Identification and Interpretation of Spinal Cord Injuries in Robbery Victims: A Forensic Review

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Abstract

Robbery is intrinsically a violent crime and is defined as the original criminal plan of the perpetrator by committing robbery, by force committed on occasion or with the pretext of robbery. Strangulation by ligature occurs when an external force is applied to the neck causing various traumatic pathologies. If the injury is severe enough, cerebral perfusion and oxygen delivery are compromised and can lead to asphyxia and rapid neuronal death. These injuries can be encountered in a variety of clinical scenarios and may be present in suicide attempts, sports injuries, motor vehicle trauma, and may have implications in the fields of criminology and forensic pathology. In this case, a 66-year-old woman who was a victim of a robbery suffered a neck injury. After examination, there was a fracture in the cervical spine and was diagnosed with spinal cord trauma. As a result of this injury, the victim suffered permanent paralysis. The perpetrators of the robbery are threatened with criminal penalties under 364 KUHP and/or Article 351 No 3 KUHP.

Introduction

Ligature strangulation is a traumatic condition resulting from external pressure exerted on the neck and its adjacent structures. This form of asphyxia occurs due to impaired oxygen delivery, typically caused by the compression of cervical blood vessels or obstruction of the trachea.[1,4]

In cases of ligature strangulation, death is primarily attributed to cerebral hypoxemia, which progresses to cerebral ischemia. Four principal mechanisms contribute to mortality in such cases. First, compression of the jugular veins impairs venous return from the brain, elevating intracranial pressure and causing loss of consciousness, brainstem dysfunction, asphyxia, and ultimately death. Second, obstruction of the carotid arteries restricts the delivery of oxygenated blood to the brain, resulting in asphyxia and death. Third, compression of the larynx can obstruct oxygenation of pulmonary vessels,

leading to fatal hypoxia. Lastly, although uncommon, bilateral carotid artery compression may induce cardiac dysrhythmias, culminating in cardiac arrest.[1,3,4]

Robbery is intrinsically a violent offense, characterized as a criminal act where the primary intent is theft, with murder occurring either incidentally or as a direct consequence of the act. A criminal act refers to an unlawful behavior that contravenes societal norms and established regulations. Criminologists emphasize the importance of understanding crimes within the broader framework of societal structures, particularly the disparities in power and wealth, as well as the effects of economic and political transitions. Criminal cases are widespread in Indonesia, occurring at both high and moderate levels. Victims of crime encompass individuals across all income groups, including high-, middle-, and low-income communities. These victims frequently endure the loss of property, physical and psychological harm, and long-term trauma. Economic challenges, such as unemployment, inadequate wages, or job loss, often motivate individuals to engage in criminal behavior. Furthermore, limited educational attainment restricts their access to better employment opportunities, perpetuating economic hardship and increasing the likelihood of criminal activity.[2,3,15]

Crimes are broadly classified into four categories: (1) Property-related offenses, including robbery, theft, arson, and embezzlement; (2) Crimes targeting individuals, such as murder, rape, and assault; (3) Socially deviant behaviors, including gambling, prostitution, and substance abuse; and (4) Regulatory violations, such as participation in riots and traffic infractions.[10]

Table 1. Crime Rates in Indonesia from 2016 to 2021

Year	Crime Rate (per 100,000 people)
2016	140
2017	129
2018	113
2019	103
2020	94
2021	90

According to Table 1, which utilizes data from the Central Bureau of Statistics spanning 2016 to 2021, the crime rate in Indonesia exhibited a fluctuating pattern, declining from 140 crimes per 100,000 individuals in 2016 to 90 crimes per 100,000 individuals in 2021. Analyzing the causes of crime through an economic perspective provides deeper insights into the underlying factors.[7]

Central Sulawesi Province reported the highest average crime rate, with 303 cases, while Central Java Province recorded the lowest, with 43 cases. In terms of unemployment rates, Aceh Province had the highest rate at 9.53%,

whereas East Nusa Tenggara (NTT) Province had the lowest, at 3.33%.[7]

Murders occurring during robberies and those with unidentified motives present unique challenges for law enforcement in uncovering facts and determining motives. A significant proportion of these cases involve victims and perpetrators with no prior connection. These crimes frequently lack third-party witnesses, requiring investigators to infer violent motives from limited evidence. As a result, a substantial number of robbery-related murders appear to arise from instances where the motive remains unclear, rather than from any simplistic assumptions or projections.[10]

Case Report

A 66-year-old woman presented to the Emergency Department of Siloam Hospital Lippo Village on December 15, 2022, with complaints of bilateral leg paralysis. She was referred from the North Jakarta Regional General Hospital. According to her medical history, the paralysis occurred following a robbery incident in which the perpetrator forcibly twisted her neck. At the formal request of the Indonesian National Police, North Jakarta Metro Police, Tanjung Priok Sector, dated January 20, 2023, a medical examination was conducted to assess her condition.

On physical examination, the patient was alert but exhibited moderate discomfort. Her blood pressure was significantly elevated at 175/57 mmHg. She had a normal pulse rate of 64 beats per minute and a normal body temperature of 36°C. However, tachypnea was noted, with a respiratory rate of 25 breaths per minute.

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For diagnostic evaluation, imaging studies were performed, including a non-contrast MRI of the cervical spine, a chest X-ray in the posteroanterior (PA) view, and cervical spine X-rays in anteroposterior (AP) and lateral views.

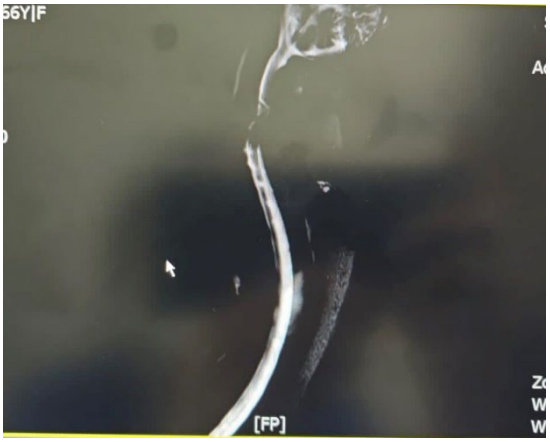

Figure 1. MRI of the Cervical Spine Without Contrast

Figure 2. MRI of the Cervical Spine Without Contrast

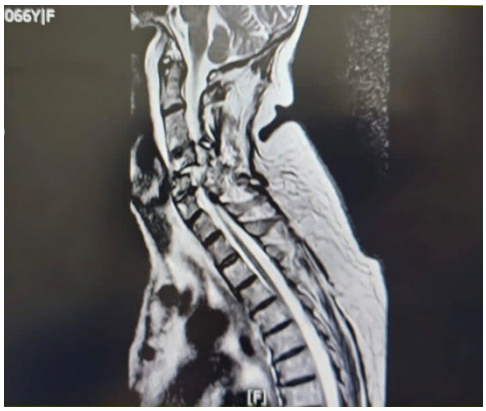

Figure 3. MRI of the Cervical Spine Without Contrast

MRI imaging of the cervical spine without contrast revealed several findings, including cervical reverse lordosis, thoracic scoliosis to the left, mild osteopenia, intervertebral disc degeneration, and cervical spondyloarthrosis. Compression of the C4-C6 vertebral bodies with associated bone edema was noted. Myelopathy and spinal cord edema extended from C3 to T1, along with tears in the interspinous ligaments at the C3-C6 levels. Paraspinal soft tissue edema was observed from C2 to T5, and fluid intensity was noted in the prevertebral soft tissues at these levels. At the C3-C4 level, there was bulging of the intervertebral disc, indenting the thecal sac without compressing the nerve roots. At the C4-C5 level, mild posteromedial disc protrusion was noted, predominantly on the left side, with hypertrophy of the left facet joint, causing compression of the thecal sac and impingement of the left C5 nerve root. At the C5-C6 level, there was posteromedial disc protrusion, mainly on the right side, along with retrolisthesis, thickening of the ligamentum flavum, and hypertrophy of the right uncinate process, leading to compression of the thecal sac and the right C6 nerve root. At the C6-C7 level, there was posteromedial disc protrusion, accompanied by thickening of the ligamentum flavum and bilateral hypertrophy of the uncinate processes, resulting in compression of the thecal sac and bilateral C7 nerve roots.

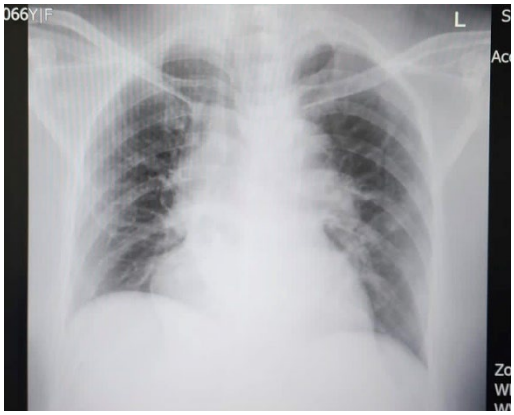

Figure 4. Chest X-ray PA View

The chest X-ray revealed minimal opacities in both the hilar and paracardiac regions. The Cardio-Thoracic Ratio (CTR) was measured at 60%, and there was evidence of calcification in the wall of the aortic arch.

Figure 5. Cervical X-ray AP View

Figure 6. Cervical X-ray Lateral View

The cervical X-ray revealed the presence of spur formations on the surface of the cervical spine. Additionally, a plate and screws were noted to have been installed at the C3 to T1 vertebral bodies.

Following the imaging examination, the patient was diagnosed with spinal cord trauma and epidural hemorrhage. Consequently, the patient underwent decompression laminectomy and stabilization. A tracheostomy was also performed, and the patient was subsequently admitted to the Intensive Care Unit (ICU) for further management.

Discussion

Trauma can result from violence associated with criminal acts, such as robbery, murder, or traffic accidents. In cases involving injuries due to criminal acts, investigators may seek assistance from medical professionals, as outlined in Article 133, Paragraph 1 of the Indonesian Criminal Code (KUHP). This provision states: "In instances where an investigator is handling a victim—whether injured, poisoned, or deceased—who is suspected of being involved in a criminal act, they are authorized to request expert testimony from a forensic doctor or another medical expert."[7] Examinations conducted by experts, including forensic doctors, general practitioners, or other specialists, are carried out under oath to ensure that the procedures adhere to the proper legal authorities at both the investigative and trial stages. This oath guarantees that the examination is conducted in accordance with established protocols, and that the information provided is truthful, accurate, and grounded in professional knowledge.[10]

In assessing the severity of an injury, the doctor must determine the source of the trauma and evaluate its impact on the body. It is essential to establish whether the injury resulted from sharp force trauma, blunt force, electrical trauma, thermal injury, chemical trauma, or other causes. Understanding the extent of the injury's effect on the victim is critical, as it directly influences the criminal penalty that may be

imposed on the perpetrator. The Criminal Code outlines three classifications for the consequences of abuse: (a) maltreatment that does not cause disease or impair the ability to perform tasks, hold a position, or sustain a livelihood, as described in Article 352 (minor assault); (b) abuse causing disease and impairment in work and livelihood, as defined in Article 351, Paragraph (1) (assault); and (c) torture resulting in severe injury, as specified in Article 351, Paragraph (2) and Article 90. Article 90 of the Criminal Code defines severe injuries as: (a) injuries or illnesses with no prospect of recovery or that pose a life-threatening risk, (b) incapacity to continue working or earning a living, (c) loss of one of the senses, (d) severe disability, (e) paralysis, (f) mental disturbances lasting four weeks or more, or (g) death or fetal death.[7]

In managing victims of criminal acts, doctors are bound by regulations that govern their responsibilities toward patients. They are obligated to provide medical care in line with professional standards, standard operating procedures, and the patient's medical needs, as outlined in Article 51, Paragraph (a) of Law No. 29 of 2004 on Medical Practice.[7,10,11]

In this case, the perpetrator of the robbery could face the death penalty as specified in Article 365, Paragraph (4) of the Indonesian Criminal Code. This article pertains to theft accompanied by violence, committed by two or more individuals, which results in severe injury or death.[7]

The cervical spine is a dynamic structure that serves to protect the nervous system and maintain the range of motion for the head and neck. Cervical spine fractures are a leading cause of morbidity and mortality in trauma patients, with fractures accounting for 56% of cervical spine injuries. These fractures are categorized based on the level of involvement, typically divided into three groups: C1, C2, and the sub-axial cervical spine (C3-C7). This study reviews the etiology, presentation, evaluation, and management of cervical spine fractures, as well as the role of the interprofessional team in evaluating, diagnosing, and managing these conditions. Cervical spine fractures typically occur due to abnormal movements or a combination of movements, including hyperflexion, hyperextension, rotation, axial loading, and lateral bending of the spine. Evaluation of a patient with a cervical spine fracture should begin with a thorough trauma assessment of the ABCs (airway, breathing, and circulation). Injuries to the cervical spine may disrupt respiratory and cardiovascular functions, and even after stabilization, these patients must be closely monitored for ongoing respiratory and cardiovascular changes. Early identification of acute spinal cord injury is critical, as early decompression within 24 hours can improve neurological recovery outcomes. Indications for cervical spine imaging include local neck pain, deformity, edema, changes in mental status, head injury, or

neurological deficits. Further evaluation of spinal cord structures using MRI is important for determining spinal stability and planning surgical management. The Spinal Injury Classification System (SLICS), which includes classifications for ligament, bone, and neurological injuries, can be used to help guide surgical or non-surgical management. SLICS scores of 1 to 3 indicate non-surgical treatment, scores of 4 are indeterminate, and scores of 5 or higher indicate the need for surgery.[14,15,16]

Spinal cord injury (SCI) refers to damage to the nerve cells within the spinal cord, which extends from the brain to the lower back. SCI may result from trauma to the spinal cord or its surrounding structures, such as the vertebrae that encase it. This trauma can cause either permanent or temporary impairments in sensation, movement, strength, and function below the injury site. SCI is categorized into two types: incomplete and complete. In incomplete SCI, the spinal cord retains some ability to transmit impulses, enabling the individual to maintain partial control over muscle activity below the injury level. In complete SCI, no impulses are transmitted below the injury site, leading to a total loss of both sensory and motor functions below that point.[11,13]

In a retrospective study involving 98 patients who suffered strangulation, CT scans and MRIs identified trauma in only 8 cases. Specifically, two patients had injuries to the cervical vessels, three had fractures of the thyroid cartilage and hyoid bone, and three presented with vertebral trauma.[5]

In this case, the twisting trauma inflicted by the perpetrator caused a cervical fracture, leading to spinal cord injury and subsequent paralysis. Based on the medical examination findings, the patient is classified as having a severe injury, resulting in permanent disability. As a result, the perpetrator of the robbery faces potential penalties under Article 365, Paragraph (4) of the Criminal Code, which applies to theft with violence, committed by two or more individuals, leading to severe injury or death.[7]

Conclusion

In this case, based on the findings from the examination, it was determined that the victim is a 66-year-old woman. She sustained a cervical fracture at the C5-C6 level, caused by the perpetrator twisting her neck during the robbery. As a result of the injury, the victim experienced paralysis. This case involves theft with violence and/or aggravated assault, as outlined in Article 364 and/or Article 351, Paragraph 3 of the Indonesian Criminal Code (KUHP).

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References

1. Claydon SM. Suicidal strangulation by ligature: Three case reports. Medicine, Science and the Law. 1990;30(3):221–4. https://doi.org/10.1177/002580249003000310
2. Cook PJ. Robbery violence. The Journal of Criminal Law and Criminology (1973-). 1987;78(2):357. doi:10.2307/1143453 https://scholarlycommons.law.northwestern.edu/cgi/viewcontent.cgi?article=6558&context=jclc
3. Saukko P, Knight B. Knight's Forensic Pathology. CRC Press; 2023.
4. Glass N, Laughon K, Campbell J, Block CR, Hanson G, Sharps PW, Taliaferro E. Non-fatal strangulation is an important risk factor for homicide of women. J Emerg Med. 2008 Oct;35(3):329-35. https://doi.org/10.1016/j.jemermed.2007.02.065
5. Berke DM, Helmer SD, Reyes J, Haan JM. Injury Patterns in Near-Hanging Patients: How Much Workup Is Really Needed? Am Surg. 2019 May 01;85(5):549-555. https://doi.org/10.1177/000313481908500534
6. Published by Statista Research Department SRD. Crime rate in Indonesia Crime rate in Indonesia from 2012 to 2021 [Internet]. Statista; 2023 [cited 2023 Jun 26]. Available from: https://www.statista.com/statistics/705464/crime-rate-in-indonesia/
7. Zimring FE. Determinants of the death rate from robbery: A Detroit Time Study. TheJournal of Legal Studies. 1977;6(2):317–32. doi:10.1086/467574 https://www.jstor.org/stable/723992
8. *Himpunan Lengkap Kuhper (Kitab Undang-Undang Hukum Perdata), KUHP (Kitab Undang-Undang Hukum Pidana), KUHAP (Kitab Undang-Undang Hukum Acara Pidana)*. 2014. Laksana.
9. Strack GB, McClane GE, Hawley D. A review of 300 attempted strangulation cases. Part I: criminal legal issues. J Emerg Med. 2001 Oct;21(3):303-9. https://doi.org/10.1016/s0736-4679(01)00399-7
10. Rahman YA, Prasetyo AD. Economics and crime rates in Indonesia. JEJAK. 2018;11(2):401–12. https://doi.org/10.15294/jejak.v11i2.16060
11. Kusuma, Soekry Erfan. Yudianto, Ahmad. Forensik Klinik. Buku Ajar Ilmu Kedokteran Forensik dan Medikolegal Edisi Kedelapan. 2012. FK Unair
12. Lembaran Negara Republik Indonesia Tahun 2004 Nomor 116. Undang- Undang RI No. 29 Tahun 2004 tentang Praktek Kedokteran. http:// ditjenpp.kemenkumham.go.id/arsip/ln/2 004/uu29-2004.pdf
13. Eckert MJ, Martin MJ. Trauma: Spinal Cord Injury. Surg Clin North Am. 2017 Oct;97(5):1031-1045. https://doi.org/10.1016/j.suc.2017.06.008

14. Fehlings MG, Tetreault L, Nater A, Choma T, Harrop J, Mroz T, Santaguida C, Smith JS. The Aging of the Global Population: The Changing Epidemiology of Disease and Spinal Disorders. Neurosurgery. 2015 Oct;77 Suppl 4:S1-5. https://doi.org/10.1227/neu.0000000000000953
15. Hussain M, Javed G. Diagnostic accuracy of clinical examination in cervical spine injuries in awake and alert blunt trauma patients. Asian Spine J. 2011 Mar;5(1):10-4. https://doi.org/10.4184/asj.2011.5.1.10
16. Girotto D, Ledić D, Strenja-Linić I, Peharec S, Grubesić A. Clinical and medicolegal characteristics of neck injuries. Coll Antropol. 2011 Sep;35 Suppl 2:187-90.
17. Van Goethem JW, Maes M, Ozsarlak O, van den Hauwe L, Parizel PM. Imaging in spinal trauma. Eur Radiol. 2005 Mar;15(3):582-90. https://doi.org/10.1007/s00330-004-2625-5

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