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FORENSIC ASSESSMENT OF LUNG AND LIVER INJURIES IN CAR ACCIDENTS

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Abstract. This article examines the forensic medical approaches to diagnosing and analyzing traumatic injuries to the lungs and liver resulting from road traffic accidents. It presents the pathophysiological mechanisms, injury classifications, and diagnostic methods used to identify both ante-mortem and postmortem trauma to these vital organs. Given the high incidence of thoracoabdominal trauma in vehicular collisions, the forensic interpretation of such injuries plays a critical role in determining the cause and mechanism of death, reconstructing the accident scenario, and establishing causal relationships between mechanical trauma and biological response. The study emphasizes the medico-legal value of autopsy findings, radiological imaging, histological evaluation, and biomechanical analysis in comprehensive forensic assessment.

Keywords: Forensic medicine, lung injury, liver trauma, car accidents, blunt force trauma, thoracoabdominal injury, medico-legal autopsy, biomechanics, cause of death, expert evaluation.

INTRODUCTION

Road traffic accidents remain one of the leading causes of death and severe injury globally. According to World Health Organization (WHO) data, thoracic and abdominal injuries are present in up to 35–45% of fatal collisions. Among these, damage to the lungs and liver are among the most common and lethal due to their vital function and anatomical positioning. The lungs, occupying the thoracic cavity, are highly susceptible to rapid deceleration forces and compression, whereas the liver, being a dense, vascular organ in the upper right quadrant of the abdomen, is prone to rupture from blunt trauma, especially in frontal collisions [1].

From a forensic standpoint, accurate assessment of such injuries is crucial not only for determining the immediate cause of death but also for reconstructing the dynamics of the crash, evaluating seatbelt usage, and identifying potential medical malpractice or mechanical failure factors. The complexity of these injuries often necessitates an interdisciplinary approach involving forensic pathologists, radiologists, biomechanical experts, and traffic accident reconstruction specialists.

MATERIALS AND METHODS

The lungs are composed of soft, elastic tissue encased within the pleural cavities and protected by the rib cage. Despite this protection, they are vulnerable to pulmonary contusions, alveolar rupture, and hemothorax due to rapid changes in intrathoracic pressure. Direct compression from seatbelts or impact against the steering wheel can result in lung lacerations, pneumothorax, and bilateral hemorrhagic infiltration. Rib fractures commonly accompany such injuries and serve as both a marker and a cause of secondary trauma [2].

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The liver, due to its large mass, rich blood supply, and fragile capsule, is the most frequently injured solid organ in blunt abdominal trauma. Sudden deceleration causes the liver to shift relative to surrounding structures, resulting in lacerations, capsular rupture, subcapsular hematomas, and parenchymal fragmentation. In car accidents, the right lobe is more commonly affected due to its anatomical exposure. A significant concern in forensic practice is massive intra-abdominal hemorrhage, which may lead to rapid exsanguination and death before medical intervention.

RESULTS AND DISCUSSION

In car accidents, kinetic energy transfer to the body results in varying injury patterns depending on crash dynamics. For the lungs, this includes compression between the chest wall and spine, leading to pressure-induced alveolar damage. Blast injuries from sudden airbag deployment or sudden chest compression can also cause barotrauma.

In the liver, shearing forces during abrupt acceleration or deceleration events lead to rupture along anatomical planes, particularly near the ligamentum teres or hepatic veins. Coup-contrecoup effects may also be observed when the organ impacts multiple surfaces internally. Delayed rupture due to evolving hematomas is another forensic concern, especially in cases where survival lasted hours to days.

Understanding these mechanisms helps forensic experts determine not just the presence of injury, but its timeline, severity, and compatibility with the described crash circumstances.

In forensic medicine, a multi-modal approach is used to assess lung and liver trauma [3]:

Postmortem Autopsy: A detailed gross examination provides direct visualization of lacerations, contusions, hematomas, and hemorrhages. Lung tissues are checked for edema, congestion, and air leakage (bubbling). The liver is inspected for rupture patterns, hemorrhage volume, and bile duct integrity.

Histopathology: Microscopic examination of tissues determines the vitality of injuries (whether they occurred ante-mortem or postmortem), identifies inflammatory responses, ischemia, and signs of medical intervention.

Imaging Studies: In living victims or where virtual autopsy (virtopsy) is used, CT scans and MRI imaging detect internal organ damage with high sensitivity. For the lungs, they reveal contusions and pneumothorax; for the liver, imaging can locate hematomas, lacerations, and active bleeding.

Toxicological Analysis: Assessing the presence of alcohol, narcotics, or sedatives helps clarify the victim's physiological state at the time of injury and can support causation in accident dynamics.

Biomechanical Evaluation: Simulation of forces involved in the accident helps correlate observed injuries with likely body positions, seatbelt use, and vehicular intrusion levels.

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The forensic interpretation of thoracoabdominal injuries requires differentiation between primary fatal injuries, contributory injuries, and non-fatal findings. In court settings, this classification helps determine legal liability—whether death was due to immediate trauma, a delayed medical response, or pre-existing health conditions exacerbated by trauma.

CONCLUSION

Forensic assessment of lung and liver injuries in car accidents represents a vital component of modern medico-legal practice. These organs, due to their anatomical location and physiological significance, are among the most frequently injured in blunt trauma scenarios. A comprehensive evaluation—encompassing autopsy, histology, radiology, and biomechanics—not only facilitates the accurate determination of cause and manner of death but also contributes to fair legal outcomes in civil and criminal proceedings.

Given the evolving nature of crash dynamics and vehicle safety technologies, forensic experts must remain updated with current methodologies, including advanced imaging and virtual autopsy tools. Ultimately, the accurate interpretation of lung and liver injuries ensures justice for victims, informs public safety measures, and reinforces the role of science in legal adjudication.

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