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TRAUMATIC INTRA CRANIAL INJURY - COMPUTED TOMOGRAPHY, PER OPERATIVE AND POST MORTEM FINDINGS: A PROGNOSTIC CORRELATION

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ABSTRACT: The present study was undertaken in department of Radio-Diagnosis, Government Medical College, Kozhikode, Kerala, in 70 patients who underwent CT scan head for evaluation of head injury. CT findings in traumatic head injury patients were recorded and studied. CT findings were correlated with preoperative and postmortem findings. Sensitivity of CT in detection of various traumatic intracranial lesions and role of CT findings in predicting outcome of head injuries were assessed. The study group consisted of 64 males and 6 females between the ages of 1 to 70. Initial CT findings were evaluated. Those patients who were conservatively managed are followed up for three months, follow up CT findings and mortality was assessed. Those cases subjected to neurosurgical interventions were followed up and surgical & post procedural data are collected. Post-mortem findings in head injury deaths were collected and studied. Present study shows majority of head injuries in economically productive age group (21-30 year), in males and as a result of road traffic accidents. Skull fractures were seen in 50 % of cases. CT detection rate for linear fractures is around 90 % and for base of skull is 82 %. Most common CT finding was subarachnoid hemorrhage followed by cerebral contusions. 39 % of cases were managed conservatively and has got favorable outcome. 31 % underwent cerebral decompression procedures in which 85 % had a good post-operative outcome. Evacuation of extra axial bleed (EDH and SDH) was the common procedure undertaken. Extra axial bleed was the cause for 14 % of total mortality. Midline shift of approximately 8-10 mm corresponded to 100 ml of extra axial bleed. Present study showed a mortality rate of 32 %. Most common cause of death was multiple intra parenchymal bleeds, in which brain stem bleed was the major cause (44 %). CT detection rate for brain stem injury was around 75 %. Diffuse brain injuries were the cause in 22 % of deaths. CT detection rate for diffuse brain injury was around 70 % and mortality 60 %. Diffuse brain injuries and brain stem injuries were under diagnosed in CT. Even though some of the diffuse brain injuries were under diagnosed in CT, all the surgically correctable lesions were detected by CT.

KEYWORDS: Trauma, Head injury, Neuro imaging, Computed tomography, Post mortem.

INTRODUCTION: Brain injury is the most common cause of mortality and morbidity in modern trauma. In acute emergency settings imaging can help in determining the presence and extent of injury and guide surgical planning and minimally invasive procedures.⁽¹⁾

Introduced by Hounsfield and Ambrose in 1972 computed tomography (CT scan) has revolutionized the diagnostic evaluation of traumatic intra cranial lesions.

In acute setting, early diagnosis and intensive management may prevent secondary injury from complications of brain injury. Imaging helps in identifying intra cranial problems and determines their severity and operability.⁽²⁾

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CT is the initial modality of choice during the first 24 hour after the injury, because it is widely available, cost effective, require short imaging time and easier to perform on patients who are on ventilator support, on various splinting devices or agitated.

Head injury consists of skull injury, focal brain injury (Epidural, subdural and intra parenchymal bleeds) and diffuse brain tissue injury. Motor vehicle road accidents accounts for most of the causes. Other causes includes work related falls, being struck by equipment, machinery and related items.

On imaging brain contusions are relatively common. Subdural and epidural hematomas are also often seen.⁽³⁾ Other findings are the subarachnoid and intra ventricular bleed often associated with brain herniation, fractures, foreign body, vascular injury and ischemia.

MATERIALS AND METHODS:

Study Design	Diagnostic Test Evaluation
Study Setting	Cases coming to, Causality, Government Medical College Kozhikode, Kerala , India
Study Period	Jan 2010 to Dec 2011
Study method	Axial CT scan head
Sample size	70 subjects, The study group consisted of 64 males and 6 females between the ages of 1 to 70
CT protocols and imaging	GE Hi Speed FX / I spiral CT scanner. 5 mm contiguous sections are taken for posterior fossa including foramen magnum and 10mm sections for supra tentorial brain.

Initial CT findings were evaluated with reference to the focal brain lesions, diffuse lesions, secondary injuries and skull fractures. Patients are followed up in emergency department and corresponding neurosurgical ward.

Those patients who were conservatively managed are followed up for three months, follow up CT findings (Decrease or increase in size of previous lesions, appearance of new lesions and secondary brain injuries) and mortality was assessed.

Those cases subjected to neurosurgical interventions were followed up and surgical & post procedural data are collected. Cases are then followed up for post-operative complications, secondary injuries and mortality.

Post-mortem was done in all cases of head injury deaths and findings were collected and studied. Relevant data were recorded at every step and were tabulated for further statistical analysis and graphical presentation. Logical and statistical conclusions are then drawn from all the above information and available data.

Ethics

The study was approved by the institutional research committee and ethics committee of Government Medical College, Kozhikode, Kerala, India.

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DISCUSSION: In this study majority of head injuries were in economically productive age group (21-30 year), in males and as a result of road traffic accidents. This may be due to travelling by this economically productive age group. There was unmistakable male preponderance in most cases of head injuries, out of the 70 cases 92% were males. This higher incidence is due to the high outdoor activities.

50% showed fracture skull in which 65% showed involvement of vault. Squamous temporal was the most common bone involved, 56%. This was slightly higher than the Cooper's study which showed 37% incidence of skull fractures.⁽⁴⁾

On analysis of CT findings among all type of intra cranial hemorrhage, subarachnoid hemorrhage was the commonest (55%) followed by cerebral contusions (52%) and subdural hemorrhage (46%), extradural hemorrhage in 30% and intra ventricular bleed in 11%. In the various combinations of intra cranial injuries subarachnoid hemorrhage and cerebral contusions were common.

55% of cases showed SAH, out of which 76% were focal, Parietal sulci being the most common location. Among these 58% was associated with hemorrhagic contusion. 46% showed SDH, out of which 31% was, isolated SDH, while 69% of it was associated with other types of hemorrhages. Hyper acute subdural hematoma which shows mixed blood in the CT was seen in 4 cases (13%).⁽⁵⁾ Hemorrhagic contusion was the commonest associated bleed. SDH was unilateral in 75%. Fronto-parietal location was the commonest site (56%) followed by temporo-parietal region (25%). Posterior fossa involvement was seen in 12% of cases, all of which was taken for surgery and has a good outcome. Associated skull fractures were noted in 28%.

Unilateral massive brain swelling as a complication of SDH was seen in 6%. 30% of SDH cases were taken up for surgery. 100-150ml of blood was seen in all cases. This was comparable with the findings of Hume Adam which show a minimum 35-100 ml of blood for clinical signs and 150 ml for fatalities. Dural tear was seen in most of the cases.⁽⁶⁾ Present study shows a mortality of 14% by SDH. It was comparable to most of the other studies.

30% of cases in present study showed EDH, which was higher than most of the other studies, in which highest incidence was reported in Glasgow (20%). Hemorrhagic contusion was the commonest associated bleed. EDH was unilateral in (81%). Fronto-parietal location was the commonest site (67%) followed by temporo-parietal region (25%).⁽⁷⁾

Associated skull fractures were not seen in 19% of cases. This was in agreement with the findings of Mckissock, which showed intact skull in 15% of EDH cases. 26% of EDH cases undergone decompression surgeries. No mortality was noted in this group of patients in the present study. This was in agree with the Hooper's finding that rapid diagnosis and early treatment significantly reduces the mortality.⁽⁸⁾

Intra ventricular hemorrhage was seen in 11% of all intra cranial bleeds. It was always in association with other types of intra cranial hemorrhages.

Cerebral contusions were seen in 52% and were multiple in 56%. Most common sites were temporal lobe followed by frontal and parietal. Brain stem involvement was seen in 17% of cases. Delayed imaging in first three days shows increased detection of contusion up to 65%.

Intra cerebral hematoma was observed in 32% with parietal lobe as predominant location (50%). Associated skull fractures were seen in 43% of cases. Mortality was high among this group with multiple hematomas. This study shows a mortality of 40% among these patients. Brain stem

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bleed contributed about 40%. This was in agreement with the various autopsy series of 7-30% mortality caused by brain stem bleed.

Rebleed on follow up was noted in 22% of our cases, this was less than most of the other studies. 30% mortality was noted in these patients with rebleed. Cooper's study showed new lesions on follow up study has got poor outcome upto 80 %.⁽⁹⁾

Posterior fossa injury noted in 17% of patients in this study, which was similar to various studies showing an incidence of 2-15%. Brain stem injury was the common followed by extra axial bleed and cerebellar hematoma. No posterior fossa vascular injury was noted. Brain stem injury was responsible for 18% of total death. No mortality noted in posterior fossa injuries other than the brain stem injury. It is probably due to the rapid diagnosis and evacuation of posterior fossa extra axial hemorrhages.

CT findings favoring diffuse axonal injuries were noted in a total of 8%. All of them where with a Glasgow coma scale of less than 7. CT scans showed subtle petechial bleeds in the gray white junction and brain stem. These findings were in agreement with reporting's of Zimmerman showing CT incidence of 3 -15% of diffuse axonal injury. All of which were confirmed in post mortem. Two cases were additionally seen in post mortem. Present study shows a CT detection rate around 60% for DAI. Present study showed a mortality of 60% among this group. This was comparable with study of Zimmerman.⁽¹⁰⁾

Diffuse brain edema was a common finding (60%) which was commonly associated with multiple parenchymal contusions. Mortality from brain edema was closely related to associated injury.

54% showed pneumocephalus in which fractures were not seen in 4%.

Two cases of (Total incidence of 3%) traumatic vascular injury were noted in the study. One had (Dissection of internal carotid Artery with thrombosis of middle cerebral artery) CT diagnosis, whereas the other was post mortem diagnosis, showing internal carotid dissection with fracture middle cranial fossa. Present study shows 100% mortality and 50% CT detection rate among this group. Vietnam vascular directory shows an incidence of 4% traumatic vascular injury.⁽¹¹⁾ No cases of venous sinus injury or ruptured aneurysm were seen in this study. No intra cranial foreign bodies were noted.

Out of the secondary injuries brain edema was the common. Infarcts were secondary to herniation in majority of cases.

Associated benign conditions noted in the present study include arachnoid cyst 6%, meningioma 3% and epidermoid 1.3%.

Delayed bleed of 22% were noted among cases managed conservatively. Post-operative mortality was 7% for SDH and none for EDH.

Most of the CT findings were confirmed on post mortem. Additional findings detected (missed in initial CT) are brain stem bleeds, 3 case (14%), Small basifrontal intra parenchymal bleed, 2 case (9%) and linear fractures involving the vault, 2 case (9%) & involving the base of skull (middle cranial fossa), 3 case (14%).⁽¹²⁾

Of the total 22 deaths maximum number was due to multiple intraparenchymal hematomas with mass effect (40%) in which brain stem injury contributed to the most (44%). All the CT detected brain stem injuries were confirmed in post mortem examination with additional detection of 3 cases (14%).⁽¹³⁾

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13% of death was unrelated to head injury in which lung contusions, cardiac contusion and myocardial infarction were the causes.

Introduction of CT scan has dramatically reduced the mortality in head injury by providing a reliable method of detecting the intra cranial pathologies. Even though some of the diffuse brain injuries are under detected on CT, all the surgically correctable lesions are detected by CT. Only some of the diffuse axonal injuries and brain stem lesions are under diagnosed in CT.

RESULTS: Age Distribution of the cases of severe traumatic brain injuries.

Age Group	Number of Patients	Percentage
1 -- 10	3	4.29
11 -- 20	11	15.71
21 -- 30	23	32.86
31 -- 40	10	14.29
41 -- 50	12	17.14
51 -- 60	5	7.14
61 -- 70	6	8.57

Fracture Skull: 35 cases (50%) showed fracture skull.

Subarachnoid Hemorrhage: 38 cases (54%) showed SAH (Figure 1).

Subdural Hemorrhage: 32 cases (46%) showed SDH, in which 31% was isolated subdural while in 69%, it was associated with other types of hemorrhages.

Extradural Hemorrhage: 21 cases (30%) showed EDH (Figure 2)

Intra ventricular Hemorrhage: Intra ventricular hemorrhage was seen in 8 cases (11%) of all intra cranial bleeds.

Cerebral Contusions: Cerebral contusions were seen in 32 cases (52%) and were multiple in 56%. Most common sites were temporal lobe followed by frontal and parietal. Brain stem involvement was difficult to assess and seen in 17 % of cases (Figure 3).

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A) Posterior fossa injuries (Figure 4).

Type of Injury	Number	Percentage
Subarachnoid hemorrhage	38	55
Subdural hemorrhage	32	46
Extradural hemorrhage	21	30
Intra ventricular hemorrhage	8	11
Cerebral contusions	36	52
Intra cerebral hematoma	22	32

B) Diffuse Brain Injury: CT findings favoring diffuse axonal injuries were noted in a total of 5 cases (7%). (Figure 8).

Findings in Diffuse Axonal Injury:	
Brain edema	5 cases
Petechial bleeds in the grey white junction	4 cases
Brain stem bleed posterior aspect	3 case

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Pneumocephalus: 54% showed pneumocephalus in which fractures were not seen in 4% (of total pneumocephalus) (Figure 6).

Vascular Injury: One case of traumatic vascular injury was noted in CT.

Mass effect and Secondary Injuries: Mid line shift was seen in 42 cases (60%) of which 22 (32%) showed shift more than 5 mm. Sub falcine herniation was noted in 24 cases (34%). Descending and uncus herniation was noted in 34 cases (48%). Ascending transtentorial herniation was seen in 4 cases (6%). Out of the secondary injuries brain edema was the commonest (Figure 8).

Two deaths occurred within 4 hours of initial CT. One was due to large SDH with mass effect And other due to extensive intra parenchymal bleed.

27 cases (39%) were managed conservatively, of which 6 (22%) cases showed delayed bleed and one case was taken for decompression surgery. 22 cases (31%) underwent decompression surgery within first week, of which two cases expired due to recurrent bleed and mass effect. Rebleed was noted in 4 cases (18%) following surgery, of which one had repeat surgery and decompression.

22 cases of death were seen in this study, most of them were within first 5 days. Two cases were following surgery whereas the rest were under conservative management.

ANALYSIS OF OPERATIVE FINDINGS: In this study 32% (22 cases) had undergone various neurosurgical (decompression) procedures from the Department of Neurosurgery, Medical College Kozhikode. 63% (14 cases) were for evacuation of extra axial bleed, 13% (3 cases) for evacuation of intra parenchymal bleed and 22% (4 cases) for evacuation of intra parenchymal bleed.

Most of the extra axial bleeds operated had midline shift of more than 5 mm. An average of 100 – 150 ml of blood was noted in every case. Active bleeding was noted in 5 cases (22%). Dural tear was noted in majority of cases (50%). Evacuation of hematoma and repair of dura was done.

Three cases showed postoperative recurrent bleed, out of which one had under gone repeat surgery. One mortality was noted among these. All other cases of extra axial bleed evacuation had a good post-operative outcome.

Intra parenchymal hematoma evacuations were done in 7 cases (33%) in which temporo-parietal lobe was the common site. One case had post-operative recurrent bleed and death.

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ANALYSIS OF POST MORTEM FINDINGS (Figure 9, 10 & 11)

Causes of Death:

Cause of death	Number	Percentage
Multiple parenchymal hematomas	9	40
Diffuse axonal injury	5	22
Sub dural bleed	3	14
Vascular injury with diffuse brain edema	2	10
Unrelated to head injury	3	14

Figure 1

Figure 2 - Axial CT sections showing acute EDH in left parietal region

Figure 2

Figure 3 - Axial CT sections showing Cerebellar parenchymal hematoma

Figure 3

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Figure 4 –Axial CT scan shows brain stem contusions, temporal lobe hematomas

Figure 4

Figure 5 - Axial CT sections showing Sub arachnoid air

Figure 5

Figure 6 - Axial CT sections showing
Tension pneumocephalus in frontal region

Figure 6

Figure 7 - Diffuse brain edema

Figure 7

Figure 8

Figure 9

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Figure 10- Post mortem specimen showing subarachnoid hemorrhage

Figure 10

Figure 11 - Post mortem specimen showing brain stem contusions

Figure 11

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