

CT SCAN FINDINGS IN MILD HEAD TRAUMA

A series of 2,000 patients

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ABSTRACT - The present study describes the cranial computed tomography (CT) scan findings of 2,000 cases of mild head trauma (HT) in Curitiba, Southern Brazil. The mean age of the entire series was 30.8 ± 19 years. The overall male to female ratio was 2:1. The most common causes of head injury were interpersonal aggression (17.9%), falls (17.4%), automobile accidents (16.2%), falls to the ground (13.1%) and pedestrian injuries (13%). Alcohol intoxication was associated with HT in 158 cases (7.9%). A normal CT scan was seen in 60.75% (1215) and an abnormal CT scan in 39.25% (785) of patients. Out of 785 abnormal CT scan, 518(65.9%) lesions were related to HT. The most common CT scan HT related findings were: soft tissue swelling (8.9%), skull fractures (4.3%), intracranial and subgaleal hematomas (3.4% and 2.4%), brain swelling (2%) and brain contusion (1.2%). Out of 785 abnormal CT scans, 267 (34.1%) lesions were not related to head trauma. Incidental CT scan findings included brain atrophy (5.9%), one calcification (5.2%) several calcifications (2.4%) (probably neurocysticercosis in most cases), ischemic infarct (1.9%) and leukoaraiosis (1.3%). These findings showed the importance of CT scan examination in mild head injuries. Further studies to identify mild HT patients at higher risk of significant brain injury are warranted in order to optimize its use.

KEY WORDS: head trauma, epidemiology, computed tomography, alcohol abuse.

Achados tomográficos no trauma cranioencefálico leve: análise de 2000 casos

RESUMO - São descritos os achados de tomografia computadorizada craniana (TC) de 2000 casos de trauma cranio-encefálico (TCE) leve em Curitiba, Paraná. A idade média de toda série de pacientes foi $30,8 \pm 19$ anos. A razão homem/mulher foi 2:1. As causas mais comuns de TCE foram agressão interpessoal (17,9%), quedas de nível (17,4%), acidentes automobilísticos (16,2%), queda ao solo (13,1%) e atropelamento (13%). Intoxicação por álcool foi um importante fator associado ao TCE e esteve presente em 158 casos (7,9% de 2000 pacientes). Uma TC normal ocorreu em 60,75% (1215) e uma TC anormal em 39,25% (785) dos pacientes. Das 785 TC anormais, os achados tomográficos mais comuns relacionados ao TCE foram: aumento de partes moles (8,9%), fraturas de crânio (4,3%), hematoma intracraniano e subgaleal (3,4% e 2,4%), "swelling" cerebral (2%) e contusão cerebral (1,2%). Os principais achados incidentais das TC anormais foram: atrofia cerebral (5,9%), uma calcificação (5,2%), múltiplas calcificações (2,4%), lesões isquêmicas vasculares (1,9%), leucoaraiose (1,3%). Achados mais incomuns foram calcificação de gânglios da base (0,8%), lesão ocupando espaço-neoplasia (0,4%) e cisto aracnóideo (0,5%). Estes achados mostram a importância da TC no TCE leve. Estudos para avaliar pacientes com TCE leve e com alto risco de lesão cerebral significativa são ainda necessários para otimizar o uso da TC.

PALAVRAS-CHAVE: trauma craniano, epidemiologia, tomografia computadorizada, alcoolismo.

Trauma is the leading cause of death in children and young adults, and head trauma is the cause of death in more than 50% of trauma patients¹. More than 100,000 Brazilians, the majority between 5 and 40 years of age, lost their lives each year due to external causes², akin to what happens in other Western Countries and USA, where injuries are also the leading cause of death under 45 years³. In Curitiba, external causes were observed in 1251 deaths/year⁴.

Head trauma (HT) is any injury that cause lesion

or functional damage of cranium, meninges and brain. It is the most frequent lesion seen in trauma related-death⁵.

A CT scan is probably recommended for all patients with mild head injury because one in five will have an acute lesion detectable by the scan⁶. The present study describes the profile of head injury in Curitiba, depicting causal factors, age and gender distribution, and CT scan findings related to head trauma.

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METHOD

From September 1996 to June 1999, we prospectively registered all cases of mild head trauma (Glasgow Coma Scale score of 13,14,15), who were assisted at Emergency Services of two referral Hospitals for trauma in Curitiba: Hospital Evangelico and Hospital Cajuru. Curitiba is a 1,550,317 people city in Parana State, southern Brazil (Latitude 25° South, longitude 49° W-GR). Only the first CT-scan performed in each patient was analyzed. Most patients reported loss of consciousness, though the time length could not be reliably retrieved in a few cases. Regarding cause of trauma, falls were considered in all patients who suffered fall from a higher level from ground. Direct trauma was defined as having the head struck by an object (e.g. stone, piece of wood, ball), and excludes cases of interpersonal aggression.

RESULTS

One thousand three hundred and six (67.3%) patients were male and 654 (32.7%) were female

(sex ratio M:F=2:1). Ages ranged from some days of life to 98 years, with a mean age of 30.5 ± 19 years. The mean age \pm standard deviation (SD) of males and females patients were 30.2 ± 22.2 and 30.2 ± 17.2 years, respectively. The highest frequency of HT occurred in the 21-30 years interval (25.1%), followed by the age groups 11-20 (21.6%) and 31-40 (17.5%) (Fig 1).

The most common causes of head injury were aggression (17.9%), falls (17.4%), automobile accidents (16.2%), falls to the ground (13.1%) and pedestrians injuries (13%) (Fig 2). The medium age for each group of causes varied from 21 to 44 years. There was a pronounced difference in the distribution of causes according to age and gender (Table 1).

Fall to the ground was the most frequent cause of HT associated to alcohol abuse (17.6%), followed by aggression (12.3%) and motorcycle accidents (9.4%) (Fig 3).

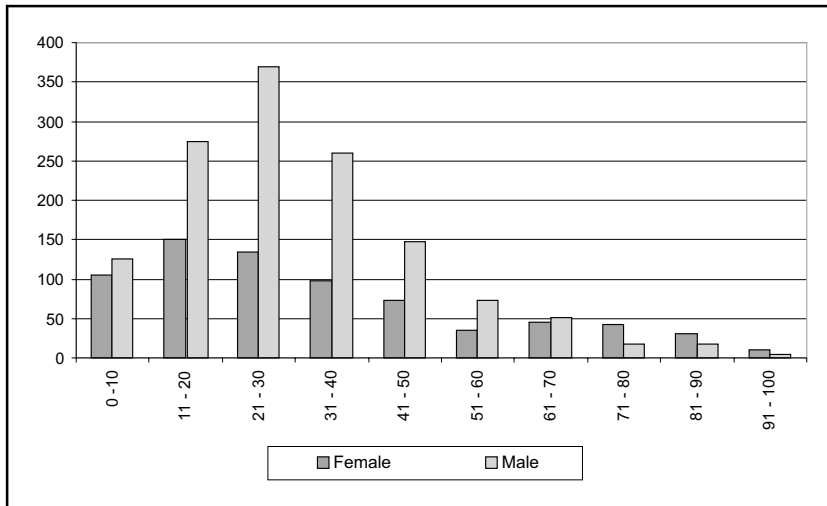


Fig 1. Age distribution per decade in 2,000 HT patients.

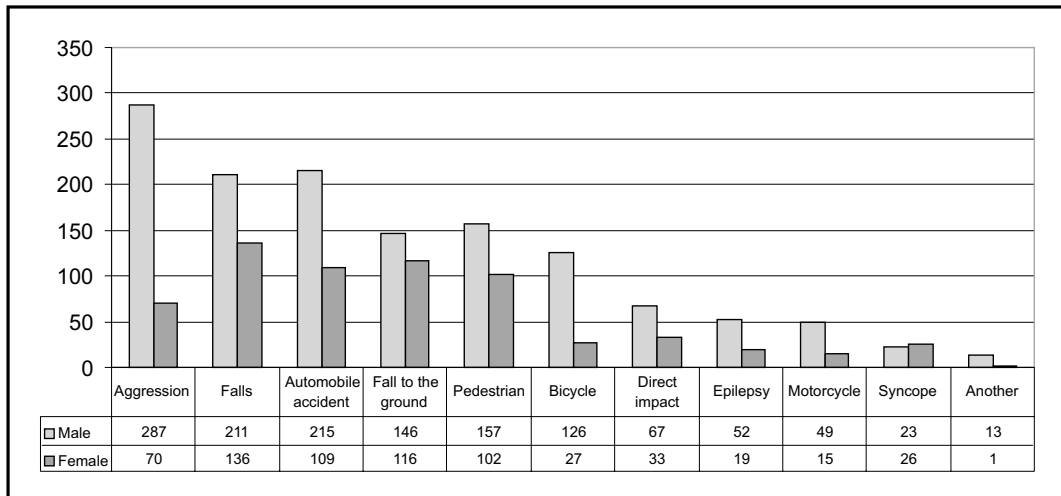


Fig 2. Causes of trauma, distributed by gender.

Table 1. Causes of HT according to age and gender.

Type of accident	Number	Age (mean±SD) years	Sex ratio (M:F)
Aggression	357	30.5 ± 13.0	4.1:1
Falls	347	27.9 ± 20.4	1.6:1
Automobile	324	29.2 ± 13.4	2.0:1
Fall to the ground	262	44.6 ± 25.9	1.3:1
Pedestrians	259	28.4 ± 19.1	1.5:1
Bicycle	153	21.5 ± 12.1	4.7:1
Direct impact	100	26.1 ± 17.7	2.0:1
Epilepsy	71	37.9 ± 16.1	2.7:1
Motorcycle	64	25.6 ± 9.4	3.3:1
Syncope	49	42.3 ± 21.7	1:1.1

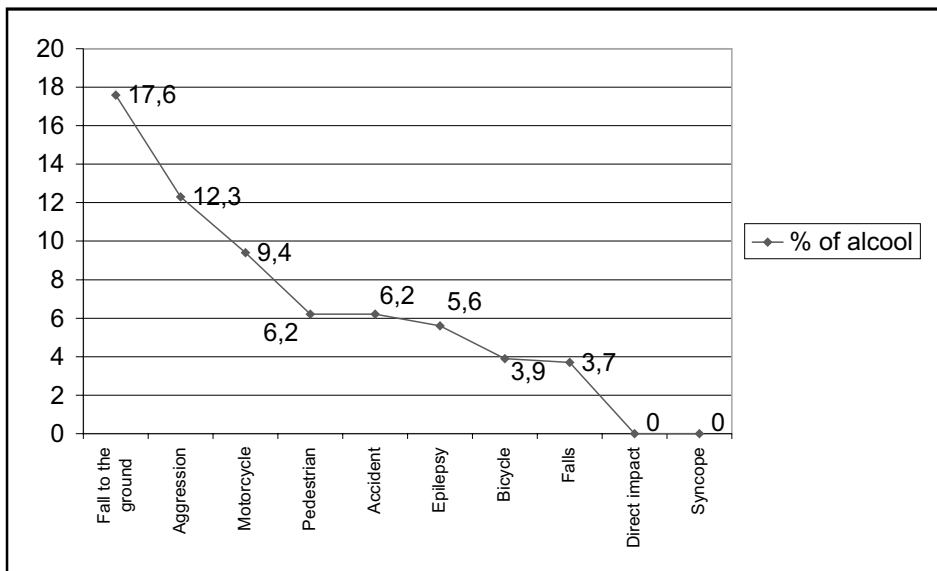


Fig 3. Percentage of excessive alcohol intake and related forms of HT.

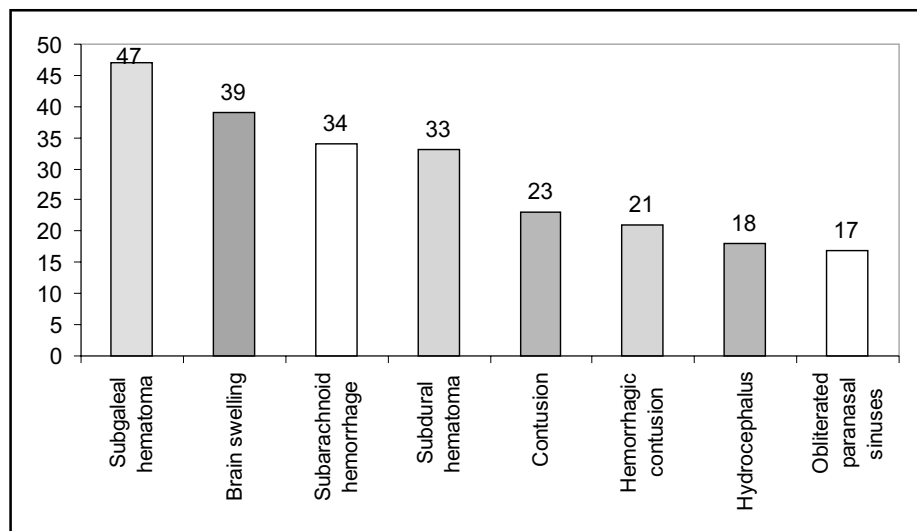


Fig 4. CT scan findings related to HT in 2,000 patients.

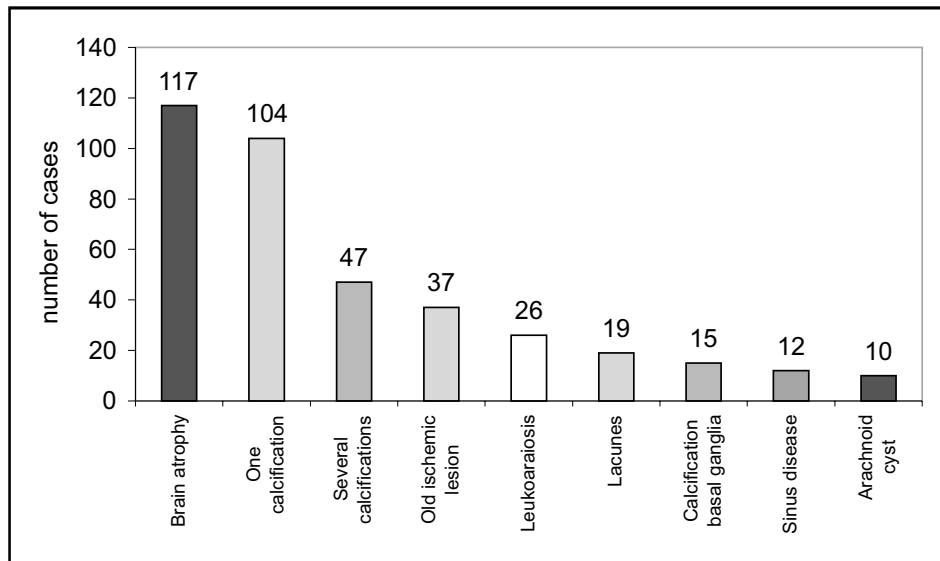


Fig 5. Distribution of incidental findings.

Of 2,000 patients studied, 518 (25.9%) had 14 different lesions related to HT detected on CT scans. Soft tissue swelling was the most common finding (178), followed by fractures (86) (Fig 4). Fractures included facial fractures, skull base fractures, vault skull fractures, both lineal and depressed ones. Figure 4 shows the different CT scan findings and their respective numbers. Ventricular dilatation and epidural hematoma were observed in 2 and 7 cases respectively. Obliterated paranasal sinuses and pneumocephalus were present in 17 and 8 victims, respectively.

Twelve different lesions not related to HT were present in 267 patients (13.3%) out of the total 2,000 patients. The most common incidental findings included brain atrophy, calcifications, vascular ischemic lesion, lacunes, leukoaraiosis, sinus disease and arachnoid cyst (Fig 5). Other findings were gliosis (7 cases), space-occupying lesion (7 cases), and active neurocysticercosis (3 cases).

DISCUSSION

Head injury is a major world health problem. Several reports point automobile accident as the most important cause of HT. Motor vehicle accident causes HT about 35% to 60% in diverse series, and is usually a leading cause of serious injuries with head trauma in youth and middle age people and a common cause of morbidity and mortality related to trauma⁷. They are also the most frequent cause of death in individuals from 1 to 35 years of age^{8,9}. Previous studies of head trauma in the United States demonstrated traffic accidents accounting for about half the fatal cases^{10,11}. Other series show automobile acci-

dents as a major cause of HT. In Massachusetts, USA, 33.4% of causes were related to automobile accidents¹². In our series, we only observed 16.2% of automobile accidents in mild HT. Automobile accidents may be less common in low socioeconomic populations due to limitation of owning a car. In fact, a study of Taiwan did not find very significant figures for automobiles, because motorcycle is the most common means of transport in that country⁷.

Our findings are thus not in keeping with the above mentioned literature, for aggression, which includes assaults and firearms injuries, were the commonest cause of HT (17.9%). Assault, one form of aggression, is a common cause of head injury in some places, particularly in economically depressed, densely populated urban areas³. Alcohol abuse also contributes with higher rates of aggression. In fact, it was present in 12.3% of all aggressions in our series. A study from Scotland found 20% of HT causes related to assault³. In Chicago¹³ and Massachusetts¹², 40% and 24.9% (respectively) of mild HT were caused by assaults. In the Bronx¹⁴, assault was the leading cause of head injury, but overall in the United States it accounted for only 10%³. Steven et al.³² found interpersonal attacks (aggression) responsible for the largest proportion (40%) of head injuries in Blacks in an inner city community of Chicago. The authors again raised the possibility of socioeconomic status as an important factor related to HT in different communities^{15,16}. Therefore, socioeconomic factors may play a major role leading to higher prevalence of aggression observed in Curitiba. It is interesting to observe the correlation of excessive alcohol intake with aggression, as already commented.

Falls are second only to motor vehicle accidents among unintentional traumatic causes of death in all ages¹⁷. A study from Scotland³ found 39% of HT related to falls, in Chicago (29%)¹³ and in Massachusetts (30.5%)¹². Our series observed falls as the second cause of HT (17.4%). The higher percentage of falls in those series may be due to the separation between of falls and falls to the ground we made in our series. If we combine both conditions, we come with 30.45% of HT as caused by falls, a similar proportion observed in other countries.

Among elderly people, falls are particularly important as causal factor of morbidity and mortality. In Massachusetts, a retrospective case series of 318 patients aged 60 years and over, falls causing HT were seen in 189 patients (59%)¹⁸. In our study, falls reached an overall proportion of 17.35%, and the falls to the ground represented 13.1%. Taking in account only patients aged 60 years and older, we also found a high proportion of falls (58.5%) as a major cause of HT in the elderly.

Although not very well documented, many falls in adults are related to alcohol. In our study, 17.6% of the falls to the ground were associated with alcohol abuse. Nagurney et al.¹⁸ referred alcohol abuse in 11% of elderly falls. Our study did not find alcohol abuse in elderly falls. As a matter of fact, the rate of alcohol intake in elderly falls is quite variable, ranging from 2% to 34%¹⁹.

Motorcycle or injured pedestrians are less frequent causes of HT (5-10%)^{20,21}. Nevertheless, in Taiwan the most common causes of head injury were motorcycle accident (53.6%) and pedestrian injuries (29.47%), since motorcycle is the most common means of transport in that country⁷. Sallum and Koizumi²², in a study of 220 injured patients in traffic accidents (TA) in São Paulo, identified the following TA types: 50.46% pedestrians, 37.73% automobile, and 11.81% motorcycle. Our study showed similar proportion of types of TA causing HT: pedestrians (50.1%), automobiles (40%), and motorcycle (9.9%). We observed alcohol intoxication in 9.4% of motorcyclists and in 6.2% of pedestrians.

There is increasing awareness of the importance of bicycle accidents, which are particularly common in children^{23,24}. In this study there is a high frequency of bicycle accidents (7.7%), probably related to the frequent use of bicycle by Brazilians, mainly during the second and third decade of the HT population (63.4% of all bicycle accidents). We observed alcohol intoxication in 3.9% of the cyclists, although in

San Diego over half the brain injured cyclists over 15 years-old were intoxicated²⁴. These differences may reflect biases of selection or of data retrieval.

Alcohol is an important contributory cause of injury. Its influence is best documented by automobile accidents, especially drivers³, since alcohol intoxication is more thoroughly investigated in such situation. In our series, alcohol abuse was present in 7.9% of the all HT cases. This relatively small fraction may be due to the smaller number (16.2%) of automobiles accidents causing HT in Curitiba. Notwithstanding, Schackford et al⁶ found that 28.2% of all HT victims were drunk, but more than half of their 2,766 HT patients suffered accidents with vehicles motors. This could explain the larger proportion of alcohol intoxication in that series, since the screening for alcoholic intake is more systematic in these accidents.

The mean age in HT causes was relatively low in our series. For example, in Taiwan⁷, the mean age in different HT groups were: motorcycle - 32.6 years, pedestrians - 32.5 years, automobile - 32.8 years, and fall - 34.5 years (Table 1). It can be explained for higher rate of smaller ages in Brazil. A statistics database observed that 35% of Brazilians were below 14 years old²⁵.

In our series, men were more prevalent than women in all groups of HT causes, except syncope, where women presented a slightly higher frequency (F:M ratio = 1.1:1) (Table 1). In fact, another series²⁶ presented also a higher F:M ratio (1.51:1).

Cranial CT-scan is the most frequently performed radiological investigation in developed countries¹⁸. Stein and Ross recommended routine and immediate cranial CT scanning of all head injury patients who have lost consciousness and were amnesic, even if all other physical findings were normal²⁷. They reported a high risk of intracranial lesions (12.9%) in mild head injury²⁸. In subsequent prospective studies of mild HT, the frequency of intracranial lesions on CT-scan was lower (6 to 9%)^{29,30}. Haydel et al. identified patients with mild HT who should undergo CT-scan based on clinical findings and, thus, did not recommend CT-scan in all patients with mild HT³¹.

In our series, 518(25.9%) out of the 2,000 patients presented CT-scan findings related to HT. Two studies observed 17.2%²⁷ and 18%³² of abnormal CT-scan in mild head trauma, numbers close to our observation. However, another study found a higher frequency (46%)⁶, but the authors included other non acute cranial and cerebral findings, what would

explain such discrepancy. On the other hand, Jeret et al.³³ found 9.4% of abnormality on the CT-scan, but they excluded lineal fractures and isolated soft tissue swelling. It's conceivable that methodological differences among those studies and ours may account for such different proportions.

Regarding lesion types, soft tissue swelling was the most common (178 cases - 34% cases out of 518 abnormal CT scans). Skull fractures were also important, accounting for 74 (14.3%) cases. In other reports, the rates of skull fractures were much lower (8.5% and 4.1%)^{27,33}. Only 2% of attenders at Scottish accident departments for recent head injury have a skull fracture³. But, Shackford et al.⁶ observed 19.3% of skull fractures, a number closer to our study.

Intracranial hematoma after HT is a frequent cause of death and disability. Expedient evaluation and adequate management of patients who initially seem at low risk are the most important factors to reduce their mortality³⁴. Among our HT patients, 21 cases (4.1%) presented intracerebral hematoma. Jeret et al.³³ found 10.4% of intracranial bleeding in his study with mild head trauma and GCS score of 15. However, his work excluded patients younger than 18 years. Focal lesions are less common in children with HT when compared to adults³⁵, what probably explains our lower number of intracranial hematomas (23.7%) of our patients were younger than 18-year-old. Stein and Ross²⁷ found 4.2% (11 cases) of intracerebral hematomas, 7 of them with skull fracture. In our study, only one case of intracerebral hematoma was associated with skull fracture.

Stein and Ross²⁷ found 6.8% of epidural hematoma (EH), 5.7% of subarachnoid hemorrhage (SAH), and 4.5% of subdural hematoma (SH). Our study showed similar numbers: 6.6% of SAH, 6.4% of SH, and 1.4% of EH.

Cerebral contusions were seen in 25%³³ to 26.8%²⁷. The present study showed lower numbers (12.9%). The other series^{27,29} only included patients with loss of consciousness or amnesia, therefore selecting patients at higher risk of intracranial injuries. Stein and Ross²⁷ obtained 30.9% for the brain swelling and the literature varied from 5%⁶ to 11%³⁷, and our study found a number between these extremes (7.5%). We had a lower frequency of pneumocephalus (1.5%), when compared to Shackford⁶(5.4%) and Feuerman et al. (13.2%)³⁶.

As expected, a vast majority of 2,000 HT patients did not demonstrate incidental CT findings. As a

matter of fact, the relative young age of our all cohort decreased the chance of revealing pathologic findings such as those related to age, in spite of having been the most common findings.

Katzman³⁷ found 18% of incidental findings on MRI of 1000 asymptomatic volunteers, a higher number when compared to our 13.3% on CT scan. This difference may be due to the higher sensitivity of MR imaging when compared to CT scan.

Age related changes occurred in 173 (8.7%) patients: brain atrophy (5.9%), ischemic vascular lesions (1.9%) and lacunes (1%). The small proportion of those findings are clue to the relative young age of our studied population (the vast majority between 10 and 50 year old).

One calcification (5.2%), several calcifications (2.3%) (probably mostly neurocysticercosis in our series) and basal ganglia calcification (0.8%) were not reported by Katzman³⁷. This is not surprising due to the relative low MR sensitivity to calcifications and the different epidemiological profile regarding the neurocysticercosis/taeniasis between the series. Other findings were leukoaraiosis (1.3%) and space-occupying lesion (0.4%)(0.5% in Katzman's work)³⁷.

We found ten patients (0.5%) with arachnoid cyst (AC) comparing with 0.3% in the literature³⁷. Other series³⁸ observed a higher prevalence of 1.4% of AC, probably because only neurological patients were included. Another report found five in 3000 consecutive fetal and neonatal autopsies, a much lower number³⁹.

In conclusion, our study showed the epidemic profile of the head trauma in the city of Curitiba, Brazil. Aggression and falls played a major role as causes of HT. Automobile accident still has a great importance. The prevalence of abnormal CT-scan findings did not significantly change according to the HT cause. Alcohol intoxication played a major role as an associated factor related to HT. The high prevalence of HT related CT findings probably justify the use of CT scan in mild HT. Further studies to identify which mild HT patients are at higher risk of significant cerebral injury are warranted in order to optimize its use.

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