ORIGINAL ARTICLE

Overview of Traumatic Brain Injury Patients at a Tertiary Trauma Centre

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ABSTRACT: ***Objective:*** The goal of this study was to provide a general descriptive and cognitive portrait of a population with traumatic brain injury (TBI) at the time of their acute care stay. ***Material and methods:*** Three hundred and forty-eight TBI patients were assessed. The following data were collected for each patient: age, level of education, duration of post-traumatic amnesia, Galveston Orientation Amnesia Test score, Glasgow Coma Scale score, results of cerebral imaging, Neurobehavioral Rating Scale score, the Functional Independence Measure cognitive score and the Glasgow Outcome Scale score. ***Results:*** The clinical profile of the population revealed a mean age of 40.2 (±18.7) and a mean of 11.5 (±3.6) years of education. Most patients presented with frontal (57.6%) and temporal (40%) lesions. Sixty-two percent had post-traumatic amnesia of less than 24 hours. Seventy percent presented with mild TBI, 14% with moderate and 15% with severe TBI. The cognitive deficits most frequently observed on the Neurobehavioral Rating Scale were in the areas of attention, memory and mental flexibility as well as slowness and mental fatigability. Most patients had good cognitive outcome on the Functional Independence Measure and scores of 2 and 3 were frequent on the GOS. Forty-five percent of the patients returned home after discharge, 51.7% were referred to in or out patient rehabilitation and 3.2% were transferred to long-term care facilities. ***Conclusion:*** Because of the specialized mandate of acute care institutions, the information provided here concerning characteristics of our TBI population is essential for more efficient decision-making and planning/programming with regards to care and service delivery.

RÉSUMÉ: Profil global et fonctions cognitives chez les traumatisés crâniens en soins actifs. ***But:*** Le but de cette étude est de présenter le tableau initial tant au plan descriptif que cognitif des traumatisés crâniens (TCs) lors de leur séjour dans un centre de soins actifs. ***Matériel et méthodes:*** 348 TCs ont été évalués. Les données suivantes ont été colligées pour chaque patient : l'âge, le niveau d'instruction, la durée de l'amnésie post-traumatique, le score au test d'orientation et d'amnésie de Galveston, le score à l'échelle de Coma de Glasgow (GCS), les résultats de l'imagerie cérébrale, le score à l'échelle neurocomportementale révisée (NRS), le score cognitif de la mesure d'indépendance fonctionnelle et le score à l'échelle de devenir (issue) de Glasgow (GOS). ***Résultats:*** La moyenne d'âge des patients était de 40,2 ans (± 18,7) et ils avaient en moyenne 11,5 années (± 3,6) d'instruction. La plupart des patients avaient une lésion frontale (57,6%) ou temporale (40%). Soixante-deux pour cent ont eu une amnésie post-traumatique de moins de 24 heures. Soixante-dix pour cent avaient subi un traumatisme crânien léger, 14% un traumatisme modéré et 15% un traumatisme sévère. Les déficits cognitifs les plus fréquemment observés selon le NRS étaient ceux de l'attention, de la mémoire et de la flexibilité mentale ainsi qu'un ralentissement psychomoteur et de la fatigabilité. La plupart des patients ont eu un bon rendement avec des scores de 2 et 3 au GOS. Quarante-cinq pour cent des patients sont retournés à la maison après leur congé de l'hôpital, 51,7% ont été référés en réadaptation (interne ou externe) et 3,2% ont été transférés dans un centre de soins de longue durée. ***Conclusion:*** Comme le mandat des centres de soins actifs est spécifique, les caractéristiques de notre série de TCs pourraient aider à la prise de décision et à la planification des soins et des services offerts à cette population.

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Traumatic brain injury (TBI) has become a significant problem of our modern society and is one of the most common causes of neurologic mortality and morbidity in adults younger than 50 years of age.[1] In Canada, and more specifically in the province of Quebec, there have been few studies on the incidence of traumatic brain injury. However, it is estimated at 200/1,000,000 in the province of Quebec alone.[2] According to Khan et al,[3] 25% of the trauma patients seen at the McGill University Health Centre-Montreal General Hospital (MUHC-MGH) have sustained a TBI. Moreover, the volume of TBI patients seen at this specific centre has recently increased from 5% to 12% per annum: 372 in 1998-1999 compared to 235 patients in 1993. Outcome and recovery for these patients have significant financial impact on our society[3] but, most importantly, they are of critical importance to the patient, their family as well as to the health care professionals involved in their treatment.

From a methodological point of view, most previous studies providing descriptive statistics on status and outcome of patients

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with TBI were carried out in postacute rehabilitation centres (intensive functional rehabilitation and community/vocational re-integration programs).[4] These studies were conducted several weeks, months or years after the injury.[5-7] Few studies on profiles or outcome have been conducted in an acute care setting (trauma centre) and even fewer have described cognitive status of TBI patients a few hours or days following their trauma.[8]

There are significant differences between the mandate of an acute care institution and that of a subacute rehabilitation centre. The severity of their respective caseload, general characteristics and cognitive profiles of the patients admitted are different. The mandate of the MUHC-MGH is to provide specialized and ultra-specialized services to trauma patients at the regional and supra-regional level. The aim of the TBI program at the MUHC-MGH, which has been described in detail by Khan et al[3] is to provide early rehabilitation services to adult TBI patients regardless of the severity of their TBI, to ensure continuity of care in order to enhance social reintegration potential as well as to facilitate adjustment of the family to the traumatic event and the patient's condition (seamless delivery of care from the Emergency Room (ER) to discharge home).

Involvement of the TBI program begins in the ER where the main focus of intervention is to properly assess and to stabilize the patient's medical condition as much as possible, in addition to offering information and support to families. Here, an intricate collaboration between the team's physicians, nurses and social workers is required. When the patient is transferred to intensive care or to the trauma floor, other members of the TBI program from physiatry, physiotherapy, occupational therapy, speech-language pathology, nutritional services and neuropsychology become involved and carry out detailed assessments in order to determine the patient's needs for early rehabilitation. Discharge planning begins early as the team determines the patient's rehabilitation needs which may include transfer to a rehabilitation centre, discharge home with or without community services and/or orientation to a long term care facility. Healthcare delivery within the integrated TBI programme of the MUHC-MGH[3] fosters a seamless continuum of care.

By contrast, a rehabilitation centre provides intensive and longer term treatment for physical, cognitive and psychological impairments and promotes social and professional reintegration. The patient is well enough at this point to actively and intensively participate in rehabilitation. It is to be expected that his cognitive, functional and neuropsychological status during the process of rehabilitation will be different from that during the first few days or weeks post-trauma. In fact, many authors have reported neuropsychological improvement between the time of injury and several weeks, months and years post TBI (in rehabilitation and postrehabilitation). In mild TBI patients, a return of functional and neuropsychological skills to normal levels was observed within one to three months after injury.[9-11] Cognition was also seen to improve within the first few months for patients with moderate and severe TBI.[12,13]

At the MUHC-MGH, all moderate and severe TBI patients are admitted. Mild TBI patients who present with a history of a recent trauma and a Glasgow Coma Scale (GCS) score of 13-15 are also admitted in our institution if one of the following is observed: positive CT of the brain with the presence of a traumatic injury, basal skull fracture, open skull fracture, past medical history of mild TBI with post-traumatic amnesia (PTA) of ≥60 minutes, post-traumatic convulsion, ≥3 episodes of vomiting, multiple complex facial fractures, mild TBI associated with other major traumatic injury, ie: orthopedic, abdominal, etc., age of 65 years or more and living alone, patient on anticoagulant. Patients with isolated mild TBI are observed for at least 48 hours. Mean length of stay is 8.69 days but may be higher for those patients with signficant injury to other systems. In comparison, moderate TBI patients have a length of stay of 16 days and length of stay for severe TBI patients is 25.36 days.

Therefore, the caseload in an acute care trauma centre includes a wider range of severity of TBI than a rehabilitation centre. The general characteristics and cognitive profile of TBI patients before discharge from acute care will thus be different from that of patients in rehabilitation centres.

The results of this descriptive overview of the acute care clientele will add pertinent information to the current knowledge in the literature concerning TBI and its treatment. This study, conducted at the MUHC-MGH, one of the four tertiary trauma centres in Quebec, is the first in an acute care setting to detail the general characteristics and early cognitive status of TBI patients that are between a few hours and two weeks postinjury.

Subjects and Methods

Subjects. All patients consecutively admitted to the Traumatic Brain Injury Program of the MUHC-MGH between 1998 and 2000 who were diagnosed with TBI by an emergency room physician and/or by the admitting physician were considered for this study. Patients with a premorbid history of alcohol abuse or psychiatric problems and those suffering from neurological deficits before the admission were excluded. Therefore, a total of 348 patients out of 715 patients were included in this study. Approval for this retrospective study was granted by the research ethics board of the MUHC-MGH.

Variables. Along with a recent history of trauma to the head, radiology results were considered in the diagnosis of brain damage; a positive finding on imaging was sufficient to confirm the diagnosis of TBI. For those with negative imaging, the concurrent presence of two indicators among the ones described next led to the diagnosis of TBI: loss of consciousness, alteration of level of consciousness of any duration (lowered GCS), post-traumatic amnesia of the event or significant facial or extra-cranial injuries.[14]

Patients' charts were reviewed to gather data on age, education and whether neurosurgical intervention (craniotomy for evacuation or resection) was required following admission. The results of cerebral imaging were also collected and the type of injury was documented (epidural hematoma, subdural hematoma, subarachnoid hemorrhage, parenchymal-intraparenchymal hematoma, skull fracture), as well as the site of injury (frontal, temporal, parietal, occipital and others such as the brain-stem, cerebellum, ventricules etc.) and laterality (unilateral vs bilateral).

Duration of Post traumatic amnesia (PTA) was assessed by serial administrations of the Galveston Orientation Amesia Test. Two consecutive scores (during the acute period after admission) greater than 75 on two consecutive days indicated emergence

from PTA.[15] The rehabilitation nurse specialist of the TBI program administered this test for all patients.

Traumatic brain injury severity was determined with the GCS. In order to ensure consistency with other trauma hospitals in Quebec, the Quebec Trauma Registry is used to collect data on all Quebec trauma patients. As per this Registry, the initial GCS done in the emergency room in the acute period post-trauma is used as the baseline to classify the severity of the TBI. The GCS is most commonly used to evaluate level of consciousness and to determine severity of TBI.[16] Brain injury is classified as mild if the GCS ranges from 13-15, moderate if the score is 9-12 and severe if the GCS is 3-8.[17] It is important to keep in mind that the GCS is closely monitored once the patient is admitted. It may change dramatically during the 72 hours postadmission and impact on outcome and prognosis. These changes are taken into consideration by the treating team.

Neuropsychological deficits were measured within the first week following the trauma using the Neurobehavioral Rating Scale (NRS).[5] In this battery, the neuropsychologist rates each patient on neurobehavioral and cognitive variables. Sixteen items were included in this research (vigilance, hyperactivity/agitation, disorientation, attention, verbal expression and comprehension, memory, slowness, judgment, lability, irritability, disinhibition, concept organization, mental flexibility, planning and mental fatigability). For each variable, the deficit was scored as absent (0), mild (1), moderate (2) or severe (3). As suggested, a global NRS score was calculated by summing the 16 individual scores. The global score varied between 0 and 48.

The Functional Independence Measure (FIM) was also used by the neuropsychologist and the speech-language pathologist during the acute phase to measure cognition.[18] Only the cognitive and communication scales were scored (social interaction, problem solving, memory, expression and comprehension). For each scale, the scores can vary between 1 and 7; 1 indicating complete dependence and 7 complete independence. Following the authors' recommendations, the global score was calculated by summing the five scales and this score varied from 7 to 35.

The last tool used in this study was the Glasgow Outcome Score (GOS).[19] The GOS score was determined by the TBI interdisciplinary team of the MUHC-MGH upon discharge of the patient from acute care and represented a short term global functional outcome. The GOS score varies from 0 to 6, a higher score indicating poorer global functional outcome. The last variable considered was the destination upon discharge. There were four mutually exclusive possibilities: home, home with outpatient rehabilitation, in-patient rehabilitation or transfer to a long-term care facility.

Statistics. In the next section we will present the descriptive results for 348 patients. When sample size differs from 348, the discrepancy is due to missing values unless stated otherwise.

Results

Age

The mean age of the sample was 40.2 with a standard deviation of ±18.7 (median: 35 years). The youngest subject was 15 years old and the oldest, 89 years. Figure 1 shows the right asymmetry in the age distribution.

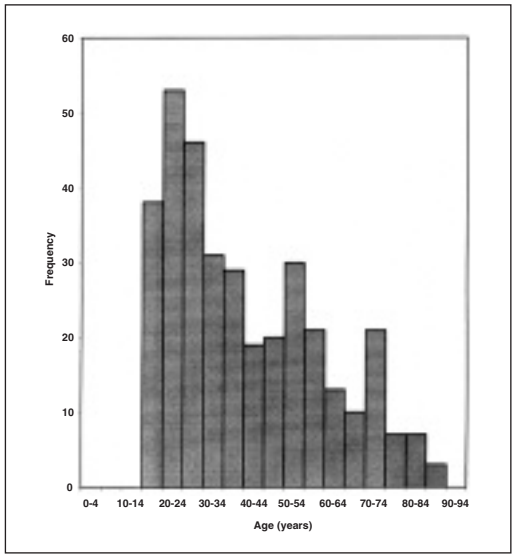

Figure 1: *Distribution of age (n=348)*

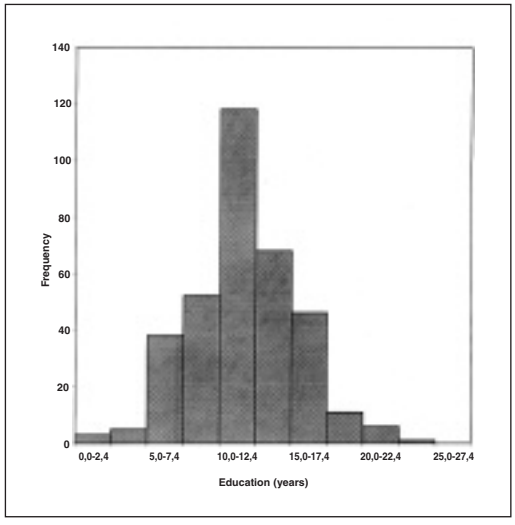

Figure 2: *Distribution of years of education (n=348)*

Education

The number of years of schooling of our group was 11.5 with a standard deviation of ±3.6 (median: 11 years). Level of education varied between 1 and 24 years (see Figure 2). The distribution is rather symmetric.

Site/laterality/neuropathology and presence of neurosurgical intervention

Three hundred and forty subjects underwent a Computed tomogram of the brain. Among them, 185 patients, more than 54%, had a cerebral lesion. Of these 185 subjects, 57.8% had frontal lesions, 40% temporal lesions, 35.7% parietal lesions, 11.4% occipital lesions and 41.6% lesions in other sites of the brain (cerebellum, intraventricular, brainstem, corpus callosum).

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Forty-nine percent were unilateral lesions, 39%, bilateral lesions and the others were central (interhemispheric, corpus callosum). Neuropathology of lesions included; 13% epidural hematoma, 49% subdural hematoma, 47% subarachnoid hemorrage, 61% parenchymal or intraparenchymal bleeding and 36% skull fractures. An MRI was carried out for only 25 of the 348 patients. Among them, 17 (68%) had an apparent traumatic lesion. Finally, only a few patients required a neurosurgical intervention (25 patients or 7% of the 348).

Post-traumatic amnesia

Most subjects presented with post-traumatic amnesia of less than 24 hours (216 patients, 62%). Twenty-one percent presented with post-traumatic amnesia of one to seven days and 17% (60 subjects), more than seven days.

Glasgow Coma Scale

One of the most important results of this study is the data on TBI severity. Figure 3 shows a left asymmetry in the distribution of the GCS score at admission. The mean was 12.5 with a standard deviation of ±3.4 and a median of 14. Overall, 70.4% of the patients were diagnosed with mild TBI, 14.4% with moderate TBI and 15.2% were considered as severe TBI.

Neurobehavioral Rating Scale

On the arousal scale of the NRS, 95% of 347 subjects showed no deficit during the assessment, within one week after trauma. On the disinhibition, disorientation and hyperactivity/agitation scales most of the patients did not show any deficit during assessment (89%, 88% and 86% respectively). Other scales showed more variation. For example, more than 21% of subjects had moderate to severe deficits of attention and more than 25% had moderate to severe deficits on the memory, slowness, mental flexibility and fatigability subscales. For this last subscale, only 17% of patients had no deficit in this area during assessment. Table 1 shows the subject distribution within each category. It should be noted that the percentage of individuals scoring 0 (no deficit) on the various NRS subscales varied substantially across severity categories. Table 2 shows those percentages. When crossing each of the subscale scores with severity as defined in this article, all 16 chi-square tests were significant ($p < 0.001$) indicating that the deficits were significantly different according to the severity category. The tendency was consistently toward a decrease in the percentage of subjects without deficit as the severity of injury increased.

The mean total score on the NRS was 8.1 with a standard

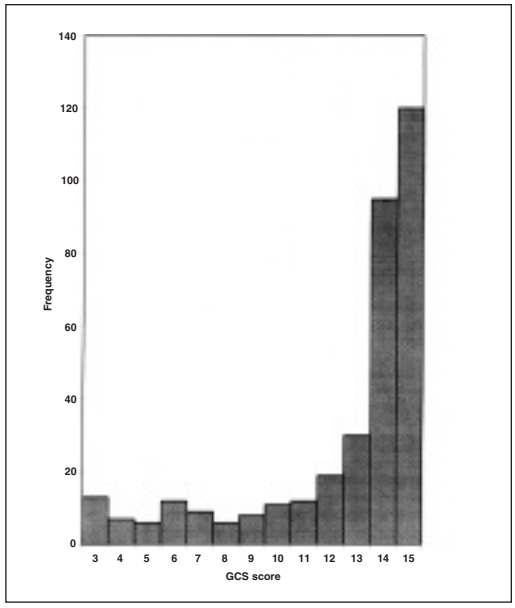

Figure 3: *Distribution of Glasgow Coma Scale score (n=348)*

Table 1: Distribution of Neurobehavioral Rating Scale subscales score (n = 347)

Deficit	None n (%)	Mild n (%)	Moderate n (%)	Severe n (%)
Subscales of Neurobehavioral Rating Scale				
Arousal	331 (95.4)	13 (3.7)	3 (0.9)	0 (0.0)
Hyperactivity/Agitation	299 (86.2)	35 (10.1)	9 (2.6)	4 (1.1)
Attention	153 (44.1)	121 (34.9)	54 (15.6)	19 (5.5)
Disorientation	307 (88.5)	25 (7.2)	10 (2.9)	5 (1.4)
Verbal expression	206 (59.4)	102 (29.4)	29 (8.4)	10 (2.9)
Comprehension	243 (70.0)	79 (22.8)	23 (6.6)	2 (0.6)
Memory	156 (45.0)	97 (28.0)	58 (16.7)	36 (10.4)
Slowness	149 (42.9)	107 (30.8)	68 (19.6)	23 (6.6)
Judgment	271 (78.1)	30 (8.6)	34 (9.8)	12 (3.5)
Lability	260 (74.9)	63 (18.2)	22 (6.3)	2 (0.6)
Irritability	255 (73.5)	59 (17.0)	26 (7.5)	7 (2.0)
Disinhibition	309 (89.0)	23 (6.6)	14 (4.0)	1 (0.3)
Concept organization	273 (78.7)	45 (13.0)	24 (6.9)	5 (1.4)
Mental flexibility	133 (38.3)	124 (35.7)	66 (19.0)	24 (6.9)
Planning	241 (69.5)	54 (15.6)	41 (11.8)	11 (3.2)
Mental fatigability	60 (17.3)	191 (55.0)	80 (23.1)	16 (4.6)

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Table 2: Percentage of subjects (by severity category) scoring 0 on Neurobehavioral Rating Scale subscales score (n = 347)

Deficit	Mild TCC	Moderate TCC	Severe TCC
Subscales of Neurobehavioral Rating Scale			
Arousal	97.6	93.9	86.8
Hyperactivity/Agitation	94.3	75.5	58.5
Attention	55.5	16.3	17.0
Disorientation	95.1	79.6	66.0
Verbal expression	71.4	34.7	26.4
Comprehension	83.7	42.9	32.1
Memory	57.1	22.4	9.4
Slowness	55.9	14.3	9.4
Judgment	90.6	57.1	39.6
Lability	81.2	65.3	54.7
Irritability	82.4	61.2	43.4
Disinhibition	96.3	85.7	58.5
Concept organization	88.2	67.3	45.3
Mental flexibility	48.6	18.4	9.4
Planning	78.4	53.1	43.4
Mental fatigability	21.2	10.2	5.7

deviation of ± 8.6 and a median of 5. Scores for the 347 subjects varied between 0 and 38, the maximum possible score being 48. Figure 4 shows that the distribution of NRS's score is asymmetric to the right.

Functional Independence Measure

With regards to the social interaction scale of the FIM, the scores of the 348 subjects varied between 3 and 7 with a median of 7. On the problem solving scale, scores varied between 1 and 7 with a median of 6. The scores on the memory, expression and comprehension scales varied between 2 and 7. For the memory scale, the median was 6 and for expression and comprehension, the median was 7. The mean for the FIM total score was 30.0 with a standard deviation of ± 5.2 and a median of 33. Individual scores ranged between 14 and 35 and showed an important left asymmetry as demonstrated in Figure 5.

Glasgow Outcome Scale and destination upon discharge

The GOS theoretically ranges between 0 and 6. The 348 subjects of this study did not cover the entire span of the scale. The scores varied between 1 and 4 and most of the patients had a score of 2 or 3 (76%). When considering destination upon discharge, most subjects (69%) returned home and/or were referred to an outpatient rehabilitation centre after their hospitalization. Only 11 out of the 348 subjects were transferred to a long-term care facility. Subject distribution within each GOS category and discharge destination are shown in Table 3.

We computed a measure of association (Cramer's V) between the severity of injury and each of the four discharge location variables. There was a significant association between injury severity and being discharged home (r = 0.39, p = 0.00). In fact 58% of mild TBI patients were discharged home compared to 18% of moderate and 13% of severe. The association between

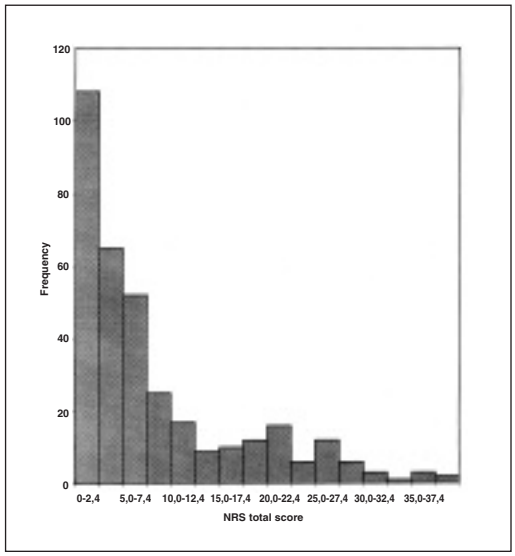

Figure 4: *Distribution of Neurobehavioral Rating Scale total score (n = 347)*

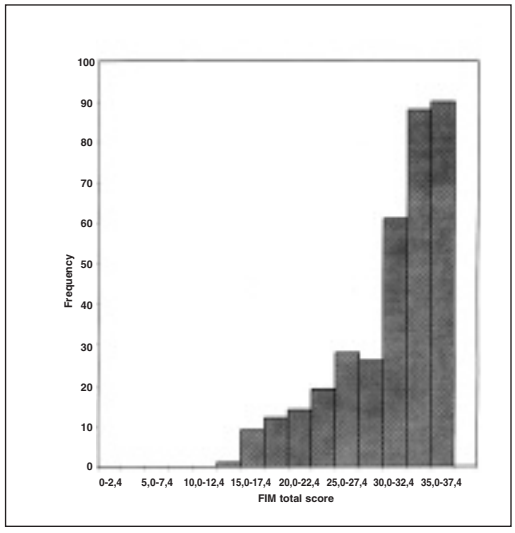

Figure 5: *Distribution of Functional Independence Measure total score (n = 348)*

Table 3: Distribution of Glasgow Outcome Scale and place of discharge (n = 348)

	N	(%)
Glasgow Outcome Scale		
1	63	18.1
2	150	43.1
3	115	33.0
4	20	5.7
Place of discharge		
Home (no rehabilitation)	157	45.1
Home with outpatient rehabilitation	84	24.1
Inpatient rehabilitation	96	27.6
Long term care facility	11	3.2

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injury severity and being discharged home with outpatient rehabilitation was not significant (r = 0.06, p = 0.53). There was a significant association between injury severity and being discharged to inpatient rehabilitation (r = 0.49, p = 0.00). In fact 68% of severe TBI patients were discharged to inpatient rehabilitation compared to 54% of moderate and 13% of mild. The association between injury severity and being discharged to a long-term care facility was not significant (r = 0.09, p = 0.22).

Discussion

The general description of the TBI clientele presented in this study reflects the clinical cognitive reality of TBI patients at the MUHC-MGH. We have, in fact, excluded some patients whom we felt could bias the true cognitive picture of this population. Thus, the results of our study are based on 348 patients, which is less than the 378 patients admitted between 1998-1999 and 343 admitted between 1999 and 2000 reported by Khan et al.[3] This discrepancy is explained by the exclusion of patients with a history of alcohol or drug abuse, those with a documented psychiatric history or premorbid neurological deficits. Some studies have shown that patients with history of substance abuse or psychiatric disorders have several atypical reactions after a TBI. In the case of chronic alcohol or drug users, the GCS is often altered and it is difficult to differentially diagnose cognitive deficits post TBI vs those related to effects of substance use.[20-22]

Other patients excluded in this study were those not followed by the TBI program, namely patients who were seen only in ER and those who died. The first group would typically be comprised of mild TBI patients without post-concussion symptoms or with only a few such symptoms who did not require more than 24 hour observation in the ER. Those patients who continued to present with post-concussion symptoms after leaving the ER were referred to an outpatient clinic and seen by a physiatrist and by a neuropsychologist if need be. The other group of excluded patients were those who died in the ER, in the intensive care unit (ICU) or on the trauma unit. Between 1998 and 2000, 29 TBI patients died in ER (26 patients with a GCS of 3, one patient with a GCS 15 and two with no GCS score) and 73 patients died in ICU or on the trauma unit (52 with a GCS of 3-8; two patients with a GCS of 9-12 and 15 patients with a GCS of 13-15; four patients with no admission GCS). These mortality numbers reflect what is found in the literature. Mortality rates of head injured patients varied from less than 5%[23] to as much as 10%.[24]

Another possible selection bias to consider is the fact that patients admitted to our institution are mainly adults. In the metropolitan area covered by the MUHC-MGH, children under 18 years of age who sustain head trauma are usually taken to a specialized hospital for children. In our study, the mean age of the population was 40 years old and Figure 1 illustrates that the majority of patients were between the ages of 20 to 25. This result is in keeping with the results of Levin in 1990[6] who reports a high incidence of head injury between 15-24 years old.

With regards to education, the mean number of years of schooling was 11.5 years with a median of 11. Eleven years of formal education in the Province of Quebec corresponds to the end of high school and the age at which schooling is no longer mandatory by law. A high school degree is also the minimum diploma required to obtain a job in the Province of Quebec.

The distribution of severity of TBI in this study is quite similar to that reported in the literature. In a cohort similar to the one reported here (taken from the same TBI program at the MUHC-MGH), Khan et al[3] reported 22.5% of severe TBI, 13% of moderate and 64.5% of mild cases. Alves and Jane[25] have found the occurrence of mild TBI to be 75%-90%. According to Berrol[26] and Kraus et al,[27] 8-10% of TBI patients are moderate and 10% are severe. The difference in percentages is explained by the various selection criteria (different populations). We note that the proportion of severe cases is not that different. It is a bit higher in the study by Khan et al who did not exclude patients who died, and it is somewhat lower in other studies which were based in rehabilitation settings and, therefore, did not include those more impaired patients who required long-term care.

Post-traumatic amnesia is also used in studies as an index of severity of TBI. Russell and Smith[28] have suggested that duration of PTA is, in fact, the best index of severity of brain injury. Post-traumatic amnesia of less than 24 hours is considered as mild TBI, PTA of one to seven days is moderate and more than seven days reflects a severe TBI. By using the PTA as indicator of severity, 62% of our population had a mild TBI, 21% had a moderate TBI and 17% sustained a severe TBI, which is a closer distribution to what has been reported in the literature.

The classification of TBI patients into distinct severity categories is not an easy task. In fact, it is a grey area in a number of outcome studies and a subject of discussion in many descriptive studies.[29-31] A number of studies[32,33] agree on the fact that mild TBI is not as clear cut as we might want it to be. As far as neurobehavioural outcome and persistent residual symptoms after a mild TBI are concerned, research results are inconsistent and sometimes contradictory.[33] A great majority of these patients will go back to their premorbid level of function but a number of them will have to learn to cope with long-term deficits. Early detection of these cases should be a concern in acute care settings.

Interesting results were found with regards to the neuropsychological functioning of our patients. The asymmetry to the right in the NRS scores indicates that most of our patients demonstrated mild and moderate deficits (lower scores). We should nonetheless point out that the wide span of scores emphasizes the diversity of the clientele in acute care.

There is an asymmetry to the left in the FIM total scores which shows again mild and moderate cognitive deficits prior to discharge. Considering that the majority of our clientele had mild and moderate TBI, these results were to be expected. The severity of the cognitive deficits paralleled the severity of the TBI. Again, the scores are widespread and highlight the importance of considering the diversity of levels of cognitive skills in the acute phase.

Table 1 shows that the five most common areas of cognitive deficit were attention, memory, slowness, mental flexibility and mental fatigability. These deficits are frequently observed clinically.[34] Moreover, they are common in the TBI population and remain for several years.[35] Some studies have demonstrated that the frontal and temporal lobes are responsible for these cognitive functions.[36,37] Accordingly, 57.8% of our subjects had frontal lesions and 40% had temporal lesions. Recent studies in neuroimaging have also demonstrated that the frontal and temporal areas are most often affected in a TBI.[38-40]

Finally, we can parallel severity of deficits and outcome of

patients. The majority of our patients had a score of 2 and 3 on the GOS which is in the mild and moderate category of impairment and fit with the mild and moderate cognitive deficits observed in the acute phase (NRS). A sizable proportion of subjects was able to go back home (45.1%) although they may not have been at the same level of functioning as before the accident. For some patients, residual deficits remained in the days and weeks post-trauma and they were unable to go back to work immediately. Many patients were referred to inpatient (27.6%) or outpatient (24.1%) rehabilitation. These percentages are important in the planning of rehabilitation resources. They show that most patients (52%) will need some rehabilitation services to regain their premorbid capacities or to adjust to their new reality.

Information gathered in this study regarding the association between severity of TBI and discharge destinations can be helpful to plan rehabilitation services for the TBI population. Most of the mild TBI patients (58%) were discharged home. Most of the severe TBI patients (68%) were discharged to inpatient rehabilitation compared to 54% of the moderate and 13% of mild TBI patients. Efficient discharge planning needs to begin early for each patient. Knowing the correlation between severity and eventual outcome can lead the team to better predict outcome of patients upon their admission and to plan for discharge accordingly. An association which was found not to be significant was between severity and discharge to long-term care. This result could be explained by the small number of patients in this category. However, from a clinical point of view, a qualitative analysis of the data showed that all patients transferred to a long-term care facility were severe TBI patients.

In order to ensure the continuity of care and enhance the potential of social reintegration of patients with TBI, the major objective of the TBI program of MGH since its implementation in 1994, was to create a continuum of care with the health network and the community. To achieve this goal, we established strong alliances with our partners of inpatient and outpatient rehabilitation institutions, long term care facilities and the Quebec Association of patients with TBI.

The emphasis in this comprehensive process was to develop a common vision of patient needs and appropriate services, increase accessibility of care to all TBI patients by eliminating the delays in transferring/referring patients to postacute rehabilitation, establish corridors of services with formal interhospital ententes, develop common care maps, ensure coordinated care through out the continuum and develop a mechanism to assess the performance/quality of the TBI continuum of care.

Throughout the years, multiple meetings were held with our partners, an organizational structure was established with the definition of roles and responsibilities of each party. The development of common care maps is still ongoing.

Some concrete outcomes are the reduction of length of stay in acute care from 30 days to 11 days; the reduction of waiting time in acute care for patients with TBI to be transferred to postacute rehabilitation facilities ie: in four years the waiting time has been reduced from 9.5 days to 4.5 days and, finally, to approximately two days.

As described, it is important to implement services specific to the needs of this acute care population. These services include not only rehabilitation but follow-up for those discharged home. Routine follow-up for all head-injured patients was recommended by the Medical Disability Society's 1988 report.[41] For the majority of patients going back home and presenting with mild difficulties, a telephone follow-up is necessary to insure that the patient is safe and that the transition back to their regular activities is going well. Many family members have difficulties adjusting to the newly discharged patient and can benefit from a simple follow-up in order to answer their questions and concerns. Given that these patients are seen by the TBI acute care team while in hospital, these clinicians are in the best position to provide an efficient follow-up.

In conclusion, using information about the characteristics of the traumatically brain injured patients, their problems and their needs as well as networking with postacute care facilities and the community are crucial steps in providing patients with TBI with appropriate care and services, while facilitating decision-making for programming and service delivery.

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