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Predictors of psychological distress following major trauma

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ABSTRACT

Aim: The aim of this study was to identify variables that may predict later psychological distress in patients following admission to a Major Trauma Centre (MTC) and to determine whether a psychological screening tool, the Posttraumatic Adjustment Screen (PAS), administered on admission was able to contribute to this.

Methods: Patients referred to the MTC clinical psychology service completed the PAS during their inpatient stay over an eight-month period. Following discharge from hospital, patients were telephoned (1 month, 3 months and 6 months post injury) by a member of the clinical psychology team and asked two validated questionnaires; the Impact of Events Scale revised (IES-R) (measure of posttraumatic stress symptoms) and the CORE-10 (measure of global psychological distress). In addition, patients' data from the local Trauma Audit & Research Network (TARN) database was reviewed to identify information related to injury and other demographic data. Patients were divided into groups for comparison based upon their PAS scores using previously described severity cut offs for posttraumatic stress symptoms and depression. Receiver Operator Characteristic and Multiple Linear Regression analysis was used to examine for significant baseline predictors of psychological distress during follow up according to the IES and CORE-10 scores.

Results: One hundred and fourteen patients completed the PAS over the study period. Follow-up psychological data was available for 63 (56%) of patients. Except for the patient's home address, no baseline parameter examined in this study regarding patient demographics, injury or treatment was associated with reported psychological symptoms in the first six months post injury as measured by the IES-R or CORE-10 scores. Multiple linear regression analysis revealed that both PAS-P and PAS-D were significant predictor variables for patients reporting significant symptoms of posttraumatic stress and global psychological distress (according to IES-R and CORE-10 scores) in the first six months post injury.

Conclusions: Psychological screening on admission may be helpful in identifying patients admitted to MTCs who are at risk at developing posttraumatic stress symptoms and psychological distress following major trauma.

Introduction

Trauma remains the leading cause of death in those aged under 40 in the United Kingdom. [1] The introduction of the UK Major Trauma Network has resulted in concentration of patients with the most severe injuries in specialist centres [2].

The network utilises a 'hub and spoke' design, where patients triaged as major trauma by the pre-hospital team bypass local hospitals to receive specialist care in the regional Major Trauma Centre (MTC). The effectiveness of this approach in terms of saving lives has been demonstrated, with a reported reduction in mortality of approximately 20%. [3,4,5,6]

Posttraumatic stress disorder (PTSD), depression and anxiety are all widely reported sequelae of significant injury. [7] It has been estimated that approximately one-third of patients with major trauma suffer persisting significant psychological impact [8]. [9] In some patients this may have greater long-term consequence than any physical functional loss [10]. Large prospective studies have identified a high prevalence of psychological disorders following traumatic injury that may be associated with reduced quality of life and occupational outcomes [11,12,13,14]. Findings from the Trauma Recovery Project (TRP) have identified that post injury depression and PTSD are significant predictors of quality of life six months following trauma [15]. Previous research has identified a number of variables as being associated with the development of PTSD following injury including intensive care unit admission,

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intentional injury, previous trauma, female gender, ethnic minority heritage, and pre-existing psychiatric disorders [16,17,18].

Whilst resource allocation in creating the Major Trauma Networks has focused primarily on saving lives and restoring physical function, some attention has been given to addressing this psychological impact. Access to psychological services is a requirement of the NHS Standards Contract for Major Trauma Service', which defines required services for MTC designation [19].

One issue in targeting resources is correctly identifying those who might benefit most from psychological assessment and intervention. One approach is to focus on those who are the most severely injured or who have suffered particular injury mechanisms. Specific tools also exist to screen injured patients for risk psychological conditions, one example being the Posttraumatic Adjustment Screen (PAS) [20]. The aim of this study was to identify what variables may predict later psychological distress in patients following admission to a Major Trauma Centre (MTC). Furthermore, it was to determine whether a psychological screening tool, the PAS, administered on admission was able to predict later psychological distress. This may then help triage patients to appropriate treatment, in particular psychological treatment.

Methods

All patients admitted to Leeds General Infirmary Major Trauma Ward between October 2016 and May 2017 who were referred to clinical psychology were approached. This service is routinely offered to all patients cared for under the major trauma service and includes those with multiple injuries, complex isolated extremity trauma and open fractures. Members of the multidisciplinary Major Trauma team discuss the clinical psychology service with patients and refer those patients who have given consent for a referral to be made. For those patients who were referred, a clinical psychologist routinely administered the Posttraumatic Adjustment Screen (PAS) at first contact during their inpatient stay, prior to any psychological assessment or intervention. Patients consented to complete the PAS and to be contacted for follow-up via telephone following discharge from Leeds General Infirmary MTC. Contact details for patients were obtained from the medical records. The PAS is a 10-item validated measure developed to screen adults for risk of psychological distress following traumatic injury. [20] It is freely available to use, administered on paper and scored manually. The PAS produces a score related to PTSD (PAS-P) and a score related to depression (PAS-D) [20]. Patients were divided into groups for comparison based upon their PAS-P and PAS-D scores using previously described severity cut offs [9,20]. For PAS-P, a score of 16 or more indicates patients at risk of developing PTSD and for PAS-D, a score of four or more indicates patients at risk of developing depression.

Following discharge from hospital, patients who had completed the PAS were contacted by telephone and asked to complete two validated assessments of their current psychological state (at 1 month, 3 months and 6 months post injury). The IES-R is a measure of posttraumatic stress symptoms and the CORE-10 is a measure of global psychological distress [21,22]. Validated cut offs for these scores were used to define significance. For IES-R a score of 33 or more indicates a patient suffering from clinically significant symptoms of PTSD and for CORE-10, a score of 15 or more indicates a patient suffering moderate or worse global psychological distress. [22,23], The worst recorded psychological scores (the highest score that each patient scored on the IES-R and CORE-10) over the 6-month period were used as the main outcome measure. The study period was a total of 18-months.

In addition, our local Trauma Audit & Research Network (TARN) database was reviewed to identify information related to injury and other demographic data. This supplies data to the national audit and research database for injured patients. Variables include; gender, age, postcode, treating hospital, mechanism of injury, Cardiovascular status on arrival, intubation, GCS on arrival to the emergency department at initial treating hospital, length of hospital stay, ICU admission, and Injury Severity Score. The number of patients who accepted outpatient clinical psychology support was also recorded. Patients socioeconomic status was estimated by retrieving the Index of Multiple Deprivation (IMD) for their postcode from the 2015 version of the UK Ministry of Housing, Communities and Local Government website. This ranks UK postcodes from one (most deprived) to 32,844 (least deprived) based upon multiple social and economic domains and is the official measure of relative deprivation for small areas in England. [24]

Statistical analysis

Statistical analysis was undertaken using *Analyse-it* software for Microsoft Excel (Version 4.9). [25] Key variables were either not truly continuous or their distribution significantly skewed (Shapiro-Wilks test $p < 0.05$) and therefore did not meet the-assumptions for parametric analysis. Results were therefore described using the median as a measure of central tendency and both the interquartile (IQR) and absolute range as a measure of spread. Non-parametric methods were used to test for statistically significant differences between groups. A Wilcoxon-Mann-Whitney or Kruskal-Wallis test was used to compare location of data between groups as appropriate. A Fisher's Exact or Chi-Squared test was used to compare nominal variables. Association between continuous variables was examined using a Spearman's Rank correlation coefficient.

Multiple linear regression models were constructed using IES-R or CORE-10 as response variables and PAS-P or PAS-D as predictors along with ISS, ICU admission and whether the patient usually lived in the primary catchment of the Major Trauma Centre. All predictor variables were included in the model simultaneously and the number of predictors was limited to 4 given the convention to include only one variable per 15–20 study participants.

ROC (receiver operating characteristic) curves were used to examine the ability of the psychological screening tests (PAS-P and PAS-D) to identify patients who reported symptoms of PTSD or psychological distress (according to IES-R and CORE-10 scores) during the follow-up period. An IES-R of 33 or more and a CORE-10 of 16 or more were used for this purpose. Decision threshold plots derived from these curves were used to examine the effect of using different cut of levels of PAS-P or PAS-D for screening purposes. Statistical significance was assumed at the $p < 0.05$ level.

Results

Patients and baseline variables

One hundred and eighty two patients meeting the inclusion criteria over the study period were identified. PAS-P and PAS-D scores were available for 114 included study participants. There were 68 patients who did not complete the PAS due to clinical reasons. Demographic, treatment and injury data was complete for all 114 patients. Follow-up psychological data was available for 63 (56%) of patients. Sixty percent of the patients were male, with a median age was 45 years (IQR 23 to 58, range 16 to 89). Sixty nine percent of patients lived outside of the primary catchment area of the hospital (out-of-region). The median IMD rank based upon the patient's postcodes was 13,227 (IQR 5936 to 22995, range 11 to 31,557). Seventy one percent of patients received their entire care in our unit, 23% were initially assessed elsewhere and then transferred to our MTC for specialist care. Four percent of patients were transferred back to a local hospital for rehabilitation once their requirements for specialist care had passed, prior to discharge

home. The remaining two percent were both transferred to the Major Trauma Centre from a smaller non-specialist hospital (trauma unit) for specialist care and returned to their local units prior to discharge. Table 1 shows injury variables for the overall group and divided by availability of follow up psychology scores (IER-R and CORE-10). There were no statistically significant differences in any of these baseline variables other than the proportion presenting with haemodynamic instability when comparing the patients who had returned their follow-up psychological questionnaires and those who had not. A total of 25 (of 114) patients who completed the PAS as an inpatient, opted in for clinical psychology outpatient follow-up.

Psychological scores

The median reported PAS-P and PAS-D scores during initial admission were 11 (IQR 7–16, range 1–32) and four (IQR 2–8, range 0–18) respectively. Thirty-two patients (28%) screened high risk of PTSD (PAS-P 16 or more) and 68 (60%) patients screened high risk of depression (PAS-D 4 or more). Neither PAS-P nor PAS-D correlated with overall trauma severity as measured by Injury Severity Score (ISS) nor socio-economic status as measured by the IMD (Spearman's Rank). There was a weak negative correlation between age and both PAS-P (Spearman's Rank rs -0.2, 95% CI −0.02 to −0.38, p = 0.03) and PAS-D (rs −0.2, 95% CI −0.01 to −0.38, p = 0.04).

Table 2 shows PAS-P and PAS-D scores associated with different baseline variables. Of these variables, only mechanism of injury demonstrated any statistically significant relationship, with victims of stabbings reporting higher PAS-P and PAS-D scores than any other mechanism (Kruksal-Wallis test overall $p < 0.05$ for both with Dunnett test for multiple comparisons against Stabbing $p < 0.05$).

There was no statistically significant difference in PAS-P scores between patients who subsequently returned the follow-up psychological outcome scores and those who did not. (Median PAS-P 10 (IQR 7–15, range 1–32) vs 11 (IQR IQR 7–19, range 2–30), median PAS-D four (IQR 2–7, range 0–18) vs five (IQR 3–9, range 0–16). For the 63 patients returning IES-R and CORE-10 scores in the follow-up period, the median worst reported scores in the first 6 months were 20.5 (IQR 7.9–34, range 0–80) and 10 (IQR 4.9–14, range 0–35). This equates to 16 patients (26%) reporting symptoms of PTSD (IES-R 33 or more) and 29 patients (46%) reporting symptoms of global psychological distress (24% mild, 6% moderate, 8% moderate, no severe and 8% severe). Table 3 shows IES-R and CORE-10 scores associated with different baseline parameters. Patients who usually lived outside the normal catchment area of the Major Trauma Centre reported higher IES-R and CORE-10 scores during follow up, there was otherwise no statistically significant difference between the groups. There was no significant difference in the IMD rank between patients residing in our primary catchment area and those who did not. There was no statistically significant correlation between IMD rank and either worst reported IER-R or CORE-10.

There was no significant correlation between either IES-R or CORE-10 and age (Spearman's rank rs −0.15, 95% CI 0.10 to −0.40 and rs −0.21 95% CI 0.04 to −0.44, p = 0.09 respectively) or ISS (Spearman's rank rs 0.07, 95% CI -0.19 to 0.32 and rs 0.12 95% CI -0.14 to 0.37, p = 0.34 respectively). Baseline PAS-P correlated strongly with both follow-up IES-R (Spearman's rank rs 0.45, 95% CI 0.21 to 0.66, p = 0.0004) and CORE-10 (Spearman's rank rs 0.42, 95% CI 0.19 to 0.61, p = 0.0006) scores. Baseline PAS-D also correlated with follow-up IES-R (Spearman's rank rs 0.41, 95% CI 0.16 to 0.60, p = 0.001) and CORE-10 (Spearman's rank rs 0.32, 95% CI 0.07 to 0.53, p = 0.01).

The results of multiple linear regression analyses are shown in Table 4. In all models, the screening tools (PAS-P or PAS-D) were significant predictor variables for both CORE-10 and IER-R at follow up. Other variables that were included in the models did not improve this. Thus, with these variables controlled for, the screening scores remained significant predictors of reported psychological distress according to the utilized scoring systems in this group of patients.

The results of the ROC analysis can be found in Table 5. Both PAS-P and PAS-D were able to predict which patients would report symptoms of PTSD and psychological distress in the first six months as defined by raised IES-R and CORE-10. The curves demonstrated moderate efficacy with AUC values of around 0.7, no statistically significant differences were demonstrable between the efficacy of PAS-P or PAS-D for any outcome. Examination of the decision threshold plots for the ROC analysis revealed that for PAS-P, using a traditional cut off of 16 or more to select at risk patients had a sensitivity of 35% (95% CI 19–64) and a specificity of 86% (95% CI 72–95%) (Chart 1). Using a cut off of more than 10 had a sensitivity of 65% (95% CI 41–85%) and specificity of 58% (95% CI 42–73%) (Chart 1). Using these techniques for the PAS-D revealed that using a traditional cut off of four or more had a sensitivity of

Table 1
Summary of injury variables for all patients included in the study and divided by those who had completed psychology follow up scores and those who had not (IES-R and CORE-10 data available). (RTC – road traffic collision, Trauma team – patients initial assessment was by hospital trauma team, Haemodynamic Instability – Systolic Blood Pressure less than 90 mmHg on presentation, Intubated – patient underwent intubation as part of their initial management, GCS – Glasgow Coma Score on initial assessment in emergency department, ISS – Injury Severity Score, ICU – Intensive Care Unit – ICU length of stay only for those admitted to ICU). * - Statistically significant difference between groups (Odds Ratio 0.27 (95% CI 0.09 to 0.80), Fisher Exact p = 0.01).

Variable	All Patients (n = 114)	With Psychology Scores (n = 63)	Without Psychology Scores (n = 51)
Mechanism			
RTC	60 (53%)	38 (60%)	22 (43%)
Fall >2m	18 (16%)	8 (13%)	10 (19%)
Fall <2m	15 (13%)	10 (16%)	5 (10%)
Stab	9 (8%)	1 (1%)	8 (16%)
Crush	7 (6%)	3 (5%)	4 (8%)
Blunt assault	5 (4%)	3 (5%)	2 (4%)
Trauma Team (Yes)	73 (64%)	42 (68%)	31 (61%)
Haemodynamic instability (Yes)	23 (20%)	7 (11%)	16 (31%)*
Intubated (yes)	8 (7%)	5 (8%)	3 (6%)
GCS on arrival	15 (9-15, IQR 15-15)	15 (9-15, IQR 15-15)	15 (12-15, IQR 15-15)
ISS	9 (2-45, IQR 8-19)	8 (4-36, IQR 8-17)	8 (8-22, IQR 2-45)
Length of stay (days)	11 (2-45, IQR 7-16)	11 (3-40, IQR 8-16)	10 (2-45, IQR 6-15)
Admitted to ICU (yes)	44/114 (39%)	25/63 (40%)	19/51 (37%)
ICU length of stay (days)	2 (1-11, IQR 1-4)	2 (1-11, IQR 1-4)	2 (1-8, IQR 1-2.8)

Table 2
PAS-P and PAS-D results by different injury and demographic variables. (RTC – road traffic collision, Trauma team – patients initial assessment was by hospital trauma team, Haemodynamic Instability – Systolic Blood Pressure less than 90 mmHg on presentation, Intubated – patient underwent intubation as part of their initial management, GCS – Glasgow Coma Score on initial assessment in emergency department, ISS – Injury Severity Score, ICU – Intensive Care Unit. KW – Kruskal-Wallis test, WMW – Wilcoxon-Mann-Whitney test, *-statistically significant $p < 0.05$.

Variable	PAS-P (IQR) (n = 114)	Analysis	PAS-D (IQR) (n = 114)	Analysis
Male	10 (6 - 19)	WMW test	4 (2 - 7)	WMW test
Female	11.5 (8 - 16)	p = 0.33	5 (3 - 8)	p = 0.19
GCS 15	10 (7 - 16)	WMW test	4 (2 - 7)	WMW test
GCS <15	13 (7 - 26)	p = 0.15	5 (3 - 10.7)	p = 0.18
Not intubated	11 (7 - 16)	WMW test	4 (2 - 7)	WMW test
Intubated	10 (8 - 21)	p = 0.69	4 (2 - 9)	p = 0.89
Local patient	9 (4 - 15)	WMW test	4 (2 - 6)	WMW test
Not local patient	11.5 (7 - 18)	p = 0.071	5 (3 - 8)	p = 0.22
No trauma team	11 (5 - 15)	WMW test	4 (3 - 7)	WMW test
Trauma team	11 (5 - 17)	p = 0.55	4 (2 - 8)	p = 0.93
No shock	10 (7 - 15)	WMW test	4 (3 - 7)	WMW test
Shock	14 (7 - 20)	p = 0.21	6 (2 - 10)	p = 0.25
ISS 1-8	10 (6 - 17)	KW test	4 (3 - 9)	KW test
ISS 9-15	11 (8 - 16)	p = 0.88	5 (2 - 7)	p = 0.70
ISS >15	11 (7 - 16)		4 (2 - 8)	
Mechanism				
Fall >2m	7.5 (5 - 21)	KW test	4 (1 - 8)	KW test
Crush	9 (7 - 15)	p = 0.03*	2 (1 - 7)	p = 0.006*
Blows	9 (7 - 11)		3 (2 - 3)	
Vehicle incident	10 (7 - 15)		4 (2 - 7)	
Stabbing	20 (17 - 24)		9 (7 - 11)	
ICU care	10.5 (6-15)	KW test	4 (2-7)	KW test
No ICU care	11.5 (7-19)	P=0.24	4.5 (3-9)	P = 0.67
No operation	11 (7 - 14)	KW test	5 (2 - 8)	KW test
One operation	10.5 (6 - 18)	p = 0.95	5 (2 - 8)	p = 0.92
>1 operation	10 (7 - 20)		4 (2 - 7)	

Table 3
IES-R and CORE-10 results by different injury and demographic variables. (RTC – road traffic collision, Trauma team – patients initial assessment was by hospital trauma team, Haemodynamic Instability – Systolic Blood Pressure less than 90 mmHg on presentation, Intubated – patient underwent intubation as part of their initial management, GCS – Glasgow Coma Score on initial assessment in emergency department, ISS – Injury Severity Score, ICU – Intensive Care Unit. KW – Kruskal-Wallis test, WMW – Wilcoxon-Mann-Whitney test, *-statistically significant $p < 0.05$. Please note that for blunt assault and crush injuries absolute range given as only 3 observations in each category.

Variable	IES-R (IQR) (n = 63)	Analysis	CORE-10 (IQR) (n = 63)	Analysis
Male	17 (6 - 26)	WMW test	9 (4 - 13)	WMW test
Female	26 (15 - 36)	p = 0.08	12 (4 - 15)	p = 0.29
GCS 15	21 (9 - 33)	WMW test	10 (4 - 14)	WMW test
GCS <15	12.5 (6 - 54)	p = 0.79	8 (6 - 32)	p = 0.50
Not intubated	21 (8 - 34)	WMW test	10 (4 - 14)	WMW test
Intubated	15 (7 - 24)	p = 0.37	9 (6 - 10)	p = 0.61
Local patient	10 (2 - 24)	WMW test	5.5 (3 - 8)	WMW test
Not local patient	22 (13 - 35)	p = 0.04*	12 (7 - 15)	p = 0.008*
No trauma team	16 (6 - 28)	WMW test	8 (3 - 13)	WMW test
Trauma team	23 (10 - 34)	p = 0.36	11 (5 - 14)	p = 0.93
No shock	20 (7 - 31)	WMW test	9 (4 - 14)	WMW test
Shock	26 (11 - 41)	p = 0.52	14 (11 - 15)	p = 0.17
ISS 1-8	18.5 (5 - 26)	KW test	6 (3 - 13)	KW test
ISS 9-15	22.5 (13 - 36)	p = 0.47	11 (6 - 17)	p = 0.38
ISS >15	18.5 (7 - 31)		10.5 (6 - 14)	
Fall >2m	8 (0 - 45)	KW test	3 (1 - 21)	KW test
Crush	22 (18 - 35)	p = 0.93	11 (9 - 14)	p = 0.84
Blunt assault	14 (8 - 60)		8 (4 - 18)	
Vehicle incident	22 (10 - 34)		10 (5 - 14)	
Stabbing	21 (-)		14 (-)	
ICU care	23 (7-28)	KW test	10 (6-14)	KW test
No ICU care	19.5 (7-28)	p = 0.47	9.5 (4-14)	p = 0.64
No operation	20 (12 - 25)	KW test	12 (7 - 14)	KW test
One operation	19 (5 - 28)	p = 0.59	6 (3 - 14)	p = 0.18
>1 operation	25.5 (8 - 36)		10.5 (6 - 16)	

Table 4
Multiple Linear Regression Analyses: ***Core-10 or IES-R as response variable.*** All variables considered simultaneously. 4 models, one including each screening score (PAS-P or PAS-D) as a predictor variable for each outcome score (CORE-10 and IES-R). ISS (injury severity score), ICU (intensive care unit) admission during treatment and whether the patient usually lived in the primary catchment of the major trauma center also included in each model. For quantitative variables, parameter estimates represent the change in the response variable associated with a one-unit change of the predictor, all other predictors being held constant. For nominal predictors the parameter estimates represent the difference between the mean with that variable present and the overall mean. P-values for each variable indicatewhether is offers a statistically significant contribution to the model.

	CORE-10			IES-R		
Parameter	Estimate	95% CI	p-value	Estimate	95% CI	p-value
Constant	2.08	−3.13 to 7.29	–	6.41	−6.04 to 18.87	–
ISS	0.09	−0.15 to 0.33	0.48	0.14	−0.43 to 0.71	0.63
PAS-P	0.56	0.29 to 0.83	0.0001	1.09	0.45 to 1.73	0.001
ICU admission	−0.66	−2.70 to 1.37	0.52	0.10	−4.82 to 5.02	0.97
Primary patient	−1.77	−3.82 to 0.27	0.09	−3.89	−8.84 to 1.06	0.12
R^2	0.28			0.23		
P-value	0.0006			0.005		

B)

	CORE-10			IES-R		
Parameter	Estimate	95% CI	p-value	Estimate	95% CI	p-value
Constant	3.76	−1.42 to 8.94	–	7.38	−4.59 to 19.34	–
ISS	0.13	−0.12 to 0.39	0.31	0.28	−0.31 to 0.86	0.35
PAS-D	0.86	0.36 to 1.36	0.001	1.98	0.85 to 3.12	0.0009
ICU admission	−0.52	−2.63 to 1.59	0.62	0.12	−4.78 to 5.02	0.96
Primary patient	−1.98	−4.09 to 0.14	0.07	−4.27	−9.18 to 0.64	0.09
R^2	0.22			0.23		
P-value	0.005			0.004		

Table 5
Results of ROC analysis examining ability of baseline psychological assessments (PAS-P and PAS-D) to predict PTSD (IES-R) and psychological distress (CORE-10).

Outcome	Predictor Variable	AUC (95% CI)	Z	p-value
IES-R 33 or more	PAS-P	0.68 (0.52 to 0.83)	2.23	0.026
	PAS-D	0.72 (0.58 to 0.87)	3.02	0.003
CORE-10 moderate or worse	PAS-P	0.72 (0.55 to 0.90)	2.57	0.010
	PAS-D	0.67 (0.51 to 0.83)	2.05	0.041
Either IES-R 33 or more *or* CORE-10 moderate or worse	PAS-P	0.70 (0.55 to 0.84)	2.69	0.007
	PAS-D	0.67 (0.53 to 0.82)	2.35	0.019

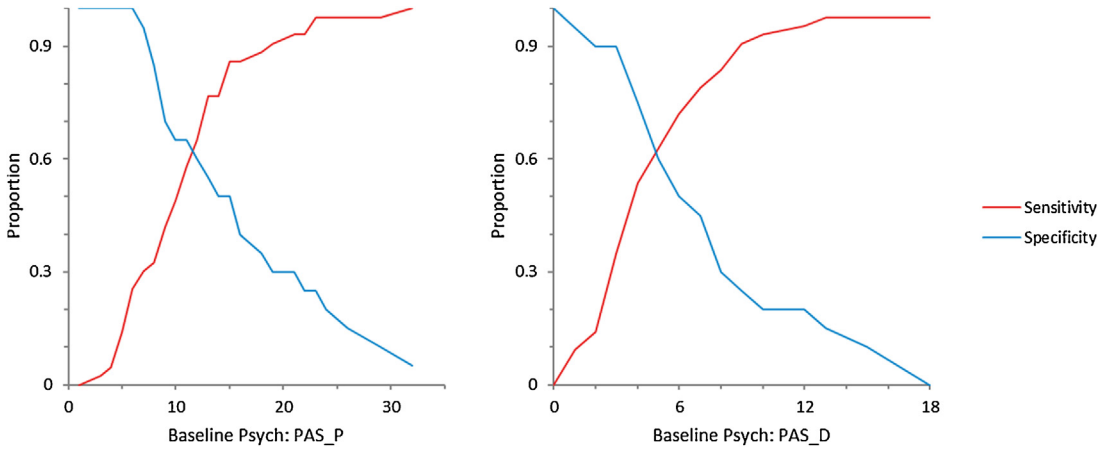

Chart 1. Decision threshold plots for PAS-p and PAS-d in identifying patients who went on to record either IES-R of 33 or more or CORE-10 scores of moderate or worse psychological distress in the first 6 months after discharge from the major trauma ward.

75% (95% CI 51–91%)and a specificity of 54% (95% CI 38–69%) whilst changing this to five or more changed these values to 60% (95% CI 36–81%) and 63% (95% CI 47–77%) respectively.

Discussion

The psychological trauma associated with major injury is well documented. [7 10 15] An apparently widely held perception amongst staff treating trauma patients is that those most with the most severe injuries are at most risk of experiencing psychological distress. The potential for adverse psychological outcome is often not considered in other patients and referral to psychology services may not occur or can be delayed. This is potentially problematic, as early intervention in high risk individuals' is associated with better outcome. [26] With limited resource, predicting which individuals are more likely to develop psychological distress is therefore vital. The aim of this study

was to evaluate predictors of psychological distress in a cohort of injured patients treated in a UK Major Trauma Centre and to establish whether a simple screening tool could augment other factors which have been traditionally considered. We were unable to demonstrate any statistically significant relationship between psychological responses and severity of injury or the majority of other patient factors considered. Elevated scores in the PAS-P and PAS-D questionnaires were however significantly associated with increased risk of later psychological distress following discharge.

When considering patient, injury and treatment variables, we found few statistically significant relationships with psychological outcomes. In particular, we found no relationship between overall injury severity, as measured by the ISS, and any of the psychological scores. This is perhaps surprising as the ISS is a well validated tool and has a well-established correlation with clinical outcomes including length of stay, complications and mortality [27]. One might naturally assume therefore that patients with more severe injuries, who are more likely to have a difficult treatment course, would be more likely to suffer adverse psychological outcome. This finding is however in keeping with previous studies which have also found no relationship between the ISS and development of PTSD or depression [27,28,33]. It is important that staff treating trauma patients are aware of this finding. Importantly, the patient's perception of the severity of their injury may impact on the way in which they experience the injury [29].

We found that patients who normally lived outside the area primarily served by our hospital were significantly more likely to report high PAS-D, PAS-P, IES-R and CORE-10 scores than those who did not. Many psycho- and socio-demographic factors may be linked to place of residence which might influence the psychological response to trauma. We could however find no link between socio-economic status (as estimated by the IMD of the patient's residential postcode) and the psychological screening or outcome scores. This perhaps suggests that something inherent about being treated away from a patient's usual place of residence influences their psychological response. Remote treatment will likely reduce access to the patient's usual social network more than would be the case if admitted to their nearest centre. Social support is a widely accepted influence on psychological wellbeing, and this is likely to be even more important at times of psychological stress from injury [30,31]. Patients taken to a major trauma centre for treatment may also perceive that their injuries are more serious than if the same injuries were treated at their local hospital and therefore suffer greater psychological reaction. These findings might be worthy of further investigation. Systems should allow family and friends to visit at their convenience and early repatriation of these patients should be arranged where appropriate to help maintain social support networks.

We found no relationship in our study group between ICU admission, intubation or requirement for surgical intervention and the likelihood of developing posttraumatic stress symptoms, depression or psychological distress. Only 8% of our patients required intubation and mechanical ventilation which may, in combination with a small study size, be the reason for not eliciting statistical significance. Previous studies have demonstrated a correlation between mechanical ventilation and psychological distress with up to 14% of patients developing PTSD following ventilation [32,33]. The main pre-disposing factor within these studies was the presence of any pre-existing psychiatric condition but the studies only included ICU patients, limiting generalisability to all trauma patients.

In this cohort of patients, we found little evidence of statistically significant relationships between injury mechanism and adverse psychological response. This is perhaps not surprising given the sample size and large number of different mechanisms involved, it is likely that a much larger study would be required for meaningful evaluation. The finding that stabbing was associated with worse psychological screening scores is in keeping with previous work. [34] Various studies have demonstrated the significance of direct, intentional interpersonal violence in the development of PTSD [35,36,37]. The screening tools we used in this study identified all but one of the nine patients who had been stabbed as at high risk of later abnormal psychological response. Unfortunately, only one of these patients returned psychology follow up scores making any conclusions on this finding difficult. This perhaps reflects an association between this injury mechanism and reduced engagement, meaning that patients in such situations should have additional efforts made to ensure appropriate follow-up treatment is available to them.

Correlation in our study cohort between PAS-D or PAS-P and the subsequent follow up assessment questionnaires (IES-R and CORE 10) is in keeping with findings from the original studies which developed and validated these tools in a cohort of Australian trauma patients. [20] Multivariate analysis revealed that PAS-P was a significant predictor variables for patients reporting significant psychological symptoms (according to IES-R and CORE-10 scores) in the first six months post injury. No other considered parameter improved this relationship.

ROC analysis revealed that using the traditional PAS-P cut off of 16 resulted in 88% specificity but only 35% sensitivity in predicting patients who would later develop PTSD or moderate depression according to the scoring systems utilised. Lowering this cut off to more than to 10 would increase sensitivity to 65%, this however lowers the specificity to 58%. It is important to balance the risk of missing patients who might have benefitted from intervention against the resource implications of making unnecessary referrals. However, given the use of this measure as a screening tool for further assessment, it is likely preferential to increase the true positive detection of patients who will later develop psychological pathology. PAS-D scoring on ROC analysis identified that utilising the traditionally recommended threshold of four or more was likely optimal. This provided a true positive rate of 75% and a false positive 46.5%. Given that these new cut offs have been defined from the study population, the sensitivity and specificity they suggest are potentially subject to inherent bias. These cut-offs would therefore need validating using an independent dataset.

The findings from this study suggest that the use of a screening measure, such as the PAS, may help identify major trauma patients at risk of later posttraumatic stress symptoms and depression. This is a self-administered questionnaire and requires minimal training to interpret. Clinical psychology resources remain relatively scarce and it is not usually feasible for qualified psychology staff to assess all injured patients. Using a screening tool might help more appropriately target formal psychological assessment, whilst also identifying patients in whom distress might not be readily apparent to clinical staff. Given that any patient may experience psychological distress following injury, including those who screen negative, flexible access to services remains important. We therefore feel that clinical psychology staff should form part of the multidisciplinary team caring for severely injured patients. Access to evidence-based psychological interventions for these difficulties is outlined within relevant National Institute for Health and Care Excellence (NICE) guidelines and is a service specification for commissioning of MTCs [38,39,40].

The present study included a relatively small sample size and unfortunately, 44% of our patients did not complete the IES-R and CORE-10 measures and were lost to follow up. Our study did not assess specifically for the presence of pre-injury psychiatric and psychological wellbeing. The impact of pre-existing psychological functioning on the psychological scores and outcome in our

patients is therefore unclear. Previous work suggests pre-traumatic psychiatric pathology is an important consideration in predicting later distress. [36] Furthermore, other variables which were not explored in the study, such as coping self efficacy, anger, and education level have been found to impact on psychopathology following traumatic injury [41]. This is a limitation of the study and further work is required to investigate this in more detail in trauma populations [34,42].

Conclusions

We conclude that the Posttraumatic Adjustment Screen (PAS) has reasonable accuracy in our series and shows promise in objectively identifying patients who might benefit from clinical psychology intervention at an early stage. It must be noted that such an approach still potentially misses a significant number of patients who might benefit from treatment and therefore clinicians treating trauma patients should remain vigilant for such problems during follow-up. It is important to highlight that patients with less severe injuries or less apparently violent injury mechanisms appear no less at risk.

Conflicts of interest

None.

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