Original Research Article

Correlation of 128-Slice Computed Tomography Scan and Autopsy Findings in Fatal Craniocerebral Trauma

Jerine S. Das[1], Alan James[2], Mislvao Glady Louis[3], Simon I[4], R. Rajesh[5]

[1]Assistant Professor, Department of Forensic Medicine, Sree Mookambika Institute of Medical Sciences, [2]Assistant Professor, Department of Forensic Medicine, Kanyakumari Government Medical College, [3]Assistant Professor, Department of Emergency Medicine, Sree Mookambika Institute of Medical Sciences, [4]Assistant Professor, Department of Anaesthesia, Sree Mookambika Institute of Medical Sciences, [5]Professor & Head, Department of Forensic Medicine, Kanyakumari Government Medical College.

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Abstract

Background: Head injury remains a major cause of morbidity and mortality worldwide. While computed tomography (CT) scans serve as a critical diagnostic tool in detecting intracranial lesions, forensic autopsy remains the gold standard for definitive assessment. This study evaluates the diagnostic accuracy of 128-slice CT scans in identifying fatal head injuries by comparing imaging findings with autopsy results.

Methods: A retrospective observational study was conducted on 60 cases of fatal head injuries admitted to A.J. Institute of Medical Sciences & Research Centre between December 2016 and April 2018. CT scan findings were systematically compared with autopsy results, with a focus on intracranial haemorrhages and contusions. Sensitivity, specificity, and concordance between imaging and post-mortem findings were analyzed using IBM SPSS Statistics (Version 17).

Results: Among the 60 cases, 90% were males, with road traffic accidents accounting for 86.67% of cases. The sensitivity of CT scans for different types of hemorrhages was as follows: subarachnoid hemorrhage (60.71%), subdural hemorrhage (58%), extradural hemorrhage (40.9%), and intracerebral hemorrhage (11.11%). Contusion detection was highest in the frontal lobe (90.32%) and lowest in the corpus callosum (16.67%). Smaller contusions and posterior cranial fossa lesions were frequently missed on CT scans.

Conclusion: While CT scans play a valuable role in forensic and clinical assessments, they exhibit limitations in detecting smaller hemorrhages and contusions. The study underscores the need for high-resolution imaging, contrast-enhanced CT, and serial imaging to improve diagnostic accuracy. Future research should focus on MRI integration, AI-assisted imaging, and multicentric studies to enhance forensic radiology.

Keywords: Head injury, CT scan, autopsy, forensic radiology, intracranial hemorrhage, contusions, forensic imaging.

Corresponding Author: R. Rajesh, Professor & Head, Department of Forensic Medicine, Kanyakumari Government Medical College.

E-mail: rajiahrajesh72@gmail.com

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Introduction

Head injury is a significant cause of morbidity and mortality worldwide, with road traffic accidents being the primary contributor. Computed tomography (CT) scans are indispensable in diagnosing intracranial injuries, but forensic autopsy remains the definitive method for determining the extent of injuries. This study aims to evaluate the diagnostic accuracy of 128-slice CT scans in identifying fatal head injuries by correlating their findings with autopsy results.

Aims and Objectives

1. To correlate post-mortem examination findings with 128-slice CT scan findings in fatal head injuries.
2. To identify lesions that CT scans may fail to detect but are present at autopsy.
3. To compare findings with national and international studies.
4. To recommend improvements in imaging protocols to reduce discrepancies between CT scan and autopsy findings.

Need for the Study:

1. **Accuracy Evaluation:** This study assesses CT scan reliability in fatal head injuries by comparing CT findings with autopsy results, quantifying concordance and discordance.
2. **Missed Lesion Detection:** It identifies lesions missed by CT but found at autopsy, aiming to improve imaging protocols and interpretation.
3. **Forensic Impact:** The research clarifies CT's strengths and limitations in forensic head injury investigations, addressing potential legal implications.
4. **Clinical and Radiological Advancement:** By comparing findings with other studies, it aims to enhance CT protocols, leading to better clinical and forensic outcomes.
5. **Regional Data Contribution:** This study adds to regional head injury data, reflecting local injury patterns and diagnostic practices.

Research Gaps in the Study

1. **Limited Sample & Regional Focus:** Findings from 60 cases in a single institution may not be generalisable.
2. **Lack of Advanced Imaging:** MRI and post-mortem CT angiography (PMCTA) were not included, limiting the detection of subtle injuries.
3. **Histopathological Correlation:** Microscopic analysis of brain injuries was not extensively compared with CT findings.
4. **Temporal Evolution:** The impact of time on lesion detectability between imaging and autopsy was not analysed.
5. **Mechanism-Specific Analysis:** No subgroup analysis based on different injury mechanisms.
6. **Inter-Observer Variability:** Differences in CT and autopsy interpretations were not assessed.
7. **Clinical Implications:** The role of improved imaging in real-time clinical decision-making was not discussed.

Materials and Methods

Study Design

This retrospective observational study analyzed data from a cohort of fatal head injury cases. The study systematically compared CT scan findings with autopsy results to determine diagnostic concordance.

Sample Size and Selection

A total of 60 fatal head injury cases were selected to provide meaningful statistical comparisons. The study period (December 2016-April 2018) was chosen to ensure consistency in imaging and autopsy protocols.

Institutional record availability and ethical considerations constrained the number of eligible cases. Including only those with complete documentation ensured data reliability and minimized bias. While the sample provides valuable insights, future studies with larger multicenter datasets are recommended to improve generalizability.

Rationale for Sample Size Selection – explanation.

- The sample size of **60 fatal head injury cases** was determined based on statistical power, feasibility, and practical constraints. Given the **retrospective** nature of the study (December 2016–April 2018), a larger sample was not feasible due to the limited availability of cases with both **complete CT scan and autopsy records**.

- Previous forensic radiology and neuropathology studies have used **comparable or smaller sample sizes**, demonstrating reliability in identifying diagnostic trends. The study focuses on **fatal head injuries**, a subset of forensic cases, making large-scale sampling challenging. However, the selected cases encompass a **diverse range of intracranial hemorrhages and contusions**, ensuring statistical representation of common traumatic brain injury patterns.
- The chosen sample size allows for **adequate calculation of sensitivity, specificity, and concordance** between CT and autopsy findings, particularly in detecting smaller hemorrhages and posterior fossa lesions, which are often missed on CT scans.

Additionally, **institutional record availability and ethical considerations** constrained the number of eligible cases. Including only those with **complete documentation** ensured data reliability and minimized bias. While the sample provides valuable insights, future studies with **larger multicenter datasets** are recommended to improve generalizability

Consent

- Written informed consent from the next of kin was not obtained**.** As the study was conducted on cases that underwent **medicolegal autopsy**, the bodies were under the jurisdiction of the **state**, and consent for examination was granted by the **investigating officer**. In all cases, **requisitions were received from the investigating officer**, ensuring compliance with legal procedures.
- Since all cases were **medicolegal (MLC) in nature**, there was **no direct interaction** between the autopsy physician and the relatives of the deceased. Consequently, **written informed consent from the next of kin was not obtained**.
- Furthermore, as the study followed a **retrospective observational design**, only **existing autopsy and CT scan findings were analysed**. Given the nature of the study, obtaining consent from all cases was **not feasible**, as the data was derived from records of previously conducted medico-legal examinations.

Data Collection

- **Ethical Considerations:** The study was conducted following ethical principles, with approval from the institutional ethics committee (Ref No: AJEC/REV/175/2016, dated 29/11/2016).
- **Hospital Records Review:** Data included demographics, clinical history, injury mechanism, and Glasgow Coma Scale (GCS) scores.
- **CT Scan Analysis:**
  - o 128-slice CT scans were reviewed by a radiologist blinded to the autopsy findings.
  - o Findings included intracranial haemorrhages, skull fractures, cerebral oedema, and other abnormalities.
  - o The timing of CT scans post-injury was documented.
- **Autopsy Findings:**
  - o Detailed macroscopic documentation of haemorrhages, skull fractures, and brain contusions/lacerations.
- **Comparative Analysis:**
  - o Systematic comparison of CT and autopsy findings.
  - o Concordance and discordance analysis.
- Statistical Analysis:
  - o IBM SPSS Statistics (Version 17) was used for analysis.
  - o Sensitivity, specificity, positive predictive value, and negative predictive value of CT scans were calculated..

Inclusion Criteria

1. All fatal head injury cases were admitted during the study period.
2. Availability of 128-slice CT scan reports.
3. Complete autopsy records.

Exclusion Criteria

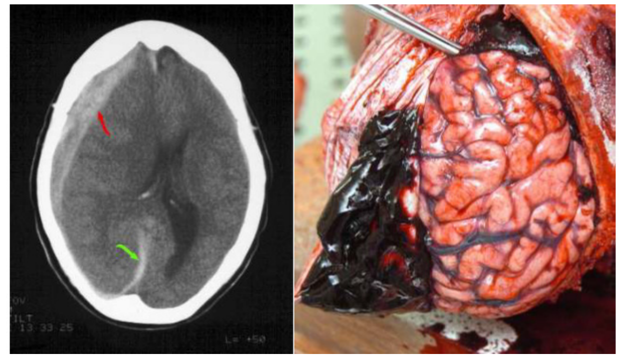
1. Cases with total structural distortion of cranial contents precluding interpretation.
2. Cases where either a CT scan or autopsy was not performed.

Results

- 90% of cases were male, with the most affected age group being 20–30 years (25%).
- **Primary cause of injury:** Road traffic accidents (86.67%), followed by falls (11.67%) and assaults (1.67%).

Table 1: Correlation of Head Injury Lesions at Autopsy and CT Scan

Lesion Type	Detected at Autopsy	Detected at CT Scan	Not Detected at CT Scan
Intracranial Hemorrhages	58	55	3
Contusions	53	40	13

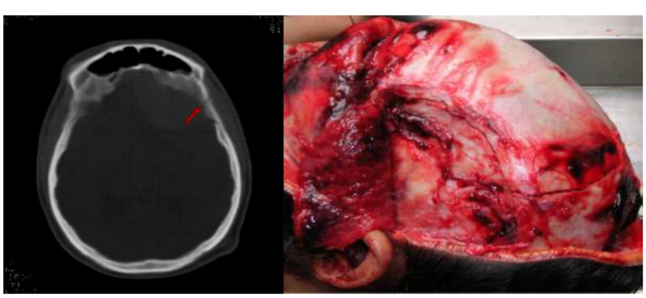


PICTURE 1. A. CT SCAN SHOWING SUBDURAL HEMATOMA WITH LOSS OF NORMAL GREY-WHITE MATTER DIFFERENTIATION.

PICTURE 1.B. BRAIN SHOWING FLATTENED PALE GYRI AND NARROWED SULCI –WITH SUBDURAL HEMATOMA (PM NO 64/17).

Table 2: Sensitivity of CT Scan in Detecting Hemorrhages

Hemorrhage Type	Detected at Autopsy	Detected at CT Scan	Sensitivity (%)
Extradural (EDH)	22	9	40.9%
Subdural (SDH)	50	29	58%
Subarachnoid (SAH)	56	34	60.71%
Intraventricular (IVH)	43	18	41.86%
Intracerebral (ICH)	9	1	11.11%



PICTURE 2 A. CT SCAN SHOWING LINEAR SKULL FRACTURE THROUGH THE TEMPORAL SQUAMOSA (ARROW) AND SCALP CONTUSION.

PICTURE 2 B. AUTOPSY (PM NO. 245/17) SHOWING FISSURE FRACTURE (ARROW) OF VAULT OF SKULL INVOLVING LEFT PARIETAL BONE AND SCALP EXTRAVASATION

Discussion

CT scans demonstrated limitations in detecting certain intracranial injuries, particularly small contusions and posterior cranial fossa lesions. The findings were consistent with previous studies that reported similar challenges in the CT-based detection of haemorrhages and contusions.

Conclusion

While CT scans are valuable, forensic autopsy remains the gold standard in detecting intracranial injuries. Improved imaging protocols, high-resolution CT scans, and contrast enhancement are recommended to reduce discrepancies.

Limitations of the Study

1. **Sample Size Constraints:** The study was limited to 60 cases, which may restrict the generalizability of the findings. A larger dataset could provide more robust statistical insights.
2. **Retrospective Design:** The study relied on existing records, which may introduce biases due to variability in imaging and autopsy documentation.
3. **Absence of MRI Data:** MRI could provide additional insights into subtle brain injuries, particularly diffuse axonal injuries, which CT scans may miss.
4. **Timing of CT Scans:** The interval between injury and CT scan varied, potentially affecting lesion detectability.
5. **Limited Assessment of Radiological Expertise:** Variability in radiologists' interpretations may have influenced sensitivity findings.

Future Research Recommendations

1. **Larger, Multicentric Studies:**Conduct similar studies across multiple centres with larger sample sizes to validate findings.
2. **Prospective Studies:** A prospective study design with standardized imaging and autopsy protocols would improve data accuracy.
3. **MRI Integration:** Future studies should explore the role of MRI alongside CT and autopsy to assess its effectiveness in forensic investigations.
4. **Advanced Imaging Techniques:** Evaluating the benefits of ultra-high-resolution CT scans and dual-energy CT scans for improved detection of subtle injuries.
5. **Artificial Intelligence (AI) in Imaging:** Exploring AI-assisted CT scan analysis to enhance the detection of intracranial haemorrhages and contusions.
6. **Longitudinal Studies on Evolving Lesions:** Examining how intracranial lesions progress over time with serial imaging could provide further forensic and clinical insights.

Conflict of Interest: NIL

Source of Funding: NIL

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