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Imaging of Violence Against the Elderly and the Women

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Emergency department assessment is a critical opportunity to identify elder abuse and violence against women, which represent a growing problem, requiring the attention of health care systems. Elder abuse is most frequently perpetrated by family members because of the higher levels of stress, burnout, and financial problems affecting the caregivers that can even lead to deadly consequences. Intimate partner violence is defined as physical, sexual, or psychological harm caused to another by a current or former partner or spouse, and can range from a single acute hit to chronic battering, varying in frequency and severity. Radiologists have a critical role in detecting those injury findings suggestive of abuse and violence. When appropriate, additional information about the social circumstances in which an injury took place, linked with imaging findings, may also be helpful in diagnosing abuse. The purpose of this article is to highlight the role of diagnostic imaging in the detection of lesions compatible with domestic abuse in elderly patients and women, and to allow the recognition of the alterations most frequently associated with this type of violence.
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Introduction

Intimate partner violence (IPV), the most frequent type of violence against women, is defined as physical, sexual, or psychological harm caused to another by a current or former partner or spouse. Intimate partner sexual violence is a significant aspect of IPV.[1] IPV can range from a single acute hit to chronic battering and can vary in frequency and severity. There are reports that domestic violence has been happening for centuries. In 1985, a team lead by paleopathologists from the Medical College of Virginia studied 2000- to 3000-year-old mummies and they found more skull fractures in women than in men. These injuries occurred during times of peace and were felt to be injuries inflected by intimate partner acts of violence. It has been estimated that up to 35% of emergency room visits by women and 21% of injuries requiring urgent surgery are the result of IPV.[2] In the United States prevalence studies estimate that more than 1 million elderly persons are victims of abuse annually, and about the 25% have been physically abused.[3] Multiple fractures, inconsistent histories, bruising, dehydration, and malnutrition are indications of abuse that can be identified by the orthopedic surgeon.[4] These statistics suggest that health care providers can have a crucial role in screening, treating, and preventing future acts of domestic violence. As in cases of child abuse, radiologists are in unique positions to accurately diagnose IPV, as they are usually unbiased by interactions with the victim and the potential abuser.[5] Therefore, it is imperative that radiologists be familiar with the most common injuries of IPV, because they may be the first to suggest the diagnosis based on imaging alone. Individuals may be or may have been married, cohabiting, or dating and violence can occur at home or outside.[6] Although violence against women is wide-spread across all countries, the World Health Organization (WHO) Multi-Country Study of Women's Health and Domestic Violence suggests that there are regional patterns in its prevalence. Of the 24,097 interviewed women, those 19,517 who ever had a partner showed a wide variability in the lifetime prevalence of

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IPV, according to the country involved, and in the context of the same country, according to the type of site (urban or rural), with the latter reporting less IPV than the former.[7] This WHO effort indicated that from 15% to 71% of women worldwide had been physically and/or sexually assaulted by an intimate partner. Women in Africa were found to be twice as likely to experience violence than women in Europe and women in Southeast Asia a little less than this a particularly striking finding given that *women* were defined in the study as female humans aged 15 years or older. Although wife battering may be endemic in some cultures, it has been recognized as a social problem in the Western world since the mid-60s. This eventually led to the recognition of a "battered wife" or "battered woman syndrome." Literature defined the *battered woman* as one receiving "deliberate, severe, repeated, demonstrable, and physical injury from her partner." This paved the way to the definition of IPV, which includes not only physical, but also sexual abuse.

In Italy, physical and sexual violence against women is diffuse. IPV was suffered by 14.5% of all Italian women who have or had a partner in 2006, with 5.8% of women reporting violence from both current and former partners (Istituto Centrale di Statistica ISTAT, 2007). In 2006, IPV represented 82% of all kinds of violence suffered by women. Despite the introduction of an antistalking law in 2009 and antiviolence campaigns, IPV is on the increase in both absolute figures and proportion of overall violence. Generally, only a small proportion of IPV is reported to the police; in Italy, no more than 5% is reported to authorities. This percentage is higher when women confide in the emergency staff, doctors, nurses, or lawyers, than when they discuss the suffered abuse with family members.

IPV can occur at any time during a relationship, even during pregnancy. It has been estimated that at least 30% of IPV begins during this period, with 13.8% of pregnant women worldwide experiencing physical violence, and 8.0% sexual violence by their partners. The sequelae of violence during pregnancy affect both the mother and child and may lead to abortion, recurrent fetal loss, preterm delivery, low-birth weight as well as postnatal depression and mother-infant bonding disorders. Women abused during pregnancy are also at greater risk for further abuse and in severe danger of homicide. To ensure the safety of pregnant women, screening policies for IPV are essential. The most consensual definition, adopted by the WHO, describes elder abuse as a single or repeated act or lack of appropriate action within any relationship in which there is an expectation of trust or dependence that causes harm or distress to older people, contributing to decreased quality of life, increased morbidity, reduced survival and increased risk of death.

The WHO and the International Network for the Prevention of Elder Abuse define elder abuse as "a single or repeated act, or lack of appropriate action, occurring within any relationship where there is an expectation of trust which causes harm or distress to an older person." Clinical and legal publications on the subject generally recognize 5 types of abuse: neglect, psychological or emotional, physical, financial or material, and sexual abuse. It has been shown that elder abuse confers additional death risk.[8] Despite the significant and increasing prevalence given the increase in the size of this vulnerable population, elder abuse remains underreported, which may lead to an increase in morbidity and mortality from a delay in intervention. Although it would be expected that medical practitioners are ideally positioned to detect elder abuse, physicians account for only 2% of reported cases of elder abuse, for, among other reasons, uncertainty of the diagnostic validity, especially in physical abuse.[9]

It is generally thought to be difficult to distinguish between accidental and nonaccidental causes of injury in the elderly, mainly because changes that occur with aging, such as osteoporosis and brain atrophy, predispose to injury from relatively minor trauma such as falls. Elder abuse is common and has serious consequences, but it is under-recognized. As many as 10% of older US adults experience elder mistreatment each year, and evidence suggests that victims have dramatically increased mortality and morbidity. Unfortunately, fewer than 1 in 24 cases of elder abuse are identified and reported to the authorities.[10] Evaluation by health care providers represents a critical but often missed opportunity to identify elder abuse, because medical evaluation of acute injury or illness is frequently the only nonfamily contact for isolated older adults. Because many geriatric patients, particularly those with acute injuries, undergo radiographic imaging, diagnostic radiologists may be well positioned to raise suspicion for mistreatment. Little radiology literature currently exists describing imaging correlates of elder abuse. In addition, little is known about radiologist experience with elder abuse. The use of different definitions, as well as the sampling and survey methods, applied to different populations makes it difficult to compare studies, describe elder abuse and estimate its prevalence. Although most elders are autonomous and independent, older populations have a higher prevalence of health disorders and increased consequences of accidents. According to literature, poor physical health and disability, mental illness are the most important risk factors for abuse contributing to limitations in daily living activities making them completely or partially dependent, and, in many cases, isolated from society.[11] Lower physical resistance to violence, the higher difficulty understanding and reporting the abuse are also possible explanations for the increased risk of abuse in the elderly with disabilities. Abuse against these elders is, therefore, an expected event in the aging population where in 50% of people 65 years of age or older in Portugal report that they have substantial difficulty performing at least 1 of 6 activities of daily living (seeing, hearing, walking, memory and/or concentration, bathing and/or dressing, and understanding and/or making themselves understood).[12] Elder abuse is most frequently perpetrated by family members because of the higher levels of stress, burnout and financial problems affecting the caregivers that can even lead to deadly consequences.

The purpose of this article is to highlight the role of diagnostic imaging in the detection of lesions compatible with domestic abuse in elderly patients and women, allowing the recognition of the alterations most frequently associated with

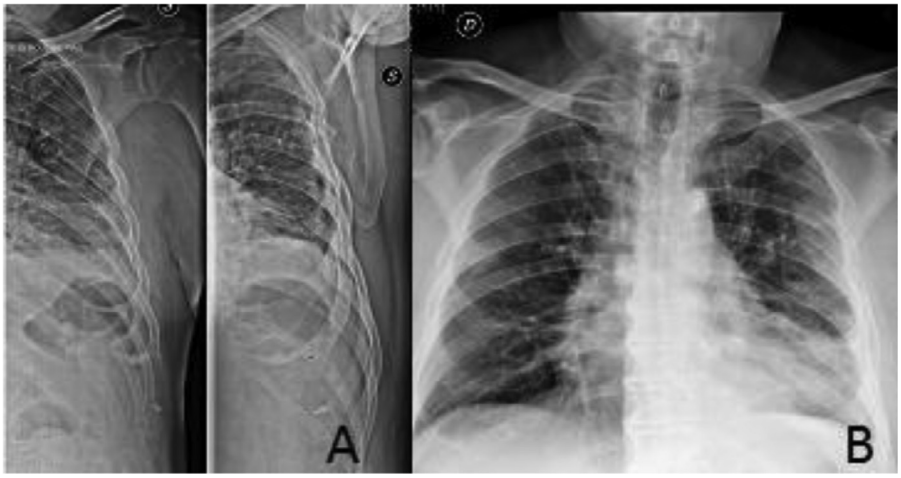

Figure 1 Chest examinations. A 72-year-old man with left apical pneumothorax associated with multiple ipsilateral rib fractures and pleural effusion (A and B).

this type of violence. The radiologist, who is in an important and unbiased position, may be the first to suggest the diagnosis of abuse based on imaging alone.

Radiologists and detection of abuse in elderly

Potential radiographic findings associated with elder abuse may be linked with patterns of visible injury described in the limited existing evidence-based literature. Elder abuse victims are more likely to have bruising on the posterior torso correlated to posterior rib fractures (Figs. 1 and 2). Another injury pattern associated with elder abuse is bruising of the ulnar forearm, which may occur when a victim defends himself or herself from an abuser.[13] Fracture of the distal ulnar diaphysis, which is uncommon after a fall or other unintentional injury, may suggest elder abuse. Future quantitative imaging research is needed to identify potential imaging patterns strongly suggestive or pathognomonic for elder abuse.

Radiologists reported believing that improved collaboration with treating physicians and more complete descriptions of the purported mechanism of injury and functional status of the patient would change their perspective when reading images and improve their ability to assess for elder abuse. The value of clinical history in accurately interpreting radiographic images has been well established, as the unfortunately common practice of treating physicians providing little or no clinical narrative when ordering an imaging study.[14] The knowledge of the reported mechanism and circumstances surrounding an injury is critical to detect cases of abuse, as suggested by the literature.[15] Radiologists appreciated that treating physicians may be reticent to document their suspicion and recommended telephone calls as a potentially effective informal way to collaborate. Knowing about a patient's functional capabilities would encourage radiologists to evaluate images differently and improve their ability to identify elder abuse. When appropriate, additional information about the social circumstances in which an injury took place will also be helpful.[16] Clearly, improved communication with treating

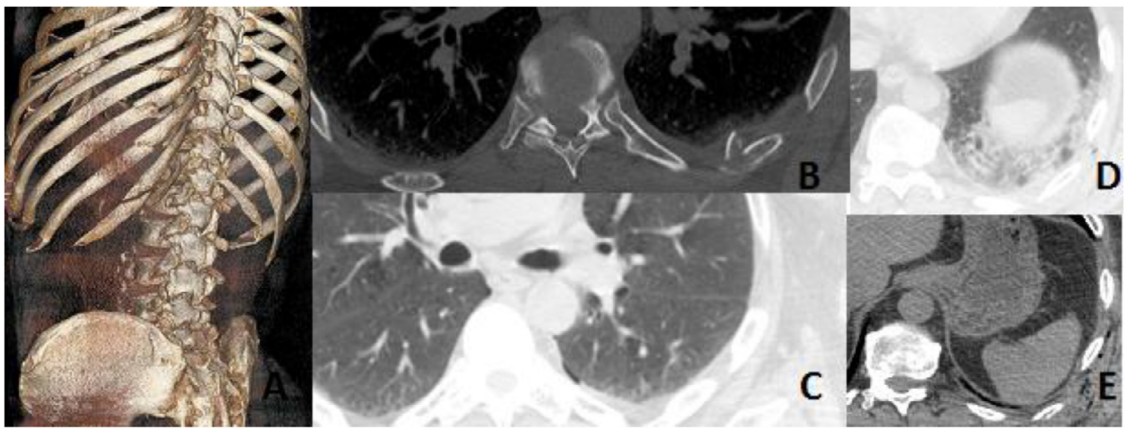

Figure 2 Computed tomography (CT) examination. A 71-year-old man hit by a bar with multiple rib fractures, minimal pneumothorax, soft tissue emphysema and left pulmonary contusion (A-E).

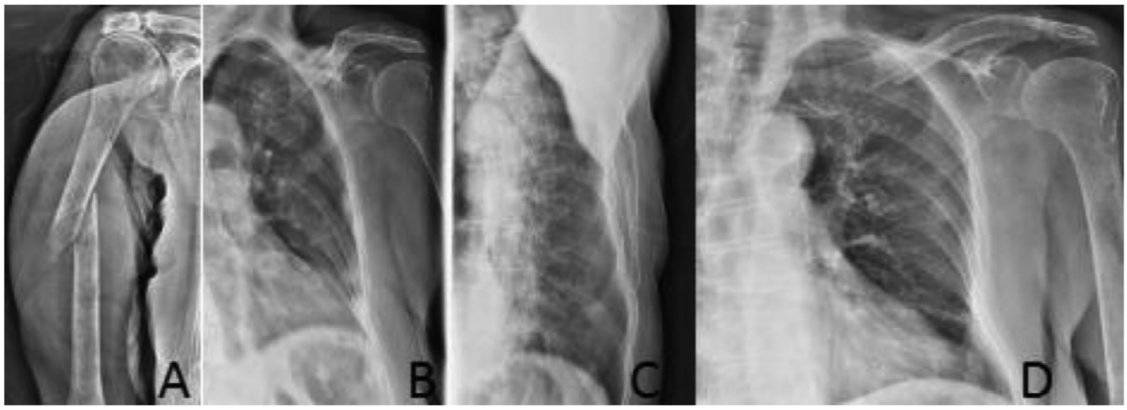

Figure 3 A 76-year-old man victim of multiple episodes of violence presenting recent fracture with angulations of the fragments at the middle third diaphyseal of the right humerus (plain radiograph, A) and previous fracture at the middle third of the left clavicle and multiple ipsilateral rib fractures (left chest radiographs, B-D).

physicians is critical to empowering diagnostic radiologists to contribute to elder abuse detection. The possibility of the presence of injuries specific to nonaccidental trauma in the elderly is intriguing to medical practice and particularly medical specialties such as radiology. In the extensive literature on nonaccidental injury in children, the role of medical imaging has been established for 5 decades, starting with a description of long-bone fractures and subdural hematomas in 1946 and the classic metaphyseal lesion in 1957 by Caffey. In contrast, no injuries specific to elder abuse, a possible equivalent of Caffey-Kempe (battered baby) syndrome have been determined. However, a pattern of the distribution of injury in physical elder abuse is emerging that would present radiologists with a starting point in determining imaging correlates. According literature, the largest numbers of physical injuries were located in the upper extremity (43.98%) (Fig. 3). Pointers to physical abuse in this location include contusions and abrasions to the axilla and inner aspects of the arms that do not commonly arise from accidental trauma.[17] Mechanisms of injury could include grasping by the abuser, use of restraints, or as a result of attempted self-defence by the victim.[18] Bruising on the lateral aspect of the arm has also been reported as occurring more commonly in physically abused elders.[19] Injuries to the posterior torso and the lower extremity, inner thigh, or dorsal or plantar aspect of the foot have also been suggested as indicators of physical elder abuse because these areas are less likely to be the point of impact in accidental injury.[20] Certain patterns of physical injury in elder abuse may lend themselves particularly well to identification by specific disciplines. Studies that reported most injuries that occurred in the upper extremity also noted that most of these injuries were of a mild nature.[21] Patterns of injury that occurred with this localization and severity would probably be more noticeable to clinicians in primary care, and appropriate intervention by a family physician at this point could prevent significant morbidity or mortality. However, in the autopsy series and case-control study of severe trauma,[22] most of the injuries were to the brain, head, and neck; patterns that would be most useful in emergency department and forensic practice. Reports of injury distribution in intimate partner (domestic) violence rarely occur in the extremities as is the case in physical elder abuse, instead mostly localized to the head, neck, and face.[23] Although the distribution of injuries that commonly occur in physical elder abuse have been outlined, there is no convincing evidence as yet that distinguishes them from those that occurred accidentally, and, therefore, risk factors that relate to the victim, potential perpetrator, and circumstances remain crucial to accurate detection of this entity. Risk factors that relate to the victim, perpetrator, and circumstances have been well documented in the literature and provide important context in the clinical setting. Dementia and depression are documented risk factors for elder abuse, and physical abuse in particular appears to occur more frequently in the elderly with dementia, possibly due to disruptive and aggressive patient behavior that provokes retaliation.[24] The concept of transgenerational violence, in which abused children later abuse their parents, which perpetuates a cycle of violence, is considered a major factor in physical elder abuse.[25] Physical elder abuse appears to occur more commonly in the evenings and on weekends due to increased social interaction and increased alcohol intake by the perpetrators during this time.[26] Social isolation of the victim, except for contact with the caregiver, increases the risk of elder abuse in general. Although elderly women were thought to be the most common victims of abuse, some large surveys have reported no sex differences.[27] Characteristics of perpetrators include ongoing mental illness, alcohol and/or drug abuse, financial and/or emotional dependence on the victim, and depression.[28] Screening tools, such as the elder abuse index and elder abuse suspicion index that incorporate physical findings and social factors, have been developed and validated for use in the community and in busy clinics or emergency departments to assist in detection of elder abuse.[29] However, because it relates to radiologic and pathologic findings, more work is warranted to determine whether there are definite distinguishing factors between accidental and abuse-related injury to the head, neck, torso, or upper and lower extremities in the elderly. Radiographic findings potentially suggestive of elder abuse are: injuries inconsistent with reported mechanism; injuries in multiple stages of healing, particularly in maxillofacial region and upper extremities; injury patterns uncommon in accidental injury, such as ulnar diaphysis fracture.[30]

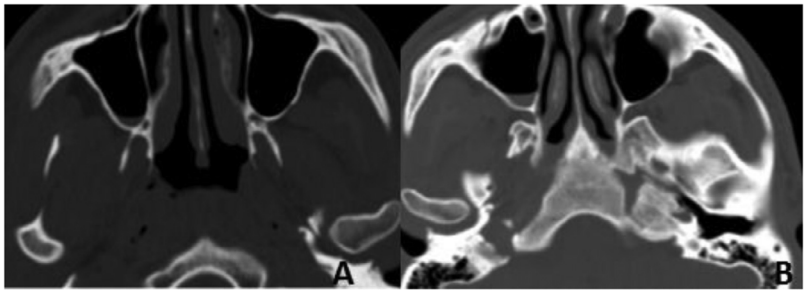

Figure 4 Computed tomography (CT) examination. A 20-year-old girl victim of multiple punches to the face with fracture of the right maxillary sinus with hemosinus (A and B).

Radiologists and detection of abuse in women

The head, neck, and face (Figs. 4 and 5) are easily accessible targets for abuse and are the most commonly injured body parts, with a frequency reported to range from 50 to 80% of IPV cases. The middle third of the face is most commonly wounded, specifically the nose. This is likely secondary to the prominence of the nose as a projection from the face and the minimal force required to fracture the nasal bones.[31] The left side of the face is more often injured than the right, thought to be due to the fact that 90% of the population is right-handed. Additionally, often because of hemispheric dominance, the victim will reflexively turn to the right to avoid a hit, exposing the left side of the face to insult. Therefore, it is not surprising that the left zygoma is the second most commonly injured bone of the face. Mandibular fractures can be seen in cases of IPV, with the angle of the mandible and the mandibular condyles being the most common sites of injury. Although mandibular fractures are not usually life threatening, there have been reports of asphyxia from oral bleeding, especially in unconscious patients.[3] Ligature strangulation also occurs, most often with a rope or a seatbelt. Many victims are strangled by a combination of mechanisms. Neck edema may present immediately; however, there have been reports of delayed edema even up to 36 hours after the initial injury, which can lead to airway compromise, neck abscesses, and arterial occlusion. Carotid dissections, possibly with a delayed presentation, and vertebral artery injuries have been described in the literature in strangulation and chokehold positions. In such cases, close attention should be focused on the neck bones and cartilages as one study showed that 80% of strangulation victims had fractures of these site. Studies have suggested that strangulation is a method of abuse that occurs later in the cycle of violence, placing the victim at heightened risk of morbidity and mortality. Additionally, in the vast majority of cases the victim resides in the same household as the abuser. Musculoskeletal injuries are the second most common type of injury associated with IPV following head and neck injuries. The spectrum of injury ranges from sprains to fractures to dislocations. Upper extremity injuries are common, likely secondary to defense mechanisms. Unfortunately, it may be difficult to distinguish accidental from intentional musculoskeletal injuries; however, it has been suggested that accidental injuries tend to be more distal, whereas intentional injuries tend to be more proximal or central. Injuries to bony prominences such as the chin, elbows, hips, and knees are particularly difficult to differentiate, as they can be caused by either accidental falls or intentional injuries.[32] Although a paucity of literature exists describing the incidence of shoulder girdle injury in cases of IPV, scapula fractures, and clavicular fractures (specifically at the lateral end) have been reported to have a high specificity for nonaccidental injury in children. A large amount of force is required to cause a shoulder girdle injury. There is also a scarcity of literature describing the incidence of traumatic pneumothorax caused by IPV. A retrospective review of 191 cases of emergency tube thoracostomy for acute trauma from March 1993 through March 1998 by Bergaminelli *et al.* showed a 6% incidence of traumatic pneumothorax caused by domestic accidents.[33] Karangelis *et al.* reported the case of a 42-year-old female who

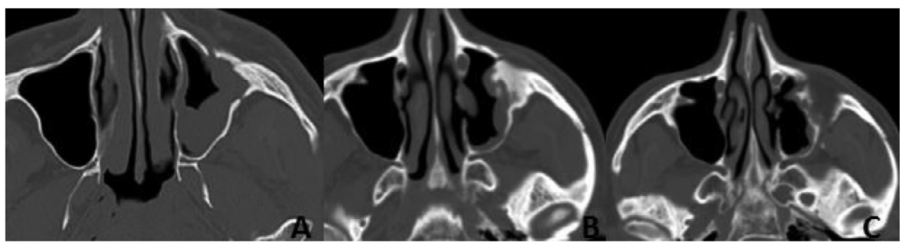

Figure 5 Computed tomography (CT) examination. A 30-year-old woman repeatedly hit to the face with mutiple fractures of the left maxillary sinus associated with hemosinus and ipsilateral zygomatic arch fracture (A-C).

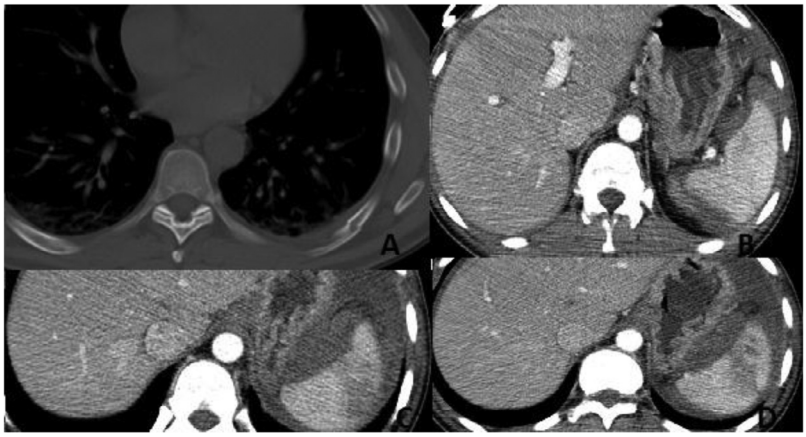

Figure 6 Computed tomography (CT) examination. A 36-year-old woman victim of repeated kicks in the left flank with dislocated ipsilateral rib fracture, splenic parenchyma rupture with hemoperitoneum (A-D).

presented with pain on the left side of her chest, supposedly from falling down a flight of stairs.[34] PV during pregnancy can adversely affect the well-being of the fetus as well as the mental, physical, and reproductive health of the mother. Specific risks include miscarriage, antepartum hemorrhage, and perinatal death.[35] The literature shows that pregnant women subjected to IPV are more likely to have multiple sites of injury than their nonpregnant counterparts, with the most common target being the abdomen.[36] Other injuries include broken bones, cuts, burns, hemorrhages, and broken teeth.[37] No association was found between the nationality of the women and IPV. Accessing the emergency department after 24 hours or more, previous emergency department accesses because of injuries, and mismatch of historical data were associated with IPV, both at the univariate and multivariate analyses. At radiological examination, it is important to consider the time of occurrence of the fractures, their type, and the type of lesions other than fractures. Regarding other lesions, soft tissue thickening was associated with IPV at the univariate analysis only, but visceral contusion or laceration (Fig. 6), fluid in the abdomen, and spinal dislocation are not frequently associated with IPV.[38,39,40]

Conclusion

Violence against the women and the elderly is common worldwide, leading to devastating impact and a significant health burden. As anatomical sites, head and neck injuries are the most common. However, any part of the body is at risk for injury in cases of domestic violence. Health care providers have a crucial role in the detection and preventing injuries from IPV and elder abuse. The radiologist is in a unique, unbiased position and may be the first to suggest the diagnosis of abuse based on imaging alone. Therefore, recognition of common injuries can help expedite care and remove the victim from an unsafe environment before further events. Radiologists are uniquely positioned to identify elder abuse. Though training in detection is currently lacking, providers expressed a desire for increased knowledge about elder abuse. In addition, radiologists were able to identify radiographic findings that may be suggestive of elder abuse and focused on improved collaboration with treating providers as critical for improved identification. Future research is important to define pathognomonic injury patterns and to explore how to reinforce diagnostic radiologists to incorporate detection into their daily practice.[41-45]

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