the fact that only rarely a fingerprint can be identified on the marks left on skin. Circular abrasive injuries found in the victim are usually the result of self-defense. In a criminal context, the analysis of traces of skin cells left by the

aggressor in the nails of the victim might enable the identification of the aggressor by extracting and processing his DNA [33-39]. Strangulation is another variation of asphyxia; it consists in constricting the neck with a lace actioned by the force of the aggressor's hands. Fractures of the thyroid cartilage may occur as a result of the compression, as well as retropharingeal haematomas (injuries on the soft tissues of the retropharinx). The terminal phase is estimated to occur ten minutes after uninterrupted constriction, but the duration varies according to factors related to the victim and the aggressor. In cases of strangulation with lace, it is usual to identify single or multiple abrasive injuries displayed on the horizontal all over the neck.

The association between asphyxia and the presence of abrasive injuries and contusions on the neck is widely accepted; however, the identification of victims and the diagnosis of these injuries can be challenging, particularly due to the inexistence of sufficient injuries that are typical of, and that result from, episodes of asphyxia. The inexistence of visual signs that could lead to a diagnosis of asphyxia injuries makes it difficult to identify the victim and to document the case when there's a reported situation. In a study published in 2001 by Strack and McClane, which was based on the police records of 300 women who were strangled by their partners, 50% of the victims do not had visible injuries, 35% had visually insignificant injuries and only 15% presented injuries that are specific of asphyxia on the neck [13-16,33-39].

Symptoms and consequences of non-fatal asphyxia

The symptoms and consequences of non-fatal asphyxia in IPV circumstances vary according to the intensity and duration of these conflicts, factors related to the victim and the perpetrator, and the intention of the practice.

Some of the symptoms felt by the victims are described in the literature, and include neck pain, hoarseness, dizziness, painful swallowing, breathing difficulties, paralysis, headaches, memory loss, sensory deficit, tinnitus and light-headedness. In addition to these, victims might manifest psychological symptoms such as nightmares, suicidal ideation, depression, anxiety, insomnia, personality changes and post-traumatic stress disorder (PTSD). When associated with loss of consciousness, urinary or faecal incontinence and the presence of petechia on the face, such symptoms point to an almost fatal experience [38-43]. In a study conducted by Smith, D.J. et al. (2001), the victims of isolated acts of asphyxia reported feeling neck pain (51.5%), swallowing difficulties (48.5%) and sore throat (46.9%) [14].

The consequences of practices of aggression by asphyxia are severe and can cause long-term damages. The new scientific researches seek to clarify the relationship between the deficit of oxygen and the damages on brain cells, given that the blood flow in the brain is extremely sensitive to changes in the concentrations of O_2 e CO_2. The effects of these changes are complex, and they're associated with alterations in the mitochondrial oxidative metabolism that are a consequence of asphyxia, and can trigger a brain dysfunction and cell lesions. On the other hand, the synaptic dysfunction caused by the depolarization of the membrane and the deficit in the energy metabolism can lead to neuronal death [46-54].

In 2020, Rajaram and his colleagues published an article in which they reinforced the existence of a high risk of suffering a brain injury (BI) in an IPV context when these conflicts include episodes of asphyxia or blows to the head [46]. A study conducted by Valera et al. in 2003 showed that brain injuries are common among survivors of IPV, and that these injuries can result from episodes of asphyxia, strong shakes or heavy blows on the head [47]. Brown and his collaborators affirm that 30-74% of the victims who seek assistance have traumatic brain injury (TBI) [48].

Brain injuries can cause a reduction of cognitive capacities and be the source of psychological disorders such as anxiety, depression and PTSD. It can also be said that the more severe an abuse is and the more often it occurs, the more severe will also be the variables of psychopathy. When the victim survives an episode of asphyxia, she may develop severe brain injuries that might cause her death at a later stage [43-50].

Fatal asphyxia in the context of intimate partner violence

When applied with enough intensity and for enough time, an act of asphyxia can result in the victim's death. The possibility of a fatal episode depends on factors related to the victim, such as advanced age, heart disease, intoxication with stimulating drugs, and previous brain injuries; it also depends on facts related to the aggressor, such as his force and the duration and intensity of the act [15-17].

Immediate death by asphyxia can occur by way of four mechanisms: a cardiac arrhythmia might be caused by the pressure exerted on the carotid artery (carotid body reflex), causing cardiac arrest; an obstruction of the carotid arteries prevents blood from reaching out to the brain; pressure or obstruction of the jugular veins prevents the venous blood from returning from the brain, resulting in shortness of breath, asphyxia and unconsciousness; and pressure or obstruction of the larynx cuts off the air flow to the lungs, resulting in asphyxia. The amount of force required to compress the jugular vein is less than the one needed to compress the carotid, and that in turn is less than the force required to constrict the airway. However, the absolute values vary tremendously from one person to another. Four variables work together: the amount of force or pressure, the duration of the applied force, the surface area over which the force is distributed, and the specific anatomical location where the force is applied.

Occasionally, the victims die as a consequence of one or more severe episodes of mechanical asphyxia. The prolongation of hypoxia and the reduction of blood flow or oxygen to the brain cause severe brain injuries that may result in the victim's death in a few hours after the incident [13-16,55-57].

A victim who died as a result of intimate partner violence by mechanical asphyxia usually presents a set of signs that vary according to the intensity and duration of the episode, such as edema and generalized visceral congestion, brain edema with perivascular hemorrhages, pulmonary edema, early and intense rigidity, increase of blood fluidity, livor mortis and petechiae [33,36].

Primary and secondary prevention measures

The continuing aggressions that are typical of IPV include verbal insults, threats, psychological attacks, emotional, economic and physical abuse which, depending on their intensity and duration, can cause immediate, short-term or long-term consequences, and even death.

The victim's survival to episodes of violence leads, in most cases, to the phenomenon of revictimization, with repetition of the previous patterns of abuse and potentially more severe conflicts. Head and face injuries, orthopedic problems, pathologies caused by anxiety, chronic pain and psychological disorders are examples of consequences that persist during abusive relationships or even after such relationships have ended. Those who are subjected to abuse involving asphyxia are at a higher risk of developing these clinical conditions, which may influence their physical and psychological state in a negative way [3,11,19,41-45].

The application of performance algorithms to the victims and survivors of IPV can avoid the revictimization and allows application of protective measures. The development of processes of screening, evaluation and diagnosis is fundamental to provide the victims the necessary healthcare and help them get the help they need to break free from the abusive relationships. Brown and his collaborators reinforce the need to educate health professionals, police forces and those who work directly with the victims to support the provision of adequate healthcare and interventions [48].

The process of approaching victims includes listening, validating, inquiring about needs and concerns and providing appropriate physical and psychological health care. It's essential to document and enhance safety and referring for additional support and follow-up care of victims and survivors of IPV [58].

The treatment of victims and survivors of asphyxia in the context of IPV should include screening for brain injuries, as the latter often occur as a result of these abusive acts. In fact, most of the traumatic brain injury (TBI) cases among survivors are undiagnosed and the victims do not receive the appropriate rehabilitation treatments. Rajaram and his collaborators suggest the application of the "HELP" algorithm by health professionals in order to search for possible brain injuries in survivors, enabling their rehabilitation and improving their quality of life. The acronym is the key to the screening: "H"- hit in the head; "E"- emergency room treatment; "L"-loss of consciousness; "P"-problem because of a hit to the head or due to strangulation. A HELP screening is considered positive for a possible brain injury when the following three items are identified: (a) an event that could have caused a BI (yes to H [Hit in the head] or E [Emergency room treatment]); (b) a period of loss of consciousness or altered consciousness after the injury or another indication that the injury was severe (yes to the L [Loss of consciousness] or E [Emergency room treatment]); and (c) the presence of two or more chronic problems listed under P (problem because of a hit to the head or due to strangulation) that were not present before the injury [46].

The identification of victims of asphyxia in the context of intimate partner violence, as well as the documentation and reporting of these cases are measures of prevention and protection that reduce the likelihood of a fatal outcome for the victims [21,46].

The severity of the consequences of this public health issue demands the conduction of new studies with the objective of understanding this type of interpersonal violence and developing methods of primary and secondary prevention. The need to identify victims of asphyxia in the context of intimate partner violence makes it fundamental to educate health professionals for the recognition of signs that are typical of this type of abuse. In this regard, dentists might play a critical role in the identification of victims, since the most of the characteristic injuries are located on the neck [57-78].

Conclusions

The victims of intimate partner violence are often subjected to episodes of mechanical asphyxia by compression of the neck, with the most frequent being throttling and strangulation. This type of abuse manifests itself through signs, symptoms, short-term and long-term consequences whose severity varies according to the intensity, duration and number of repetitions of asphyxia. Among the possible consequences of non-fatal violence it can be included brain injuries. The severity of the episodes of mechanical asphyxia is aggravated by the fact that these are considered risk factors for death by homicide in the context of intimate partner violence, increasing the likelihood of a fatal outcome. In this regard, the identification of victims of asphyxia becomes imperative in order to ensure the provision of healthcare and the application of protection and preventive measures adequate to the needs of victims and survivors.

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