

Suicidality after traumatic brain injury: demographic, injury and clinical correlates

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ABSTRACT

Background. In spite of the high frequency of emotional distress after traumatic brain injury (TBI), few investigations have examined the extreme of such distress, namely, suicidality, and no large scale surveys have been conducted. The current study examined both the prevalence and demographic, injury, and clinical correlates of hopelessness, suicidal ideation and suicide attempts after TBI.

Methods. Out-patients ($N = 172$) with TBI were screened for suicidal ideation and hopelessness using the Beck Scale for Suicide Ideation and the Beck Hopelessness Scale. Data were also collected on demographic, injury, pre-morbid and post-injury psychosocial variables and included known risk factors for suicide.

Results. A substantial proportion of participants had clinically significant levels of hopelessness (35 %) and suicide ideation (23 %), and 18 % had made a suicide attempt post-injury. There was a high degree of co-morbidity between suicide attempts and emotional/psychiatric disturbance. Results from regression analyses indicated that a high level of hopelessness was the most significant association of suicide ideation and a high level of suicide ideation, along with occurrence of post-injury emotional/psychiatric disturbance, were the most significant associations of post-injury suicide attempts. Neither injury severity nor the presence of pre-morbid suicide risk factors contributed to elevated levels of suicidality post-injury.

Conclusions. Suicidality is a common psychological reaction to TBI among out-patient populations. Management should involve careful history taking of previous post-injury suicidal behaviour, assessment of post-injury adjustment to TBI with particular focus on the degree of emotional/psychiatric disturbance, and close monitoring of those individuals with high levels of hopelessness and suicide ideation.

INTRODUCTION

Suicide is hovering with open doors. ('Bernard', 2000.)

Numerous studies have described a range of psychosocial and psychological sequelae as a consequence of TBI (Tate *et al.* 1989; Ponsford *et al.* 1995; Bowman, 1996; Rosenthal *et al.* 1998), however not all areas of injury sequelae

have received equal research attention. In 1990, Eames and colleagues observed that 'little systematic study of the incidence of suicide attempts and actual suicides in head injured persons has been conducted' (p. 426). A decade later this observation is still pertinent with a dearth of knowledge about important aspects of suicidality (hopelessness, suicide ideation, suicide attempts) after TBI.

A number of reasons have been advanced that could explain why suicide ideation and behaviours are a common psychological reaction to TBI (Tate *et al.* 1997). They include the

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suddenness of the onset of disability in previously healthy young males, the often global negative effects of disability on the person's life, the difficult and painful process of grieving the loss of a valued pre-injury lifestyle, a growing realization of the level of effort involved in maintaining levels of functioning, as well as reduced neuropsychological resources to cope with the stresses of everyday living and the aforementioned changes. The quotation at the beginning of this article written by a person with TBI, conveys how imminent and inviting the possibility of suicide can be at varying times post-injury.

A recent epidemiological study by Teasdale & Engberg (2001) has reported that rates of deaths by suicide for people with traumatic brain injury are between 2.7 and 4.1 times that of the general population when matched for age and sex. Given these rates, the pressing clinical concern is one of suicide prevention (Tate *et al.* 1997), targeting clinical signs such as hopelessness, suicide ideation and suicide attempts. Research with non-clinical and psychiatric populations have found that these three phenomena are interconnected with increased risk of death by suicide. A high level of hopelessness is a key long-term predictor of death by suicide and evidence suggests it is a more powerful predictor than depression *per se* (Beck *et al.* 1985). Levels of suicide ideation increase as levels of hopelessness increase (Motto, 1977) and there is a relationship between the frequency of suicidal ideation and the probability of suicide attempts (Schotte & Clum, 1982). These various types of suicidal behaviour can be conceptualized as lying along a continuum of increasing risk, ranging from mild suicide ideation to suicide attempts and death by suicide at the end of the continuum (Beck *et al.* 1979; Bonner & Rich, 1987). In the TBI field to date, these phenomena have only been examined in isolation. For example, Jorge and colleagues (1993) reported levels of hopelessness ranging from 19% to 36% in a depressed group of people with TBI; Brooks (personal communication in Eames *et al.* 1990) reported a 15% rate of suicide attempts at 5 years post-injury; and the prevalence of suicide ideation at varying times post-injury has been estimated at between 10% and 30% (Brooks 1987; Jorge *et al.* 1993; Klonoff & Lage, 1995; Leon-Carrion, 1997). Klonoff &

Lage (1995) have noted that research needs to examine whether linkages between hopelessness, suicide ideation and attempts can be found after TBI as this would constitute an important step towards suicide prevention.

Looking more closely at suicide ideation, the current prevalence estimates need to be treated with caution due to the use of non-standardized measures, retrospective ratings, small sample sizes, or no description of the sample upon which the rate was calculated. Furthermore, nothing is known of the stability of suicide ideation after TBI or the extent to which it may fluctuate over time. In addition, suicide ideation is not a unitary phenomena and clinical assessment typically examines a range of facets including the intensity of ideation, the frequency of suicide thoughts, reasons for suicide, acceptability of suicide and so forth. Therefore, it is important to investigate the complex characteristics involved in suicide ideation.

Apart from the specific suicidal phenomena so far discussed, there are other types of important risk factors that need consideration. Examination of risk factors such as substance abuse, mental health problems and emotional distress (Bongar, 1991) that increase the likelihood of death by suicide in the general community have proved an important avenue for research. One focus of the present study is the examination of four particular aspects of risk factors and suicidality after TBI. First, the potential role of pre-injury suicide risk factors in increasing vulnerability to suicidality post-injury was noted in our earlier study of completed suicide after TBI (Tate *et al.* 1997) but this finding required further validation due to the small sample size and retrospective methodology employed. Secondly, although post-injury levels of substance abuse (e.g. Kreutzer *et al.* 1991), psychiatric morbidity (e.g. Shoumitro *et al.* 1999) and emotional disturbance (e.g. Kinsella *et al.* 1988) have been studied, they have not been examined collectively to develop an overview of post-injury suicide risk factors in populations of people with TBI. Klonoff & Lage (1995) have highlighted the interrelationship among such factors and elevated suicidality after TBI as an important area requiring further research.

The third aspect of risk factors to be explored involves demographic characteristics of people

with TBI. Given the preponderance of youth in TBI populations (Tate *et al.* 1998) and the current international problem of youth suicide, it is important to ascertain whether youth sustaining TBI are at higher risk of suicide post-injury than people who sustain a TBI later in life. Epidemiological evidence (Teasdale & Engsmyr, 2001) suggests that in fact youth sustaining TBI (15–19) have lower rates of death by suicide than later age cohorts (20–60) but it is not known whether this also applies to the clinical signs (hopelessness, ideation, attempts) of suicidality. Another demographic issue relates to gender. A number of studies in the general community have found the female: male ratio of suicide attempts as high as 3:1 (Robins, 1986; Bongar, 1991). It is not yet known, given the contrasting 3:1 male: female sex ratio in severely injured TBI populations (Tate *et al.* 1998), whether this gender disparity in suicide attempts generalizes to a TBI population.

Finally, Klonoff & Lage (1995) have conjectured that if the aetiology of a TBI is a suicide attempt, there is an increased likelihood of elevated levels of suicidal signs continuing post-injury. Parmelee *et al.* (1989) provides some evidence for this, finding four out of a series of ten adolescents with brain damage as the result of failed suicide attempts exhibiting continuing suicidal behaviour at 6–9 months post-injury. Klonoff & Lage (1995) extend this further, hypothesizing that a larger proportion of TBIs may be the result of undiagnosed suicide attempts (e.g. single driver high-speed motor vehicle accidents) and ask whether such individuals are also vulnerable to continued or increased levels of suicide risk post-injury. However, the salience of such an aetiology to post-injury suicide risk requires further study.

Apart from Jorge *et al.* (1993), many of the studies cited have been unreplicable, univariate studies of suspect validity leading to a fragmented, limited understanding of the nature of suicidal responses to TBI. The aims of this study are therefore to: (i) ascertain the prevalence of hopelessness, suicide ideation and suicide attempts after TBI; (ii) identify clinical aspects of suicide ideation associated with heightened levels of distress; (iii) ascertain the prevalence and role of key suicide risk factors both pre-morbidly and post-injury; and (iv) examine predictors of suicide ideation and suicide attempts.

METHOD

Sample

The Brain Injury Rehabilitation Unit (BIRU) at Liverpool Hospital in Sydney is a regionally-based provider of rehabilitation and long-term follow-up services to people with TBI and their families. The research proposal was approved by the South Western Sydney Area Health Service Ethics Committee. All patients on the BIRU out-patient caseload who met the criteria during the 24-month study period were recruited with the exception of nine who refused participation. Exclusion criteria were sustaining TBI before the age of 16 or after the age of 65; sustaining non-traumatic brain injury; less than 12 months post-injury at the time of the study; too severely impaired to be able to answer survey items; inability to speak English; and, for clinical reasons, new referrals attending the out-patient clinic for first time.

The sample consisted of 172 out-patients of the BIRU. Demographic, injury, psychosocial and clinical data are reported in Table 2. Glasgow Coma Scores (GCS) were available for 94 participants and ranged from mild (GCS 13–15, $N = 21$) to moderate (GCS 9–12, $N = 20$) and severe ($GCS \leq 8$, $N = 53$). No differences were found (by t test) between males and females on length of PTA ($t = 0.37$), age at injury ($t = 0.88$) and years post-injury ($t = 0.67$). Road traffic accidents (driver, passenger, motorbike, pedestrian and pushbike) constituted the most frequent cause of injury ($N = 108$, 62.8%), followed by falls ($N = 32$, 18.6%), assaults ($N = 17$, 9.9%) and miscellaneous causes ($N = 15$, 8.7%). Three-quarters of the sample ($N = 130$, 75.6%) sustained closed head injuries, a further 19.8% ($N = 34$) initially closed but requiring neurosurgery and 4.7% ($N = 8$) sustained open head injuries.

Measures

The Beck Hopelessness Scale (BHS) is a measure with both high internal consistency and concurrent validity which elicits the level of negative expectations people hold about the future (Beck *et al.* 1974). Scores range from 0 to 20, with scores ≥ 9 representing moderate to severe levels of hopelessness.

The Beck Scale for Suicide Ideation (BSSI) is a 21-item measure with both high internal con-

Table 1. *BSS: means (and s.d.) of response for the five factors and their individual items on results of Mann–Whitney U test (z statistic) comparing clinical and non-clinical groups*

Factor and individual items	Clinical (N = 28)	Non-clinical (N = 26)	z statistic
	Mean (s.d.)	Mean (s.d.)	
Factor 1: Intensity of suicidal ideation	0.688 (0.460)	0.289 (0.372)	3.343*
Item 6: Duration of suicidal thoughts	0.64 (0.73)	0.23 (0.51)	2.363
Item 7: Frequency of ideation	0.61 (0.63)	0.19 (0.49)	2.800
Item 9: Control over suicidal action	0.46 (0.64)	0.28 (0.46)	1.001
Item 15: Expectancy of actual attempt	1.04 (0.51)	0.46 (0.65)	3.483*
Factor 2: Active suicidal desire	1.136 (0.415)	0.485 (0.321)	4.905*
Item 1: Wish to live	0.93 (0.60)	0.15 (0.37)	4.627*
Item 2: Wish to die	1.25 (0.75)	0.58 (0.58)	3.262*
Item 3: Reasons for living or dying	1.11 (0.63)	0.31 (0.47)	4.329*
Item 4: Active suicide attempt	1.21 (0.57)	0.81 (0.57)	2.494
Item 8: Attitude towards ideation	1.18 (0.67)	0.58 (0.58)	3.176*
Factor 3: Planning	0.464 (0.389)	0.259 (0.412)	2.495
Item 12: Specificity of planning	0.93 (0.66)	0.58 (0.70)	1.956
Item 16: Extent of preparation	0.32 (0.61)	0.07 (0.39)	2.089
Item 17: Suicide note	0.29 (0.53)	0.15 (0.46)	1.205
Item 18: Final acts	0.32 (0.55)	0.19 (0.49)	1.101
Factor 4: Passive suicidal desire	1.200 (0.369)	0.877 (0.487)	2.455
Item 5: Passive suicide attempt	1.18 (0.77)	0.85 (0.61)	1.724
Item 11: Reasons for attempt	1.75 (0.59)	1.15 (0.88)	2.801
Item 12: Specificity of planning	0.93 (0.66)	0.58 (0.70)	1.956
Item 13: Availability of opportunity of method	0.96 (0.88)	0.81 (0.90)	0.670
Item 14: Capability to carry out attempt	1.18 (0.67)	1.00 (0.75)	0.897
Factor 5: Concealment	0.786 (0.499)	0.385 (0.454)	2.902*
Item 10: Deterrents to attempt	0.86 (0.76)	0.42 (0.76)	2.317
Item 19: Deception and concealment	0.71 (0.81)	0.35 (0.56)	1.718

Analysis of five factors, * significant at Bonferroni adjustment 0.010 ($\alpha/5$); analysis of 19 items, * significant at Bonferroni adjustment 0.002 ($\alpha/19$).

sistency and concurrent validity that assesses severity of suicide ideation (Beck *et al.* 1979). The first 19 items are scored, with total scores ranging from zero indicating no suicide ideation through to 38. Respondents with no ideation are screened out after the first five items while people with some level of ideation complete a further 14 items (see Table 1). All respondents then complete the final two items which are not scored and assess history of suicide attempts. The present study used a score of 9 as the cut-off score separating participants with low ideation from participants with clinically significant levels of ideation. The manual reports the results of a Principal Components Analysis of the BSS. Five factors were extracted accounting for 64.2% of the variance and labelled as: Intensity, Active Desire, Planning, Passive Desire and Concealment.

An interview protocol was used to collect data on three risk factors: alcohol abuse; other drug use; and emotional/psychiatric disturbance both pre- and post-injury. A classification of substance abuse problem required evidence of

significant disruption to the person's life as a consequence of the abuse (e.g. incurring legal charges, loss of job due to intoxication, relationship breakdown). A classification of emotional/psychiatric disturbance required any of having a diagnosable mental illness, an admission to a hospital psychiatric ward, being on antidepressant medication or receiving counselling for depression or other emotional disturbance from a clinical psychologist, social worker or other trained counsellor. Conditions included psychotic disorders, bipolar disorder, depressive syndromes and anxiety disorders. Post-injury conditions did not need to be current at the time of screening.

Risk factors for suicide salient in the general population (Bongar, 1991) were used in statistical analysis. Pre-morbid unemployment (employed *versus* unemployed), emotional/psychiatric disturbance (present *versus* absent) and suicide attempts (present *versus* absent) were analysed for their potential impact on suicidality post-injury. Three potential post-injury psychosocial risk factors were also examined:

occupational status (return to work/study *versus* unemployed/unemployable); substance abuse (present *versus* absent); and emotional/psychiatric disturbance (present *versus* absent).

Finally, three demographic and two injury variables, extracted from the medical files, were also examined: age (dichotomized as less or greater than 25 years), gender, and relationship status (dichotomized as single *versus* married/defacto). Injury variables comprised duration of PTA (days) as an index of severity of injury, and time (years) post-injury. The medical files were also reviewed for additional information about client suicidality and to examine the circumstances of each injury to assess whether it could have been due to a diagnosed or undiagnosed suicide attempt.

RESULTS

Hopelessness and suicide ideation

A substantial proportion of the sample scored within the clinical range on the measures with 34.9% ($N = 60$) scoring at moderate to severe levels of hopelessness and 22.7% ($N = 39$) reporting clinically significant levels of suicide ideation within the previous 7 days. Spearman correlations indicated no relationship between age at injury, severity of injury or time post-injury and either BHS or BSS scores. There were no significant gender differences on either BHS or BSS ($t = 0.18$ and -0.94 respectively). The test-retest correlations for the BHS and BSS were calculated for 78 participants with either low or high scores (low scores, BHS 0–3 and BSS 0; high scores, ≥ 9 on either BHS or BSS) who were retested approximately 3 weeks later. The intraclass correlation coefficients were high for both measures ($r_{ICC} = 0.85$ and 0.79 for BHS and BSS respectively).

The BSS was further analysed in terms of the five factors described in the test manual. Data from all respondents ($N = 54$) who completed the 19 BSS items, thus indicating some level of suicide ideation, were included. Participants were allocated to the 'clinical' group if scoring above the cut-off of 9 on both the BHS and BSS ($N = 28$) with the rest being allocated to the 'non-clinical' group ($N = 26$). Participants in the 'non-clinical' group had a variable range of scores on the BSS (between 1 and 26) and the BHS (between 0 and 17), but did not score

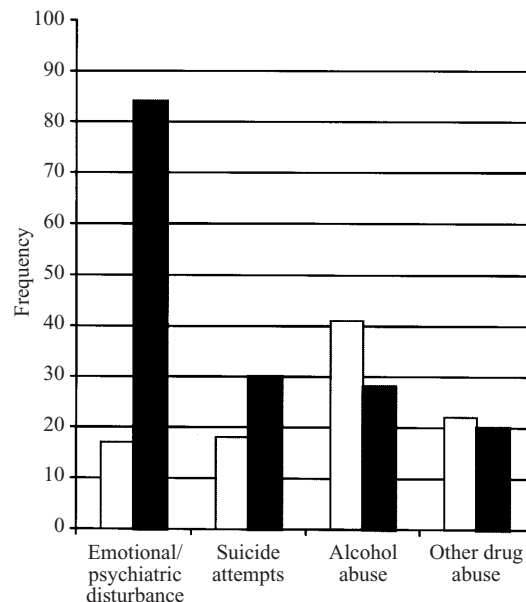


FIG. 1. Change in frequency of suicide risk factors from pre-injury (□) to post-injury (■).

above the cut-off mark on both measures. Table 1 provides descriptive data and results of multiple Mann–Whitney U analyses with Bonferroni adjusted alpha set at $P < 0.01$ ($0.05/5$) to control for Type 1 errors. Analysis found that the 'clinical' group scored significantly more highly on three factors of the BSS (Ideation intensity, Active suicidal desire and Concealment) in comparison to the non-clinical group. Comparison between the two groups on the 19 individual items of the BSS (with adjusted alpha level set at $P < 0.002$) found that the 'clinical' group expressed a significantly weaker wish to live, a stronger wish to die, could identify more reasons for dying than for living and had a higher expectation of committing suicide in comparison to the 'non-clinical' group.

Suicide attempts

The post-injury suicide attempt rate for the sample was 17.4% over a mean period of 5 years. This high rate elevated the life-time attempt rate of the sample to 26.2% ($N = 45$). Half of the group made one attempt only ($N = 23$; 51.1%) with the remainder making two or more attempts. Only three participants made attempts both pre- and post-injury, underscoring that the clear majority of people who made

attempts post-injury had no pre-injury history of similar behaviour. The co-morbidity of post-injury suicide attempts with presence of emotional/psychiatric disturbance was extremely high with 26 of the 30 people making attempts also having a post-injury episode or history of emotional/psychiatric disturbance ($\chi^2 = 20.81$, $df = 1$, $P < 0.000$). During the study period there were no instances of completed suicide in the group.

Risk factors

The presence of any of the four risk factors (suicide attempts, alcohol abuse, other drug abuse, emotional/psychiatric disturbance) pre-injury was identified in 36.6% ($N = 63$) participants of the sample and this increased to 61.0% ($N = 105$) post-injury (see Fig. 1). The changing pattern of risk factors from pre- to post-injury shows a decline in the frequency of alcohol abuse while the number of participants making suicide attempts almost doubled. The greatest change was the increase of participants experiencing emotional/psychiatric disturbance (9% and 48% respectively).

Demographic variables

A comparison of the proportions of youth under the age of 25 years making suicide attempts ($N = 4$) and those 26-years and older ($N = 28$) found no statistical difference ($\chi^2 = 1.309$, $df = 1$, $P > 0.05$) and, as has already been reported, there were no significant correlation coefficients between age and levels of hopelessness and suicide ideation. In the general population, women make three times as many suicide attempts as men. A chi-square analysis comparing the adjusted observed rate in the sample to the expected gender rate from the general population found a significant difference between the two rates ($\chi^2 = 9.42$, $df = 1$, $P < 0.005$) suggesting that in this TBI sample, many more men made suicide attempts than expected from the general population rates.

TBI as the result of diagnosed or undiagnosed suicide attempts

The causes of all injuries were reviewed. Only one was identified in which a suicide attempt was the possible aetiology and that person had low clinical scores (BHS = 0; BSS = 0) at the time of screening. Next, all road accidents

involving single drivers ($N = 36$, 20.9%) were reviewed to identify possible undiagnosed suicide attempts. Twenty-six cases were assessed as unlikely to be undiagnosed suicide attempts (e.g. driving to or from work, another driver legally at fault for the accident, driving to a recreational activity). The remaining 10 accidents could be considered as potential undiagnosed suicides (e.g. high speed crashes, crashes in the early morning, over legal limit of alcohol, no clear purpose for the trip etc.) although a number of these accidents could equally be explained as resulting from reckless driving or fatigue. No significant differences were found between these 10 drivers and the rest of the sample on the BHS or BSS ($t = 1.16$ and 0.98 respectively), suggesting that even if some of these accidents had been the result of undiagnosed suicide attempts, there was no contingent elevated level of suicidality post-injury.

Associations of suicide ideation and suicide attempts

Two logistic regression analyses were conducted using the dichotomized scores on the BSS and suicide attempts as outcome variables. Fourteen independent variables were initially considered, sampling a range of demographic, injury, pre-injury and post-injury psychosocial variables. Table 2 provides descriptive data on these variables for the sample.

A number of independent variables were significantly intercorrelated and consequently two variables were excluded to avoid problems with multicollinearity: pre-injury relationship status was excluded because it was highly correlated with post-injury relationship status ($cc = 0.59$, $P < 0.001$), the latter being retained because post-injury circumstances were considered to be more clinically relevant than pre-injury circumstances. Similarly, pre-injury substance abuse was excluded because of the high correlation with post-injury substance abuse ($cc = 0.54$, $P < 0.001$), the latter being retained because it is a stronger indicator of post-injury psychosocial disturbance. A number of other intercorrelations were statistically significant, due in part to the large sample size, but as the corresponding coefficients were not high (range 0.15 to 0.35) no other variables were excluded. BHS and BSS themselves were also intercorrelated ($r_s = 0.60$) and thus, in examining associ-

ations of suicide attempts, BHS was excluded because of its lower correlation with the outcome variable in comparison with BSS.

Table 2. Means, standard deviations and frequency data for predictor variables

Predictor variables (<i>N</i> = 172)	Mean/ <i>N</i>	S.D./ (%)
First block		
Demographic and injury variables		
Age at injury (years)	30.81	12.09
Time post-injury (years)	5.37	5.55
Length of PTA (days)	46.80	49.45
Sex, <i>N</i> (%)		
Male	149	(86.6)
Female	23	(13.4)
Second block		
Pre-morbid psychosocial variables		
Activity status, <i>N</i> (%)		
Unemployed	28	(16.3)
Employed	144	(83.7)
Emotional/psychiatric disturbance, <i>N</i> (%)		
Present	17	(9.9)
Absent	155	(90.1)
Suicide attempts, <i>N</i> (%)		
Present	18	(10.5)
Absent	154	(89.5)
Third block		
Post-injury psychosocial variables		
Relationship status, <i>N</i> (%)		
Single	46	(26.7)
Married/de facto	126	(73.3)
Return to work*, <i>N</i> (%)		
Unemployed	102	(59.3)
Employed	70	(40.7)
Substance abuse, <i>N</i> (%)		
Present	43	(25.0)
Absent	129	(75.0)
Psychiatric/emotional disturbance, <i>N</i> (%)		
Present	84	(48.8)
Absent	88	(51.2)
Additional variables		
Hopelessness (BHS)	6.85	5.48
Suicide ideation, <i>N</i> (%)		
High	34	(22.7)
Low	133	(77.3)
Suicide attempts, <i>N</i> (%)		
Present	30	(17.4)
Absent	142	(82.6)

* Post-injury return to work includes supported work, homemaker, volunteer, still in rehabilitation; unemployed, includes people unable to return to work.

The two regression analyses each used 12 independent variables entered in three blocks (see Table 2) and included the dichotomized variable for either BHS (analysis 1) or BSS (analysis 2). The ordering of the analyses was based on theoretical grounds outlined in the introduction, namely that the sequence of hopelessness, suicide ideation and suicide attempts represent an increasing severity of suicidal states. The results of the regression analyses are presented in Table 3.

Analysis 1: associations of suicide ideation, using BSS (low versus high) as the outcome variable

The first regression equation included all variables from blocks 1–3, as well as the dichotomized BHS score. A test of the full model with all predictors against a constant-only model was statistically reliable ($\chi^2 = 49.34$, *df* = 12, $P < 0.001$) indicating that these associations in combination reliably distinguished between low and high levels of suicide ideation. Using Nagelkerke R^2 , the model explained 37.9% of the variance in high versus low levels of suicide ideation. Association success in the model correctly classifying people with high levels of suicide ideation who actually were suicidal (sensitivity) was 56.4% and specificity rate in the model correctly classifying people who had low levels of suicide ideation was 92.5%. According to the Wald criterion, the variables that contributed significantly to the model were levels of hopelessness and occurrence of post-injury emotional/psychiatric disturbance.

Analysis 2: association of suicide attempts, using post-injury suicide attempts (absence versus presence) as the outcome variable

The second regression equation included all variables from blocks 1–3, adding the dichotomized BSS score and excluding BHS. A test of the full model with all associations against a

Table 3. Results from regression analyses

Analysis	Dependent variable	R ²	Individual variables	β	Wald	<i>P</i>	OR
1	BSS (low v. high)	0.379	BHS	2.16	21.43	0.000	8.69
			Post-injury EmPs	−1.71	10.30	0.001	0.18
2	Post-injury suicide attempt (no v. yes)	0.398	Post-injury EmPs	2.06	9.48	0.002	0.13
			BSS	−1.58	9.62	0.002	0.21

BHS, Beck Hopelessness Scale; BSS, Beck Scale for Suicide Ideation; EmPs, Emotional/psychiatric disturbance.

constant-only model was statistically reliable ($\chi^2 = 47.28$, $df = 12$, $P < 0.000$), indicating that these associations in combination reliably distinguished between presence and absence of suicide attempts and the model accounted for 39.8% (Nagelkerke R^2) of the variance in people making suicide attempts. Overall classification accuracy was 86.0% with sensitivity at 33.3% and specificity at 97.2%. According to the Wald criterion, the presence of post-injury emotional/psychiatric disturbance, as well as levels of suicide ideation, reliably predicted the model, with a weak effect for pre-injury emotional/psychiatric disturbance.

DISCUSSION

This is the first report to provide objective data derived from standardized measures on factors related to suicide in a civilian TBI population using a large sample of out-patient attendees over an 24-month period. The results draw attention to the magnitude of the problem, with high rates identified for a number of critical indicators of suicide risk including hopelessness, suicide ideation, suicide attempts and emotional/psychiatric disturbance. Furthermore, in line with suicide research on other populations, the regression analyses showed that high levels of hopelessness were the strongest predictor of suicide ideation and high levels of suicide ideation, in association with emotional/psychiatric disturbance, the strongest predictor of post-injury suicide attempts.

In terms of hopelessness and suicide ideation, the profile of moderate to severe levels of hopelessness is similar to the rate of 36% Jorge and colleagues (1993) found for depressed clients at 12 months post-injury. The 22.7% rate of clinically significant levels of suicide ideation (i.e. scores > 9) is higher than previous clinical estimates (such as 12.6% by Klonoff & Lage, 1995), but is comparable with the single other study using a standardized measure (27% by Jorge *et al.* 1993). These rates for the TBI group are high compared with studies in the general community using a similar time frame (e.g. Kienhurst *et al.* 1990 found a prevalence rate of 3.5% reporting 'recent' suicidal thoughts), although comparisons are complicated by the skewed age and gender profile of TBI populations. Moreover, the findings of significant levels

of suicide ideation within the first 12 months post-injury (ranging from 16% to 27%) by Jorge and colleagues (1993) combined with the lack of relationship between time post-injury and suicidality found in the current study, suggests that people with TBI may exhibit suicidal ideation at any time post-injury. Also, while suicide ideation is typically a transient phenomenon (Graham *et al.* 2000), the high intraclass correlation coefficient for the test-retest interval suggest some degree of chronicity in suicide ideation after TBI. The 17.4% rate of suicide attempts over a mean 5.37 year time-frame is similar to that suggested by Brooks (personal communication in Eames *et al.* 1990). This high rate is of concern given that suicide attempts are the strongest risk factor for eventual death by suicide (Shaffer *et al.* 1988) with mortality rates ranging from 12.5% (Hirschfeld & Davidson, 1988) to 15% (Maris, 1981). The current study found that the lifetime rate of suicide attempts for the sample prior to the injury was 10.4% but when post-injury attempts were included, this escalated to a rate of 26.2%. This is beyond the upper estimate of the lifetime prevalence in the general community (2.2% to 20%) in studies using similar community-survey methodologies (Diekstra & Garnefski, 1995), although the same caution about the skewness of the TBI population applies.

Additionally, the study sought to examine a number of aspects of suicide risk factors. In examining the role of pre-injury factors, the regression analyses suggested that in fact, post-injury psychosocial factors, in particular the presence of emotional/psychiatric disturbance, had far greater significance than pre-injury vulnerabilities or injury variables in predicting elevated levels of suicidality post-injury. In particular, the descriptive data and regression analyses indicated that a history of pre-injury suicide attempts did not create a post-injury vulnerability to suicide ideation or attempts. Furthermore, none of the other pre-morbid factors examined was associated with elevated levels of suicide ideation and attempts post-injury, with the exception of a weak association between pre-injury emotional/psychiatric disturbance and suicide attempts. Finally, the study found no relationship between injury variables (severity of injury, age at injury, time-post injury) and elevated suicidality post-injury. The absence

of any association between suicidality and severity of PTA may reflect the broader finding that it is people's appraisal of their situation post-injury rather than any objective measure of circumstances (in this case severity of injury as measured by length of PTA) that is more salient in predicting an individual's psychological reaction (Moore *et al.* 1989; Kendall & Terry, 1996).

The potential role of emotional/psychiatric disturbance as a strong predictor of elevated levels of suicide ideation is in line with the general population where psychiatric disturbance is a recognized predictor of suicide (Bongar, 1991). The frequency of post-injury emotional/psychiatric disturbance within the sample is similar to previous reports (Kinsella *et al.* 1988; Shoumitro *et al.* 1999) and the co-morbidity of this disturbance with suicide attempts indicates the importance of providing effective clinical management and support of people in emotional distress post-injury. Importantly, this variable spanned a range of clinical presentations, from those with diagnosed mental illnesses through to people on anti-depressant medication or receiving counselling for depression/mood disturbance.

In examining the possible role of age and gender as suicide risk factors, the lack of relationship between age at injury and suicidality indicates that youth 25 years and younger had no greater vulnerability to suicidality after TBI than those who sustain the injury at an older age, although the rates of ideation and attempts among youth with TBI may still be higher compared with the youth rates in the general community (Schweitzer *et al.* 1995). The finding that males made a significantly greater number of attempts relative to females than would be expected from the gender ratio of those who attempt suicide in the general community needs further replication.

The findings raise some important questions for suicide risk assessment. First, in our earlier report of eight cases of completed suicide (Tate *et al.* 1997) we underscored the potential significance of pre-morbid psychosocial variables, especially risk factors for suicide. However, while it was not clear how central these issues may have been in representing an underlying vulnerability to suicide post-injury, the possibility remains that pre-morbid risk factors

may well be potent predictors of completed suicide, but their contribution to suicide ideation/attempts is minimal. Therefore, while the current findings emphasize the need for close assessment of an individual's post-injury adjustment, a conservative approach is required in clinical management because of the seriousness of this clinical issue, and evidence of risk factors from the pre-morbid history need to be given due attention.

The other implication stemming from the findings for suicide risk assessment is that although both regression analyses were statistically significant, at the clinical level the models may have limited applicability due to their relatively low sensitivity (56.4% and 33.3% in Analyses 1 and 2 respectively), in contrast to the very high specificity in each respective analysis (92.5% and 97.2%). These patterns of low sensitivity and high specificity suggest that the current set of variables in the models have limited utility at identifying those with high suicide ideation or those who make suicide attempts, but those individuals who are identified as such are very likely to have high suicide ideation/make suicide attempts (i.e. false positive errors are low). The difficulty of predicting clinical features of suicidality is a broader challenge in the field of suicide research and Bongar, in an evaluation of the state of knowledge about suicide risk assessment concluded that in spite of '... the enormous amount of empirical and clinical research on the subject, completed and attempted suicide are not precisely understood phenomenon' and further that '... there is a lack of consensus on specific causal pathways and on the weight and significance to be given to various ... factors' (1991, p. 30).

There are a number of clinical implications that flow from the findings of this study for the assessment, management and prevention of suicidality after TBI including: (i) the recognition that suicidality is a common psychological reaction to TBI requiring proactive assessment; (ii) an understanding that people will be at risk regardless of the degree of injury severity, or the age at which the injury occurs; (iii) that brain injury services need to provide support to people with TBI over the long term, because a suicidal crisis may not occur until many years post-injury; (iv) that any suicide risk assessment of people with TBI should include the interrelated

triad of hopelessness, suicide ideation and post-injury suicide attempts; (v) that particular monitoring and social support should be given to people exhibiting a broad spectrum of emotional/psychiatric disturbance; and (vi) that services explore ways of countering the widespread hopelessness common after TBI.

To date, clinicians have had a limited knowledge base to draw on in the assessment and treatment of people with TBI who are suicidal. The current study seeks to redress this lack of data, outlining some of the parameters and inter-related dynamics of suicidality after TBI. Further research is required to explore a range of important issues. These include the link between neuropathology of TBI, depression and subsequent suicidal behaviours. Furthermore, a closer examination is needed of the role of specific psychiatric conditions, the role of cognitive impairments in reducing an individual's coping abilities, the potential interaction between cognitive impairments and clinical factors in increasing risk of suicidal behaviour, and further study of the patterns of suicide attempts post-injury. The challenge is to then link the emerging findings into improved clinical management and prevention practices. The driving force behind these efforts is not so much the desire to understand fully this complex phenomenon, but rather to learn enough so that, in the terms of Bongar and colleagues, we can better 'attempt to meet the immediate need to keep the person alive' (1989, p. 64–65).

Funding support was provided by the New South Wales Motor Accidents Authority and the Brain Injury Rehabilitation Unit. Thanks to Linda Jurgevic for reviewing the medical files.

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