COMPARATIVE STUDY OF COMPUTED TOMOGRAPHY AND AUTOPSY FINDINGS IN TRAUMATIC BRAIN INJURY

Priyatha P[1], K. Prasannan[2]

[1]Senior Resident, Department of Forensic Medicine, Government Medical College, Kozhikode, Kerala.
[2]Professor and HOD, Department of Forensic Medicine, Government Medical College, Thrissur.

ABSTRACT

INTRODUCTION

Diagnosis, treatment and outcome vary significantly by the mechanism, severity and the morphology of underlying injury. CT (Computed Tomography) scan is said to reveal promptly, accurately and noninvasively the intracranial and parenchymal abnormalities in acute cranio-cerebral trauma. The information in the literature regarding the short comings of routine CT scan in picking up of lesions in TBI (Traumatic brain injury) is limited. The present study is undertaken to correlate the CT scan and autopsy findings in TBI. 50 cases of TBI from a period Dec 2012 to May 2014 brought for autopsy at a Government Medical College were studied and analysed. The study showed that the sensitivity of CT for Subarachnoid haemorrhage (SAH) with respect to various regions of brain ranged from 8.3% to 22.9%. Sensitivity of CT for intra Ventricular haemorrhage was only 27.3% and of Subdural haemorrhage (SDH) was also low (50%). Sensitivity of CT for the detection of IVH was 27.3% and specificity 94.9%. For Intra parenchymal haemorrhage the specificity was 98% and sensitivity range from 40 to 66.7%. Haemorrhagic contusions showed overall sensitivity of 42.9% and specificity 72.4%. Brain stem contusions were detected in 14% of cases where as PM examination revealed it in 46% of cases.

Sensitivity of CT for brain oedema, herniation and midline shift were poor.

KEYWORDS

CT scan, Traumatic brain injury, Intra cranial haemorrhage.

HOW TO CITE THIS ARTICLE: Priyatha P, Prasannan K. Comparative study of computed tomography and autopsy findings in traumatic brain injury. J. Evid. Based Med. Healthc. 2016; 3(18), 706-709. DOI: 10.18410/jebmh/2016/160

INTRODUCTION: Traumatic brain injury is a silent epidemic in the developed nations and one of the leading causes of death and disability, accounting for almost 1/3rd of trauma related deaths. Any type of cranio cerebral trauma is caused by any kind of blow on any part of head.[1] Diagnosis, treatment and outcome vary significantly by the mechanism, severity, and the morphology of underlying injury. Conventionally brain damage following head injury is divided into primary, which occurs at the moment of impact and secondary damage which results from the process that are initiated at the time of impact. Primary are scalp lacerations, skull fractures, intra cranial haemorrhages, contusions and lacerations of brain and diffuse axonal injury.

Secondary damage takes the form of brain oedema, increased intracranial tension, ischemia of brain, brain infarction and epilepsy.[2]

Focal brain injuries are macroscopically visible damage that is generally limited to well defined areas, like contusions, lacerations, subdural, extradural and intra cerebral haemorrhages and cranial nerve lacerations. Diffuse brain injuries are associated with wide spread brain dysfunction. Lesions are predominantly microscopic but include focal necrosis, tears of corpus callosum and haemorrhagic necrosis of brain stem.

Submission 06-02-2016, Peer Review 20-02-2016,
Acceptance 29-02-2016, Published 02-03-2016.
Corresponding Author:
Dr. Prasannan K,
Professor & HOD, Department of Forensic Medicine,
Government Medical College, Thrissur, Kerala.
E-mail: ranjiprasannan@gmail.com
DOI: 10.18410/jebmh/2016/160

Before the advent of radiological imaging technique the diagnosis and hence the management solely depended on the clinical evaluation. CT scan is said to reveal promptly accurately and noninvasively the intracranial abnormalities in cranio cerebral trauma and so indispensable in the diagnosis and management of TBI.[3] Imaging traumatically injured brain should be fast, precise, diagnostic, reliable and readily available. CT scan serves these conditions reasonably well. Its limitations include insensitivity in determining small and non-haemorrhagic lesions particularly adjacent to bony surfaces. Diffuse axonal injury also goes undetected. However there is paucity of information in the literature regarding the short comings of routine CT scan in picking up the lesions in TBI. The present study aims to analyse the discrepancies between findings of CT study and autopsy findings in TBI.

OBJECTIVES:

1. To compare findings of CT scan and autopsy in TBI.
2. To identify the findings appreciated better with naked eye examination than CT scan reporting and vice versa.

MATERIAL AND METHODS:

Study Design: Prospective study design.

Study Subject: Medico legal cases that are subjected to autopsy in the Department of Forensic Medicine in a Government. Medical College, from December 2012 to May 2014.

Inclusion Criteria: Cases of TBI with proper history, with admission care and CT scan reports.

Exclusion Criteria: Head injury cases subjected to surgical procedure in TBI resulting from assault (To protect the confidentiality of the case).

Study Tools: Requisition furnished by police, Clinical case sheet, CT scan and reports and proforma for data collection. Data Analysis: Analysis with appropriate statistical tests using level of agreement 16.0.

Permission for the study was granted by the Institutional Ethics Committee.

OBSERVATION AND RESULTS: During the period of study from December 2012 to May 2014, 50 cases of TBI who had at least one CT scan report and evaluation and later succumbed to death and subjected to post mortem examination were studied and analysed.

Among the 50 cases studied 43 were men (86%) and 7 were females (14%).

Age group of the study ranged from 3 years to 85 years. Majority belonged to the age group 40-59 years constituting 44% of the total cases.

Sl. No.	History	Frequency	Percentage
1	RTA	37	74%
2	Fall	10	20%
3	Others	3	6%
Table 1: History of the case			

History: Majority of the case were RTA (74%)-Table 1

Time interval	Frequency	Percentage
1-2 hours	22	44%
3-4 hours	26	52%
5-6 hours	2	2%
Table 2: Interval between first CT and the incident		

96% of cases CT was done in 1 to 4 hrs (Table 2).

Among the 50 patients subjected to the initial CT scan, 10 patients had their repeat CT.

Subarachnoid haemorrhage over Cerebral Surface-CT and Post mortem findings. Table-3.

	RF	LF	RP	LP	RT	LT	RO	LO
CT	10	10	8	9	9	9	5	5
PM	37	35	49	37	33	39	33	32
Table 3								

Out of the 50 cases studied SAH was present in 90% cases of which 86% was over parietal lobes followed by72% each over the frontal and temporal regions followed by occipital region 65%. CT scan revealed only 27%, 19%, 25% and 15% respectively. (Table-3)

Basal SAH-Table-4

	Left	Right	Cerebellum
CT	4	4	2
PM	27	29	24
Table 4			

Basal SAH: Basal SAH was detected in 27 (Left side), 29(Right) and 2(Cerebellum) cases in CT.

During Autopsy it was 27, 29 and 24 respectively. (Table 4)

Sl. No.	SAH	Sensitivity	specificity	kappa	p value
1	RF	18.9%	76.9%	-0.25	0.747
2	LF	22.9%	86.7%	0.065	0.440
3	RT	20.5%	90.9%	0.058	0.384
4	LT	18.2%	82.4%	0.004	0.963
5	RP	18.9%	92.3%	0.065	0.342
6	LP	21.2%	88.2%	0.070	0.410
7	RO	15.2%	100%	0.104	0.100
8	LO	15.6%	100%	0.118	0.077
9	RB	10.3%	95.2%	0.048	0.473
10	LB	11.1%	95.7%	0.063	0.380
11	Cerebellum	8.3%	100%	0.086	0.133
Table 5: SAH statistics					

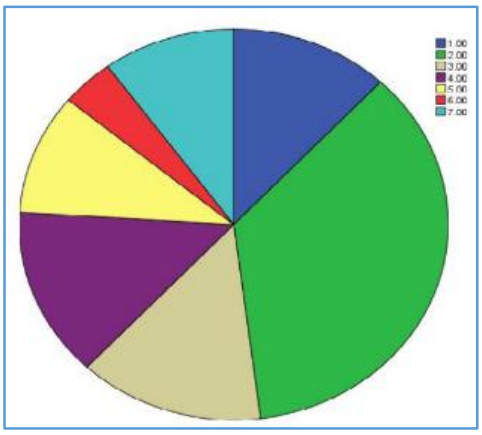
Sensitivity of CT scan was 8.3% to 22.8% in various parts of brain and specificity was 76.9% to 100%. (Table-5)

	Right	Left
CT	15	11
PM	28	29
Table 6: Subdural haemorrhage		

SDH was present in 22-30% of cases as per CT scan where as it was present in 56-58% of cases as per Autopsy finding. (Table 6)

Survival Period in hours	Frequency	Percentage
1-4 hours	6	12%
5-12 hours	18	36%
13-24 hours	7	14%
25-48 hours	7	14%
49-72 hours	5	10%
73-96 hours	2	4%
>96 hours	5	10%
Table 7: Survival period		

Of the 50 cases, maximum survival period was as high 216 hours and the least 2 hours. The maximum number of cases had their survival period between 5-12 hours. 10% of cases belonged to more than 96 hours survival period.



Survival period

Sl. No.	Types	Sensitivity	Specificity	kappa	p value
1	EDH-R	100%	95.7%	0.730	000
2	EDH-L	-	-	-	-
3	SDH-R	39.3%	81.8%	0.198	0.106
4	SDH-L	34.5%	95.2%	0.266	0.012

Table 8: EDH and SDH statistics

The sensitivity for detection of EDH was 100% and specificity 95.7% (Table-8).

Intra ventricular and Intra parenchymal haemorrhages and contusions. Table-9.

	IVH	IPH RF	IPH LF	IPH GC Rt	IPH GC Lt	Hemorrhagic Contusion	Bain Stem contusion
CT	5	5	3	2	1	17	7
PM	3	11	5	1	1	21	23

Table 9

Out of the 5 cases of intra ventricular haemorrhages detected at CT, Autopsy demonstrated only 3cases. PM demonstrated 16 cases of intra parenchymal haemorrhage, 23 cases of brain stem contusions, 21 case of haemorrhagic contusions against CT diagnosis of 3, 6, 17 and 7 cases respectively. One case of intra parenchymal haemorrhage in left ganglio-capsular region, CT aptly diagnosed that. (100%). (Table-9)

STATISTICS:

Sl. No.	Types	Sensitivity	Specificity	Kappa	p value
1	IVH	27.3%	94.9%	0.275	0.031
2	IPH-RF	66.7%	97.9%	0.459	000
3	IPH-LF	40%	97.8%	0.645	0.001
4	IPH-Rt GC	0%	95.9%	0	0.837
5	IPH-Lt GC	100%	100%	1	000
6	HC	42.9%	72.4%	0.157	0.261
7	BS contusion	17.4%	88.9%	0.066	0.524

Table 10

The sensitivity of CT for detection of intra ventricular haemorrhage was 27.3% and specificity was 94.9%. The specificity of CT in the detection of intraparenchymal haemorrhage was 98% where as it showed variation in its sensitivity of 40% and 66.7% for left frontal and right frontal lobes respectively. Haemorrhagic contusion showed an overall sensitivity of 42.9% and specificity of 72.4%. Brain stem contusions were detected in 14% cases mean while post mortem examination revealed 46% of positive cases making the sensitivity 17.4% and specificity 88.9%. Intraparenchymal haemorrhage in the left gangliocapsular region showed 100% sensitivity and 100% specificity. The sensitivity for intraparenchymal haemorrhage on right gangliocapsular region showed 0% sensitivity and 95.9% specificity. (Table-10)

Brain Oedema, Herniation and Midline Shift: Table-11.

	Brain Oedema	Herniation	Mid line shift
CT	8	1	2
PM	21	11	8

Table 11

Out of 21 cases of brain oedema detected at autopsy, CT picked 8 cases. Herniations 11 detected at autopsy, CT failed to pick 10 cases. 2 cases of midline shift was reported at CT against 8 detected at autopsy. (Table-11)

STATISTICS:

Sl. No.	Findings	sensitivity	specificity	kappa	p value
1	BO	23.8%	89.7%	0.147	0.200
2	BH	9.1%	100%	0.135	0.057
3	MLS	12.5%	97.6%	0.145	0.181

Table 12

CT showed 100% specificity for brain herniation whereas the sensitivity was only 9.1%. CT showed brain oedema in 8 cases and was demonstrated at post-mortem in 21 cases ie 58%. The CT sensitivity for brain oedema is 23.8% and specificity is 89.7%. Midline shift was reported in 4% cases in CT and post-mortem examination was 16% resulting in sensitivity of 12.5% and specificity of 97.6%. (Table 12)

DISCUSSION: Autopsy findings in 50 cases of TBI were compared of that of CT scan study. The commonest cause of head trauma is found to be road traffic accidents (74%), followed by fall from height (20%) and others amount to 6%.Similar observations were made by Mukesh K Goyal, Rajesh Verma, Shiv R Kochev where the cause of head trauma was due to RTA in 62.1% of cases.[3]

In the present study out of 50 cases SAH were present in 90% of cases at autopsy. CT scan revealed SAH in 19%-27% in different lobes of brain. Asok Pathak, Dalbir Singh, and Khandelwal observed that traumatic SAH was present in CT only in 10 cases where as it was detected in 33 cases during autopsy. CT revealed SDH in 5 cases where as autopsy revealed it in15 cases.[4]

Subdural haemorrhage may not be recognized in CT scan when it is very close to tentorium or skull bone. Similarly SAH may go undetected in CT scan if thin in blood density. The same reason explains the fallacies of CT in detecting small traumatic lesions of the brain stem or posterior fossa structures and also of thalamic and hypothalamic areas. This explains the disparity in CT and autopsy findings. The proximity of skull bone can create beam hardening effects and also cause small haematoma to spread in a convex manner making volume averaging problems.[5]

Brain stem contusions were detected in 14% of cases where as autopsy revealed them in 46% of cases. Artefacts often obstruct the detection of findings in posterior cranial fossa. In addition obliteration of cisterns may be due to small amount of SAH in the cisterns which appears iso dense against adjacent brain.

In the present study CT scan has shown 100% specificity for brain Herniation whereas sensitivity was only 9.1%.

CT showed brain oedema in 8 cases where as autopsy demonstrated it in 21 cases (58%). The probable reason for this disparity is the long survival period with single initial CT scan taken after the incident.

Diffuse Axonal Injury was undiagnosed in CT and autopsy, but by microscopic examination only. Death in TBI is said to be mainly due to diffuse axonal injury.[6]

SUMMARY AND CONCLUSIONS: The present study was done to compare CT findings with that of the autopsy findings and to discuss the discrepancies. Total of 50 cases were studied, excluding those who underwent surgical correction of the lesion detected at CT and the results were analysed with degree of association, kappa and by means of sensitivity and specificity of the test and by the significance of the p value.

The Observations are as Follows: Of the various causation of trauma to head, the order of frequency was of the order 74%, 20% and 6% for RTA, fall and other causes respectively. 52% of the patients had their first CT between 3-4 hours of the incident where as 44% could take their first CT within first two hours of the incident. Maximum survival period was as high 216 hours and the least was 2 hours. The maximum number of cases the survival period was between 5-12 hours. The sensitivity for subarachnoid haemorrhage with respect to various areas of brain ranged from 8.3% to 22.9%, the lowest for the cerebellum (8.3%). The sensitivity of CT for detection of intra ventricular haemorrhage was only 27.3%. CT showed 100% sensitivity for EDH and Ganglio capsular region contusions. A repeat CT was taken in which 8 cases showed brain oedema, 1 case of brain herniation and 2 case of midline shift.4 cases of brain oedema was newly set (absent in the first CT) and so was the brain Herniation and midline shift. As the study group is less, a statistically significant explanation could not be derived.

ABBREVIATIONS:

CT: Computed Tomography.
TBI: Traumatic Brain Injury.
PM: Post mortem.
RF: Right Frontal.
LF: Left frontal.
RP: Right Parietal.
LP: Left Parietal.
RT: Right temporal.
LT: Left Temporal.
RO: Right Occipital.
LO: Left Occipital.
RB: Right Basal.
LB: Left Basal.
GC: Ganglio Capsular.
SAH: Sub Arachnoid Haemorrhage.
SDH: Sub Dural Haemorrhage.
EDH: Extra Dural Haemorrhage.
IPH: Intra Parenchymal Haemorrhage.
HC: Haemorrhagic Contusion.
MLS: Mid line Shift.
BO: Brain Oedema.
BH: Brain Herniation.

BIBLIOGRAPHY:

1. Munro D. Cranio-cerebral injuries. In: Gordon I, Shapiro HA. Forensic Medicine A Guide to Principles. Oxford University Press: Churchil Livingstone, 1998;3rd ed:252.
2. Payne-James Jason, Busultid Anthony, Smock William. Forensic medicine clinical and pathological aspects. Marks P, London (England): Greenwich medical media Ltd. J R Soc Med 2003;96(10):517-18.
3. Goyal Mukesh K, Verma Rajesh, Kochar Shiv R, et al. Correlation of CT scan with post mortem findings of acute head trauma cases at SM Hospital, Jaipur. J Indian Academy of Forensic Med 2008;32(3):211.
4. Pathak Ashis, Singh Dalbir, Khandelwal N. Fallacies of routine CT scan in identifying lesions in severe head injury. Indian Journal of Neurotrauma 2006;3(1):37-42.
5. Krotz M, Linsenmaier U, Kanz KG, et al. Evaluation of minimally invasive percutaneous CT-controlled ventriculostomy in patients with severe head trauma. Eur Radiol 2004;14(2):227-233.
6. Gentry LR, Godersky JC, Thompson B, et al. Prospective comparative study of intermediate-field MR and CT in the evaluation of closed head trauma. AJR Am J Roentgenol 1988;150(3):673-82.