e-ISSN: 0976-822X, p-ISSN: 2861-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(3); 271-277

Original Research Article

Intravital CT and Autopsy Findings in Traumatic Head Injuries: A Comparative Study

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Received: 10-03-2023/ Revised: 05-04-2023 / Accepted: 08-05-2023

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Conflict of interest: Nil

Abstract

Background: Any injury to the skull or brain that causes trauma qualifies as a head injury. In the medical literature, the phrases traumatic brain injury and head injury are sometimes used interchangeably. One of the major health issues of the present is traumatic injuries. Approximately 4.5 million people each year globally pass away from trauma in the twenty-first century. CT scans are frequently used to diagnose injuries and provide details on the precise location and degree of organ and tissue damage. Whole-body CT is becoming a common diagnostic tool in cases of severe trauma. The final diagnostic test is an autopsy, which is still regarded as the best diagnostic technique in medicine. Rarely are secondary analyses conducted because they are never as effective as the initial one. The use of post-mortem imaging (CT and MRI) has increased although the number of autopsies has declined recently, mostly due to financial concerns.

Aim: The aim of the study was to assess the reliability and accuracy of CT scan results, as well as limits in detecting trauma for forensic purposes.

Material and Method: The Department of Forensic Medicine carried out this retrospective-prospective investigation. At the Department of Forensic Medicine, all fatal head injury cases underwent a medico-legal autopsy after a prior CT head scan was performed while the patient was hospitalized. 25 cases totalled in our final dataset, 15 of which were men and 10 of which were women. When antemortem CT scan records were available, all fatal instances of head injuries that were subjected to post-mortem inspection were selected for analysis.

Results: The age group with the greatest vulnerability in the current study was those between the ages of 21 and 30 (13 cases), followed by those under 20 (7 cases). The most vulnerable age range was between the ages of 21 and 30 (13 instances), followed by the under-20 age range (7 cases). 19 of the instances included RTA injuries, and the other 3 involved assault and falls, respectively. At autopsies, scalp injuries were found in 22 out of the 25 cases, although CT found them in just 28. Of the 25 cases, skull fractures were found at autopsy in 22 cases, but the CT scan revealed the same thing in 25 cases.

Conclusion: It was found that the diagnosis of different types of brain injury lesions may be made using a combination of CT scan and autopsy results, which aids in developing better policies. In forensic medicine, certain injuries that are clinically inconsequential but crucial to understanding the mechanism of harm and mode of death may be present. A CT scan can considerably supplement an autopsy's results. It is currently still not viable as a substitute for the conventional autopsy, nevertheless. Only in a few number of situations is CT scanning thought to be a viable alternative to an autopsy.

Keywords: Trauma, Autopsy, Computed tomography, CT scan and Head injury.

Introduction

Any injury to the skull or brain that causes trauma qualifies as a head injury. In the medical literature, the phrases traumatic brain injury and head injury are sometimes used interchangeably.[1] Due to the wide range of injuries covered by head injuries, there are numerous causes for head injuries, including slips and falls, physical attack, and vehicle accidents. One of the major health issues of the present is traumatic injuries. Approximately 4.5 million people each year globally pass away from trauma in the twenty-first century. The trauma leaves millions of additional people with long-term problems and effects. Injuries caused 4.48 million (4.33-4.59) deaths in 2017, or 8.0% (7.7-8.2) of all fatalities. Overall, there were 20.1 million (18.7-20.8) unintentional injury deaths from 2007 to 2017, 15.1 million (14.8-15.4) transport injury deaths, and 14.4 million (13.7-14.7) self-harm and interpersonal violence deaths. Between 2007 and 2017, the overall number of injury-related deaths increased marginally by 2.3%, but the injury-related mortality rate fell by 13.7% (12.2-15.1) to 57.9 (55.9-59.2) per 100,000 people in 2017.[2]

In the United States, there are 1.7 million new cases each year, and roughly 3% of these incidents result in fatalities. Adults are more likely than any other age group to sustain brain injuries from attacks, collisions with objects, falls, and car accidents. However, children may sustain brain injuries from unintentional causes (such being struck or startled) or from accidental falls, necessitating hospitalization.[2]

The main applications of computed tomography (CT) are the investigation and diagnosis of severe injuries. In contemporary clinical medicine, CT performs a critical diagnostic function.[3] The accessibility, speed, and comparatively high diagnostic accuracy of CT are its main benefits. The location and severity of internal organ and tissue damage can be precisely determined with the help of computed tomography.[4]CT scans are being performed more often in clinical settings. Whole-body CT (WBCT), which reduces missed injuries in patients with severe trauma, is steadily becoming a common diagnostic method.[5] The key benefit of WBCT, in addition to speed, is the early availability of a diagnosis prior to a choice on therapy management.[4,6,7]It is crucial to identify severe injuries quickly and accurately. There is no effective treatment if an accurate, evidence-based diagnosis cannot be made. Due to its precision, dependability, safety, and accessibility, computed tomography (CT) has emerged as the preferred diagnostic technique for brain injuries. The clinical, biochemical, and radiological abnormalities that result from the changes in microcirculation, decreased auto-regulation, cerebral edema, and axonal damage begin as soon as the head injury does.[8]

A specialist medical procedure is an autopsy. With a presumptive 100% sensitivity for identifying causes of death and 100% specificity for excluding them, it is the ultimate diagnostic test and the gold standard in diagnostic techniques. The continued importance of autopsies does not imply that medical science has not progressed; rather, it shows that each advancement carries with it fresh problems and unanswered questions.[9] The advancement of medical theory and practice still heavily depends on autopsies.[10] The ultimate method of choice for determining the precise cause of death is an autopsy. The full degree of injuries in head traumas may not be revealed by clinical and radiological examination of the injury. An autopsy on a patient who passes away from their illness may reveal any gaps in the clinical diagnosis and inquiry. These autopsy results are an important source of knowledge. This is a rare chance to determine the precise cause of death.[11]

Material and Methods

The Department of Forensic Medicine carried out this retrospective-prospective investigation. At the Department of Forensic Medicine, all fatal head injury cases underwent a medico-legal autopsy after a prior CT head scan was performed while the patient was hospitalized. 25 cases totalled in our final dataset, 15 of which were men and 10 of which were women. When antemortem CT scan records were available, all fatal instances of head injuries that were subjected to post-mortem inspection were selected for analysis. The "Autopsy diagnosis and technique" standard approach was followed when doing the post-mortem examination on each instance. Additionally, a comparison of the post-mortem results for the head injuries with the CT scan report was done.

Computed tomography

The study comprised traumatic deaths in which an autopsy was conducted after an antemortem CT was performed. Selected autopsy injuries and the most recent antemortem CT results were compared and evaluated as a single diagnosis. In addition, the method of death, ICD-determined cause of death, gender, age, and length of survival were assessed. By carefully examining autopsy protocols, autopsy photographs, medical records, and the findings of CT scans, injury data were gathered. Spiral or multidetector CT scanners were used to collect all antemortem CT scans.

When there were differences between autopsy and CT findings, CT data were borrowed and examined by qualified clinical radiologists with extensive work experience (each with >10 years of experience), with an emphasis on traumatic changes identified by autopsy. Radiologists made their own conclusions after doing the picture revision in the dark.

Inclusion criteria

- Cases of fatal head injuries using ante-mortem CT The study contained head scan reports.
- Cases were considered for the study if they underwent an autopsy within 48 hours of death, a CT scan within 48 hours of death, or a fracture examination within 96 hours of death, and if there was no surgical intervention. The adequate radiologic and morphological interpretation of the traumatic results required for comparison was another need.

Exclusion criteria

Cases in which surgical intervention had resulted in a significant difference between the results of the CT scan and the autopsy were disregarded.

Autopsy

The radiologist sent a pre-report of the PMCT to the forensic pathologist before the autopsy. One of 12 forensic pathologists conducted an exterior inspection before to the autopsy. The brain was then extracted when the cranium was opened. The brain was not further dissected but instead put in a formaldehyde solution for possible future anatomical pathology evaluation when brain damage was visible upon macroscopic examination. One or more sections were carried out if no signs of external brain injury were discovered. The neuroradiologist reread the autopsy records utilizing the PMCT reading grid. Additionally, the autopsy results were used to determine the cause of death.

In this investigation, selected traumatic findings in the head, cervical spine, trunk, and pelvic injuries were compared between the autopsy results and the most recent antemortem CT scans. The gold standard for statistical analysis was determined to be autopsy.

Statistical Analysis

Analysis was performed to assess the correlation between the autopsy and CT scan results. Sensitivity (percentage of those with injury that have injury detected on CT scan.

Result: -

In the present study, the vulnerable age group was those in the 21-30 years (13 cases) followed by the age group of < 20 years (7 cases).

Table 1: Age and Sex distribution of the cases

SI. No.	Age Group	No. of Cases	Male	Female	Total
1	<20 Years	08	05	02	07
2	21-30Years	13	8	03	11
3	31-40Years	04	01	03	04
4	41-50Years	03	01	02	03

The vulnerable age group was those in the 21-30 years (13 cases) followed by the age group of < 20 years (7 cases).

Table 2: Etiology of head injury

Etiology	Number of Cases
RTA	19
FallfromHeight	03
Assault	03
Total	25

19 cases were due to RTA injury and the remaining 3 cases were due to falls and assault respectively.

Table 3: Comparison of scalp injury as in Autopsy and CT scan

Number of cases	Scalp injury detected at autopsy	Scalp injury detected in CT Scan report
25	20	23

Of the 25 cases, scalp injuries were noted in 22 cases at autopsy whereas CT reported scalp injury in only 28 cases.

Table 4: Comparison of Skull fractures as in Autopsy and CT scan

Number of cases	Skull fractures detected at autopsy	Skull fractures detected in CT scan report
30	22	25

Of the 25 cases, in 22 cases skull fractures were observed at autopsy but in 25 cases the same was commented upon in the CT scan.

Discussion

In the present study, the vulnerable age group was those in the 21-30 years (13 cases) followed by the age group of < 20 years (7 cases). According to a study by Mukesh K Goyal, Rajesh Verma, Shiv R Kochar, and Shrikant S Asawa where the maximum number of cases i.e. 56 cases (40%) belonged to the age group 21-40 years, followed by below 10 years age group which were 30 cases (30.4%). Traffic accidents were the primary cause of injuries (62%). It is 66% among men and 33% among women. Falling from a height is the main reason why women get hurt. Males outnumbered girls 122 to 18 (87.1% to 12.8%).[12] Another study undertook a thorough review of 14 occurrences of blunt force-induced skull fractures. Regarding fractures that were situated in the posterior fossa, the results demonstrated a satisfactory diagnostic correlation. Contrarily, it was challenging to evaluate the presence of fractures in the middle and, in particular, anterior fossa.[13]A study by Swiss researchers from the Universities of Bern and Zurich's Institute of Forensic Medicine demonstrated great sensitivity in identifying fractures of the orbital roof but much lower specificity than an autopsy. Therefore, the gold standard for evaluating orbital roof fractures is autopsy. The study also demonstrated that retrobulbar hemorrhage, one of the "blind spots" in autopsy, may be detected well with CT.[14]In contrast to earlier research and our findings, a study by authors from France that compared postmortem CT data with autopsy findings in a group of 236 cadavers found a link in both fractures of the skull and cranial base. However, when a greater number of diagnoses were made at autopsy, inconsistencies were observed in cerebral injuries, including hemorrhage, as well as injuries to internal organs.[15]

Kelly C. Bordignon, and Walter Oleschko Arruda 2002 observed in their study that the highest frequency of Head Trauma occurred in the 21-30 years (25.1%) age group, followed by the age groups 11-20 (21.6%) and 31-40 (17.5%) One thousand three hundred and six (67.3%) patients were male and 654 (32.7%) were female (sex ratio M: F=2:1).1626 instances in the current study were related to RTA injuries, while the other 4 cases were related to assault and falls, respectively.

In the current study, out of the 25 instances, 20 cases had scalp injuries found during autopsies, however only 23 cases were found during CT scans. Of the 30 cases, skull fractures were found in 22 cases at autopsy, although they were also noted in 25 other cases based on the CT scan.

The observation was made by G Gururaj and Sastry Kolluri1999where RTA constituted 62%, fall constituted 22% and assault constituted 10%.[17]

In a study done by Mohammad Zafar Equabal, Shameem Jahan Rizvi, Munawwar Husain, and V.K Srivastava, 2005 Scalp swelling or hematoma was observed in 86.3% of the cases and the CT Scan concurred in all cases. It was also the most common CT finding.18Sharma R, and Murari A 2006 in their study observed that amongst skull fractures, 76.3% of them were diagnosed in both CT scan and Autopsy; whereas 23.7% of them remained undiagnosed by CT scan.[19]

Other studies have demonstrated the potential utility of CT and three-dimensional imaging methods for assessing skull injuries caused by firearms. In identifying the entrance wound and exit wound of the bullet, tracing the path of the wound, assessing the severity of brain injuries, and, in the case of a penetrating wound, identifying the bullet and its fragments, they get very good results—in some circumstances, even better than conventional autopsy.[20]The projectile's angle in all three planes may be seen and calculated thanks to other academic studies on 3D modeling and biometric reconstruction.[21]

Another study found that there are limitations to chest CT scanning and that it may be more challenging to identify small organ lesions. Despite CT's excellent sensitivity, there is ongoing debate about whether it is effective for identifying undetected chest injuries.[22]According to another study, the use of chest CT for screening patients with penetrating chest trauma has significantly increased in the recent decade. Since injuries to the chest commonly damage the lungs, it is possible that knife wound traces are too minute to be picked up by CT.[23]

Our research has some drawbacks. First, there is a chance for bias because forensic doctors weren't blinded to the antemortem CT results before the autopsy. Second, there was some clinical history knowledge among the radiologists who did the antemortem CT assessment.

In this investigation, CT images were borrowed and reevaluated in every instance where autopsy and CT findings differed. The study's interpretation of CT results, which is based on radiologists' experience, had certain limitations.

As a result, all repeat evaluations were carried out by qualified clinical radiologists with an emphasis on traumatic alterations found during autopsy. Radiologists independently made decisions after doing the picture revision in the dark.

Conclusion

It was found that the diagnosis of different types of brain injury lesions may be made using a combination of CT scan and autopsy results, which aids in developing better policies. In forensic medicine, certain injuries that are clinically inconsequential but crucial to understanding the mechanism of harm and mode of death may be present. A CT scan can considerably supplement an autopsy's results.

It is currently still not viable as a substitute for the conventional autopsy, nevertheless. Only in a few numbers of situations is CT scanning thought to be a viable alternative to an autopsy. As a result, traditional autopsy must continue to be used in forensic practice as a fundamental examination and diagnostic technique. The combination of a CT scan and an autopsy appears to be the best method for forensic injury diagnosis.

This study made clear the necessity of providing postmortem CT examination capabilities in forensic offices in order to advance forensic science in the area of postmortem diagnoses.

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