Journal of Psychiatric Research 103 (2018) 229–236

Contents lists available at ScienceDirect

Journal of Psychiatric Research

journal homepage: www.elsevier.com/locate/jpsychires

Emergency room intervention to prevent post concussion-like symptoms and post-traumatic stress disorder. A pilot randomized controlled study of a brief eye movement desensitization and reprocessing intervention versus reassurance or usual care

Cédric Gil-Jardiné[a,b,*], Grégoire Evrard[a,b], Samantha Al Joboory[d], Juliane Tortes Saint Jammes[d], Françoise Masson[b,f], Régis Ribéreau-Gayon[b,c], Michel Galinski[a,b], Louis-Rachid Salmi[b,e], Philippe Revel[a,b], Cyril Alexandre Régis[d], Guillaume Valdenaire[a,b], Emmanuel Lagarde[b]

[a] University Hospital of Bordeaux, Pole of Emergency Medicine, F-33000, Bordeaux, France
[b] INSERM, ISPED, Bordeaux Population Health Research Center INSERM U1219-"Injury Epidemiology Transport Occupation" Team, F-33076 Bordeaux Cedex, France
[c] University Hospital of Bordeaux, Pole of Medicine, F-33000, Bordeaux, France
[d] CASPERTT, Hospital Center of Cadillac, 31 Rue des Cavaillès, F-33310 Lormont, France
[e] University Hospital of Bordeaux, Pole of Public Health, F-33000, Bordeaux, France
[f] University Hospital of Bordeaux, Pole of Anesthesia and Intensive Care, F-33000, Bordeaux, France

A B S T R A C T

Up to 20% of patients presenting at an emergency room (ER) after a stressful event will for several months suffer from very diverse long-lasting symptoms and a potentially significant decline in quality of life, often described as post concussion-like symptoms (PCLS). The objectives of our randomized open-label single-center study were to assess the feasibility of psychologist-led interventions in the context of the ER and to compare the effect of eye movement desensitization and reprocessing (EMDR) with reassurance and usual care. Conducted in the ER of Bordeaux University Hospital, the study included patients with a high risk of PCLS randomized in three groups: a 15-min reassurance session, a 60-min session of EMDR, and usual care. Main outcomes were the proportion of interventions that could be carried out and the prevalence of PCSL and post-traumatic stress disorder (PTSD) three months after the ER visit.

One hundred and thirty patients with a high risk of PCLS were randomized. No logistic problem or patient refusal was observed. In the EMDR, reassurance and control groups, proportions of patients with PCLS at three months were 18%, 37% and 65% and those with PTSD were 3%, 16% and 19% respectively. The risk ratio for PCLS adjusted for the type of event (injury, non-injury) for the comparison between EMDR and control was 0.36 [95% CI 0.20–0.66].

This is the first randomized controlled trial that shows that a short EMDR intervention is feasible and potentially effective in the context of the ER.

The study was registered at ClinicalTrials.gov (NCT03194386).

1. Introduction

According to a 2012 national survey in France, 10.6 million people came or were taken to the emergency room (ER), several times in some cases, accounting for 18 million visits recorded that year (Vuagnat, 2013). About half of these visits are the consequence of injury and more than 90% of patients will leave the service within hours, without hospitalization (Carrasco and Baubeau, 2003). Consistent recent studies (de Leon et al., 2009; Friedland and Dawson, 2001; McLean et al., 2009; Stovner et al., 2009) reveal that 10–20% of these injured patients for several months after the event will suffer from very diverse symptoms often associated with a potentially significant decline in quality of life, delay in return to school or work activities and change in social and family relationships. Extrapolating these figures to the annual number of ER visits in France led us think that at least one million people each year could be concerned by varying degrees of difficulty in the months following an ER visit. The potential link with the initial event, often unidentified, is all the more difficult to make as these symptoms are

* Corresponding author. University Hospital of Bordeaux, Pellegrin Hospital, Emergency Department, Place Amélie Raba-Léon, 33000 Bordeaux, France.
E-mail address: cedric.gil-jardine@chu-bordeaux.fr (C. Gil-Jardiné).

https://doi.org/10.1016/j.jpsychires.2018.05.024
Received 24 October 2017; Received in revised form 23 May 2018; Accepted 25 May 2018

non-specific: headaches, concentration disorders, memory problems, stress intolerance, personality change, irritability. They have been described for more than 50 years, in the context of head injury, and thus referred to as the post-concussion syndrome (PCS). Recent studies suggest that these symptoms are not specific to brain injuries and can occur for all types of trauma (Laborey et al., 2014; Lagarde et al., 2014; McLean et al., 2009; Smith-Seemiller et al., 2003), greatly expanding the size of the population concerned. They are henceforth now frequently described as post concussion-like symptoms (PCLS) (Edmed and Sullivan, 2012).

Further, the results of a study we conducted among injured patients admitted to the ER (Lagarde et al., 2014) reinforced the hypothesis that concussion-like symptoms included ones that were very similar to those of the hyperactivation and numbing dimensions of post-traumatic stress disorder (PTSD) (Diagnostic and Statistical Manual of Mental Disorders, 2013). This led us, with other authors (Edmed and Sullivan, 2012), to raise the hypothesis that PCS and PTSD partly share a causal pathway in which stress plays a key role. Another interesting result of our previous study (Lagarde et al., 2014) was that a small set of measurable factors were associated with the risk of PCS and PTSD, paving the way to the development of simple assessment tools to identify a subset of high-risk patients. Consistently, several studies conducted in the past five years noted that patients' psychological vulnerability and stress experienced during and in the aftermath of the event that led to ER admission were the two most predictive elements of these long-lasting symptoms (Bernard et al., 2016; Lee et al., 2015; Losoi et al., 2016; Manners et al., 2016; Stein et al., 2016). These result prompted us to consider testing the feasibility and the effectiveness of stress management interventions during ER stay, with the hope of improving outcomes of injured patients, but also of all patients presenting at the ER and who experience stress either related to an event (accident or medical condition) or to the ER stay. While no result is available in the literature concerning the prevention of PCLS, studies evaluating interventions for PTSD prevention are sufficient in number and quality to identify credible modes of intervention. We identified eye movement desensitization and reprocessing (EMDR) (Bisson et al., 2013) as an intervention both promising and potentially suitable for use in the ER:, for which. Because of (i) the strong overlap between PTSD and PCLS, (ii) the importance of stress as reported in the ER in the sustained PCLS three months later, and (iii) the availability of a shortened adapted protocol (Jarero et al., 2011; Quinn, 2013; Shapiro and Laub, 2013), we decided to define a first comparison group of the trial with patients recieving the EMDR intervention by trained psychologists. We selected reassurance as a second comparison group as a small number of study reports suggest a preventive potential of reassuring patients about recovery and persistent symptoms (Absolom et al., 2007; Odeen et al., 2013; Pincus et al., 2013; Schmulson et al., 2006). This second intervention group will allow us to compare the impact of EMDR with a shorter interaction by the same trained psychologists.

We conducted a pilot randomized controlled study to assess the feasibility of psychologist-led interventions in the context of the ER and to compare the 3-month rate of PTSD and PCLS among patients presenting at the ER, assessed as being at high risk for these two syndromes and randomized in three groups: a 15-min reassurance session, a single 60-min session of EMDR, compared with usual care.

2. Patients and method

2.1. Study design

Between October 1st and December 31st, 2016, we conducted a randomized open-label single-center study in the ER of Bordeaux University Hospital, one of the main ERs in the region of Nouvelle-Aquitaine, accounting for more than 52 000 admissions per year. Patients were then contacted at 3 months by phone, to assess the prevalence of PCLS and PTSD symptoms.

2.2. Participants

All patients aged 18 years or more, admitted to the ER were assessed for study inclusion using a scoring tool designed to select patients with a high risk of PCLS. The score items were selected using data from a previous study we conducted among more than 1963 injured patients presenting to the ER (Lagarde et al., 2014) and split into a training sample (2/3) and a testing sample (1/3). Items included gender (+1 point for Female), self-assessment of health conditions before admission (0 for Excellent to +3 for Poor), and history of anxiolytic use (+1). The assessment tool developed in the training sample was validated in the testing sample, and yielded an sample an area under the curve of 0.67, a positive predictive value of 51%, and a negative predictive value of 74% for a score threshold of 2. Patients with a score strictly higher than 2 therefore had a PCLS prevalence at 3 months of 51%, as compared with 29%. Exclusion criteria were altered consciousness (defined as Glasgow coma scale score less than 14), cognitive impairment, confusion according to the attending ER physician, not speaking French, unable to be contacted by phone, requiring admission to the operating room or critical care unit. Patients admitted to the ER for an injury were excluded if the event had occurred more than 24 h before. People admitted to the ER for a medical disorder were excluded if the problem had already been assessed or discovered during a previous ER visit. All participants provided written informed consent to participate.

2.3. Recruitment and randomization

The identification and recruitment of potential study participants were carried out between 8 a.m. and 6 p.m. by the ER staff, under the supervision of the project manager, as soon as the patient's condition permitted, always after the initial clinical evaluation conducted as part of usual care. Included patients were randomized into one of three groups: (i) care as usual; (ii) 15-min reassurance session; (iii) 60-min EMDR session (using the EMDR recent traumatic episode protocol as described below).

The randomization plan was established before the study began. The study protocol was open-label, but the randomization group allocation was masked to the personnel in charge of calling the participants at 3 months and to the statistician in charge of the analysis.

2.4. Interventions

2.4.1. Care as usual

Patients in this control group were medically and psychologically attended to by ER staff with no intervention of the study psychologist.

2.4.2. Reassurance

During the 15-min reassurance intervention, participants were educated regarding the response to stressful medical events. The therapist also identified, discussed, and challenged any cognitive distortions such as unrealistic beliefs about being responsible for their injury or medical event.

2.4.3. The EMDR recent traumatic episode protocol (R-TEP)

Due to the situation and conditions in the ER, a brief EMDR intervention, utilizing the *R-TEP protocol,* was chosen (Shapiro and Laub, 2013). This protocol is specially designed for victims of recent traumatic events based on Francine Shapiro's early EMDR intervention protocols (Shapiro, 1989). It takes into account the fragmented, unconsolidated nature of recent traumatic memories and the need for safety and containment. After identification, disturbing fragments are processed using a current trauma focus. Sessions were carried out by two trained psychologists from a team specialized in the management of patients with psychological trauma (Center d'Accueil SPEcialisé dans le Repérage et le Traitement des Traumatismes psychiques (CASPERTT) of the Cadillac hospital center (Gironde, France)).

One of the two psychologists was present every day of the study and performed either an EMDR or reassurance session. No specific room was allocated to the study. The intervention sessions could be performed in any available closed treatment room, at the bedside. The psychologist had to make sure that no specific care was needed in the following hour (15 min for reassurance) before starting the intervention.

2.5. Data collection during ER stay

Participants were asked at ER admission and discharge to describe, using 0-to-10 numerical rating scales, their stress level, acute pain intensity, and their expectation for recovery. In the admission questionnaire, patients were asked to rate on a 5-item scale their overall health condition just before the event, and one year earlier. Finally, they were asked in the discharge questionnaire to rate their satisfaction with the ER stay using a 0-to-10 numeric rating scale.

2.6. Measure of primary outcome: EMDR completion rates

Feasibility was assessed by the completion rate of the intervention in the EMDR group defined by the proportion of patients randomized in the EMDR group who received the intervention before leaving the ER. The reasons for noncompletion were also recorded (patient refusal, logistic problems).

2.7. Measurement of secondary outcomes: PCLS and PTSD at 3 months

Patients were contacted by phone 3 months after the ER visit using the phone number provided by the patient during ER recruitment. Whenever needed, several attempts were made; attempts to contact a patient were interrupted when the time since admission exceeded 3 months plus one week. Symptoms were assessed with a standardized questionnaire administered by one of the investigators, none of whom were aware of the randomization group of the interviewee. PCSL was defined using the ICD-10 definition of PCS ("WHO | International Classification of Diseases," n.d.). PCLS was defined as reporting at least 3 symptoms among the following: headache, dizziness, sleeping disorders, fatigue, irritability, decreased stress tolerance, memory trouble and concentration disorders. Further, questions related to symptoms listed in the DSM-IV-TR definition of PCS and Rivermead Post-concussion Symptoms questionnaire (King et al., 1995) were added to the 3-month questionnaire in order to test the sensitivity of our results to the definition of PCS.

As regard to PTSD, because the risk assessment score was developed from a previous study we conducted using the fourth version of the diagnostic and statistical manual of mental disorders, text revision (DSM-IV-TR) (American Psychiatric Association, 2000), it was assessed using the PTSD checklist – civilian version based on DSM-IV-TR. (Blanchard, E. B., Jones-Alexander, J., Buckley, T. C., & Forneris, C. A. (1996). Psychometric properties of the PTSD checklist (PCL). Behavioral Research & Therapy, 34, 669–673). PTSD was defined as follows: Criterion A: all patients were supposed to have been exposed to a traumatic event; Criterion B: at least one of the re-experiencing symptoms (reliving the event through upsetting thoughts, nightmares or flashbacks, or having very strong mental or physical reactions if something reminds the person of the event); Criterion C: at least three of the avoidance and numbing symptoms (avoiding activities, thoughts, feelings, conversations, people, or places that remind the person of the event; having markedly diminished interest or participation in significant activities; feeling of detachment or estrangement from others; having restricted range of affect; having sense of foreshortened future; or being unable to recall important aspects of the event); Criterion D: at least two alterations in arousal and reactivity (feeling that one can never relax and must be on guard all the time to protect oneself; trouble sleeping; feeling irritable or angry outbursts; overreacting when startled; or trouble concentrating), functional significance and exclusion; Criterion E: the duration of disturbance was more than 1 month; Criterion F: reported symptoms interfere seriously with leading a normal life.

2.8. Sample size

The sample size was planned to be able to evidence a 40% decrease in PCLS in the EMDR group as compared with the "care as usual" control group. With a 20% prevalence of PCLS in the general population as estimated from our previous study (Lagarde et al., 2014), of 70% in the high-risk population, an alpha risk of 5% and a power of 80%, we needed 32 patients in each group. Anticipating a 10% rate of loss to follow-up, the protocol aimed to include 36 patients per group.

2.9. Statistical analysis

Primary outcome analysis simply consisted in observing the proportion of patients randomized to the EMDR group who successfully received the intervention. Secondary outcome analyses were performed using the chi-square test to compare the of 3-months prevalence of PCLS and PTSD among the three treatment groups. Because the phone number was only collected at the end of the ER stay (discharge questionnaire), it was not possible to contact participants who were randomized but did not go on to receive the intervention they were allocated to. Consequently, only a per-protocol analysis could be performed.

A Mantel-Haenszel estimates of the risk ratio for the association between PCLS and treatment group stratified on the cause of ER admission (injury or non-injury) was performed. Complementary analyses were performed using DSM-IV-TR and Rivermead PCS definitions instead of ICD-10. A worst-case scenario was also analyzed in which all participants who were randomized in an intervention group but who did not complete the protocol and could therefore not be contacted 3 months later were recorded as having PCLS.

2.10. Role of the funding source, administrative and ethical clearance

The study was approved by the local institutional ethics committee (Comité de protection des personnes Sud-Ouest Outre-Mer III).

The study was registered at ClinicalTrials.gov (NCT03194386).

3. Results

3.1. Recruitment, follow-up and EMDR R-TEP feasibility

Of 933 patients assessed for inclusion, 13 declined and 447 were excluded either because the event occurred more than 24 h before ER admission or because the cause of ER admission was a non-injury condition that was already known (Fig. 1). Finally, we included 343 patients with a low risk of PCLS and 130 with a high risk of PCLS (Table 1). Patients of the latter group were randomized. There were no differences in the characteristics of the three treatment groups except for a lower proportion of injury events in the control group (Table 2). The numbers of patients who declined participation did not differ between groups (3, 2 and 2 patients in the control, reassurance, and EMDR groups, respectively). No exclusion due to clinical state worsening or early discharge was recorded in the control group, while respectively 3 and 5 patients were excluded for these reasons in the EMRD and reassurance groups. At 3 months, the number of patients lost to follow-up was low, with 1 patient who could not be contacted and 1 patient who died in each group (overall follow-up proportion was 95%). The patient in the control group was a 78-year-old man admitted to the ER following a hemorrhagic stroke. He was diagnosed with metastatic lung cancer and transferred to the intensive care unit where he died from massive hemoptysis 7 days later. The patient in the reassurance group was a 62-year-old man admitted to the ER because of

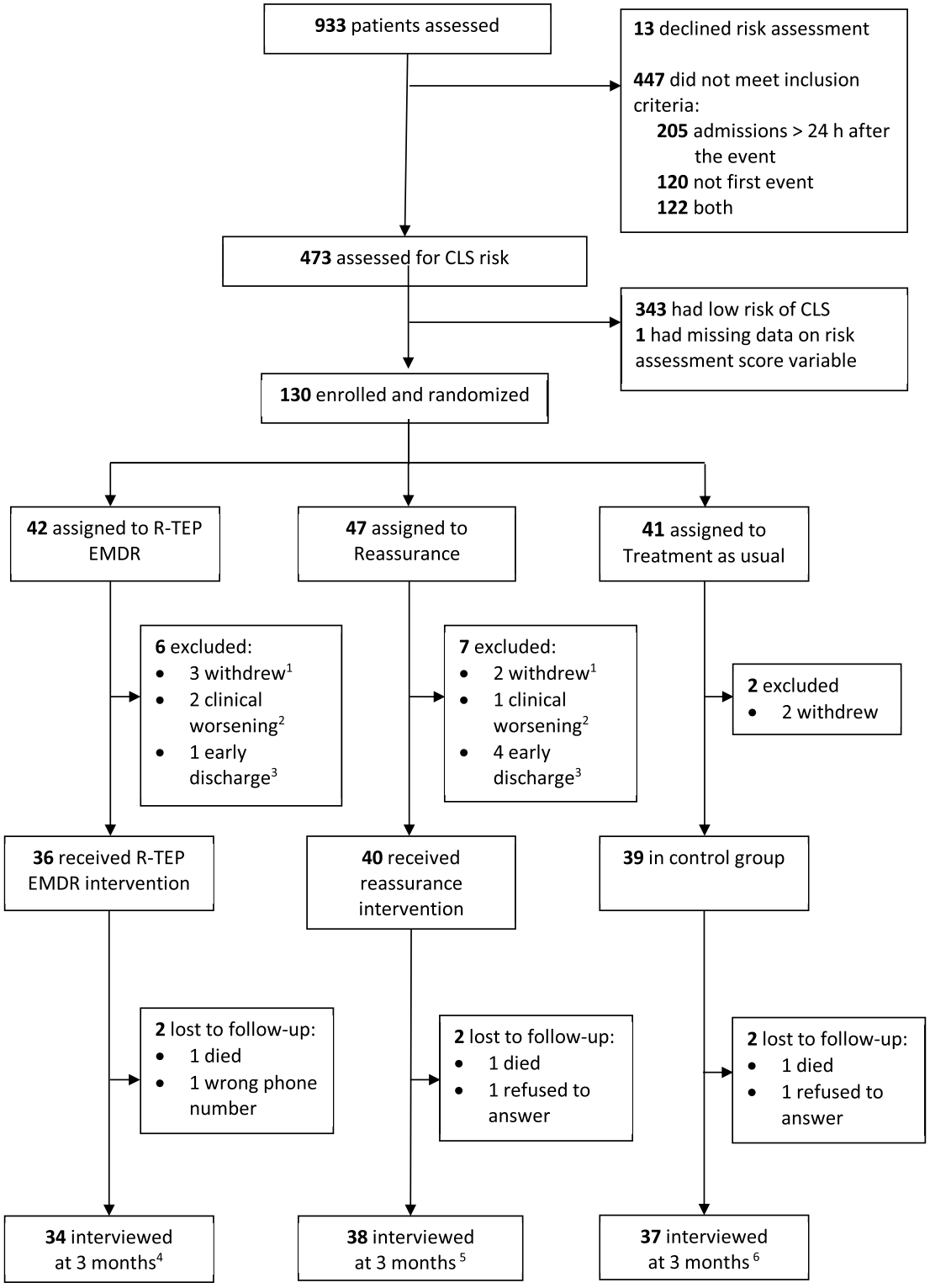

Fig. 1. Study flow chart.
1 Patients who provided consent and eventually declined before discharge.
2 Any change in patient clinical condition precluding patient participation.
3 Patients who left the emergency room before the discharge questionnaire or the interview with the psychologist, either because refused to wait for the psychologist, or because an ambulance came to pick them up for transfer.

anemia. He received a blood transfusion and returned home after 24 h. The patient died before the three-month follow-up call. The patient in the EMDR group was a 67-year-old man who attempted to commit suicide by poisoning 5 days after the intervention. He was admitted to the intensive care unit and then transferred to the psychiatric hospital where he committed suicide by hanging the following day. The patient had been diagnosed 2 months before participating in the study with relapsed glioblastoma. The case was reviewed by an independent psychiatrist who looked for any potential link between the intervention and the suicide attempt. The review concluded that the study

Table 1
Sociodemographic characteristics of patients assessed with low and high risk of Concussion-Like Symptoms.

	Total Sample		Risk Assessment Score				p-value
			< 3		> = 3		
	n	%	n	%	n	%	
Total	472	100	342	100	130	100	
Age median [IQR[a]]	40	[27–57]	38	[26–53]	46.5	[30–65]	0.10
Female	251	53	143	42	108	83	$< 10^{-5}$
Anxiolytic use	91	19	28	8	63	48	$< 10^{-5}$
Perceived health							$< 10^{-5}$
Poor	31	7	5	1	26	20	
Mean	130	27	43	13	87	67	
Good	198	42	181	53	17	13	
Very good	81	17	81	24	0	0	
Excellent	32	7	32	9	0	0	

[a] IQR: Inter Quartile Range.

Table 2
Sociodemographic characteristics of the study population and evaluation of principal and secondary outcome.

	R-TEP EMDR (N = 34)	Reassurance (N = 38)	Control (N = 37)
Population characteristics			
Age, year –median (IQR[a])	49 (34.5–67.75)	41.5 (22–58.75)	46 (30–64)
Gender – N (%)			
Male	5 (14.7)	3 (8.1)	6 (16.2)
Female	29 (85.3)	35 (92.1)	31 (83.8)
Event type – N (%)			
Injury:	16 (47.1)	20 (52.6)	10 (27)
Road traffic crash	5	4	2
Fall	9	10	4
Other accidents[b]	1	4	4
Assault	1	1	0
Suicide attempt	0	1	0
Medical:	18 (52.9)	18 (47.4)	27 (73)
Neurology	10	2	15
Abdominal	2	8	6
Other[c]	6	8	6
Pain intensity, NRS – Median (IQR[a])			
Mean score at admission	5.5 (4–7)	6 (3–7)	5 (3–7)
Mean score at discharge	3 (0.25–5)	5 (0–6)	4 (0–7)
Intensity of stress, NRS[d] – Median (IQR[a])			
Mean score at admission	4 (2–6)	3 (1–7)	5 (2–7)
Mean score at discharge	2 (1–3)	2.5 (1–4.75)	4 (1–6)
Odds of recovery, NRS[e] – Median (IQR[a])			
Mean score at admission	10 (7.25–10)	8.5 (6–10)	10 (6–10)
Mean score at discharge	10 (8–10)	9.5 (7.25–10)	10 (7–10)
Symptoms reported at admission (past 12 months) – N (%)			
Poor concentration	20 (58.8)	20 (52.6)	15 (40.5)
Restlessness	22 (64.7)	28 (73.7)	21 (56.8)
Energy loss	29 (85.3)	32 (84.2)	26 (70.3)
Anxiolytic consumption	17 (50.0)	21 (55.3)	16 (43.2)
Self-rated satisfaction for ER stay, NRS – Median (IQR)	9.5 (8–10)	8.5 (7.25–10)	8 (6–10)

EMDR: Eye Movement Desensitization and Reprocessing. NRS: Numeric Rating Scale (0–10).

[a] IDR: Inter-Quartile Range.

[b] Domestic, sports and work-related injury, excluding road traffic injury.

[c] Respiratory, cardiological and general problems.

[d] Numeric Rating Scale from 0 to 10: 0 = absence of stress, 10 = unbearable stress.

[e] Numeric Rating Scale from 0 to 10: 0 = no chance of cure, 10 = complete cure, return to pre-event condition.

participation was unrelated to the suicide attempt.

All but 2 patients were contacted within 86–93 days after recruitment; the two remaining patients were interviewed at day 84 and day 95. As regards the feasibility of the EMDR R-TEP procedure (primary outcome of the study), no logistic problem or patient refusal related to the intervention was observed.

3.2. Intervention outcomes

Fig. 2 shows the proportion of patients with PCLS (according to the ICD-10 definition of PCS) and PTSD (according to the DSM-IV-TR definition of PTSD) in the three randomization groups. In the control, reassurance and EMDR groups, the proportions of patients with PCLS were 65%, 37% and 18% and the proportions of patients with PTSD were 19%, 16% and 3% respectively. According to the DSM-IV-TR definition of PCS, the proportions of PCLS at 3 months were 65%, 50% and 15% respectively. According to the Rivermead definition of PCS, the proportions of PCLS at 3 months were 62%, 42%, and 18%, respectively.

Because of the imbalance observed between groups as regards the type of event (63 patients with a medical event and 46 patients with injury), a complementary analysis was performed adjusting for the type of event. The risk ratio for the comparison between EMDR and control was 0.41 [95% CI 0.25–0.68] and was 0.36 [95% CI 0.20–0.66] when adjusted for the type of event (injury, non-injury). Regarding the rest of comparisons, reassurance vs control groups risk ratio were 0.56 [95% CI 0.38–0.82] and 0.52 [95% CI 0.33–0.82] when adjusted for the type of event and respectively 0.73 [95% CI 0.41–1.32] and 0.75 [95% CI 0.43–1.34] for EMDR vs reassurance groups.

In the worst-case scenario, in which patients who abandoned the protocol after randomization for reasons related to clinical worsening or early discharge were designated as having PCLS at 3 months, the proportions of PCLS (according to DSM-IV-TR definition of PCS) in the control, reassurance, and EMDR groups were 65%, 44%, and 24%, respectively. The prevalence of PCLS in the EMDR group remained significantly lower than in the control group (Fisher test p = 0.001).

4. Discussion

This pilot study suggests that a single session of EMDR R-TEP psychotherapy performed at the ER in the first hours following a traumatic event is feasible and has the potential to significantly reduce the rate of both PCLS and PTSD symptoms 3 months after ER admission.

These results provide several new insights and prospects for care. While EMDR psychotherapy has been shown to help in PTSD prevention and treatment (Bisson et al., 2013; Sack et al., 2016; Shapiro, 1989), similar work has not been performed for PCLS. As discussed above, while the two conditions partly overlap, PCLS is much more frequent than PTSD (10–20% versus 5% for a population attending an ER). The use of EMDR in a high-risk population therefore carries a great potential of benefit in terms of public health and savings to society as both PTSD and PCLS are associated with costs due to treatment and to dysfunctions impacting work, education, and health care (Solomon and Davidson, 1997). To our knowledge, only one early single-session EMDR intervention (EMDR-recent Event) has been evaluated so far in a controlled comparative study and showed promising results for victims of workplace violence: none of the 19 patients who received the EMDR intervention reported PTSD symptoms after 3 months (Tarquinio et al., 2016). In this study, however, the treatment was provided 48 h after the traumatic event and lasted between 1.5 and 2 h, a protocol incompatible with the ER context. No such attempt has yet been made for PCLS. Price et al. (2014) compared PTSD symptoms 4- and 12-months after trauma among 68 patients using a Prolonged Exposure Therapy protocol, with the first session initiated at the ER, and 69 controls. Dissociation at the time of the traumatic event was associated with poorer response to treatment. It will therefore be important to verify in a larger studywhether EMDR R-TEP is suitable for this small subset of patients. Assessment of the impact of an EMDR intervention over a

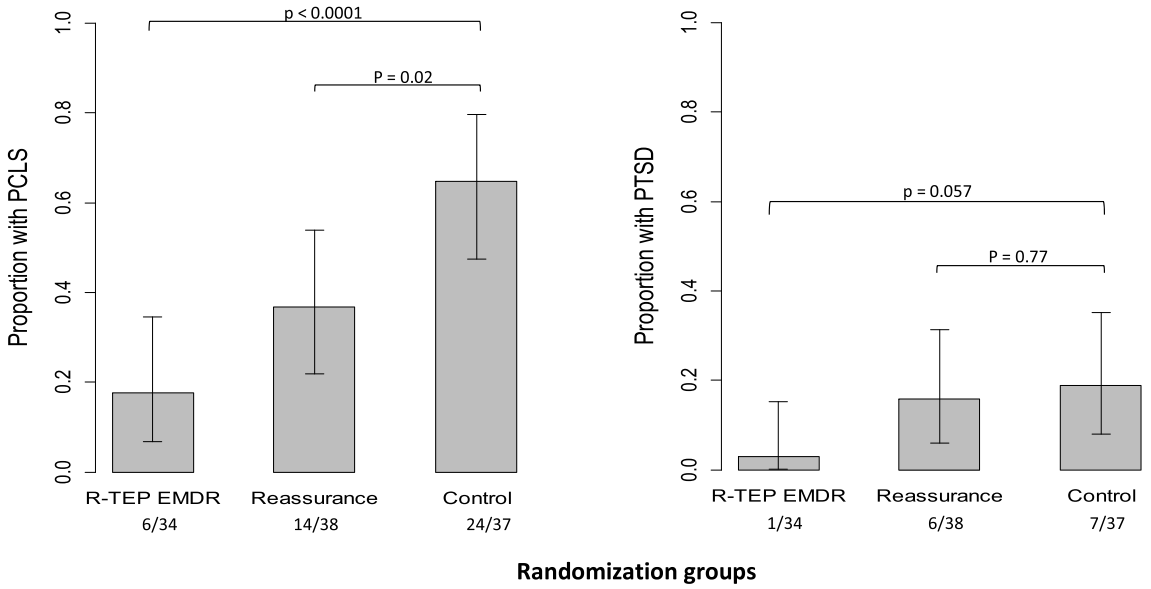

Fig. 2. Main outcomes from follow-up interview at 3-months.
Proportion of patients with Concussion-Like Symptoms (PCLS) and Post-traumatic stress disorder (PTSD) as defined by the Diagnostic and Statistical Manual of Mental Disorders version IV (DSM-IV). P values are from the double-sided Fisher exact test.

longer time-period (12 months) will also be needed.

No difference in prevalence of PCLS between EMDR group and reassurance group can be explained by a lack of power of the study. Indeed, the gap between the two rates suggests that the benefit of the EMDR intervention might not stem solely from the interaction with a psychologist, even if the shorter duration (15 min) of the reassurance session should be stressed here. The reason for the short duration of the reassurance treatment was to assure that interaction does not include elements of psychological debriefing, which has been identified as potentially harmful for the patient (Rose et al., 2002).

No exclusion due to clinical state worsening or early discharge was recorded in the control group while 3 (EMDR) and 5 (Reassurance) patients were in this situation in the two intervention groups. This may be partly related to the fact that, on average, the latter patients had to stay longer in the ER to receive the intervention than patients of the control group. To make sure this potential source of bias did not compromise our results, we performed a worse-case scenario analysis assuming that patients excluded at this stage all had PCLS. Even in this extreme situation, the 3-month prevalence of CSL remained significantly lower in the EMDR group than in controls.

The number of patients included in the study was low and replications with a larger sample size, in several other ERs, are needed before reaching a definitive conclusion. In particular, the imbalance between medical and injury patients prevented us from reaching any definitive conclusion as regards the impact in the latter group. In spite of the fact that we used no block randomization, there was no major between-group imbalance in sample size.

Individual factors used for the assessment of the risk of PCLS were selected from the literature and from the results of a prospective study we conducted among 534 patients with head injury and 927 patients with other nonhead injuries presenting at the ER (Lagarde et al., 2014), with no patients with non-injury reason for ER admission. It was therefore significant that 74% of the 24 non-injury patients in the control group had PCLS. Among the 10 injury patients in the control group, 4 had PCLS at 3 months.

As mentioned in the method section, we assessed PTSD prevalence at three months using the PTSD checklist – civilian version. Because criterion A in the DSM IV version refers to “threat to physical integrity of self or others”, we assumed this was the case for all patients attending the ER. However, the required extra criterion related to person's response involving “intense fear” was clearly not met for all study participants. Consequently, the prevalence of PTSD at 3 months should probably be considered as exaggerated.

EMDR is a psychotherapy first developed by Francine Shapiro in 1987 (Shapiro, 1989), has subsequently been adapted for use for recent trauma: recent event protocol (REP) (Shapiro and Laub, 2013), recent traumatic episode protocol (R-TEP) (Jarero et al., 2011) and EMDR-protocol for recent critical incidents (PRECI) (Schmulson et al., 2006). REP and PRECI were designed to be used between two days and six months after trauma and their suitability for intervention in the first few hours after trauma, directly in the ER, was not documented. By contrast, EMDR R-TEP was designed to be used even hours after a trauma.

As regards the procedure itself, the mechanism by which EMDR impacts memory processing is poorly understood. While not unusual for psychotherapy, knowledge in this matter will be helpful in improving its efficacy and adapting it to different contexts. For example, there is an ongoing debate on whether eye movements are a necessary part of the EMDR protocol (Jeffries and Davis, 2013). Sack et al. suggested that eye movements have no advantage compared with visually fixating on a nonmoving hand (Sack et al., 2016), and Lyaduraye and colleagues suggested that an early trauma memory reminder cue plus playing Tetris for 20 min in the 6 h following a road traffic crash was associated with fewer intrusive memories in the following weeks (Iyadurai et al., 2017). These observations support the “working memory” hypothesis that stipulates that benefits occur when patients divides their attention between traumatic memory and another competing task (Theeuwes et al., 2009; van den Hout and Engelhard, 2012). It has been suggested that eye movements may be more effective because they include visual and spatial components (Jeffries and Davis, 2013). Another neurobiological model stipulates that EMDR enhances episodic retrieval through increased interhemispheric connectivity caused by eye movements (Samara et al., 2011) but this hypothesis has yet to be supported by conclusive studies. Here again, we reviewed results obtained in PTSD and no such work is available for PCLS, a condition that has yet to be properly characterized before being acknowledge as a frequent and debilitating condition.

Observed self-assessed levels of stress as recorded at admission and at discharge support our hypothesis that early stress and hyperarousal management have a large potential for proper recovery after a

traumatic event. One strength of our results is the feasibility of the intervention in a place where a significant number of patients with a risk of PCLS and PTSD are concentrated, despite a limited time for assessment and treatment. The dissemination of this intervention depends, however, on the availability of trained psychologists in the ER, with additional costs that need further medical economics studies to quantify the overall cost/saving balance of such an amendment to the ER care system. In this respect, testing shortened treatment options in non-inferiority studies would certainly contribute to the future generalization of an intervention that may have the potential to ease the life of several hundred thousands people in France each year.

Conflicts of interest

The authors declare no conflicts of interest with respect to this article.

Contributor's statement

(1) Substantial contributions to conception or design of the work, or the acquisition, analysis, or interpretation of data for the work (all authors); and (2) drafting of the work (CGJ and EL) or revising it critically for important intellectual content (all authors); and (3) final approval of the version to be published (all authors); and (4) agreement to be accountable for all aspects of the work by ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved (all authors).

Conflicts of interest

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no financial relationships with any organization that might have an interest in the submitted work in the previous three years; and no other relationships or activities that could appear to have influenced the submitted work.

Ethical approval

The protocol was approved by the French data protection authority and the regional ethics committee. All participants gave informed consent.

Transparency declaration

The lead authors (CGJ and EL) affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; no important aspects of the study have been omitted; and any discrepancies from the study as planned have been explained.

Acknowledgements

We thank all patients whose ongoing participation made this study possible.

We thank Elan Shapiro for his useful comments on the manuscript. CGJ and EL had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jpsychires.2018.05.024.

References

Absolom, K., Greenfield, D., Ross, R., Davies, H., Hancock, B., Eiser, C., 2007. Reassurance following breast screening recall for female survivors of Hodgkin's lymphoma. Breast Edinb. Scotl 16, 590–596. https://doi.org/10.1016/j.breast.2007.05.001.

American Psychiatric Association, 2000. Diagnostic and Statistical Manual of Mental Disorders: DSM-iv-tr. American Psychiatric Association.

Bernard, C.O., Ponsford, J.A., McKinlay, A., McKenzie, D., Krieser, D., 2016. Predictors of post-concussive symptoms in young children: injury versus non-injury related factors. J. Int. Neuropsychol. Soc. JINS 22, 793–803. https://doi.org/10.1017/S1355617716000709.

Bisson, J.I., Roberts, N.P., Andrew, M., Cooper, R., Lewis, C., 2013. Psychological therapies for chronic post-traumatic stress disorder (PTSD) in adults. Cochrane Database Syst. Rev., CD003388. https://doi.org/10.1002/14651858.CD003388.pub4.

Carrasco, V., Baubeau, D., 2003. Les usagers des urgences. Premiers résultats d'une enquête nationale. Etudes et résultats 8.

de Leon, M.B., Kirsch, N.L., Maio, R.F., Tan-Schriner, C.U., Millis, S.R., Frederiksen, S., Tanner, C.L., Breer, M.L., 2009. Baseline predictors of fatigue 1 year after mild head injury. Arch. Phys. Med. Rehabil. 90, 956–965. https://doi.org/10.1016/j.apmr.2008.12.016.

Diagnostic and Statistical Manual of Mental Disorders, fifth ed., 2013., DSM Library. American Psychiatric Association. https://doi.org/10.5555/appi.books.9780890425596.x00pre.

Edmed, S., Sullivan, K., 2012. Depression, anxiety, and stress as predictors of post-concussion-like symptoms in a non-clinical sample. Psychiatr. Res. 200, 41–45. https://doi.org/10.1016/j.psychres.2012.05.022.

Friedland, J.F., Dawson, D.R., 2001. Function after motor vehicle accidents: a prospective study of mild head injury and posttraumatic stress. J. Nerv. Ment. Dis. 189, 426–434.

Iyadurai, L., Blackwell, S.E., Meiser-Stedman, R., Watson, P.C., Bonsall, M.B., Geddes, J.R., Nobre, A.C., Holmes, E.A., 2017. Preventing intrusive memories after trauma via a brief intervention involving Tetris computer game play in the emergency department: a proof-of-concept randomized controlled trial. Mol. Psychiatr. 674–682. https://doi.org/10.1038/mp.2017.23.

Jarero, I., Artigas, L., Luber, M., 2011. The EMDR protocol for recent critical incidents: application in a disaster mental health continuum of care context. J. EMDR Pract. Res 5, 82–94. https://doi.org/10.1891/1933-3196.5.3.82.

Jeffries, F.W., Davis, P., 2013. What is the role of eye movements in eye movement desensitization and reprocessing (EMDR) for post-traumatic stress disorder (PTSD)? a review. Behav. Cognit. Psychother. 41, 290–300. https://doi.org/10.1017/S1352465812000793.

King, N.S., Crawford, S., Wenden, F.J., Moss, N.E., Wade, D.T., 1995. The Rivermead Post Concussion Symptoms Questionnaire: a measure of symptoms commonly experienced after head injury and its reliability. J. Neurol. 242, 587–592.

Laborey, M., Masson, F., Ribéreau-Gayon, R., Zongo, D., Salmi, L.R., Lagarde, E., 2014. Specificity of postconcussion symptoms at 3 months after mild traumatic brain injury: results from a comparative cohort study. J. Head Trauma Rehabil. 29, E28–E36. https://doi.org/10.1097/HTR.0b013e318280f896.

Lagarde, E., Salmi, L.-R., Holm, L.W., Contrand, B., Masson, F., Ribéreau-Gayon, R., Laborey, M., Cassidy, J.D., 2014. Association of symptoms following mild traumatic brain injury with posttraumatic stress disorder vs. postconcussion syndrome. JAMA Psychiatry 71, 1032–1040. https://doi.org/10.1001/jamapsychiatry.2014.666.

Lee, J.E.C., Garber, B., Zamorski, M.A., 2015. Prospective analysis of premilitary mental health, somatic symptoms, and postdeployment postconcussive symptoms. Psychosom. Med. 77, 1006–1017. https://doi.org/10.1097/PSY.0000000000000250.

Losoi, H., Silverberg, N.D., Wäljas, M., Turunen, S., Rosti-Otajärvi, E., Helminen, M., Luoto, T.M., Julkunen, J., Öhman, J., Iverson, G.L., 2016. Recovery from mild traumatic brain injury in previously healthy adults. J. Neurotrauma 33, 766–776. https://doi.org/10.1089/neu.2015.4070.

Manners, J.L., Forsten, R.D., Kotwal, R.S., Elbin, R.J., Collins, M.W., Kontos, A.P., 2016. Role of pre-morbid factors and exposure to blast mild traumatic brain injury on post-traumatic stress in United States military personnel. J. Neurotrauma 33, 1796–1801. https://doi.org/10.1089/neu.2015.4245.

McLean, S.A., Kirsch, N.L., Tan-Schriner, C.U., Sen, A., Frederiksen, S., Harris, R.E., Maixner, W., Maio, R.F., 2009. Health status, not head injury, predicts concussion symptoms after minor injury. Am. J. Emerg. Med. 27, 182–190. https://doi.org/10.1016/j.ajem.2008.01.054.

Odeen, M., Ihlebæk, C., Indahl, A., Wormgoor, M.E.A., Lie, S.A., Eriksen, H.R., 2013. Effect of peer-based low back pain information and reassurance at the workplace on sick leave: a cluster randomized trial. J. Occup. Rehabil. 23, 209–219. https://doi.org/10.1007/s10926-013-9451-z.

Pincus, T., Holt, N., Vogel, S., Underwood, M., Savage, R., Walsh, D.A., Taylor, S.J.C., 2013. Cognitive and affective reassurance and patient outcomes in primary care: a systematic review. Pain 154, 2407–2416. https://doi.org/10.1016/j.pain.2013.07.019.

Price, M., Kearns, M., Houry, D., Rothbaum, B.O., 2014. Emergency department predictors of posttraumatic stress reduction for trauma-exposed individuals with and without an early intervention. J. Consult. Clin. Psychol. 82, 336–341. https://doi.org/10.1037/a0035537.

Quinn, G., 2013. Emergency response procedure (ERP). In: Implementing EMDR Early Mental Health Interventions for Man-made and Natural Disasters: Models, Scripted Protocols and Summary Sheets. Springer Publishing Company, New York.

Rose, S., Bisson, J., Churchill, R., Wessely, S., 2002. Psychological debriefing for

preventing post traumatic stress disorder (PTSD). Cochrane Database Syst. Rev., CD000560. https://doi.org/10.1002/14651858.CD000560.

Sack, M., Zehl, S., Otti, A., Lahmann, C., Henningsen, P., Kruse, J., Stingl, M., 2016. A comparison of dual attention, eye movements, and exposure only during eye movement desensitization and reprocessing for posttraumatic stress disorder: results from a randomized clinical trial. Psychother. Psychosom. 85, 357–365. https://doi.org/10.1159/000447671.

Samara, O.A., Haroun, D.A., Ashour, D.Z., Tarawneh, E.S., Haroun, A.A., 2011. Should excretory urography be used as a routine diagnostic procedure in patients with acute ureteric colic: a single center study. Saudi J. Kidney Dis. Transplant. Off. Publ. Saudi Cent. Organ Transplant. Saudi Arab 22, 515–520.

Schmulson, M.J., Ortiz-Garrido, O.M., Hinojosa, C., Arcila, D., 2006. A single session of reassurance can acutely improve the self-perception of impairment in patients with IBS. J. Psychosom. Res. 61, 461–467. https://doi.org/10.1016/j.jpsychores.2006.02.011.

Shapiro, E., Laub, B., 2013. The recent traumatic episode protocol (R-TEP): an integrative protocol for early EMDR intervention (EEI). In: Implementing EMDR Early Mental Health Interventions for Man-made and Natural Disasters: Models, Scripted Protocols and Summary Sheets. Springer Publishing Company, New York.

Shapiro, F., 1989. Eye movement desensitization: a new treatment for post-traumatic stress disorder. J. Behav. Ther. Exp. Psychiatr. 20, 211–217.

Smith-Seemiller, L., Fow, N.R., Kant, R., Franzen, M.D., 2003. Presence of post-concussion syndrome symptoms in patients with chronic pain vs mild traumatic brain injury. Brain Inj. 17, 199–206.

Solomon, S.D., Davidson, J.R., 1997. Trauma: prevalence, impairment, service use, and cost. J. Clin. Psychiatr. 58 (Suppl. 9), 5–11.

Stein, M.B., Ursano, R.J., Campbell-Sills, L., Colpe, L.J., Fullerton, C.S., Heeringa, S.G., Nock, M.K., Sampson, N.A., Schoenbaum, M., Sun, X., Jain, S., Kessler, R.C., 2016. Prognostic indicators of persistent post-concussive symptoms after deployment-related mild traumatic brain injury: a prospective longitudinal study in U.S. Army soldiers. J. Neurotrauma 33, 2125–2132. https://doi.org/10.1089/neu.2015.4320.

Stovner, L.J., Schrader, H., Mickeviciene, D., Surkiene, D., Sand, T., 2009. Headache after concussion. Eur. J. Neurol. 16, 112–120. https://doi.org/10.1111/j.1468-1331.2008.02363.x.

Tarquinio, C., Rotonda, C., Houllé, W.A., Montel, S., Rydberg, J.A., Minary, L., Dellucci, H., Tarquinio, P., Fayard, A., Alla, F., 2016. Early psychological preventive intervention for workplace violence: a randomized controlled explorative and comparative study between EMDR-recent event and critical incident stress debriefing. Issues Ment. Health Nurs. 37, 787–799. https://doi.org/10.1080/01612840.2016.1224282.

Theeuwes, J., Belopolsky, A., Olivers, C.N.L., 2009. Interactions between working memory, attention and eye movements. Acta Psychol. (Amst.) 132, 106–114. https://doi.org/10.1016/j.actpsy.2009.01.005.

van den Hout, M., Engelhard, I.M., 2012. How does EMDR work? J. Exp. Psychopathol 3, 724–738.

Vuagnat, A., 2013. Les urgences hospitalières, qu'en sait-on. Le Panorama des établissements de santé–édition. 11–28.

WHO | International Classification of Diseases [WWW Document], n.d. WHO. URL http://www.who.int/classifications/icd/en/(Accessed 8.4.17).