Original Research Article

A Clinico-radiological study of cranio-cerebral injuries at a rural tertiary healthcare institute in North Maharashtra

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Abstract

Introduction: Cranial and cerebral injuries are an open or closed brain damage due to short-lived mechanical factors affecting the skull Cranio-cerebral injury is a leading cause of mortality, morbidity, disability and socioeconomic losses in Indian population.**Aim and objectives:** To study the demography of cranio-cerebral injuries and to correlate various variables like clinical status, CT imaging, severity of cranio-cerebral injuries, operative need and its outcome.**Settings and Design:** This descriptive study consists of six months retrospective data and six months prospective data of 350 patients from1st June 2020 to 31st May 2021.**Methods:** Desired variables of all the patients were noted on a predesigned pro forma. The Prospective and retrospective both data was combined together and overall analysis was carried by StatsDirect statistical software to compute mean values for continuous data and categorical data percentages. **Results:** Majority of the patients were in 20 to 50 years of age group(65.14%) and males(80%).Road traffic accidents accounted for majority of the cases(65.42%),followed by assaults(25.14%) and falls(3.42%). CT imaging reported brain edema in most of the cases (76%) followed by cerebral contusions (46%),skull fractures(39%), SDH(13.14%) and EDH (9.14%).Total 28 major neurosurgeries were performed.**Conclusion:**Traumatic head injuries predominantly affect young male population. CT findings are useful as prognostic indicators and useful during counseling of patients relatives. Need of Neurosurgeons, Radiologists and infrastructure in government hospitals is a real need to meet the escalating society demands.

Keywords: Brain edema, Computed tomography, Glasgow coma scale, Intracranial hemorrhage, RTA, Rural, Traumatic brain injury.

Introduction

In year 2017,The National Crime Report Bureau reported that a total of 4,74,515 traffic accidents comprising of 4,45,730 road accidents, 27,197 railway accidents and 1,588 railway crossing accidents were reported. These accidents caused 1,50,093, 23,959 and 1,534 deaths respectively during 2017.[1] Economic development has resulted in rapid urbanization, motorization, and population migration, altering traditional methods of living and working.[2] The rapid motorization of India, especially during the past two decades, has resulted in increasing numbers of injuries and deaths due to road traffic crashes. [2] Traumatic brain injury [TBI] is the main cause of one-third to one-half of all trauma deaths and the leading cause of disability in people under forty, severely disabling 15–20/100,000 populations per year.[3]TBI is a leading cause of mortality, morbidity, disability, and socioeconomic losses in India as well. It is estimated that nearly 1.5–2 million persons are injured and 1 million die every year in India.[4] The diagnosis and management of head trauma have been changed significantly with the wide availability of CT scan since its inception in 1970s.[5] Computed tomography (CT) has become the diagnostic modality of choice for head trauma due to its accuracy, reliability, safety, and wide availability. The changes in microcirculation, impaired auto-regulation, cerebral edema, and axonal injury start as soon as head injury occurs and manifest as clinical, biochemical, and radiological changes. Proper therapeutic management of brain injury is based on correct diagnosis and appreciation of the temporal course of the disease process.[6] Most of the infrastructure-proof neurosurgical centers are established in tier-I and tier-II cities, whereas the majority of the Indian population still resides in rural areas and small towns, thus limiting timely access to the diagnosis and treatment.[7]Quality assistance of medical aid and emergency room care are extremely important contributing factors to determine the outcome in head injury patients. Trauma with a head injury and associated injuries demands rapid improvisation and interventions to save lives and permanent disabilities.[8]This present study is aimed to describe epidemiological characteristics, pattern of injuries, CT imaging features, clinical parameters and outcome of cranio-cerebral injuries..

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Materials and Methods

The present study was a observational descriptive study conducted at a tertiary healthcare institute in Northern Maharashtra. Six months retrospective and six months prospective data of 350 patients from 1st June 2020 to 31st May 2021 was recorded with the help of a standard,semi-structured, pre-validated case record proforma. The proforma included demographic data of all patients, causes of head injury,pattern of head injuries, clinical parameters, Glasgow coma scale, Computer Tomography (CT) imaging features, conservative or operative management and its outcome. The study was approved by Institutional Ethical Committee.

Statistical analysis: The data was entered with the help of Microsoft Excel sheets. The data was represented in the form of charts and tables for frequency analysis. SPSS software version 21 was used for data analysis, it is a statistical software package designed for

biomedical, public health, and general health science uses. Mean, standard deviation was calculated for continuous data and percentages were calculated for categorical data.

Results

Demographic and clinical characteristics

A total of 350 patients (GCS 3 to 12)were enrolled during the study period in which 80% were male with a mean ± SD age of 35.02 ± 16.28 years (median: 28, range: 5–90). Of these, based on post resuscitation GCS, 84.00% patients had moderate and 16.00% patients had severe TBI. [Table 1] In this study males outnumbered females four times, male: female ratio was 4:1. The age distribution of patients with moderate or severe TBI revealed that the highest occurrence was in the age group of 21–30 years (30.00%), followed by 31–40 years (20.57%). [Table 2] Daily one or two and on an average, 50 patients with moderate or severe TBI admitted every month at government hospital Dhule. The most common mode of injury was road traffic accidents (RTAs), which accounted for 75.71% of the patients, followed by assaults 26.57% and falls 2.85%.[Table1] Among RTAs the motorcycle victims were affected the most 63.39% followed by motor vehicle driver 15.47%, pedestrian 12.07% and others 6.85%.In addition to TBIs, nearly one-fourth patients (24.28%) had polytrauma or severe injuries to various parts of the body or major extra cranial injuries. These included facial injuries, chest injuries, abdominal injuries, injuries to upper and lower limb, etc.[Table no 1] Highest numbers of RTA leading to severe or moderate TBI were seen between 6PM to 12 Midnight and constituted 32.28% of patients. Followed by 12 Noon to 6 PM period having 22.67% of cases. The overall median duration of hospital stay days was 6 (range: 0–28).

Physiological characteristics and computed tomography findings

Table 3 depicted the physiological and CT characteristics at admission.Episodes of hypotension during the first 24 h of admission were present in 92(26.28%) of all patients. This proportion was higher in patients with moderate brain injury (28.91%) as compared to severe brain injury (12.50%). Brain edema was the commonest finding on CT (266, 76%), followed by brain contusions (161, 46.00%) and skull fractures(136,38.85%). Traumatic subarachnoid hemorrhage or intraventricular hemorrhage and compressed or absent basal cistern present in 126(36%) and 39(11.14%) patients, respectively. Extra dural hematoma and subdural hematoma was present in 32(9.14%) and 46 (13.14%) cases respectively. Counter coup injuries were noted in 10.57% cases and midline shift was present in 32 (9.14%) patients.

Outcome(s)

Most of the patients (322, 92%) were managed conservatively and the main indications for surgery were acute subdural hematomas, extradural hematomas, cerebral contusions, compound depressed fractures and severe cerebral edema. Table No 3 gave the description about outcomes in overall, severe, and moderate TBI patients. Total 95(27.14%) patients died in hospital, and in-hospital mortality rate was higher in severe TBI (51.78) as compared to moderate (22.44%). The functional outcome according to the GOS at 3 months post admission was available in 198 patients and 152 patients were lost to follow-up. Major life-saving surgeries were performed in 28(8.00%) patients, among these 6 (21.42%) patients died. 4 patients (14.28%) were severely disabled, and rest all 18 (64.28%) had a good recovery. Among 322 conservatively managed patients, good recovery (independent for day-to-day activities) was seen in 217 (67.39%), mild disability was seen in 12(3.72) patients and severe disability (dependent for day-to-day activities) was seen in 4 (1.24) of the patients.

Table 1:Demographic and clinical characteristics at admission

Variables	Overall (3≤GCS≤12)(n=350)	Moderate (8≤GCS≤12) (n=294)	Severe (3≤GCSs≤8) (n= 56)
Age (years)	35.02 ± 16.28(5-90)	34.56±15.78 (5-90)	36.16±17.78 (5-90)
Sex (male/female)	280(80) /70(20)	246(83.67) /48(16.32)	44(78.57) /12(21.42)
GCS eye opening response			
No eye opening (1)	254(72.57)	207(70.40)	47(83.92)
Eye opening to pain(2)	38(10.85)	31(10.54)	7(12.50)
Eye opening to verbal command(3)	46(13.14)	44(14.96)	2(3.57)
Eye opening spontaneously(4)	12 (3.42)	12(4.08)	0(0.00)
GCS verbal response			
No verbal response(1)	303(86.57)	266(90.47)	37(42.85)
Incomprehensible Words (2)	32(9.14)	17(5.78)	15(39.28)
inappropriate words (3)	10(2.85)	7(2.38)	3(7.14)
Confuse (4)	3(0.85)	2(0.68)	1(1.78)
Oriented (5	2(0.57)	2(0.68)	0(0.00)
GCS motor response			
No motor response (1)	36(10.28)	36(12.24)	0(0.00)
Extension to pain (2)	61(17.42)	61(20.74)	0(0.00)
Flexion to pain (3)	24(6.85)	24(8.16)	0(0.00)
Withdrawal from pain (4)	49(14.00)	45(15.30)	4(7.14)
Localizing pain (5)	163(46.57)	126(42.85)	37(66.07)
Obeys commands (6)	17(4.85)	2(0.68)	15(26.78)
Causes of injury			
RTA	265(75.71)	217(73.80)	48(85.71)
Assaults	93(26.57)	72(24.48)	21(37.50)
Fall	10(2.85)	8(2.72)	2(3.57)
Others	20(5.71)	16(5.44)	5(8.92)
Polytrauma	85(24.28)	74(25.17)	13(23.21)
Loss of consciousness	198(56.57)	161(54.76)	37(66.07)
Vomiting	147(42.00)	127(43.19)	24(42.85)
ENT bleeding	77(22.00)	56(19.04)	21(37.50)
Seizures present	21(6.00)	16(5.44)	5(8.92)
Papillary reactivity			
Both	260(74.28)	235(79.93)	25(44.64)
One	59(16.85)	42(14.28)	17(30.35)
None	31(8.85)	17(5.78)	14(25.00)
Limb movement			
B/L well	260(74.28)	212(72.10)	48(85.71)
LT > RT	25(7.14)	21(7.14)	4(7.14)

RT< LT	24(6.85)	22(7.48)	2(3.57)
UL>LL	3(0.85)	3(1.02)	0(0.00)
LL>UL	3(0.85)	2(0.68)	1(1.78)
Absent bilaterally	35(10.00)	34(11.56)	1(1.78)

Data are expressed in mean ± SD(range)/median(Q1-Q3)(range) or frequency (%).Q1-Q3:25-75thpersentile, BL:Bilateral,LT:Left,RT:right,Ul:upperlimb,LL:lower Limb, GCS: glassgow coma scale, RTA : Road traffic accident.

Table 2 : Age distribution and causes of cranio-cerebral injuries (column %)

Age group(In years)	RTA	Assault	Fall	Others	Total
01-10	08(3.49)	29(32.95)	00(0.00)	01(4.76)	38(10.85)
11-20	29(12.66)	08(9.09)	01(8.33)	02(9.52)	40(11.42)
21-30	78(34.06)	18(20.45)	04(33.3)	05(23.80)	105(30.00)
31-40	55(24.01)	10(11.36)	02(16.66)	05(23.80)	72(20.57)
41-50	32(32.00)	12(13.63)	02(16.66)	05(23.80)	51(14.57)
51-60	15(13.97)	06(6.81)	01(8.33)	01(4.76)	23(6.57)
61-70	06(2.62)	03(3.40)	01(8.33)	01(4.76)	11(3.14)
Above 70	06(2.62)	02(2.27)	01(8.33)	01(4.76)	10(2.85)
Total	229(65.42)	88(25.14)	12(3.42)	21(6.00)	n=350(100%)

Table 3: Physiological characteristics and computed tomography scan findings at admission

Variables	Overall (3<GCS <12)) (n= 350)	Moderate (8<GCS <12) (n=294)	Severe (3<GCSs<8)) (n=56)
Respiratory rate(b/m)	19.01± 4.47(5-40)	19.07± 4.21(7-40)	19.00± 4.55(5-40)
Pulse rate(b/pm)	97.55± 21.88(46-200)	94.78± 21.12(48-182)	97.93± 21.88(46-200)
Temperature	98.6± 0.73(94.2-104.6)	98.66± 0.49(97-102)	98.7± 0.72(94.2-104.6)
SBP (mm Hg)	124.86± 25.01(30-240)	122.01± 21.02(30-220)	126.01± 25.70(48-240)
DBP (mmHg)	79.28± 14.52(26-140)	78.01± 12.01(40-130)	77.9.0±12.61(36-130)
Hypotension (present0	92(26.28)	85(28.91)	7(12.5)
CT finding Positive	320(91.42)	271(92.17)	49(87.50)
Midline shift (present)	32(9.14)	15(5.10)	17(30.35)
Midline Shift mm	7.64±4.10(0.5-25)	6.64±3.10(0.5-17)	8.14±4.20(0.5-25)
Fracture	136(38.85)	88(29.93)	48(85.71)
Mass effect present	106(30.28)	92(31.29)	14(25.00)
Contusion present	161(46.00)	127(43.19)	34(60.71)
Temporal contusion	57(16.28)	43(14.62)	14(25.00)
Occipital contusion	17(4.85)	12(4.08)	5(8.92)
Frontal contusion	33(9.42)	19(6.46)	14(25.00)
Parietal contusion	42(12.00)	31(10.54)	11(19.64)
Cerebellar contusion	12(3.42)	07(2.38)	05(8.92)
Sub dural hematoma	46(13.14)	32(10.88)	14(25.00)
Epidural hematoma	32(9.14)	28(09.52)	4(7.14)
Brain edema	266(76.00)	221(75.17)	45(80.35)
Basal cistern affected	39(11.14)	26(8.84)	13(23.21)
tSAH/IVH	126(36)	108(36.73)	18(32.14)
Diffuse axonal injury	57(16.28)	50(17.00)	07(12.50)
Mortality	95(27.14)	66(22.44)	29(51.78)

Data is expressed in mean ± SD Frequency(%),SBP:Systolic blood pressure, DBP: Diastolic blood pressure, b/m; breaths per minute, b/pm: beats per minute,MLS:Midline shift,tSAH:Traumatic subarac-hnoid hemorrhage,IVH: Intraventricular hemorrhage, SD: standard deviation,CT:computed tomography.

Discussion

About 100,000 lives are lost every year with over 1 million suffering from serious TBIs in India.[10] In this descriptive study, the clinical relevance of findings, identification of risk factors and CT imaging were analyzed. The current study is conducted in a tertiary care hospital in rural set up in Maharashtra, Govt. Medical College Dhulethat provides medical service to main city and surrounding villages and districts.

Age

In present study about three fourths of patients were in 3rd-5th decades belonging to the financially productive age group of life.TBI involved mainly young adults and majority of the cases (30.00 %%) were in age group of 21-30 years, followed by 31-40years (20.57%), and 41–50 years(14.57%). The mean reported age of TBI cases was 35.02 years (34.56 years in moderate TBI and 61.16 years in severe).Mean age was as similar as various published Indian studies. [4, 11, 12]

Gender

Male to female ratio was 4:1. Male gender was at more risk to sustain TBI in our study population. Bharti et al.also similarly reported 85% incidence in males and male to female ratio of 4:1.[13] It has been reported in both foreign and Indian literature that among TBI patients majority were male.[14-21]

Mode of injury

In our study, RTAs constituted the most common cause of TBI. Many of the studies have reported RTA as the leading cause of TBI. Bharti et al. also reported that RTA was the mode of TBI in 64% of the patients. [13] In literature, RTA was reported as the major cause of TBI (ranging from 55% to 72%). [22-27] Moderate and severe injury mostly affected young men and mostly due to RTAs.[4,11] Our study indicated that road traffic injuries are the leading cause of moderate and severe TBIs. Similar finding reported in various parts of the country as well as in other parts of the world. [4, 10, 28, 29, 30]

Severity of injury

Severe and moderate TBI victims were 56 (16.00%) and 294 (84.00%) respectively. Low GCS at admission was associated with poor outcome. This finding is similar to many other reports from India and other countries. [2, 12, 29, 31] Conventionally we assessed the severity of TBI by GCS score. Yet, researchers historically are not having unanimous opinion on the positive predictability of GCS

on outcome analysis as it does not follow a normal distribution. [32, 33]

Type of vehicle

Most of the incident victims were motorcycle riders (skid and fall) followed by motor vehicle drivers and pedestrian injuries These findings were similar to the findings reported in other studies.[25,34,35]Studies reported that pedestrians and motorcyclists are the most frequent victims of RTAs in India. By 2050, India will have the largest number of automobiles on the planet, leaving behind the United States. [31]

Time of TBI

Majority of moderate or severe TBIs recorded during 1800–2400 hours. As the majority of these injuries were due to RTA, it could be due to alcohol influence, greater speeds, poor road condition and poor visibility factors. Other studies also reported majority of TBI during 5-9PM probably these are the peak traffic hours in cities. [18,35,36,37].

Abnormal CT findings

Abnormal CT finding were present in 320(91.42%) cases. Brain edema was the commonest finding on CT 266(76%), followed by brain contusions 161(46.00%) and skull fractures136 (38.85%). Extra dural hematoma and subdural hematoma was present in 32(9.14%) and 46(13.14%)cases respectively.Traumatic subarachnoid hemorrh-age or intraventricular hemorrhage and compressed or absent basal cistern present in 126 (36%) and 39(11.14%) patients respectively. Counter coup injuries were noted in 37(10.57%) cases and midline shift was present in 32(9.14%) patients. A study from coastal Andhra Pradesh also reported fracture skull in 40.1% cases. [39] Studies have reported 34 to 35% of skull fractures among TBI patients.[20,38] Several indian studies have reported cerebral contusions ranging from 21 to 53% [19,22,39,40], high percentage of SDH ranging from 50 to 90% and about 10 to 20% EDH. [22,41,42]

Operative and conservative management

Most of the patients 322 (92%) were managed conservatively and the main indications for surgery were acute subdural hematomas, extradural hematomas, cerebral contusions, compound depressed fractures and severe cerebral edema. Majority of patients were managed by conservative means, usually directed at reducing intra cranial pressure. Bholeanil et al managed 81% cases conservatively and only 19% cases required surgical intervention mainly for significant intracranial hematomas and compound fractures. [43] In the present study, major life-saving surgeries were performed in 28(8.00%) patients only. Neurosurgeon was available for short period, non availability of good neurosurgery set up are the reasons. These hurdles restricted us in operative management but several other Indian studies reported surgical intervention (craniotomy) in 37–67% of cases. [44,45,46,47]

Associated injuries

In our study nearly one fourth of TBI patients 85(24.28%) had associated injuries. Extremities (14.4%), chest (7.20%) and spine (2.8%) were involved in these cases.

Outcomes

Overall, 95(27.14%) patients died in hospital, and in-hospital mortality rate was higher in severe TBI 29(51.78%) as compared to moderate 66(22.44%).The functional outcome according to the GOS at 3 months post admission was available in 198 patients and 152 patients were lost to follow-up. Major life-saving surgeries were performed in 28(8.00%) patients, among these 6(21.42%) patients died. 4 patients (14.28%) were severely disabled, and rest all 18 (64.28%) had a good recovery. In a study from trauma centre in Delhi Chandra Shekhar et al [8] reported out of all 90 (11%) cases were operated and mortality of 17 (18.89%) patients. In this study among 322 conservatively managed patients, good recovery (independent for day-to-day activities) was seen in 217 (67.39%), mild disability was seen in 12(3.72%) patients and severe disability (dependent for day-to-day activities) was seen in 4(1.24%) of the patients.

Need of good care

Prompt treatment of head injuries involves immediate GCS, radiological evaluation, surgical intervention and intensive care in all appropriate cases, as the first few minutes are crucial for the final outcome. In India, 95% of trauma victims do not receive optimal care or proper management during the "golden hour" period after an injury takes place and half of those who die from TBI do so within the first 2 h of injury in our country**. [**10] Availability of early and appropriate care after an injury is a major determinant in avoiding secondary injuries and death.

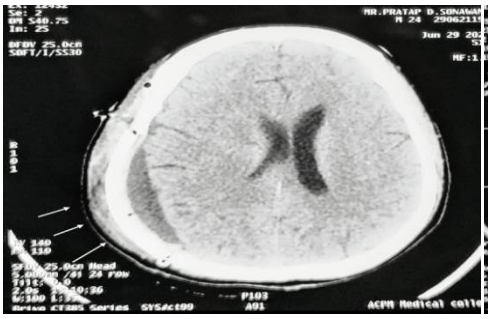


Fig 1: Right Parietal crescent shaped hypo density suggestive of chronic subdural hematoma with right parietal bone fracture with midline shift with overlying subcutaneous hematoma

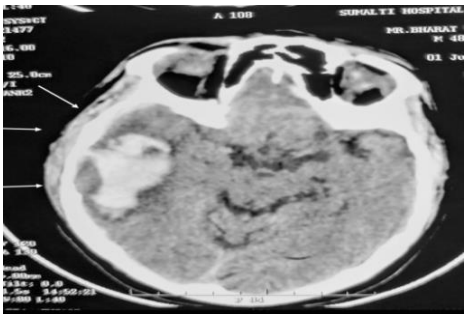


Fig 2: Right temporal parenchymal hematoma with surrounding edema

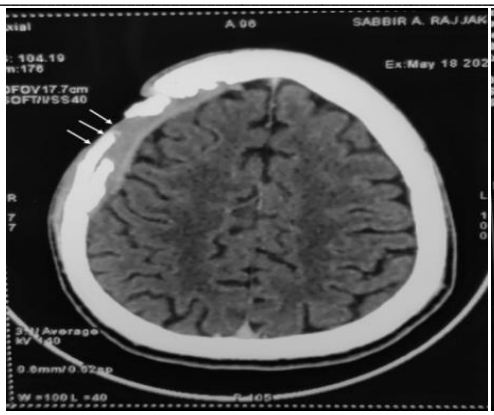


Fig 3: Right Frontoparietal multiple comminuted fractures with underlying subdural hematoma with pnematocoele

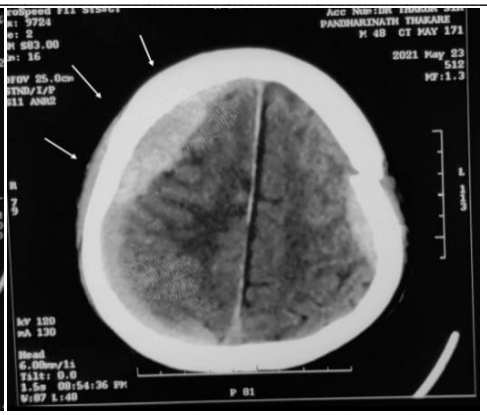
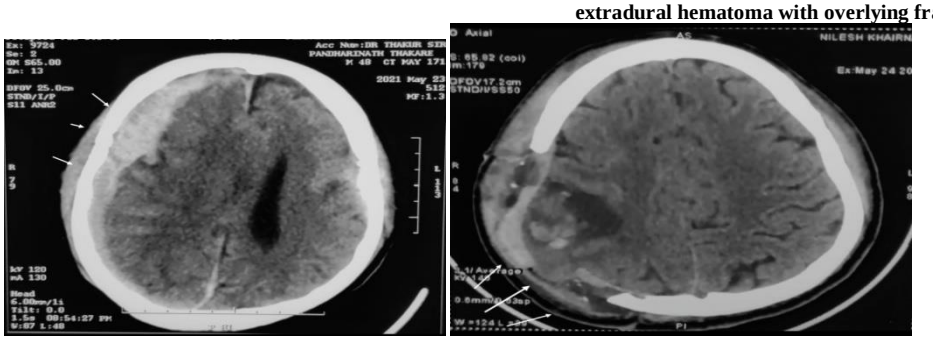


Fig 4: Right frontoparietal subdural hematoma diffusely extending over right convexicity with left sided parietal extradural hematoma with overlying fracture



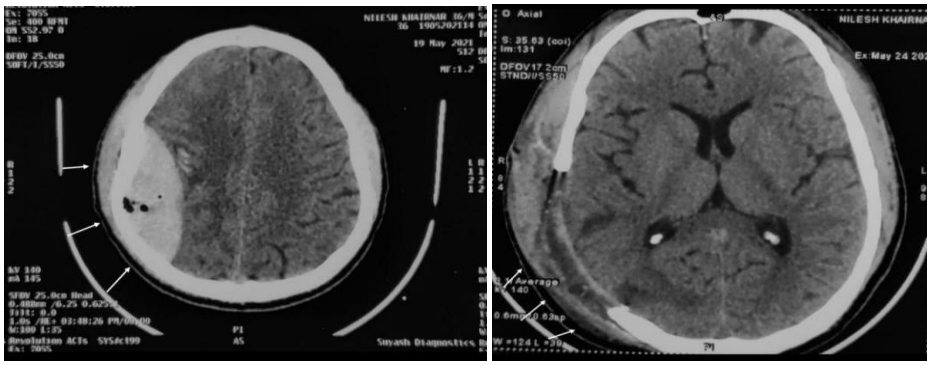
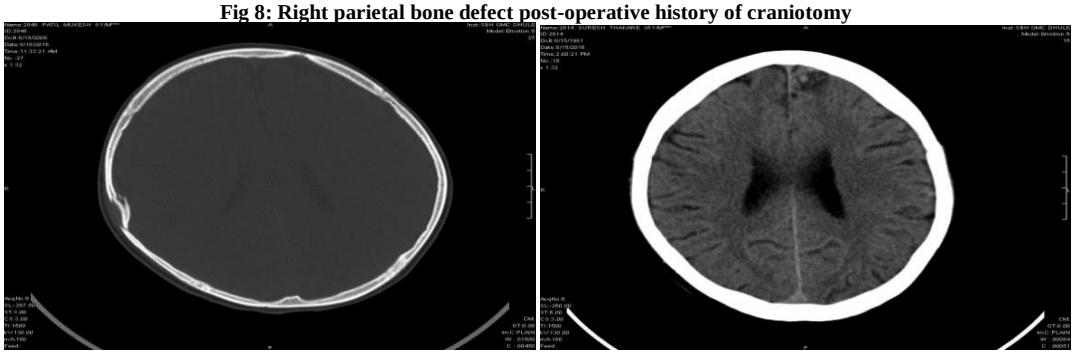


Fig 5: Right Frontoparietal subdural hematoma with left frantal cerebral contusion with midline shift from right to left

Fig 6: Right sided herniation of brain parenchyma through defect in parietal bone postoperative craneoctomy with pnemocephalus

Fig 7: Right Parietal biconvex hyperdense well marginated density suggestive of extradural hematoma with overlying parietal bone fracture with pnemocephalus with RT Parietal cerebral contusion

Fig 8: Right parietal bone defect post-operative history of craniotomy



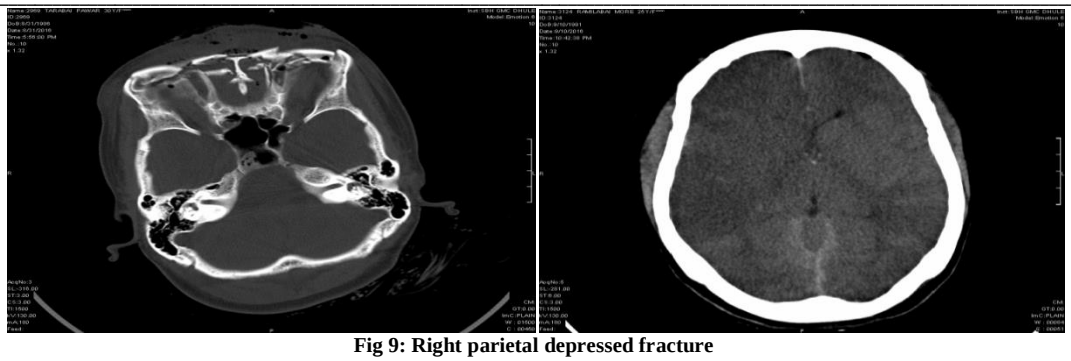


Fig 9: Right parietal depressed fracture
Fig 10: Left frontal cerebral contusion
Fig 11:Bilateral frontal bone multiple fractures
Fig 12: Diffuse brain edema

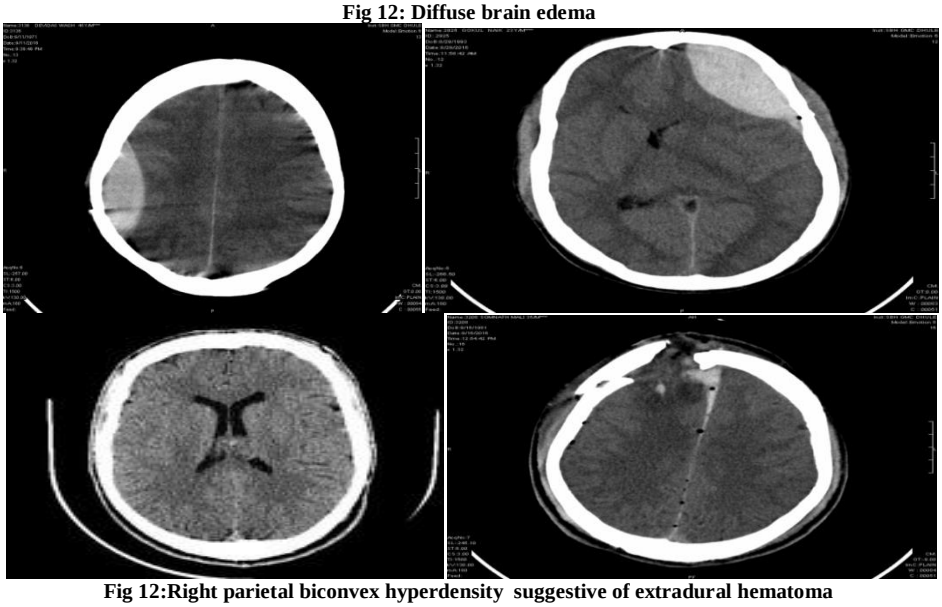
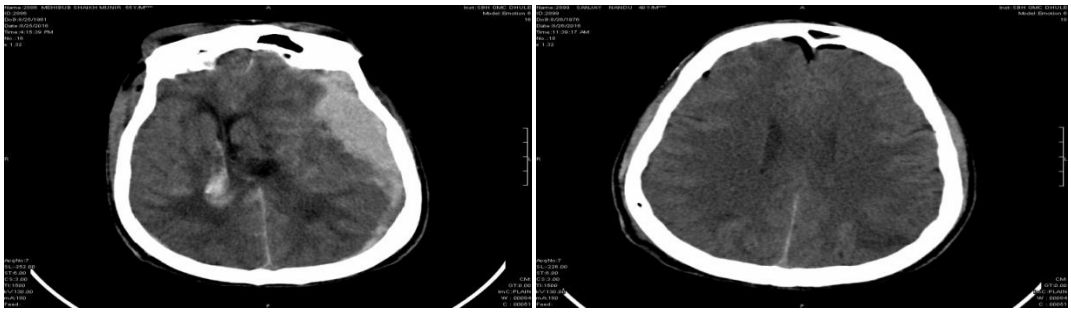


Fig 12:Right parietal biconvex hyperdensity suggestive of extradural hematoma
Fig 13:Left frontal extradural hematoma with midline shift from left to right
Fig 14: Diffuse axonal injury with thalamic and corpus callosum hemorrhage.
Fig 15: Right frontal bone fracture with subarachnoid hemorrhage with right frontal cerebral contusion with pnematocoels



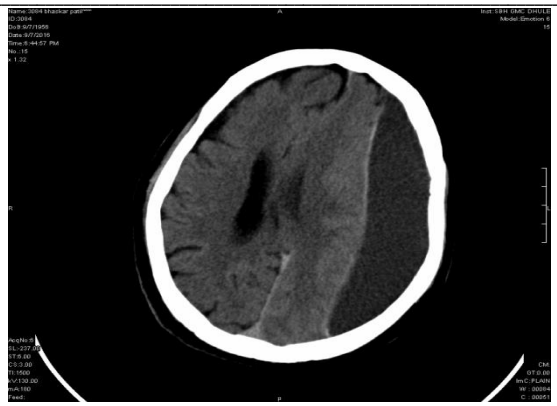


Fig 16: Left subdural hematoma with subarachnoid hemorrhage with midline shift
Fig 17:Bilateral frontal pneumocephalus
Fig 18: Left subdural hematoma with right midline shift

Conclusions

This descriptive study of cranio-cerebral injuries reveals that males outnumbered females four times and commonest in 3rd to 5thdecades of life. Majority cranio-cerebral injuries are due to road traffic accidents(63.42%)followed by assaults (26.57%) and falls(2.85%).Alcohol consumption influenced nearly one fourth of injured patients. The commonest victims were young male motorcycle riders. The commonest vehicles were two wheelers and the most common mechanisms of accident was fall after skid and collision with other vehicle. On CT findings cerebral edema was most common, followed by cerebral contusion, skull fracture, SAH/IVH, SDH and EDH. Death was reported among 27.14% of patients. Cranio-cerebral injuries have high rates of mortality and morbidity. The total number of radiologists and neurosurgeons are inadequate even to provide uniform minimum basic neurosurgical facilities. Radiologist, Neurosurgeons and infrastructure is the need of the hour at each district hospital. It is expected that this shortfall will soon be overcome. Our services should be universally available to anyone, anytime and anywhere.

Recommendations

•Neurosurgeons and radiologists are main pillars in management of cranio-cerebral injuries. Services of these specialties are a need of hour and should be made available at every district hospital in Maharashtra.

•High end CT machines, well equipped ICU's and trauma units are real need at present and will be always. So its availability should be on top priority in health administration at state and national level.

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