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**Traumatic Imagery after Life-threatening Cardiac Events**



**THE UNIVERSITY**  
*of* **EDINBURGH**

**Alexandra Curley**

**Doctorate in Clinical Psychology**

**The University of Edinburgh**

**August 2013**

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## DClinPsychol. Declaration of own work

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## Table of Contents

Acknowledgments	i
Declaration of own work	ii
Table of Contents	iii
Figures & Tables	iv
Research Portfolio Abstract	1
Journal Article 1	3
Abstract	5
Introduction	6
Method	8
Results	10
Discussion	21
Conclusions	24
References	24
Journal Article 2	27
Abstract	29
Introduction	30
Methods	33
Results	37
Discussion	45
References	53
Extended Methods	58
Full Reference List	63
Appendix 1: The Journal of Clinical Psychology in Medical Settings	70
Appendix 2: Systematic Review search strings	72
Appendix 3: Systematic Review Quality Criteria	73
Appendix 4: Systematic Review Excluded Studies	77
Appendix 5: Participant Information Sheet	80
Appendix 6: Consent Form	83
Appendix 7: Cover Letter	84
Appendix 8: Mental Health History Questionnaire	85
Appendix 9: Research Ethics Approval Letter	86
Appendix 10: Reminder Letter	95
Appendix 11: Interview Schedule	96
Appendix 12: Distress Scale	98

Appendix 13: Research & Development Approval Letter	99
Appendix 14: Site Specific Management Approval	103

## **Figures & Tables**

### **Journal Article 1: Systematic Review**

Figure 1: Flow chart of study selection processes	10
---	----

Table 1. Study Characteristics and key findings of included studies	11
---	----

Table 2. Ratings of study quality for included studies	13
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### **Journal Article 2: Primary Empirical Study**

Table 3. Themes	38
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## **Research Portfolio Abstract**

**Aims** There is a growing body of evidence that some individuals are at risk of developing post-traumatic stress disorder (PTSD) after life-threatening cardiac events, such as myocardial infarction (MI) or cardiac arrest, which can result in distress, dysfunction and increased risk of mortality. In relation to this population, this thesis had two aims: to review the evidence regarding whether pain during MI predicts post-traumatic stress symptoms; and to explore the characteristics and impact of traumatic imagery experienced by individuals who develop symptoms of post-traumatic stress subsequent to MI or cardiac arrest.

**Methods** A review of the evidence relating to pain as a potential risk factor for PTSD subsequent to MI is presented in the systematic review. The findings from a qualitative study investigating the characteristics of traumatic imagery and associated behaviours experienced by individuals who have symptoms of post-traumatic stress subsequent to MI or cardiac arrest, are presented in the journal article. Interpretative Phenomenological Analysis (IPA) was used to identify themes in the data.

**Results** The systematic review indicated that there are mixed findings for pain as a risk factor for PTSD subsequent to MI. The limited number of studies in this area and significant methodological limitations within the existing evidence make it difficult to draw any firm conclusions with regard to the relationship between pain and PTSD post-MI. With regard to the qualitative study, the majority of imagery related to flashbacks of the event and were focused mainly on external experiences. Themes arising from the distressing flashback imagery included: loss of control; realisation of threat; negative impact on others; physical sensations; and actions of others. Imaginary elements and distortions were a feature of some traumatic imagery experienced, and non-flashback imagery connected with mortality was also experienced. Imagery was associated with avoidance behaviour and affected behaviour within relationships.

**Conclusions** Findings from the systematic review indicate that further studies are warranted in this area to establish the link between pain and PTSD post-MI. These studies should seek to address methodological limitations of the current evidence by using a standardised pain measurement tool; adopting a prospective design; using a diagnostic tool to measure PTSD; ensuring PTSD is measured at least one month after the MI; assessing prior PTSD of non-cardiac origin; including a sufficient sample size and using an appropriate method of recruitment to improve generalisability. External experiences during a cardiac event are the main focus of

traumatic visual imagery experienced by people with intrusive post-traumatic stress symptoms post cardiac event. Specific aspects of the cardiac event may be particularly distressing and these may be represented in post-traumatic visual imagery. Both gradual exposure and imagery re-scripting techniques may be useful for reducing distress associated with the imagery, depending on the type of imagery experienced.

## **Journal Article 1**

### **Title**

**A Systematic Review of whether Pain Predicts Post Traumatic Stress Disorder After Myocardial Infarction**

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(Appendix 1)

# **Systematic Review of whether Pain Predicts Post Traumatic Stress Disorder After Myocardial Infarction**

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**Running head:** Pain as Predictor of PTSD After Myocardial Infarction - A Systematic Review

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## **Abstract**

There is a growing body of evidence that some individuals are at risk of developing PTSD symptoms consequent to myocardial infarction (MI). Several studies have investigated pain experienced during MI as a potential risk factor for PTSD development. This review aimed to systematically review the current evidence relating to pain experienced during MI as a predictor of posttraumatic stress symptoms. Literature was systematically searched for studies investigating the relationship between pain experience at time of MI and PTSD. Multiple electronic databases were searched and reference lists of included review articles were scanned. Included studies were methodologically appraised using quality criteria developed to address the current review question. Eight articles were included in the review; three of them were part of the same longitudinal study and were therefore considered together for the purpose of the review. The evidence was mixed in terms of both findings and quality, with some findings indicating that subjective experience of pain during a heart attack may play a role in the development of PTSD, and others finding no significant relationship between pain and PTSD. The current evidence is inconclusive. The limited number of studies available, methodological limitations inherent in the current evidence base and the heterogeneity across studies made it difficult to draw clear conclusions. Further work in this area that attempts to address the important methodological limitations found in the current evidence is necessary to make any firm conclusions regarding the predictive nature of pain.

**Keywords:** PTSD; Myocardial Infarction; Pain; Cardiac; Trauma; Heart Attack

## Introduction

Post-traumatic stress disorder (PTSD) results from the experience of a traumatic life-threatening event, which elicits feelings of “intense fear, helplessness, or horror” (Tedstone & Tarrier, 2003). According to the DSM-IV, the symptoms of PTSD fall into three sub-categories (1) repeated re-experiencing/ reliving of the event (*intrusions*); (2) avoidance of situations that trigger reminders of the trauma (*avoidance*), and (3) hyperarousal/ numbing (*arousal*) (American Psychiatric Association, 1994). The types of stressors that result in PTSD described in the early literature tended to involve external trauma incidents such as violent or sexual assault, natural disasters, wartime combat, and manmade accidents. However, the experience of a sudden, life-threatening illness is clearly a traumatic event which is out with the normal range of experience, and which may elicit feelings of intense fear and terror. In 1995, being “diagnosed with a life threatening illness” was added to the range of qualifying stressors described in the DSM-IV (Tedstone & Tarrier, 2003).

Myocardial infarction (MI) is serious cardiac event in which a coronary blood vessel becomes blocked, resulting in damage to the heart (O’Reilly, Grubb and O’Carroll, 2004). MI is a potentially life-threatening event, which can cause significant pain, and can evoke feelings of fear and helplessness (Weidemar, Schmid, Muller, Wittman, Schnyder, et al., 2008). The proportion of patients that survive an MI has increased significantly due to improvement in treatments available to treat this illness. The reduction in mortality has shifted the focus to morbidity in cardiac patients. There is a growing body of evidence that some individuals are at risk of developing PTSD symptoms consequent to myocardial infarction (MI). Rates of PTSD consequent to experiencing an MI are variable in the literature. A review by Spindler and Pedersen (2005) indicated that on average, PTSD develops in 15% of MI survivors; however, prevalence rates reported in the literature vary, ranging from between 0% to 32% (Jones, Chung, Berger, Campbell, 2007; van Driel and Op den Velde, 1995).

Wiedemar et al. (2008) noted that the development of PTSD after a cardiac event may prospectively increase cardiovascular morbidity and overall cardiovascular mortality. Furthermore, O’Reilly, Grubb and O’Carroll (2004) note that PTSD consequent to MI and cardiac arrest can result in significant distress and disability, which may lead to the avoidance of care and poor treatment adherence. Shemesh, Yehuda, Milo, Dinur, Rudnik, et al. (2004) found symptoms of posttraumatic stress related to MI were linked to nonadherence to medications and increased risk of cardiovascular readmission in the 1.5 years post MI. Wikman, Messerli-Burgy,

Molloy, Randall, Perkins-Porras, et al. (2012) note that the increased risk of recurrent cardiovascular illness may be associated with greater non-adherence to cardiac medications or could be linked to biological correlates that are a consequence of post-traumatic stress itself, which place added stress on an already damaged heart. Identification of PTSD symptoms after medical trauma is therefore important as it can enable provision of effective treatment, which may enhance the patient's ability to utilise medical care services through reducing avoidance and increasing treatment adherence. Identifying risk factors that may increase vulnerability to developing PTSD after MI is equally important as this may enable at-risk patients to be identified at an early stage and appropriate support or intervention provided. In addition, factors that could be moderated by healthcare services to reduce the prevalence of PTSD in this population may be identified.

A number of studies in the literature have investigated pain experienced during MI as a potential risk factor for PTSD development in MI survivors. It is hypothesised that pain experienced at the time of an acute cardiac event is likely to influence the level of distress experienced, and both the perception of the severity of the event and the potential threat to life, which may produce feelings of intense fear necessary for the development of post-traumatic stress. Wikman et al. (2012) suggest that some cardiac patients may find particular symptoms experienced during an acute cardiac event as more frightening than others, resulting in increased risk of developing post-traumatic stress symptoms in these patients. Indeed, Whitehead, Perkins-Porras, Strike and Steptoe (2006) found that it is the perceived severity of the cardiac event that is linked to PTSD rather than the objective severity of the cardiac illness. Wikman et al. (2012) note that risk of post-traumatic stress in cardiac patients may also be related to the intensity of symptoms rather than simply the type of symptoms experienced. Objective severity of acute coronary syndrome has been shown by a number of researchers to be unrelated to the development of post-traumatic stress disorder (Ginzburg, 2006; Whitehead et al., 2006), however, several studies have indicated that subjective experience of pain during MI is related to the development of post-traumatic stress symptoms (Doerfler, Paraskos & Piniarski, 2005; Whitehead et al., 2006; Wikman et al., 2012). If pain at the time of MI is evidenced as a reliable predictor of post-traumatic stress symptoms, it may be possible to screen and identify at-risk patients at time of hospital admission, and provide appropriate care to these individuals in order to minimise the risk of post-traumatic stress development in these patients.

This aim of this review is to systematically evaluate the current evidence for pain experienced at the time of acute MI as a risk factor for the development of post-traumatic stress disorder.

## **Method**

### ***Inclusion and exclusion criteria***

#### *Population*

All studies involving adult participants (18 years and over) who had survived a myocardial infarction (either ST elevated MI or non-ST elevated MI) were considered for inclusion, regardless of gender, race or nationality. Studies involving cardiac patients who had undergone cardiac surgery, had implantable cardio-verter defibrillator devices inserted, and studies focusing only on cardiac arrest patients were excluded as it was important for the purpose of this review to isolate MI-induced post-traumatic stress populations.

#### *Outcome measures*

Studies were considered for inclusion if they involved measures of both post-traumatic stress symptoms, using structured clinical interviews and/or diagnostic or screening tools, and patient's subjective experience of pain at the time of MI. Studies measuring only Acute Stress Disorder (ASD) were excluded.

#### ***Literature search strategies***

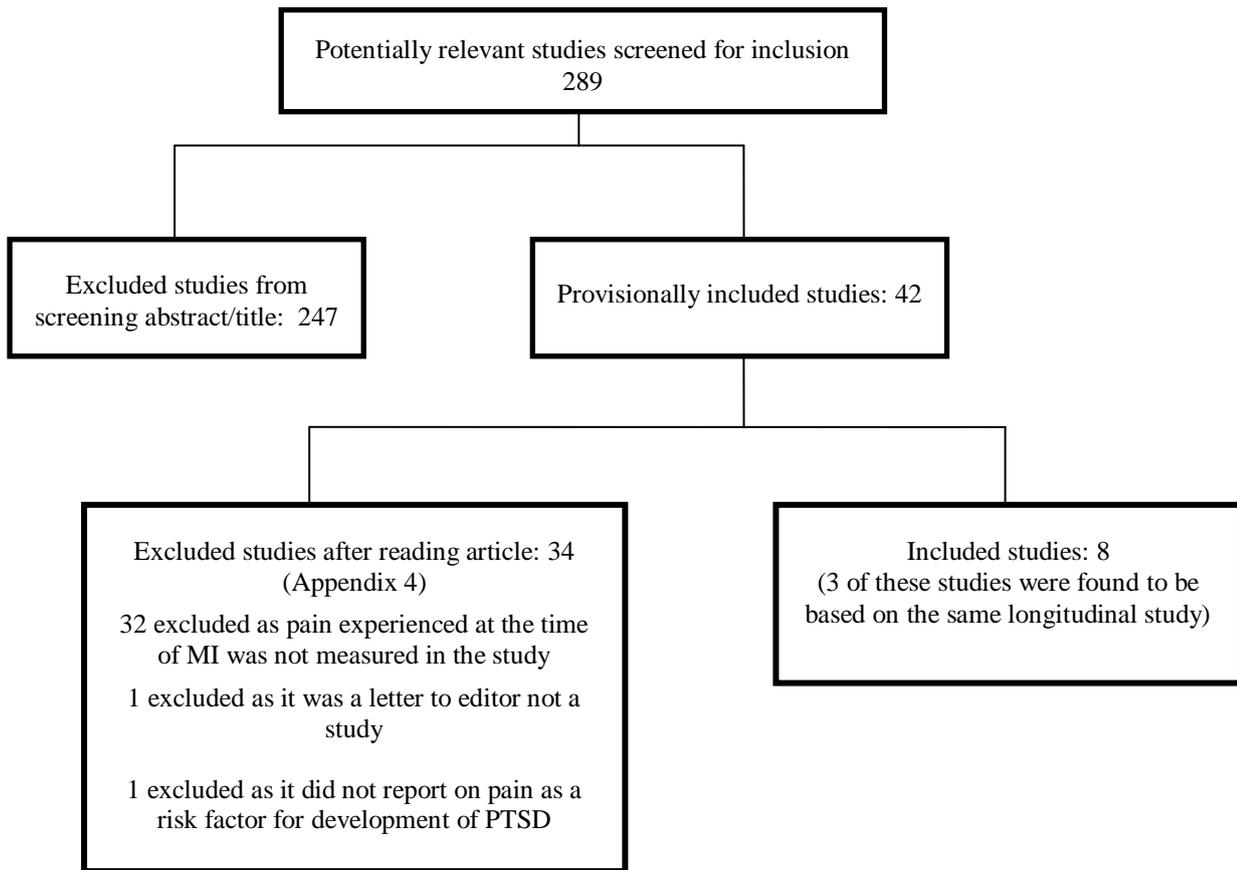
The literature search was completed in February 2013. Electronic databases searched included: Science Direct, ASSiA, PiLOTS, EMBASE (1974 to 2013 week 05) PsycINFO (1987 to Feb 2013 week 01), Ovid Medline (1946 to February 2013). The following search terms were used: cardiac, myocardial, heart attack, heart disease, cardiac arrest, acute coronary syndrome, coronary artery disease, acute coronary disease, acute coronary heart disease, myocardial infarction, cardiovascular diseases, traumatic stress, post traumatic stress, posttraumatic stress, risk factor, predict, vulnerability (Appendix 2). The searches generated 808 results, which after de-duplication provided 272 potentially relevant articles. The search process, detailed in Figure 1, was finalised by conducting a manual search of each of reference lists from the included articles within this review, which identified a further 17 articles, resulting in a total sample comprising 289 articles. The titles and abstracts of the 289 potentially relevant studies were screened to assess their suitability in relation to the inclusion and exclusion criteria. Two hundred and forty-seven studies were excluded, resulting in 42 potentially suitable studies. Full copies were accessed and then assessed for eligibility for all 42 studies, eight of which were considered suitable for inclusion.

Three of the studies, namely Weidemar et al. (2008); Hari, Begre, Schmid, Saner, Gander, et al. (2010); and Guler, Schmid, Weidemar, Saner, Schnyder, et al. (2009) were all based on the same longitudinal study, The Swiss Heart & Mind Study. Although carried out at different time points they used some of the same participants. The initial study was conducted by Weidemar et al. (2008). A second study was later conducted by Guler et al. (2009), involving a larger sample size, which included all the participants involved in the earlier Weidemar et al. (2008) study. Both studies used a similar procedure. A follow up study was then conducted by Hari et al. (2010) using participants that had been involved in the Weidemar et al. (2008) and Guler et al. (2009) studies. In this follow up study, however, only those that had participated between 30 and 365 days after their MI were included. Thus, participants that had suffered an MI less than 30 days or more than 365 days at point of participation, that had been included in Weidemar et al. (2008) and Guler et al. (2009), were excluded from this follow up study. In order to avoid overstating the evidence, the findings of these studies were considered together; however, the results were mixed across these studies and therefore it was not possible to present these studies as one study with one main finding. The studies also differed in some aspects of their methodology, therefore different ratings are given for certain quality criteria, as appropriate, and they are discussed separately in terms of their quality. A list of study characteristics and key findings are outlined in Table 1.

### ***Quality Criteria***

As there were no existing quality criteria appropriate for this review, quality criteria pertinent to the current review question were developed by the authors (Appendix 3). A checklist of the 11 quality criteria used in this review are outlined in Table 2. A.C. rated each article in relation to the quality criteria using the following six outcome ratings: 'well covered' (2 points); 'adequately addressed' (1 point); and 'poorly addressed', 'not addressed', 'not reported' and 'not applicable' (all 0 points). Thus, the minimum possible score for each article was 0 points and the maximum possible score was 22 points. P.G.M. independently reviewed two of the eight included studies.

**Figure 1: Flow chart of study selection processes**



## Results

### *Characteristics of included studies*

Five of the included studies measured pain retrospectively, three of which were part of the same longitudinal study, with the remainder implementing a prospective design. Five of the studies measured pain intensity; two measured pain severity, one of which also measured pain duration; and one study did not specify the aspect of pain that was measured. Details of relevant study findings and study characteristics are shown in Table 1.

**Table 1. Characteristics and key findings of included studies**

Study	Date	Population	Gender (% male)	PTSD Measures	Pain measure	Statistical tests used	Risk Factor	Design	Time interval - MI & PTSD measure	Key findings
Doerfler et al.	2005	MI patients  150 eligible 52 participated  57.73 (SD=12)	69	PSS-SR IES	Rating scale: rated most severe pain during MI from 0 (none) to 10 (extreme).	Correlations – specific test not reported	Pain severity & pain duration	Retrospective	3-6mths	Ratings of pain duration were related to higher levels of intrusion symptoms ( $p < .01$ ) and PTSD symptoms scores ( $p < .05$ ). Pain severity was not related to PTSD symptoms.
Guler et al.  <b>Swiss Heart &amp; Mind Study</b>	2009	951 eligible 394 completed PDS 77 eligible for CAPS interview. 66 interviewed.  MI patients  Non responders did not differ in age, but were more likely to be female ( $p = 0.002$ )  61±10yrs	83	PDS CAPS	Visual analog scale: “Please indicate how strong your pain was during the heart attack” (0=no pain at all, 10=intolerable pain).	Student t test; Pearson chi square test & Fischer’s exact test  Logistic regression.  Nagelkerke R2 statistics  PTSD status based on CAPS not PDS for prediction.	Pain intensity	Retrospective	12 - 1,673 days (MI to completion of PDS & pain ratings)  Time interval between MI and CAPS interview not reported.	Pain intensity was not a significant predictor of PTSD symptoms.
Hari et al.  <b>Swiss Heart &amp; Mind Study</b>	2010	MI patients  274 participants  61yrs ± 10	84	PDS CAPS	Visual analogue scale: “Please indicate how strong your pain was during the heart attack.” (0=no pain at all, 10=intolerable pain).	Student t test Mann-Whitney U; Pearson chi Square; Fischer’s exact test.  Hierarchical linear regression analysis used for predictors.  Potential confounds controlled for.	Pain intensity	Retrospective	30-365 days  Follow up 19-45 months	Pain during MI predicted greater posttraumatic stress at study entry ( $P = .049$ ). Compared to those with no PTSD, patients with PTSD reported greater levels of pain during MI ( $P = .001$ ). Greater posttraumatic stress at follow-up was predicted by greater pain during MI ( $P = .030$ ). Decrease in posttraumatic stress over time was greater in those with less pain during MI ( $P = .032$ ). Concluded that intense pain during MI adversely impacted both longer term posttraumatic stress and its recovery.
Weidemar et al.  <b>Swiss Heart &amp; Mind Study</b>	2008	MI patients 190 participants 60yrs ± 12	84	CAPS & PDS	Visual analogue scale: “Please indicate how strong your pain was during the heart attack.” (0=no pain at all, 10=intolerable pain).	Student t test; Pearson chi square test & Fischer’s exact test  Multiple linear regression analysis used to identify predictors.  PDS scores used to assess predictor variables	Pain intensity	Retrospective	Time between MI and PDS: 12days – 4.5 years  Time between MI and CAPS interviews: 24-336 days	Pain intensity during MI independently predicted PTSD symptom level.

Study	Date	Population	Gender (% male)	PTSD Measures	Pain measure	Statistical tests used	Risk Factor	Design	Time interval - MI & PTSD measure	Key findings
Rocha et al.	2008	53 screened  33 completed baseline interview- of these 31 suitable  25 completed follow up assessments.  42-83yrs (mean=64.2)	58 (of 31 assessed at baseline)	SCID IES-R	10pt rating scale used to assess pain at time of MI. No details on wording of scale.	Independent t tests Linear regression. (IES-R scores used to assess predictor variables)	Pain (unclear if severity/intensity/other)	Prospective: pain assessed at time of hospitalisation	1-2mths	Pain during MI was not a significant predictor of PTSD.
Whitehead et al.	2006	233 eligible to take part.  135 patients returned measures (57.9%). Patients with ACS (STEMI 70.4%; NSTEMI & UA)  61.4yrs (SD 11.3)	73	PSS-SR	Patient's rated severity of chest pain based on a standard numerical rating scale (1-10). (Wording of items not available)	X squared and t tests. Stepwise & linear regression.	Severity of chest pain	Two phase prospective study. Predictive data collected at 5 days post-admission.	3 months	Severity of chest pain was predictive of PTSD severity.  Pain scores were independent predictors of three-month PTSD symptoms ( $R^2 = 0.495$ , $p < 0.001$ ).
Wikman et al	2012	Acute coronary syndrome (STEMI -87%; NSTEMI/UA)  666 potentially eligible 294 at Time 1 156 at Time 3 (PTSD assess at 6mths) Not included - older on average & more likely to be female ( $P < .001$ ) 60yrs (SD 11.57)	84	PSS-SR	10pt rating scale (higher scores indicating more intense pain)  Pain cluster identified for analysis. Included: arm, shoulder, back, jaw, chest pain & other symptoms experienced at time, e.g. sweating, nausea, dizziness & fatigue.	Cluster analysis. Regression.	Pain intensity	Prospective – interviewed in hospital within 48 hours of admission	6 months	Pain symptoms cluster ( $\beta = .153$ , $P = .044$ ) was a significant predictor of posttraumatic symptoms severity at six months post MI.  Patients in the pain cluster reported significantly more intense posttraumatic symptoms at 6 months than either of the other clusters, and significantly more intense intrusion symptoms than those in dyspnea cluster and significantly greater avoidance than those in the diffuse cluster.
Kutz et al.	1994	106 selected consecutively from medical records 100 participated  MI patients: 32-70yr age	88	PTSD Inventory (1 item excluded)	Pain intensity – data gained via interview. Specific details of data gathering process not reported.	Chi-squared tests	Pain intensity	Retrospective	6-18mths	No significant relationship was found between PTSD and intensity of pain during MI

**Table 2. Ratings of study quality for included studies**

Study	Quality Criteria											Total score	
	(i)Confirmation of MI	(ii)Pain measure	(iii)PTSD measure	(iv)Recall bias	(v)Analysis	(vi)Time between MI & PTSD measure	(vii)Power	(viii)Cardiac event type	(ix) Generalisability	(x)PTSD related to MI	(xi) Pain related to cardiac event		
<b>Doerfler et al. (2005)</b>	Well covered	Adequately addressed	Well covered	Adequately addressed	Adequately addressed	Well covered	Adequately addressed	Well covered	Adequately addressed	Adequately addressed	Well covered	16	
<b>Hari et al. (2010),</b>	Well covered	Adequately addressed	Well covered	Adequately addressed	Well covered	Well covered	Well covered	Well covered	Adequately addressed	Adequately addressed	Well covered	18	
<b>Guler et al. (2009),</b>				Poorly addressed	Adequately addressed	Poorly addressed							14
<b>Weidemar et al. (2008)</b>				Poorly addressed	Adequately addressed	Poorly addressed							
<b>Kutz et al. (1994)</b>	Well covered	Not reported	Well covered	Poorly addressed	Adequately addressed	Well covered	Well covered	Well covered	Adequately addressed	Adequately addressed	Well covered	15	
<b>Rocha et al. (2008)</b>	Well covered	Adequately addressed	Adequately addressed	Well covered	Poorly addressed	Well covered	Poorly addressed	Well covered	Adequately addressed	Well covered	Well covered	15	
<b>Whitehead et al. (2006)</b>	Well covered	Adequately addressed	Well covered	Well covered	Adequately addressed	Well covered	Well covered	Adequately addressed	Adequately addressed	Poorly addressed	Not reported	14	
<b>Wikman et al. (2012)</b>	Well covered	Adequately addressed	Well covered	Well covered	Adequately addressed	Well covered	Well covered	Adequately addressed	Adequately addressed	Adequately addressed	Well covered	17	

(i) MI confirmed from medical records and cardiac enzyme changes, ECG or angiogram

(ii) Measure used to assess pain is appropriate and evidenced to be both reliable and valid.

(iii) Measure used to assess PTSD is evidenced to be both reliable and valid.

(iv) Efforts are made to reduce potential bias in recall of pain symptoms experienced at time of MI

(v) Analyses used are appropriate and enable relationships between pain and PTSD to be established

(vi) There is an appropriate time interval of at least 1 month between the occurrence of MI and the measure of PTSD

(vii) Sample size is adequate, enabling sufficient power to be achieved

(viii) Sample includes a sufficient number of MI patients

(ix) Patients were recruited from a representative clinical setting and participants were reasonably representative of the wider clinical population

(x) Individuals with pre-MI PTSD are identified and participants are instructed to complete PTSD measures with respect to the MI event

(xi) Individuals with pre-existing pain are identified and participants are instructed to complete pain measures with respect to cardiac event-related pain

### *Quality of included studies*

Table 2 details ratings for each of the studies regarding the 11 quality criteria. All included studies were of average methodological quality overall, with all papers scoring a mixture of well covered and adequately addressed on the majority of quality criteria. A range of measures of PTSD were used in the included studies, including the following diagnostic self-report scales: Posttraumatic Diagnostic Scale (PDS); The PTSD Symptom Scale Self Report Version (PSS-SR); The PTSD Inventory; the following screening tools: the Impact of Events Scale (IES); and The Impact of Events Scale- Revised (IES-R); and the following diagnostic clinical interview tools: The Structured Clinical Interview for DSM-IV (SCID) and the Clinician Administered PTSD Scale (CAPS). All studies used a diagnostic tool to assess PTSD, and two included a screening tool in addition to a diagnostic instrument.

In terms of reviewing the quality of the studies, the aspects of study design that are particularly pertinent to answering this review question are: PTSD measure; pain measure; recall bias; time between MI and PTSD measure; power; steps taken to control for pre-MI PTSD or to ensure PTSD symptoms are related to the MI event; and generalisability. With regard to these aspects, the Wikman et al. (2012) study is particularly strong, in comparison to the others. It was sufficiently powered, had a prospective design (measuring pain during the hospital admission period), used diagnostic tools to assess PTSD and measured PTSD symptoms at least one month post MI event, in accordance with DSM IV diagnostic criteria for PTSD, which specifies that symptoms must have been present for at least one month (American Psychological Association, 1994). This study would have been stronger had they used a more robust measure of pain, rather than a Likert style rating scale, and had their sample been more representative of the wider clinical population in order to improve generalisability. Whitehead et al. (2006) shared most of these methodological strengths, and was therefore also relatively strong; however, they did not appear to take steps to ensure that PTSD measures were completed specifically with respect to the MI event. Thus, it is not possible to be sure that the PTSD symptoms in this sample were indeed related to the MI event. It was also not clear from the article whether the pain measure used asked specifically about cardiac related pain, and therefore it is not possible to be sure that pain ratings were related to the cardiac event and not to pre-existing pain conditions. Given that this review seeks to evaluate whether post-MI PTSD is related to pain experienced at the time of the MI, these are significant flaws. This study would also have been stronger had their sample been more representative of the wider population. Both studies found a significant relationship between pain and PTSD symptoms, however, they both measured different aspects of pain, namely severity of chest pain (Whitehead et al., 2006) and pain intensity (Wikman et al., 2012). Hari et al. (2010)

was also a relatively strong study in relation to these quality criteria; however, pain during MI was measured retrospectively, thus, introducing the potential for recall bias in this study, which could have affected the results found.

The Weidemar et al. (2008) and Guler et al. (2009) studies, that were connected to the same longitudinal study as Hari et al. (2010), had limitations in some particularly important areas, as they had a retrospective design, (measuring pain after the hospital admission, and in some cases several years after the MI event), and they also measured PTSD less than one month after the event in some cases (the length of time measures were taken varied between 12 days and 4.5 years after MI, possibly longer in some cases). Thus it is difficult to be certain that participants had PTSD symptoms; some people with acute stress disorder may have been included, and furthermore there may have been some bias in recall of pain symptoms. Pain was found to predict PTSD symptoms in the Weidemar et al. (2008) study; however, this finding was not replicated in the later Guler et al. (2009) study, which involved a larger sample. This inconsistency in findings may relate in some way to differences in the analyses between the two studies, namely that Guler et al. (2009) used the CAPS interview data to analyse the relationship between pain and PTSD, whereas Weidemar et al. (2008) used the PDS. The follow up study by Hari et al. (2010), addressed some of the limitations in the earlier studies. They included only participants who had completed the PTSD measures at least 30 days post-MI, thus eliminating the chance that people with acute stress disorder rather than PTSD would be included. As highlighted earlier, this study did find a significant relationship between pain intensity and PTSD, both at study entry and at follow up. As this was a stronger study in terms of methodology, it could be argued that the lack of significant findings in the earlier study by Guler et al. (2010) were related to limitations in the design.

### *Recall bias*

The majority of the studies asked participants to rate pain retrospectively, some a significant time after their MI. Previous research indicates that 20% of the critical details of a personal event are irretrievable after 1 year, and 60% are irretrievable after five years (Bradburn, Rips & Shevell, 1987). Thus, recall of pain during MI may have been biased in these studies. It is possible that individuals who are distressed by their MI event, and are experiencing PTSD symptoms as a result, might be more likely to recall greater levels of pain retrospectively, thus increasing the probability of finding a relationship between pain and PTSD.

### *Cardiac related pain*

All studies, other than Whitehead et al. (2006), took steps to ensure that pain reported was related to the cardiac event and not pre-existing pain conditions. The majority did so by instructing participants to rate the pain they experienced during the cardiac event.

### *Pain measurement*

None of the studies included in the review used a standardised tool to measure pain, which highlights a weakness in the available literature on pain as a risk factor for PTSD. All but one study used a visual analogue scale to measure pain. The remaining study did not provide details on the method used to measure pain (Kutz, Shabtai, Solomon, Neumann & David, 1994). Given that the focus of this review relates to the experience of pain, this is a significant weakness of this particular study relative to the others, and an important limitation of all of the included studies that is particularly pertinent to this review question. For those studies that gave details of the rating scale used, it appears that the scales had anchor labels at either end of the scale only, rather than having labels for each rating point. This is an important flaw, as one person's interpretation of a particular rating point could be quite different from another, for example, if two individuals wished to represent moderate pain, one might score moderate pain as a 4 whilst another might score it as a 6. The scales would have been improved had the response options all been labelled, however, this type of measurement would still have had limitations, and the use of a standardised, reliable tool to measure pain, e.g. The McGill Pain Questionnaire, would have much improved the quality of all the included studies.

### *Analysis*

All but one study (Rocha, Peterson, Meyers, Boutin-Foster, Charlson et al., 2008) used appropriate analyses, however, only Wikman et al. (2012) and Whitehead et al. (2006) reported information indicating the robustness of statistics, with both of these studies reporting having checked multicollinearity according to variance inflation factor and tolerance values. In addition, the majority of studies did not control for potentially confounding variables, such as gender and age, that have been shown to be related to the development of PTSD post-MI, with only one of the studies (Hari et al., 2010) reporting having undertaken this step within their analyses.

### *Power*

Only one study was underpowered (Rocha et al., 2008). This study involved a relatively small sample size, was not sufficiently powered, and used an inappropriate analysis, despite achieving high quality in other aspects of their methodology.

### *PTSD assessment*

Other than two of the connected studies (Weidemar et al, 2008; Guler et al., 2009) the majority assessed PTSD symptoms at an appropriate time following the patient's MI. This is important as, according to DSM-IV criteria, PTSD symptoms cannot be diagnosed within 1 month of the traumatic event. Symptoms displayed within one month of the event, would be diagnosed as acute stress disorder, rather than PTSD. This limitation was addressed in the later follow up to these studies by Hari et al. (2010). Six of the included studies made attempts to ensure that PTSD symptoms reported were directly connected to the MI event, by instructing patients to focus on the MI when completing PTSD measures. One study (Kutz et al., 1994) identified patients with pre-MI PTSD, and considered this in relation to their findings, and another (Rocha et al., 2008) excluded patients who met criteria for PTSD at baseline interview (during their hospital admission), as well as directing patients to respond to PTSD measures with respect to their MI specifically. Kutz et al. (1994) found a significant relationship between development of PTSD post-MI and prior PTSD of a non-cardiac origin. This raises the importance of assessing for prior non-cardiac related PTSD in studies investigating risk factors for post-MI PTSD, and highlights a limitation of the majority of included studies, which did not address this. Whitehead et al. (2006) neither screened for pre-MI PTSD nor clarified in their measure of trauma symptoms that only MI-related trauma should be included and, as such, their findings are more likely to have been contaminated by non-MI trauma symptomatology.

### *Generalisability*

With respect to generalisability, although all studies recruited participants from appropriate clinical settings, all studies involved a predominantly male sample, and several had relatively low response rates thus, there may be a level of bias in those who participated in the included studies, which may affect the generalisability of the findings.

### *Narrative synthesis*

Three of the eight included studies were part of the same longitudinal study (Hari et al. 2010; Guler et al. 2009; Weidemar et al., 2008), and therefore their results must be considered together in order to avoid overstating the findings. Weidemar et al. (2008) and Hari et al. (2010), found evidence of a significant relationship between pain and PTSD; however, Guler et al. (2009) did not. Three of the remaining five studies included in the review, reported significant relationships between pain experience at time of MI and PTSD. Studies varied in relation to the aspect of pain measured, thus the findings cannot be grouped together.

### *Pain intensity/severity*

Five studies investigated pain severity and two studies investigated pain intensity. The terms severity and intensity overlap; however, there is some definitional ambiguity such that they could be interpreted by some as having a slightly different meaning. For the purpose of this review however, the terms severity and intensity will be treated as synonymous. Three of the studies that investigated pain intensity were those connected to the same longitudinal study. Of these three connected studies, Weidemar et al., (2008) and Hari et al., (2010) found that pain intensity experienced at time of MI predicted PTSD symptoms reported, however, the other did not (Guler et al., 2009). The mixed findings may be accounted for by some methodological differences across the studies. Of the other four studies investigating pain intensity or severity, Wikman et al. (2012) found pain intensity was a significant predictor of PTSD symptoms, and Whitehead et al. (2006) found that severity of chest pain was predictive of greater PTSD symptoms and that pain scores independently predicted levels of PTSD at three months. Kutz et al. (1994), however, did not find any relationship between pain intensity and PTSD, and similarly Doerfler et al. (2005) did not find any significant relationship between pain severity and PTSD symptoms.

The study by Wikman et al. (2012) used cluster analysis to assess the relationship between symptoms experienced at the time of MI and PTSD. The cluster analysis grouped together a variety of physical symptoms, which were considered to encompass pain, and this cluster was found to predict PTSD symptoms. However, in addition to arm, shoulder, back, jaw and chest pain, this cluster of symptoms included non-pain symptoms such as sweating, nausea, dizziness and fatigue, which questions whether pain experiences alone were responsible for the observed association between this cluster and subsequent PTSD symptoms. This study was of relatively high quality. It had important methodological strengths, namely the use of a prospective design, use of a diagnostic PTSD measure, measurement of PTSD at least one month after the event, steps taken to ensure pain ratings were related specifically to the MI, sufficient sample size, and confirmation of the MI, and they adequately addressed all other relevant criteria. The study by Hari et al. (2010), which addressed some of the limitations of the earlier two studies (Guler et al., 2009; Weidemar et al., 2008) was also of relatively high quality, with strengths in several areas including, the use of a diagnostic PTSD measure, steps taken to ensure pain ratings were related specifically to the MI, appropriate analysis, PTSD measurement taken at least one month post-MI, sufficient sample size, and appropriate population (MI). However, this study had some relative weaknesses, namely use of a retrospective design. Thus, there may have been a level of bias in recall of pain that could have affected the findings.

Whitehead et al. (2006) found that severity of chest pain was predictive of greater PTSD symptoms, and that pain scores independently predicted levels of PTSD at three months. Due to lack of information on the wording used for the pain severity rating scale in this study, however, it is difficult to know how similar this study was to the others in terms of the specific aspect of pain severity that was measured, and whether this could have had any bearing on differences in findings, though Whitehead et al. (2006) focused specifically on chest pain, whereas the other studies did not specify any particular part of the body when asking about pain severity. Although Whitehead et al. (2006) had several important methodological strengths, they did not take steps to ensure that PTSD symptoms were related to the MI event specifically, which is a significant limitation. Furthermore, it was not clear whether Whitehead et al. (2006) had taken any steps to ensure that pain ratings were related to the cardiac event specifically, therefore other pre-existing pain conditions could potentially have influenced the pain ratings given.

Guler et al. (2009) did not find any significant relationship between pain intensity and PTSD; however, this study was of lower quality and the lack of findings may thus relate in part to methodological limitations; the most pertinent being that the issue of recall bias was poorly addressed, and that PTSD was not always measured at least one month after the event. Kutz et al. (1994) did not find any significant relationship between pain intensity and PTSD, though it is not clear how they measured pain intensity, which could potentially have influenced the results. The Kutz et al. (1994) study was of better quality than Guler et al. (2009), however, they also poorly addressed the issue of recall bias and they did not report details of the way that they measured pain, both of which are important issues which may have influenced the results. Doerfler et al. (2005) also did not find any significant relationship between pain severity and PTSD symptoms. This was a relatively stronger study, however, it is unclear whether they took steps to ensure PTSD symptoms were related to the MI event specifically as this was not specified clearly in the article, and therefore it cannot be concluded that PTSD symptoms reported in this study were indeed caused by the MI. In addition, this study adopted a retrospective design, thus it is possible that recall bias may have affected the results.

Based on the quality of the evidence and the small number of studies investigating pain intensity/severity, it is difficult to draw any firm conclusions with regard to a link between this aspect of pain and PTSD.

### *Pain duration*

The only study to measure the duration of pain experienced at the time of MI (Doerfler et al., 2005), found pain duration was significantly related to higher levels of intrusion symptoms and to PTSD symptoms scores, however, the methodological limitations of this study may have affected the results. No conclusion can be drawn with respect to a connection between pain duration and PTSD due to the lack of studies investigating this aspect of PTSD.

### *Pain - unspecified*

The study by Rocha et al. (2008), for which there were no details regarding the specific aspect of pain experience measured, found that pain during MI was not a significant predictor of PTSD. Although this study had some methodological strengths including the use of a prospective design, sufficient time interval between MI and PTSD measure, an all MI population and steps taken to ensure that pain and PTSD symptoms were related to the MI rather than some other form of trauma or pre-existing pain condition, the study was not sufficiently powered and analyses were inappropriate, which are significant limitations, and may have affected the lack of findings in this study.

### *Comparing methodologies*

Given the potential for bias in subjective recall regarding aspects of the MI experience, perhaps particularly in those who are currently distressed (i.e. experiencing symptoms of posttraumatic stress), it is important to consider the design methodologies used in the included studies with respect to the results. Of the three studies that had a methodologically stronger, prospective design (i.e. measured pain at the time of hospitalisation), two found pain intensity to be a significant predictor of PTSD symptoms; however, one of these studies (Whitehead et al., 2006) did not appear to take sufficient steps to ensure that PTSD reported was related specifically to the MI, and the third prospective study (Rocha et al., 2008) did not find pain during MI to predict PTSD. As this study did not detail how pain was measured or indeed what aspect of pain was measured, it is possible that differences in the type of measurement and/or the aspect of pain measured in this study could have had some bearing on the results. Of the five retrospective studies, three were part of the same longitudinal study and thus their findings must be considered together, in relation to this connection. These three studies reported mixed findings, with two papers reporting a significant relationship between pain intensity and PTSD; and the other finding no such relationship. Of the other two retrospective studies, one found pain duration was linked to PTSD, but not pain severity, and the other found no significant association between pain intensity and PTSD post-MI.

Rocha et al. (2008), the least well powered study, failed to find any link between pain and PTSD, and Doerfler et al. (2005), which, although adequate, had relatively less power than the other studies, found a link between duration of pain and PTSD, but no relationship between pain severity and PTSD. It is possible that the reduced power in these studies had some bearing on the lack of findings, although not all well powered studies (Guler et al., 2009; Kutz et al., 1994) found significant results, thus it seems unlikely that a lack of power alone is sufficient to explain the lack of findings.

A particular issue affecting the quality of all the studies relates to the type of measure used to assess pain. No study used a standardised, reliable pain measure, which is a significant limitation affecting all the available evidence in this area and this issue may have affected all of the findings reported.

## **Discussion**

The systematic review conveys mixed findings with respect to pain during MI as a predictor for PTSD. The mixed findings may in part be related to the heterogeneity across studies in terms of the type of pain measured and the aspect of pain experience measured, and important methodological weaknesses affecting the quality of some of the studies, including the lack of a standardised pain measurement tool, small sample sizes, retrospective measurement of pain at time of MI, which may have resulted in recall bias, failure to take steps to ensure that PTSD symptoms were directly related to the MI event or to exclude pre-existing PTSD of another origin. Although five studies included in this review found that some aspect of pain during MI significantly predicted PTSD, two of these were part of one larger study and therefore count as one study, and the variability across studies in terms of the quality of the methodologies and the aspect of pain investigated made it difficult to synthesise the results, and draw any clear conclusions from the existing evidence. The other three studies, which also varied in quality, did not find any relationship between the variables.

Only eight studies were eligible for review, three of which were part of the same larger research project and had to be considered together, which is relatively a low number. The limited number of studies investigating pain during MI as a risk factor for PTSD, coupled with the heterogeneity across studies and methodological limitations affecting some of the studies, indicate that no firm conclusions regarding the relationship between pain experienced at the time of MI and development of PTSD can be derived based on the current evidence. Further studies in this area

are warranted in order to add to the current evidence regarding the predictive power of pain as a risk factor for posttraumatic stress. To improve the quality of the evidence, key methodological limitations that should be addressed include the type of pain measure used, the time interval between MI and PTSD measurement, the risk of recall bias regarding pain experience, failure to exclude pre-MI PTSD and/ or to ensure that PTSD symptoms are directly related to the MI event, small sample size and generalisability of the findings (due to the sampling method used and/or bias in terms of the representativeness of the sample). All studies used an adequate type of analysis, however, many failed to control for confounding variables, such as age and gender which have been found in the literature to be linked to post-MI PTSD. To improve quality, future studies should take steps to control for potentially confounding variables. Although in all but one study (Whitehead et al, 2006), the measure of pain used asked specifically about pain experienced during the cardiac event, only one study additionally identified and excluded other pre-existing conditions that could affect pain symptoms (Doerfler et al., 2005). To further enhance the quality of the evidence, future studies should take steps to address both these issues.

The majority of studies in this review measured pain experienced in any area of the body. Only Whitehead et al. (2006) specified a particular site of pain, namely chest pain and their study found a significant relationship between chest pain and PTSD. In future studies, it might be interesting to consider whether the particular area of pain is relevant in the development of PTSD. One might speculate that severe pain in the chest area might increase a person's awareness that they are having a heart attack, and thus experiencing a life-threatening event, which may increase the level of trauma experienced thereby heightening the risk of developing posttraumatic stress symptoms. Indeed there is some evidence that fear of dying experienced at the time of MI is predictive of PTSD (Weidemar et al., 2008; Guler et al., 2009). Cognitive behavioural theory would suggest that an individual's interpretation of their pain symptoms is likely to be more important for increasing the probability that the person will develop PTSD, rather than the physical symptoms alone. None of the included studies enquired about participant's interpretation of their pain symptoms. Given the importance of cognitive factors in the development of PTSD and the complex nature of this disorder, the hypothesis that pain predicts PTSD is likely to be overly simplistic. It would be beneficial in future studies to investigate, not only participant's subjective experiences of physical pain at the time of MI, but also how they interpreted the pain that they experienced, to evaluate whether interpretation of pain symptoms, or other factors, are better predictors of PTSD than pain alone and whether particular combinations of risk factors are more likely to increase the probability of developing PTSD after a heart attack.

### ***Strengths of the review***

The potential for subjective bias in methodological analysis was reduced as two of the eight included articles were independently rated with regard to methodological quality, generating a high level of inter-rater reliability, with 77.3% agreement on ratings.

### ***Limitations of the review***

The present review was limited to studies published in English, some electronic databases were not used in the search and a determinate number of search terms were utilised. All of these factors may have resulted in the inadvertent omission of potentially suitable studies. Relatively few studies were found that met the inclusion criteria for the review, limiting the findings available on this topic. In addition, three studies identified initially were conducted as part of the same longitudinal study (Guler et al., 2007; Weidemar et al., 2008; Hari et al., 2010), which meant that there was some overlap in terms of the samples used between these studies, thus further restricting the weight of evidence available.

### ***Implications for research & clinical practice***

This review presents some evidence that subjective pain experience at the time of MI may be a risk factor for development of posttraumatic stress. If pain is a reliable predictor of PTSD post-MI, this would be important from a clinical perspective as clinical staff could screen MI patients with regard to the level of pain experienced during their heart attack while they are in hospital and act accordingly to provide support and early intervention to those identified as at-risk, with a view to reducing the risk of posttraumatic stress developing in these patients. Of course, a combination of other risk factors and vulnerabilities are likely to play a role in predicting PTSD development in this population, as in other trauma populations, however, identifying specific factors such as pain that may increase risk of PTSD post-MI is nevertheless clinically useful. The limited number of studies available at present highlights the need for further research to confirm the relationship of pain experience to post-MI PTSD, and to explore further the nature of this relationship, which is unlikely to be direct. Future work should investigate, not only participant's subjective experiences of physical pain at the time of MI, but also how they interpreted the pain that they experienced, for example whether pain was interpreted as an indication that their life was under threat, and any bearing this interpretation could have had on perceived level of control and/or evocation of fear during the event. Future studies investigating the relationship of pain during MI to PTSD should use a standardised pain measurement tool, such as the McGill Pain Questionnaire, adopt a prospective design, use a diagnostic tool to measure PTSD, ensure that PTSD is measured at least one month after the MI, assess prior PTSD of non-cardiac origin,

include a sufficient sample size and use an appropriate method of recruitment to avoid opportunity sampling, both of which would improve generalisability. It is also useful for studies to specify the aspect of pain measured, as this will be more clinically useful in terms of directing assessment and screening processes for identifying potentially vulnerable patients.

## **Conclusions**

This systematic review of the evidence for a relationship between pain experienced at the time of MI and the development of PTSD indicates that the current evidence is inconclusive. The limited number of studies available, the heterogeneity across studies and methodological limitations affecting the available studies, made it difficult to draw clear conclusions. There is some evidence that pain during MI is a significant predictor of PTSD in MI patients, suggesting that subjective experience of pain during a heart attack may play a role in development of PTSD. However, further studies addressing the key methodological limitations affecting the current evidence are warranted in order to improve the quality of the evidence and ensure that clinical practice is informed by appropriate research evidence.

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## **Journal Article 2**

### **Title**

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# **Traumatic Imagery After Life-threatening Cardiac Events**

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**Abstract** The present study aimed to explore the characteristics of traumatic visual imagery in individuals who develop symptoms of post-traumatic stress after a life-threatening cardiac event. Thirty-two patients who had suffered a myocardial infarction (MI) or cardiac arrest returned screening questionnaires, including the Impact of Events Scale Revised (IES-R). Eight individuals experiencing intrusive symptoms of post-traumatic stress were identified and interviewed. This included seven survivors of myocardial infarction and one survivor of cardiac arrest. Interpretative Phenomenological Analysis (IPA) was used to analyse the qualitative data. The majority of distressing visual imagery related to flashbacks of the event and focused on external experiences. Several participants reported imaginary or distorted elements within their flashbacks. Themes arising from the visual flashback imagery included: loss of control; realisation of threat; negative impact on others; physical sensations; and actions of others, and within non-flashback imagery a theme of mortality was found. Avoidance behaviours were used to cope with the traumatic imagery and behaviour in interpersonal relationships could be affected. The results were discussed in terms of clinical implications and directions for future research.

**Keywords** Post-traumatic stress disorder; Imagery; Intrusions; Cardiac; Myocardial Infarction; Cardiac arrest.

## **INTRODUCTION**

On average, post-traumatic stress disorder (PTSD) develops in 15% of myocardial infarction (MI) survivors (Spindler & Pedersen, 2005) and PTSD after cardiac arrest has been reported at 27% (Gamper, Willeit, Sterz, Herkner, Zoufaly, et al., 2004). Wiedemar, Schmid, Muller, Wittman, Schnyder, et al. (2008) noted that the development of PTSD after a cardiac event may prospectively increase cardiovascular morbidity and overall cardiovascular mortality. Furthermore, PTSD in medical settings can result in significant distress and disability, which may lead to the avoidance of care and poor treatment adherence (O'Reilly, Grubb and O'Carroll, 2004). Edmonson, Rieckmann, Shaffer, Schwartz, Burg, et al. (2011) found that, in particular, the presence of intrusive thoughts, nightmares, or flashbacks related to acute coronary events is a strong predictor of increased risk of further major adverse cardiac events and mortality.

### **Traumatic Imagery in PTSD**

Intrusive traumatic imagery, including visual memories of the trauma event and flashbacks, is one of the core features of PTSD and causes significant distress (Steil & Ehlers, 2000). Studies of traumatic imagery in the literature on PTSD indicate that trauma survivors tend to experience intrusive visual flashbacks of the trauma event itself or events that occurred shortly before or after the trauma (Hackmann, Ehlers, Speckens & Clark., 2004; Hirsch & Holmes, 2007; Holmes, Grey & Young, 2005). In clinical practice, intrusive imagery and flashbacks frequently lead the clinician to the areas of the trauma that the individual finds most distressing (Holmes et al., 2005), for example the moment during a violent assault when the person was threatened with a gun (Hirsch & Holmes, 2007). Several studies have noted the importance of traumatic imagery in the maintenance of PTSD. Some studies have shown that intrusive imagery is often experienced by trauma survivors who fail to meet criteria for PTSD diagnosis (e.g. Blank, 1993; Foa, Riggs & Gershuny, 1995). As intrusive imagery can increase avoidance behaviours, which could inflate risk of further illness, clinicians working with individuals who disclose trauma after surviving an illness must adequately assess experiences of traumatic imagery.

### **Characteristics of traumatic imagery in PTSD**

#### *Flashbacks*

Trauma flashbacks can involve a variety of sensations, including cognitions, physical sensations and visual imagery. Hirsch and Holmes (2007) note that trauma flashbacks tend not to involve imagery of the entire trauma event, but rather include recall of the most distressing moments in the trauma memory, referred to as "hotspots". These hotspots may involve psychological threats to the person's view of themselves, and may also include physical threats to the individual.

Holmes et al. (2005) identified recurrent cognitive themes in the hotspots of trauma survivors, relating to ‘uncertain threat’, ‘general threat of injury and death’ and ‘psychological threats to the self’. These hotspot themes were found to be represented in visual flashback imagery. Hackmann et al. (2004) found that the types of intrusions most commonly experienced by trauma survivors represent the worst moments in the traumatic event, including moments when the meaning of the event became more traumatic or which signified the start of the trauma.

#### *Flash-forwards & Imagined Events*

Intrusive prospective imagery, also known as “flash-forwards”, involves experiencing images of future events, which can be very distressing. Flash-forwards have been described in various disorders in the literature, including depression and bi-polar disorder (Deepröse & Holmes, 2010). As having future-oriented images increases perceived probability of the event occurring in reality (Carroll, 1978) and plays a role in influencing future behaviour (Holmes et al., 2007), if traumatic “flash-forwards” were experienced by PTSD sufferers, these may contribute to the development or maintenance of PTSD.

A study by Rusch and Grunert (2000) reported that individuals who had sustained injuries as a result of industrial accidents were experiencing vivid, disturbing images, which were not flashbacks, or memories of actual events, but were newly created by the individual, for example, seeing their own children being injured. These images were persistent, difficult to control, caused emotional discomfort and impaired functioning. In Rusch and Grunert’s (2000) study, prolonged imaginal exposure of the trauma event was not effective in reducing distress associated with these imaginary images. Imagery re-scripting work was instead found to be more successful with this type of traumatic imagery. Although clinicians routinely ask PTSD patients about flashbacks at assessment, it is not clear that other forms of imagery such as flash-forwards or other distressing images are similarly explored, thus may not be targeted in treatment.

#### *Potential differences in traumatic imagery resulting from external non-medical illness traumas and internal medical illness traumas*

Internal medical illness traumas, such as life-threatening cardiac events, originate within the individual, often in the absence of any immediate external causal force. During these types of traumas, the person does not have visual access to the physical trauma occurring within them. This is unlike non-medical illness traumas involving an external force occurring outside of the individual, in which, as can often happen, aspects of the trauma may be observed by the person and recalled in later flashbacks. Thus, without any real visual memories of the actual trauma

occurring, it is unclear what traumatic images or visual trauma-related memories individuals who suffer internal medical illness traumas that do not involve any external force might experience, and raises the possibility that the imagery could differ from that associated with external force trauma. Additionally, as the site of an internal medical illness trauma is within the person's body, avoidance of the trauma site and related triggers is not possible, as it might be with an external force trauma. As avoidance is a core feature of PTSD, this further indicates the potential for differences in the impact of internal medical illness trauma on quality of life and behaviour in comparison with those who suffer external non-medical illness trauma.

Although it is recognised that in some circumstances non-medical illness traumas could involve on-going risk of recurrence, this may occur more often with medical illness trauma in which the underlying health problem remains, for example, with coronary artery disease. If perceived threat to life is linked to realistic on-going risk of recurrence, rather than a past event, intrusions experienced as part of post-traumatic stress syndromes, may potentially involve both past and future oriented intrusions (Mundy & Baum, 2004).

The PTSD literature to date is mainly focused on traumatic imagery related to traumas caused by external force. No research has explored traumatic visual imagery in individuals who develop PTSD after a life-threatening medical illness trauma that occurs in the absence of external force, such as a cardiac event, or the impact of these intrusive images on individuals. It may be important to explore the visual imagery experienced by people who develop PTSD symptoms after cardiac events for several reasons:

- (1) Identification of the typical characteristics of traumatic visual imagery experienced by this population and an understanding of the distress associated with the visual imagery will guide clinical practice by informing assessment procedures and treatment.
- (2) Greater understanding of the behavioural impact of traumatic visual imagery in these patients may help to inform early identification of PTSD symptoms in patients who have experienced a cardiac event and inform treatment strategies to reduce avoidance of care and improve treatment adherence.
- (3) Identification of flash-forwards or imagined events in this population could indicate the need for different treatment approaches.

The current study will therefore seek to explore the characteristics and impact of traumatic visual imagery experienced by people who develop symptoms of PTSD after suffering an MI or cardiac

arrest, specifically: what types of traumatic visual images are experienced by patients, including the typical characteristics of these visual images that cause distress, and what behaviours do patients associate with the traumatic imagery.

## **METHOD**

### **Design**

As this was an exploratory study the research adopted a qualitative design. It was retrospective and non-experimental, using semi-structured interviews to gather qualitative data.

### **Procedure**

#### ***Identifying potential participants***

In order to identify potentially suitable candidates for inclusion to the study, MI and cardiac arrest patients attending cardiac rehabilitation units at two hospital sites, were provided with information regarding the study at review clinics by healthcare staff. Staff passed on the names of interested patients, who were then contacted by telephone, and given information about the study. Those who consented were asked to complete and post back screening questionnaires sent to their home address, and their GPs were informed of their participation by letter. Personal information, circumstances of the cardiac event; and confirmation of the MI or cardiac arrest were extracted from medical records. According to DSM IV, in order to meet criteria for a diagnosis of PTSD, symptoms must have been present for at least one month (American Psychiatric Association, 1994). For ethical reasons, participants were not contacted until at least two months post-event. Questionnaires returned by participants were used to identify those meeting criteria for inclusion in the interviews stage of the study. The questionnaire pack included: participant information leaflet (Appendix 5); a consent form (Appendix 6); cover letter (Appendix 7); the Impact of Events Scale-Revised (IES-R) to assess post-traumatic stress symptoms; and a questionnaire assessing current and historical mental health problems (Appendix 8). All participants provided written informed consent to the study protocol, which was approved by NHS Lothian Research Ethics Committee (Appendix 9).

*Interview inclusion criteria* Those who did not report any intrusive symptoms on the IES-R were automatically excluded. Although the IES-R is not a diagnostic tool, studies in the literature have indicated that 33 is an appropriate cut off score for identifying individuals likely to meet PTSD diagnosis (Creamer, Bell & Failla, 2003). Rocha, Peterson, Meyers, Boutin-Foster, Charlson et al.

(2008) used a cut off of 24 to identify patients that, although may not meet diagnosis, may be experiencing clinically significant PTSD symptoms. As people with subsyndromal PTSD also display significant levels of psychological distress and impaired functioning (Grubaugh, Magruder, Waldrop, Elhai, Knapp, et al., 2005), it was considered appropriate to include in the study individuals with lower IES-R scores provided they were experiencing sufficient intrusive symptoms. Thus, all participants scoring 33 or above on the IES-R were included, and those scoring 24 or more were also included, providing they had scored on either of the two items related specifically to imagery ('Pictures about it popped into my mind' and 'I had dreams about it').

*Exclusion criteria* No potential participants met any of the exclusion criteria which included: participants who had suffered a cardiac event as a consequence of an external trauma; participants who attributed their trauma symptoms exclusively to a subsequent medical procedure rather than the cardiac event; individuals who do not accept they have experienced an MI or cardiac arrest despite medical evidence to the contrary; participants with a history of severe mental health problems (e.g. psychotic disorder); stage 4 heart failure; or who suffered the cardiac event less than two months prior to the end of the project or more than twelve months prior to participation.

### ***Screening Measures***

*Post-traumatic stress symptoms* Post-traumatic stress symptoms were assessed using the self-report Impact of Events Scale-Revised (IES-R) (Weiss & Marmar, 1997), which is frequently used to assess PTSD symptoms in medically ill patients. It consists of 22 items, comprising subscales of intrusion (8 items), avoidance (8 items), and hyperarousal (6 items), in line with DSM IV diagnostic criteria. To ensure PTSD symptoms were directly related to the cardiac event, participants were asked to rate how distressing each symptom had been for them in the past seven days with reference to their heart attack (it was thought this term may be more recognisable to participants than myocardial infarction) or cardiac arrest. Thus the wording was adapted to "*we would like to find out if you have experienced any of these symptoms as a result of your heart attack or cardiac arrest, therefore please rate the following items in relation only to the cardiac event you have experienced*". Each item is rated on a 5-point scale ranging from 0 ("not at all") to 4 ("extremely"). The IES-R is a reliable and valid measure of PTSD symptoms (Einsle, 2012).

*Screening measure of anxiety & depression* The Hospital Anxiety and Depression (HAD) Scale (Zigmond & Snaith, 1983) data taken by clinical staff at time of assessment for cardiac rehabilitation was used to provide an indication of mood state. This self-report measure consists

of 14 items made up of two seven item depression and anxiety subscales with a total scoring range of 0-21 for each subscale. Subscale scores of between 11 and 21, indicate clinically significant anxiety or depression; scores between 8 and 10 are categorized as ‘borderline significant’ and scores below 8 are considered within the normal range (O’Reilly et al., 2004).

*Mental health history questionnaire* This brief questionnaire, constructed for the purposes of the study, was used to gather information regarding current and past mental health problems. This information was used to identify patients with severe mental health problems for exclusion purposes.

### **Participants**

Of the 272 MI and cardiac arrest patients that had contact with cardiac rehabilitation services during the time period of the project, two were excluded by clinical staff; one due to suicidality and the other did not accept they had suffered a heart attack. Eighty agreed to initial telephone contact. Six were not suitable as they had experienced their cardiac event less than two months ago. Five declined to participate, and 12 could not be contacted by the researcher. Fifty-seven people agreed to participate but 19 did not return questionnaires. Reminder letters (Appendix 10) and questionnaire packs were sent out to 16 people, which resulted in one further participant.

Thirty eight adults who had experienced either a cardiac arrest, or an ST elevated MI or a non ST elevated MI, completed and returned the IES-R and a questionnaire about mental health history. All participants were medically stable and had been assessed as requiring cardiac rehabilitation. This included participants who underwent medical procedures subsequent to the cardiac event. The overall response rate for the study was 14%. Eight of the 38 participants were interviewed.

### **Qualitative interviews**

All eight individuals meeting criteria were invited to participate in an interview. Semi-structured interviews were conducted at an NHS hospital site, and digitally recorded. The concept of imagery was explained to participants, who were asked to talk about any imagery they experience that they associate with their cardiac event. Imagery was defined as a multi-sensory experience, often taking a visual form, such as a mental image or picture, “film clip”, visual memory, flashback, nightmare or hallucination, that may also involve sounds, tastes, smells, sensations you get in your body and thoughts. All participants were asked open ended core questions, and probing questions were used to gain further detail (Appendix 11). Core questions related to: the content of the images, including the presence of imaginary or future oriented images; the level of distress elicited by the images; the impact of images on behaviour; and coping strategies

employed to deal with the images experienced. A series of pre-determined non-leading prompt questions, and on occasion more leading or idiosyncratic prompts, were used to clarify or elicit further information. A Likert type item, developed for the purpose of the study, was used to gain an indication of the level of distress caused by each image. The scale ranged from 0 = 'no distress' to 4 = 'extremely distressed, the most distressed I could feel; unable to manage the unpleasant feelings' (Appendix 12).

### **Analysis**

Each participant was assigned a numerical code. Interview material was transcribed for analysis. Personally identifiable information was removed during transcription to anonymise the data. Interpretative Phenomenological Analysis (IPA) was used to draw out relevant themes within the data. The analytic process involved identifying recurrent themes across transcripts, which involved several steps: Each transcript was read several times prior to beginning analysis. Following this, each transcript was analysed with respect to semantic content and language used to describe the imagery as well as other relevant content, and then coded with a key word or phrase that represented the meaning of the content. These codes were viewed as emergent themes. Connections across the range of themes were then identified and related themes grouped together to make super-ordinate themes. Although the main concern of IPA is an exploration of lived experience, a key element of this approach is interpretation. When using this approach, it is therefore important to acknowledge that the analyst's interpretations of the data will inevitably be influenced by their own preconceptions, experiences and knowledge. To address this element of subjectivity in a transparent manner, the principal researcher kept a reflective journal throughout the research process, which involved acknowledging preconceptions and other subjective influences that may affect their analysis, and additionally, engaged in discussions with research supervisors during the analytic process. For the purposes of cross validation, two clinical psychologists (D.T. and E.J.) familiar with qualitative methods independently analysed altogether four of the transcripts. The principal researcher subsequently met with each of the secondary analysts to discuss the themes gleaned from the data. Both had identified similar themes to the principal researcher, although at times these were named differently. Two themes were identified only by the principal researcher; however, both secondary analysts agreed on the themes during post coding discussions. All participants were given the opportunity to comment on the provisional results. One participant indicated a desire to do so at interview; however, declined at later contact. Themes identified in the data that are relevant to all trauma populations, such as reliving experiences and the multisensory nature of imagery, are not reported.

## **RESULTS**

### **Participant characteristics**

Of the 38 participants who returned questionnaires, 26% were female, with ages ranging from 31 to 85 years old and an average age of 63.2. Sixteen had suffered a ST elevated myocardial infarction, 17 had suffered a non-ST elevated infarction, three had suffered a cardiac arrest and two had suffered an ST elevated myocardial infarction and cardiac arrest. IES-R total scores ranged from 0 to 57, with an average score of 14. Intrusion subscale scores ranged from 0 to 26, with an average of 4.5. HADS anxiety subscales scores ranged from 0 to 12, with an average of 5.1, and depression subscale scores ranged from 0 to 10, with an average of 3.2. Of the eight participants interviewed, three were female. Their ages ranged from 31 to 72, with an average age of 55.8. IES-R total scores ranged from 24 to 57, with an average of 37.5, and intrusion subscale scores ranged from 7 to 26, with an average of 13.5. Four participants scored above the IES-R cut-off of 33 proposed by Creamer et al. (2003), and the remaining four had total scores between 24 and 32. Anxiety subscale scores on the HADS ranged from 7 to 11, with a mean of 9.1, and scores on the HADS depression subscale ranged from 1 to 10, with a mean of 5.6. Five had suffered an ST elevated myocardial infarction, two had suffered a non-ST elevated myocardial infarction and one had suffered a cardiac arrest. Five participants reported pre- or post-cardiac event health related incidents or on-going health problems that were also distressing to them, for example a seizure event and a collapse due to low blood pressure. In two cases these were described as having been more distressing than the cardiac event. The analysis focused only on imagery of the cardiac event or other imagery types, such as future-oriented or imaginary imagery, that were associated with the cardiac event.

### **Themes**

The results focused on themes identified relating to all visual imagery that participants found distressing, including visual trauma memories that represented or were related to trauma hotspots; and behaviours associated with imagery.

**Table 3. Themes**

<p><b><u>Flashback imagery themes</u></b></p> <p><i>A. Loss of control</i></p> <p><i>B. Realisation of threat</i></p> <p><i>C. Negative impact on others</i></p> <p><i>D. Physical sensations</i></p> <p><i>E. Actions of others</i></p> <p><i>F. Imaginary elements &amp; distortions</i></p> <p><b><u>General imagery themes</u></b></p> <p><i>A. Mortality</i></p> <p><b><u>Behaviour themes</u></b></p> <p><i>A. Avoidance</i></p> <p><i>B. Interpersonal behaviour</i></p>
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***Flashback imagery themes***

By far the most frequent type of imagery, experienced by seven of the eight participants, were visual flashbacks of events that occurred around the time of their cardiac event, including the onset of physical symptoms, receiving medical treatment at home and in hospital, the ambulance journey and events that occurred in hospital. Often these were quite detailed, moving imagery sequences, with particular imagery hotspots that caused the greatest distress; however, in some cases they were more fleeting, and/ or partial in nature. The only participant who did not report a realistic image of the event had no memory of their cardiac event. Interestingly, this participant expressed a need to visualise the event and created an imagery sequence of the event based on witness accounts. Even though this participant created the imagery themselves, it was experienced in a similar manner to that of a real flashback (imagery related to the trauma event) in that it was intrusive in nature, coming into the mind unbidden and causing distress. The imagery was also 'relived' in dreams. Four individuals had dreams connected to the event.

***A. Loss of control***

This theme captured imagery in which a loss of control, either physical or psychological was represented. This included images of moments during the event where they experienced physical loss of control, such as a collapse; psychological loss of control, such as being unaware of what was happening to them, being excluded or ignored, being in a powerless position or feeling helpless; or a loss of consciousness and disorientation, which may be associated with loss of

physical and/or psychological control. This theme was represented in the flashback imagery of seven participants.

For two participants, the images that returned to them included loss of consciousness and disorientation upon awakening during the event. Participant 55 for example, described this flashback of the event, which included thoughts they had at the time: *“the one [flashback] in the hospital when I collapsed ...I opened my eyes I was like so disorientated, and I felt like I was upside down, and everything was just white and machines everywhere...and I didn’t ken where I was or anything, and they’re the most traumatic parts for me”*. Similarly, participant 7 described in their flashback imagery of losing consciousness and feeling disorientated when they awoke, a key part of the event that the participant found distressing. They appear to have felt overwhelmed and confused at this point during the event.

Participant 45 described this visual memory of their cardiac event, which was connected with a loss of control over the situation and feeling helpless, and which represented the most distressing part of the event for them: *“he [GP] came back and just said I’ve got a blue lights ambulance on the way for you, eh, ‘you’re having a heart attack’...I was lying on the couch and just seeing them [family] coming in and they weren’t actually speaking to me, they were speaking among themselves and I’m looking and thinking, why are they not speaking to me”*. The participant reported feeling a lack of control at this point during the event: *“it’s really just being, feeling helpless...I wasn’t in control, I was the, completely out of control, out of my control”*. The participant felt excluded at this point during the event, perhaps adding to their sense of a lack of control in the situation.

Participant 7’s flashbacks of the cardiac event included a visual memory of a time during the event when they felt unaware of what was happening to them: *“one of the doctor guys was like ‘are you actually aware of what’s going on [participant’s name], has anyone explained to you what is happening?’...I don’t think nobody actually did”*. This uncertainty about what was happening made them extremely distressed: *“I was anxious as well, what’s going on, and what’s going to happen, if I’m going to have a heart attack and whatever else, and what does that involve? Full of questions”*. This participant felt that they were ignored by hospital staff during the event, which was related to their on-going distress about their heart attack, and may have further contributed to a sense of a lack of control in the situation.

Participant 55 had flashbacks of points when they experienced physical collapse. They describe this loss of physical control as being the most distressing part of the flashback: *“this is my flashback constantly... my arms were just going like that [participant gestured by putting both arms out to the side, and moving them up and down in a type of flailing action] cause I was trying to push myself up, off the ground...that’s basically my most traumatic part, was like the collapsing and just not being able to push myself up.”* Both visual memory and somatosensory experience are represented in this image.

### ***B. Realisation of threat***

This theme captured imagery connected to the realisation of the serious and threatening nature of the event, reported by five participants.

Participant 7, for example, described in their flashback of the moment during the event they found out that they were having a heart attack: *“the doctors face right next to mine, you know. The hand taking the mask off my face, and he had a very, very big hand compared to my face...and the words ‘heart attack’ just ringing in my ears.”* This was the most distressing image in their flashback sequence, which they connected with their shock upon recognising the seriousness of the situation. They described feeling stunned upon hearing the words “heart attack”. They were aware that people can die as a result of having a heart attack and described this news as a *“major blow”*.

Participant 20 also described flashback imagery connected with recognition of threat during the event: *“I can visualise myself having to lie down, going to the floor with difficulty...I knew this [heart attack] was approaching. I remember very clearly doing that, going to get things to take with me [to hospital], and selecting them, and I knew there was a crisis approaching”*.

### ***C. Negative impact on others***

This theme represents imagery relating to the distress of others who witnessed their cardiac event, such as family members. These images were often associated with fears about the negative impact of their cardiac event on others, such as how loved ones will cope without them if they die.

Four participants described flashback imagery that involved witnessing the distress of others. Participant 55, for example, recalled in their flashback image the sound of their daughter screaming. They described feeling guilty about the impact of the event on their daughter, who

was distressed by the experience. Participant's 12 and 45 both reported key images relating to the distress of their family, for example participant 12 described the following image: *"my wife's face...she came in to see me and she was crying"*. Seeing their family members upset during the event increased their own distress. These visual memories were connected with a fear of leaving their family and the impact this would have on them. Participant 7 also described a flashback relating to the distress of another: *"I saw [her] face, it's something I'll never forget. She's standing next to my bed and she's got her hands up and she's shaking and she's been crying...I knew straight away just by looking at her, I knew something was wrong"*. Seeing the distress on this person's face was significant as this communicated the seriousness of the situation.

#### ***D. Physical sensations***

This theme captures those times that the participant described in their accounts of the flashback, physical sensations, which occurred during the event and which appeared to be an important part of the imagery.

Participant 7: *"So up until then, felt the clot moving...from that minute I felt it move, the movie was over. It was like an instant relief, I actually felt it moving away, so from the moment they said to me 'we think you're having a heart attack' in the resus room to the point where they took the clot away, is where the movie plays"*. For this participant, the flashback is experienced like a film clip, and physical symptoms experienced appear to drive the imagery, indicating their centrality to the participant's experience and current imagery.

Several participants described flashback moments relating to the pain experienced during the event. Participant 42 for example, described pain as a key aspect of their imagery experience: *"I can see myself going down in pain"*. Participant 27 reported experiencing in their flashback of the event an image of a *"big, massive elephant"* sitting on top of their chest, representing the physical sensations they experienced during the heart attack.

#### ***E. Actions of others***

This theme represents a focus on the social context, including unhelpful actions and responses of others during their cardiac event, in the imagery experienced. This was reported by three participants.

Participant 55 described feeling embarrassed in response to the actions of others during the event: *"I ended up, like just people were helping me and being really nice but I was really mortified,*

*just like lying on the floor and they're like "just stay down there" and I was, just didn't want to but I couldn't get back up"*, indicating the importance to this participant of the social context in which their event occurred.

Participant 7 recalled the following visual images of their interactions with healthcare staff prior to being told by the doctor that they were having a heart attack: *"there was a machine in the corner kept beeping, kept going off... nobody could find out why it was going off, but they said they were watching it at the reception desk and it was fine over there, but when they came into the room my heart rate was going through the roof, and the doctor guy ... trying to crack a wee joke and everything about it...it was, there's something not, not matching up about that, and I'm sure later on they actually said they were watching the wrong monitor at reception"*. These images evoked feelings of anger: *"I just felt nobody believed me, nobody was listening to me they just wanted to leave me in pain...It felt like nobody was taking me seriously"*. The actions of others appeared to violate the participant's expectations of care.

#### ***F. Imaginary elements & distortions***

Imaginary elements or distortion in the flashback imagery was present in five participants and captured in this theme. Participant 20 described an imaginary image involving an acquaintance whom they happened to see while in the hospital. The person was in a state of ill health. Two versions of the person are seen; the image of the person in his younger years and the image of the current "deteriorated" person, which then merge to become the present ill person. The image appeared to represent their own perception of a changed self post-event, which they viewed negatively, and their cardiac event having symbolised a transition to the end of one's life. Participant 29 had no recall of their cardiac event yet had created their own imagery of the event based on witness accounts, as a way of making sense of what had happened to them. This imagined imagery was then experienced in a similar way to a flashback. Participant 27 reported visualising a massive, grey elephant sitting on their chest during the heart attack, which appeared to represent their sense of having been physically crushed. This imagery is linked to both the theme of physical sensations, and the theme of recognition of threat.

Participant 7's flashback was distorted in that they did not see themselves in their flashback: *"the whole thing's like a movie...but it's not me that's acting in it. It's an actor, famous actor or somebody in it"*. They describe a sense of disconnection and depersonalisation both during the event and in relation to the imagery experience: *"it was all so surreal. It was like every time they were talking to me, it was like they were talking about somebody else...I still, now when I'm*

*speaking about it... think I'm talking about somebody else not myself ...I can see the whole event but...it's just a person there but it's just not me*". This may represent a dissociation from the traumatic event, which is a common coping strategy used by people who have suffered a trauma, and can serve to maintain traumatic stress.

## **General imagery themes**

### **A. Mortality**

This theme captured non-flashback imagery reported that were connected with death, appearing to represent an awareness of one's own mortality and the mortality of others resulting from the cardiac event. Participant 45 described "*looking at cemeteries in my mind*" after the event. Participant 55 had recurrent dreams about the death of loved ones. These dreams were repetitive and difficult to escape, highlighting the power of these intrusions for this participant: "*just keep going back into the same dream over and over again and I cannot get out of that dream*". These dream images were linked to the participant's fear of loss and feelings of vulnerability since their cardiac event. Participants 29 and 12 reported having experienced, since their cardiac event, past-oriented visual memories relating to the death of others. In addition, participant 20's imagery regarding the two versions of the person they knew and met in hospital, young and ill, merging into one, was associated with thoughts about their life coming to an end: "*it's end of the road stuff*", thus also appearing to represent an awareness of the participant's own mortality.

## **Behaviour themes**

These themes captured the impact that the visual imagery have on behaviour, and encompassed some of the behavioural coping strategies employed by participants to manage these imagery experiences. Some participants reported helpful behavioural coping strategies, including use of relaxation techniques, seeking support from others, and exercising.

### **A. Avoidance**

All participants described using some form of avoidance behaviour. The avoidance behaviours were either reactive to the imagery experience, designed to escape or reduce distress evoked, or pre-emptive, designed to avoid contexts that evoked imagery about the cardiac event.

With regard to avoidance behaviours in response to images, some participants spoke of an urge to withdraw, both from activities and from others when they experienced imagery, which also affected their mood. For example, participant 55: "*they just make me, if it's during the night, then*

*the next again day I'm just like really moody, really tearful, don't want to really speak to anybody.*" Participant 45 also indicated withdrawal in response to imagery: *"go very quiet, I stop speaking to anybody... I think that, if I'm not speaking and say anything to anybody, I'm not going to say, pass on that I've not got a good feeling about something ...it's like having an infection and not wanting to pass it on to someone else"*. Both participant 20 and participant 55 described avoidance of going out after experiencing imagery. Participant 55 also reported using medication to manage negative feelings evoked by flashbacks. Many participants described using behavioural distraction techniques to reduce distress experienced by the imagery, such as making a cup of tea or going shopping.

A number of participants also used pre-emptive avoidance behaviours, designed to avoid stimuli or contexts that could trigger the imagery. Participant 55, for example, explained: *"I can't watch anything to do with dying or anything like that now... I used to like all thrillers and things like that but I can't watch anything that's associated just like with people dying now, it just makes me in tears."*

### ***B. Interpersonal behaviour***

Three participants made links between the imagery experience, negative mood states and consequent impact on their behaviour towards others: Participant 55 for example, described *"It just affects my mood the next again day, I'm just in a terrible mood... and end up falling out with somebody in the house"*. Participant 12 similarly, reported: *"I just get annoyed, and I'm like 'leave me alone' ken. 'I'm fine!', ken, that kinds sharp-ish, eh, sometimes my language isn't very good either."*

### **Imagery as coping**

Interestingly, four of the participants described sometimes using the imagery in a functional way. For some to fill in memory blanks, and others to search for answers to questions they had about the meaning of the imagery or the reason for their cardiac illness. At these times, the imagery would be less distressing as participants would have some control over them. For example participant 20 explained: *"quite often, you know I think I run things through, I do a reel...I might choose to re-run that...it's this, standing back, observing, standing aside and looking at the event...It's almost a way of managing it. You're there as an observer...because you're doing a sort of repetition of a, you know, it is a form of, of self-hypnosis."* This participant would feel less distressed by the images at these times because they felt disconnected from them: *"because you're observing, you're not engaged"*.

## **DISCUSSION**

### **Imagery**

The findings add to the existing literature and provide useful information regarding conceptualisation of post-trauma syndromes that are characteristic of cardiac patients. The hypothesis that imagery resulting from internal medical illness trauma involving no external force may be different from that resulting from trauma caused by external forces, was not borne out in the data. Similar to studies of other trauma populations (Hackmann, et al., 2004; Holmes et al., 2005), the majority of participants reported visual flashbacks of the events that occurred around the time of the cardiac event. Furthermore, although the nature of the trauma experienced by participants in this study was internal, without any involvement of external force, imagery of the internal physical trauma was not reported. Only one participant reported imagery relating to their internal physical world, however, this was not a flashback of what was happening to them at the time, but rather an image of their heart post-event. Future oriented imagery was also uncommon, with only one participant reporting distressing future oriented imagery associated with their cardiac event. For all the participants in this study, the main focus of the imagery was on external experiences at the time of their cardiac event.

The tendency of participants to externalise the trauma experience, to focus mainly on the external events around them and social context of their experiences, despite the internal nature of the trauma, may be linked to external locus of control experienced during the cardiac event, which increases external focus. Several studies have reported a connection between external locus of control and development of psychological distress in response to trauma (Brown, Mulhern & Joseph, 2002; Solomon, Mikulincer, & Avitzur, 1988; Solomon, Mikulincer & Benbenishty, 1989). This externalisation of imagery may also indicate that individuals have tried to make sense of what is happening to them during the event by searching for external cues within the environment. This is consistent with attribution theory, which posits that people tend to seek explanations for events in the external world, rather than look for causes within themselves, and is also in line with the tendency for cardiac patients to attribute their heart attack to external stress rather than internal factors (French, Marteau, Senior & Weinmann, 2002).

A loss of control experienced during the cardiac event was a clear theme evident in the imagery “hotspots” of several participants, evidencing the distressing nature of these particular experiences. This is consistent with the literature on PTSD, which highlights helplessness as a key feature relevant to traumatic response, recognised in the diagnostic criteria for PTSD (American Psychiatric Association, 1994). It is also in line with the finding that lower perceived

control during MI is associated with higher PTSD symptomatology (Doerfler, Paraskos & Piniarski, 2005). This finding may have useful clinical implications, specifically, the use of imagery re-scripting to reduce sense of powerlessness and increase sense of control in relation to the imagery. Although the perspective of the participant in their imagery was not always clear, several described an ‘out of body’ or detached/ dissociated perspective. This could be a form of dissociation, which is a common way of coping with trauma. This type of detached perspective could increase a sense of powerlessness upon experiencing the image, which could also be re-scripted in treatment to increase the sense of power over flashbacks. During the cardiac event itself, actions should be taken by healthcare staff to reduce feelings of helplessness and increase sense of control, such as, including patients in discussions about their health as appropriate, and explaining clearly to them what is happening throughout the event. Feeling helpless during the event could also affect how the participant engages with healthcare services post-event.

Disorientation was a theme in the imagery of two participants, connected with a sense of lack of control during the event, and one of these participants also described a depersonalisation experience during the event that was also evident in their later flashbacks. Mental confusion during a trauma event is thought to affect the ability to engage in semantic processing of the trauma, as the person is unable to concentrate on important parts of the event (Dunmore, Clark & Ehlers, 1999). It is proposed that mental confusion may increase risk of poor outcome post-trauma as the person fails to undertake semantic processing, thus negating the creation of an integrated trauma memory (Ehlers & Clark, 2000; Dunmore, et al, 1999). Disorientation and depersonalisation in the imagery of these participants may indicate that they experienced mental confusion during the event, which could have influenced the development of their post-traumatic stress symptoms, and these aspects of the imagery experience may be useful targets for treatment.

Imagery “hotspots” connected to realisation of threat found in this study fits with diagnostic criteria for PTSD, and is consistent with previous studies highlighting that the degree of life threat perceived during MI predicts PTSD symptoms post-event (Kutz, Shabtai, Solomon, Neumann & David, 1994), and the hotspot themes of ‘uncertain threat’ and ‘general threat of injury and death’ represented in intrusive imagery and cognitions identified by Holmes et al. (2005). This also reflects the findings of Hackmann et al. (2004) that the types of intrusions most commonly experienced by trauma survivors represent the worst moments of the trauma event, including moments when the meaning of the event became more traumatic or which signified the onset of the trauma. It is possible that imagery of these moments during the event may evoke a sense of current or on-going threat when they are experienced. Indeed, Ehlers & Clark (2002)

proposed the “warning signal hypothesis” which posits that intrusive trauma memories are a re-experiencing of information that signalled threat or danger during the trauma, and thus function as a warning sign of future threat. Several participants reported cognitions that were closely connected to their imagery relating to the life-threat posed by the event, with a continued marked focus on what *could* have happened to them, namely death. This awareness of own mortality was also expressed in the non-flashback imagery of several participants, indicating that the cardiac event activates heightened focus on mortality. Participants expressed difficulty moving past these thoughts/images about what could have happened, appearing to be stuck on the life-threatening nature of the event, and many continued to experience flashback imagery connected with sense of threat during the event and/or post-traumatic imagery connected with death. These imagery themes may be evident in the post-traumatic experiences of other trauma populations; however, they may be particularly relevant to the maintenance of PTSD in cardiac event survivors, as the potential for further life-threatening cardiac events to occur could maintain heightened awareness of mortality post-event. Helping individuals to process the threat to life that occurred, as well as redirecting attention to the present and reducing misconceptions regarding the likelihood of future events, may be a useful treatment focus for clinicians working in cardiac rehabilitation.

The focus on negative consequences of the event on loved ones (both actual and potential), as well as unhelpful responses of others during the event, indicate that the impact and meaning of the event on both a personal and an interpersonal level is important for some who experience symptoms of post-traumatic stress after a cardiac event. The perception that others have responded in a negative manner during a trauma has been linked to poor adjustment (Ullman, 1996; Dunmore et al., 1997) and the results of this study support this finding. Ehlers & Steil (1995) found that assault victims who believe other people have reacted negatively after the event, associate harm with both the perpetrator and the social world, which can contribute to a sense of threat, and can be linked to feelings like anger, guilt and shame. They suggest that fixation on the negative behaviour of others can prevent acceptance of the trauma and impede emotional processing (Ehlers & Steil, 1995). Dalgleish & Power (2004) highlight the potentially important role that anger may play in PTSD. These emotions may be particularly relevant when the trauma event has involved perceived negative responses of others, and associated imagery and cognition could be modified in treatment. Interactions between patients and healthcare staff during the cardiac event may thus be particularly important, and negative interactions could have a bearing on the level of distress experienced. Increasing medical staff awareness of this potential issue via training may be useful.

With regard to the distress caused to others, visual imagery and associated feelings of guilt about the impact of the event on others, and thoughts connected to the impact their death could have had on loved ones, appeared to play a role in the maintenance of post-traumatic stress for some in this sample. Helping individuals to process the distressing social aspects of their event and relevant imagery regarding the distress of others during the event may be a useful treatment focus for psychologists and nurses working in cardiac rehabilitation. Approaches such as acceptance and commitment therapy (ACT), which emphasises being present, or cognitive behavioural therapy to explore relevant imagery and associated cognitions may be helpful.

Perhaps unsurprisingly given that the trauma event was a physical illness, physical sensations were represented in the visual imagery flashbacks reported by participants. Indeed somatic reliving experiences were also experienced by some participants in response to the imagery. Physical sensations within the imagery, and associated somatic reliving experiences, may be an important target for treatment, particularly as patients may have on-going physical symptoms, which could be misconstrued as indicating a recurrence of cardiac problems, potentially contributing to the maintenance of PTSD in this population. Physical experiences, such as pain, experienced during a cardiac event may increase distress and could be linked to recognition of the life-threatening nature of the event, which is key in producing a post-traumatic stress response (American Psychiatric Association, 1994).

Imaginary elements or distortions were evident in the flashbacks of several participants. In some cases these appeared to represent attempts to make sense of their traumatic experience, for instance to fill in memory blanks. These aspects were recognised by participants as not having actually occurred during the event, or not being accurate representations of what had happened and, therefore, may be less amenable to traditional gradual exposure treatment alone. Other modes of treatment that involve imagery modification may be more effective, such as imagery re-scripting (Rusch & Grunert, 2000). These imaginary elements may guide the clinician to particular “hotspots” in the event imagery and could also provide the clinician with useful clues about how the trauma event has been understood or processed by the individual. It is interesting that having no memory of the event does not necessarily negate the existence of traumatic imagery, and indicates the importance for some patients to have a visual script of what happened to them. Clinicians should be aware of this, and enquire about traumatic flashbacks even when people do not recall any aspects of the event.

The most common type of imagery was a form of flashback of the cardiac event itself, which sometimes included distorted or imaginary features; however, other types of distressing imagery were also reported in the sample, albeit infrequently, including ‘flash-forward’ imagery, past oriented imagery, and imaginary imagery that was not future oriented. Given the small sample in this study it is not possible to comment on the prevalence of these types of imagery in cardiac patients with symptoms of post-traumatic stress, however, the findings do indicate the presence of multiple types of imagery. Clinicians working with individuals traumatised by their cardiac event should enquire about these other kinds of imagery experiences, as they may be amenable to treatment, such as imagery re-scripting for imaginary imagery (Rusch & Grunert, 2000). Three participants reported beliefs that their imaginary imagery experiences were “stupid”, “weird”, or “crazy”, suggesting that people may be less likely to disclose these types of imagery voluntarily, and indeed for two participants these images were only reported when asked directly, further highlighting the importance of covering these in assessment. Future-oriented imagery may be particularly important to identify, as this may play an important role in maintaining distress post event by increasing perceived probability that the imagined scenario will occur. As the processing of a past trauma involves cognitive integration of the traumatic event, if there is a rational anxiety that the trauma could recur, fears may be justified and thus the process of integration may be more challenging (Mundy & Baum, 2004). Cardiac events involve on-going risk of recurrence and thus may be more difficult to process than non-medical traumas of a past event. The one participant who reported a future oriented image indicated that this image was most distressing to them.

The visual imagery themes found in this study indicate particular key aspects of cardiac event experience that may be relevant to cover in clinical assessment. In terms of early intervention, it may be useful to provide information to all cardiac patients prior to discharge from hospital about traumatic reactions to cardiac events and the possibility that distressing imagery related to the event may be experienced, imagery which may be distorted, accompanied by somatic reliving experiences, and lead to avoidance. It will be important to normalise the experience of imagery in the initial phases after a traumatic event, and to provide advice on how to access further support should one experience continued distress, or problems with concentration due to intrusive symptoms.

### **Behaviour**

With regard to the behavioural impact of imagery experiences, all participants reported the use of avoidance behaviour to cope with the experiences, which is key feature of PTSD and a common

copied strategy employed. It is well recognised in the literature that avoidance coping results in maintenance of the traumatic response (Mundy & Baum, 2004), thus the findings of this study are in keeping with other trauma populations, despite the internal nature of the trauma. A study by Orsillo and Batten (2005) suggest using ACT to treat PTSD, one of the main goals of which is to reduce experiential avoidance of painful experiences, and increasing willingness and acceptance. Previous studies (Shemesh, Rudnik, Kaluski, Milovanov, Salah, et al. 2001) have identified a link between post MI PTSD and poor treatment adherence; however, this was not evident in the findings. Treatment adherence, however, was not specifically asked about in this study, and it is possible that those wishing to avoid trauma related triggers may have been less likely to take part in the study. Some participants described the impact that the imagery had on their mood state, which then had a negative impact on their behaviour towards loved ones. This highlights the potential impact that post-traumatic stress symptoms can have on relationships, as well as other areas of functioning.

### **Imagery as coping**

The use of imagery replay and/or construction of a visual account of the event as a way of processing the trauma, reported by half of the participants in the study, was an unexpected finding. This appeared to be connected with a search for answers and meaning, or to fill in memory blanks, and seemed to have a functional use. There might be more of a tendency for people traumatised by health related events, to seek an understanding of what caused it, and whether they played a role in the development of the illness, resulting in this form of functional imagery replay. However, it is possible that this replay could also be a form of rumination, focusing on the negative experiences without processing them, which would be maladaptive and thus, potentially maintain PTSD symptoms. Indeed, some of the participants who reported this type of functional replay did so to seek answers, which they did not find, thus the replay became dysfunctional. It was interesting that these participants still experienced distress when the imagery occurred involuntarily, thus this form of exposure to the imagery did not eliminate distress associated with the image, indicating the potentially maladaptive nature of this strategy.

### **Emotions, existential concerns & perception of a changed self**

A number of participants displayed emotional responses when discussing their experiences during the interviews, for example becoming tearful when talking about their memories of the event or displaying physical symptoms of anxiety, such as sweating. One participant reported existential concerns, questioning the meaning of their survival. Others described a fragmented or changed perception of themselves post-event. They now viewed themselves differently, as if their sense of

themselves had been challenged by the event, resulting in an altered or fragmented self, a self that was viewed negatively. They reported comparing their perceived pre and post event identities, and expressed a sense of loss. These emotions, existential concerns and perceptions of a changed self were clearly very important elements of some participant's lived experiences; however, in order to maintain focus on the research aims, which included specifically the characteristics of the imagery and the behaviours associated with that imagery, these experiences were not presented within the results.

### **Limitations**

Due to the relatively small number of people identified as suitable for interview, it was not possible to use saturation methods. A study by Guest, Bunce and Johnson (2006) indicate that basic elements of superordinate themes were evident as early as six interviews, thus it is hoped that the likelihood of themes having been missed is minimal. Given the difficulty in finding suitable participants for the study, an opportunity sampling method was utilised, which may have introduced a level of bias in the sample, in terms of the type of people who agreed to participate in the study. Given the propensity for traumatised individuals to avoid reminders of the trauma, people who were highly traumatised by their cardiac event may have been less likely to agree to participate in the study. Suitable individuals may also have been disinclined to take part due to inability or reluctance to travel to the interview location. The initial stage of recruitment into the study was carried out by clinical staff during review appointments. It is possible that some potential participants may not have been recruited, due to prioritisation of clinical work, perhaps particularly with distressed patients.

The IES-R is a screening tool rather than a diagnostic tool, thus, it is not possible to state whether individuals in the study would have met criteria for diagnosis of PTSD. However, given that cardiac patients with subsyndromal PTSD have also been shown to experience distress and poorer quality of life with respect to mental health, social functioning, role functioning and physical health (Doerfler et al., 2005; Spindler & Pedersen, 2005), which may also impact on ability to engage in cardiac rehabilitation, there is nevertheless clinical relevance in exploring the nature of intrusive imagery in these individuals.

Although the researcher attempted to use open questions as far as possible during the interviews, in order to elicit information relevant to the research questions that was not offered spontaneously, some closed and more leading questions were used at times. The concept of imagery itself is quite a tricky concept to understand. Although participants were given an

explanation of the concept of imagery at the outset of the interview, participants may have varied in their understanding of imagery. It may have been difficult for participants to spontaneously recall specific details about their imagery experiences in the interview situation, perhaps leading to the omission of important aspects or details of the imagery. It might have been helpful for participants to have been sent a script of the semi-structured interview questions prior to the interview in order that they could begin the process of noticing details of the imagery as it occurs, which could then be provided more easily in the interview. Given the traumatic nature of the material, and tendency for traumatised individuals to use avoidance coping, it is possible that some highly distressing imagery may not have been disclosed.

Participant's reports of their flashbacks often involved a mixture of imagery, sensory experiences, such as sounds, movements and physical sensations, as well as their thoughts at the time and post-event reflections on the meaning of the imagery. These cognitive and sensory experiences were linked to the imagery and thus were important to understanding the lived experience and phenomenology of participant's post-traumatic syndromes; however, in terms of the data and analysis, this meant that visual imagery could often not be clearly separated from other intrusive phenomenon. It is also important to recognise the subjective influence of researcher on the interpretation of the qualitative data (Smith, 2004). Particularly relevant to this study are the researcher's familiarity with the literature on PTSD and cardiac rehabilitation, and personal experience of acquaintances having suffered cardiac events. Inevitably, these experiences and knowledge of the literature will have resulted in the formation of some preconceptions relating to cardiac events, such as the view that cardiac events can be traumatic for some individuals and may result in the development of post-traumatic stress symptoms, which could potentially have influenced the researcher's interpretation of the data. Reflective journaling and engaging in discussions with supervisors regarding the data were undertaken to try to address this issue in a transparent manner. In addition, independent analysis and coding of four transcripts by two secondary analysts for the purpose of triangulation may have served to minimise the subjective influence of the researcher in this study and increase validity of the findings. As the researcher was at the time a healthcare professional working in cardiac rehabilitation, it is possible that a perceived power differential between the participant and the researcher could have influenced information provided by participants.

### **Future research**

This is the first qualitative study of imagery experienced by people of have suffered MI or cardiac arrest events, therefore further research in this area is important to further explore the nature of

intrusive experiences in this population. Investigation of the prevalence of non-flashback types of imagery in this population, and indeed other medical trauma populations, and the role that these types of imagery may play in the maintenance of PTSD symptoms would be useful. Perspective in the image was not clear for all of the participants. It would be interesting to clarify this in future studies, as this may have implications for the powerlessness, and resulting distress, experienced in response to the images. It would be useful to directly compare the imagery experiences of internal and external trauma imagery in future work, to clarify particular differences and any bearing these differences might have in terms of understanding the trauma response and treatment implications.

Future research should also investigate further the use of imagery replay in this population to explore its functionality and consider ways that this could potentially be used in a more adaptive way during treatment, such as helping individuals to reinterpret the image or to access relevant trauma related cognitions about the event.

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## **EXTENDED METHODS**

### **Design**

As this was an exploratory study focusing on an area in which there was little existing research, the research adopted a qualitative design. It was retrospective and non-experimental, using semi-structured interviews to gather qualitative data.

### **Procedure**

#### *Identifying potential participants*

In order to identify potentially suitable candidates for inclusion to the study, a screening process using a quantitative measure was first carried out. MI and cardiac arrest patients attending cardiac rehabilitation units at two NHS hospital sites during the time period of the project were provided with information regarding the study by healthcare staff and asked if they might be interested in participating. Staff passed on to the researcher the names of interested patients, who were then contacted by telephone, and given information about the aims, process and benefits of the study. Those who consented to participate were asked to complete and post back screening questionnaires sent to their home address, and their GPs were informed of their participation by letter. Addresses, demographic information (including sex, age and gender), GP details, information regarding the circumstances of the cardiac event; and confirmation of the MI or cardiac arrest were extracted from medical records. According to DSM IV, in order to meet criteria for a diagnosis of PTSD, symptoms must have been present for at least one month (American Psychiatric Association, 1994). For ethical reasons, participants were not contacted until at least two months post-event. Questionnaires returned by participants were used to identify those meeting criteria for inclusion in the interviews stage of the study. The questionnaire pack sent out to all potentially suitable participants included: a consent form; participant information leaflet; mental health history questionnaire, assessing current and historical mental health problems; and post-traumatic stress symptoms. The IES-R data was used to identify patients experiencing PTSD symptoms.

*Interview inclusion criteria* As the study aims to explore intrusive imagery, those not experiencing any intrusive symptoms were automatically excluded. A large number of first stage participants scored on at least one intrusive symptom. Although the IES-R is not a diagnostic tool, studies in the literature have indicated that 33 is an appropriate cut off score for identifying individuals likely to meet PTSD diagnosis (Creamer et al., 2003). As people with subsyndromal

PTSD also display significant levels of psychological distress and impaired functioning (Grubaugh et al., 2005), it was considered appropriate to include in the study individuals that did not meet the 33 cut off, provided they were experiencing sufficient levels of intrusive symptoms. Rocha et al. (2008) used a cut off of 24 to identify patients that, although may not meet diagnosis, may be experiencing clinically significant PTSD symptoms. Thus, all participants scoring 33 or above on the IES-R were included, and participants scoring 24 or more were also included providing they scored on either of the two items related specifically to imagery ('Pictures about it popped into my mind' and 'I had dreams about it').

*Exclusion criteria* No potential participants met any of the exclusion criteria which included: participants who had suffered a cardiac event as a consequence of an external trauma; participants who attributed their trauma symptoms exclusively to a subsequent medical procedure rather than the cardiac event; individuals who do not accept they have experienced an MI or cardiac arrest despite medical evidence to the contrary; participants with a history of severe mental health problems (e.g. psychotic disorder); stage 4 heart failure; or who suffered the cardiac event less than two months prior to the end of the project or more than twelve months prior to participation.

### *Qualitative interviews*

All those meeting criteria for interview were contacted by phone and invited to participate in an interview. Interviews were conducted at an NHS hospital site, and digitally recorded for the purposes of transcription. A semi-structured interview format was used. At the outset of the interview, the concept of imagery was explained to participants and they were given an opportunity to ask any questions or to seek clarification. Participants were asked to talk about all types of imagery they experience, connected to their heart attack or cardiac arrest. All participants were asked core questions linked to the research questions, and probing questions were used to gain further detail. Core questions related to the content of the images they experienced (open questions asking for information regarding any images experienced associated with their cardiac event, with more specific questions exploring any experience of imagery about the future or imagery of things that did not occur at the time of the event, that could be used if these were not reported in response to the initial core question or subsequent prompting); the level of distress elicited by the images; the impact these images have on behaviour; and coping strategies employed to deal with the images experienced. Core questions were open-ended, allowing participants to contribute as much detailed information as they desired (Smith & Osborn, 2008). A series of standard non-leading prompt questions were identified in advance and used to gather further details about the images and associated experiences, including thoughts and emotions

triggered by the images. The types of prompts used varied depending on the information given by the participant, and on some occasions idiosyncratic, non-standardised prompts were used to clarify or elicit further information from participants, some of which were more leading in order to elicit information that had not arisen spontaneously. A Likert type item, developed for the purpose of the study, was used to gain an indication of the level of distress caused by each image. The scale ranged from 0 = 'no distress' to 4 = 'extremely distressed, the most distressed I could feel; unable to manage the unpleasant feelings' (Appendix 12). The interview structure and the wording of some questions were altered after the initial interview in order to improve the interview process and enhance the quality of data gathered.

### ***Participants***

Of the 272 MI and cardiac arrest patients that had contact with cardiac rehabilitation services during the time period of the project, two were excluded by clinical staff; one due to suicidality and the other who did not accept they had suffered a heart attack. Eighty agreed to initial telephone contact. Six had experienced their cardiac event less than two months previously. Five declined to participate, and 12 could not be contacted by the researcher. Fifty-seven agreed to participate but 19 did not return questionnaires. Reminder letters and questionnaire packs were sent out to 16 people, which resulted in one further participant. Thus, the overall response rate for the study was 14%.

Thirty eight adults who had experienced either a cardiac arrest, or an ST elevated MI or a non ST elevated MI, completed and returned the Impact of Events-Revised (IES-R) and a questionnaire about mental health history. All participants were medically stable and had been assessed at three hospital sites as requiring cardiac rehabilitation due to complex physical or psychological needs. This included some participants who underwent procedures, such as angioplasty and coronary artery bypass grafting, subsequent to the initial cardiac event. Of the 38 who completed questionnaires, eight participants were interviewed. All participants provided written informed consent to the study protocol, which was approved by NHS Lothian Research Ethics Committee.

### ***Screening Measures***

*Screening measure of anxiety and depression* The Hospital Anxiety and Depression Scale (HADS) was already available as this is routinely collected at review assessments by cardiac rehabilitation staff to assess psychological distress. This information was extracted from the cardiac rehabilitation database following consent from participants. The HAD Scale (Zigmond & Snaith, 1983) data taken by clinical staff at time of assessment for cardiac rehabilitation was used

to provide an indication of mood state. This self-report measure consists of 14 items made up of two seven item depression and anxiety subscales with a total scoring range of 0-21 for each subscale. Subscale scores of between 11 and 21, indicate clinically significant anxiety or depression; scores between 8 and 10 are categorized as 'borderline significant' and scores below 8 are considered to be within the normal range (O'Reilly, Grubb & O'Carroll, 2004).

*Post-traumatic stress symptoms* Posttraumatic stress disorder symptoms were assessed using the self-report Impact of Events Scale-Revised (IES-R) (Weiss & Marmar, 1997). The IES-R is frequently used to assess PTSD symptoms in medically ill patients. It consists of 22 items, comprising subscales of intrusion (8 items), avoidance (8 items), and hyperarousal (6 items), in line with DSM IV diagnostic criteria. To ensure PTSD symptoms were directly related to the cardiac event, participants were asked to rate how distressing each symptom had been for them in the past seven days with reference to their heart attack (it was thought this term may be more recognisable to participants than myocardial infarction) or cardiac arrest. Thus the wording was adapted to "*we would like to find out if you have experienced any of these symptoms as a result of your heart attack or cardiac arrest, therefore please rate the following items in relation only to the cardiac event you have experienced*". Each item is rated on a 5-point scale ranging from 0 ("not at all") to 4 ("extremely"). The IES-R is a reliable and valid measure of PTSD symptoms (Einsle, 2012).

*Mental health history questionnaire* This brief questionnaire, constructed for the purposes of the study, was used to gather information regarding current and past mental health problems, including a description of the problem, duration, diagnosis, medication and treatment. This information was used to identify participants with severe mental health problems for exclusion purposes.

## **Analysis**

With regard to the quantitative data, names were removed and each participant assigned a numerical code against which information was entered into the database. Only the researcher and clinical supervisor of the project had access to the raw data with names and corresponding numerical codes. Interview material was transcribed for analysis. Personally identifiable information was removed during the transcription process in order to anonymise the qualitative data. Interpretative Phenomenological Analysis (IPA) was used to draw out relevant themes within the data. This type of analysis was chosen as it explores lived experience and enables a detailed exploration of the ways in which people make sense of their personal and social world

and the meanings particular experiences and events hold for the person. IPA also recognises the active role of the researcher in the process of understanding and interpreting the participants' experiences of the world (Smith & Osborn, 2008), which was considered important.

Other qualitative approaches that were initially considered included grounded theory and discourse analysis. Grounded theory explores the influence of social processes, procedures and structures on the manner in which social interactions occur and the meaning of those interactions. The main goal of grounded theory is to build theories that explain basic social processes. Discourse analysis emphasises the use of language. The theory behind this method is that meaning is created through shared, mutually understood language, and that language is central to our construction of reality. This type of methodology focuses on the language people use in order to explore the manner in which meaning, personal identity, knowledge and social relationships are understood and experienced. As the study intended to explore a lived experience, including the meaning particular experiences held for participants, it was deemed that IPA would be the most appropriate analytical approach (Starks & Brown-Trinidad, 2007).

Post- interview notes were kept to capture reflections and relevant information that may not have been picked up on the digital recordings. The analytic process involved identifying recurrent themes across transcripts, which were indicative of similar and consistent ways of thinking and giving accounts about their experiences. The process of identifying recurrent themes involved several steps: Each transcript was read several times prior to beginning analysis. Following this, each transcript was analysed with respect to semantic content and use of language, and then coded with a key word or phrase that represented the meaning of the content. These codes were viewed as emergent themes. In the next stage of analysis, connections across the range of themes were identified and related themes were grouped together under broader categories, signifying super-ordinate themes.

For the purpose of analysis, flashbacks were defined as any imagery relating to the traumatic event, that involved memories of experiences that occurred before, during or after the event, whereas flash-forwards were defined as future oriented images which are newly created by the patient and do not relate to actual memories of the trauma event. Imaginary images were defined as images that have been created by the patient and are not future-oriented.

### **Quality assurance procedures**

For the purposes of cross validation two clinical psychologists familiar with qualitative methods analysed in total four of the transcripts. The principal researcher met with each of the secondary analysts to discuss the themes gleaned from the data. Both identified similar themes to the principal researcher, although at times these were named differently. Two themes were identified only by the principal researcher; however, these themes were discussed and agreed with secondary analysts in post-analysis discussions. All participants were given the opportunity to comment on the provisional results. One participant expressed a wish to do so, however declined at later contact. With regard to reflexivity, the influence the researcher may have on the research process was borne in mind throughout both data gathering and analysis stages.

### **Ethical considerations**

A contact number was provided on the participant information sheet for any participants who experienced distress as a result of completing questionnaires. Participants were also advised that they could contact their GP for support, if this was preferable to them. All interview participants were offered referral to clinical psychology for further support if desired.

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## Appendix 1: The Journal of Clinical Psychology in Medical Settings

### Manuscript Submission ([www.springer.com](http://www.springer.com))

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Submit the original, including copies of all illustrations and tables.

#### Title Page

A title page is to be provided and should include

- the title of the article
- author's name (no degrees)
- author's affiliation
- and suggested running head

The affiliation should comprise

- the department
- institution (usually university or company)
- city
- and state (or nation)

and should be typed as a footnote to the author's name. The suggested running head should be less than 80 characters (including spaces) and should comprise the article title or an abbreviated version thereof. For office purposes, the title page should include the complete mailing address, telephone number, and e-mail address of the one author designated to review proofs.

#### Abstract

- An abstract is to be provided, preferably no longer than 150 words.

#### Key Words

- A list of 4–5 key words is to be provided directly below the abstract. Key words should express the precise content of the manuscript, as they are used for indexing purposes.

#### References

List references alphabetically at the end of the paper and refer to them in the text by name and year in parentheses.

References should include (in this order):

- last names and initials of all authors,
- year published
- title of article
- name of publication
- volume number
- and inclusive pages

The style and punctuation of the references should conform to strict APA style and follow guidelines of the Publication Manual of the American Psychological Association, Sixth Edition – illustrated by the following examples:

#### Journal Article

- Burns, J. W., & Katkin, E. S. (1993). Psychological, situational, and gender predictors of cardiovascular reactivity to stress: A multivariate approach. *Journal of Behavioral Medicine, 16*, 445–465.

#### Book

- Ray, R. (2006). *Chronic Pain and Family: A Clinical Perspective*. New York: Springer.

#### Contribution to a Book

- Bleiberg, J., Ciulla, R., & Katz, B. L. (1991). Psychological components of rehabilitation programs for brain-injured and spinal-cord-injured patients. In J. J. Sweet, R. H. Rozensky, & S. M. Tavian (Eds.), *Handbook of clinical psychology in medical settings* (pp. 375–400). New York: Plenum Press.

#### Footnotes

- Footnotes should be avoided. When their use is absolutely necessary, footnotes should be numbered consecutively using Arabic numerals and should be typed at the bottom of the page to which they refer. Place a line above the footnote, so that it is set off from the text. Use the appropriate superscript numeral for citation in the text.

### Illustration Style

- Illustrations (photographs, drawings, diagrams, and charts) are to be numbered in one consecutive series of Arabic numerals. The captions for illustrations should be typed on a separate page. Photographs should be large, glossy prints, showing high contrast. Drawings should be prepared with India ink. Either the original drawings or good-quality photographic prints are acceptable. Artwork for each figure should be provided on a separate page. Identify figures with the author's name and number of the illustration. Electronic artwork should be in the TIFF or EPS format (1200 dpi for line and 300 dpi for half-tones and gray-scale art). Color art should be in the CYMK color space.
- Tables should be numbered (with Arabic numerals) and referred to by number in the text. Each table should be typed on a separate page. Center the title above the table, and type explanatory footnotes (indicated by superscript lowercase letters) below the table.

### Submission of Accepted Manuscripts

After a manuscript has been accepted for publication and after all revisions have been incorporated, a final manuscript should be submitted through the online submission system. The electronic file submitted must be the finalized version of the manuscript. The author may track the status of a submission via the online submission system at the time. At the proofreading stage, the author is solely responsible for ensuring the accuracy and correctness of the typeset article. It is not possible to make further corrections once the article has been published online. Authors must indicate whether or not they have a financial relationship with the organization that sponsored the research. They should also state that they have full control of all primary data and that they agree to allow the journal to review their data if requested. Upon acceptance of their manuscripts, authors must complete “Statement of Conflict of Interest and Informed Consent” form (found at <http://www.springer.com/medicine/journal/10880>), which they will then be required to submit to the editorial office.

### Ethical Standards

Informed consent: For studies with human subjects, please include the following statement before the References section: “All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.” If any identifying information about patients is included in the article, the following sentence should also be included: “Additional informed consent was obtained from all patients for which identifying information is included in this article.” Articles that involve patient, family, and genetic history should strive to maintain anonymity regarding private health information. Thus family history should be masked and pseudonyms used as appropriate. If any information in a case report is not anonymous (i.e. the author is discussing their family), then explicit written information for release of medical information must be obtained from all living individuals whose information is mentioned. Documentation of permission to release medical information should be provided to the Editorial office at the time of manuscript submission. Information that would identify patients should not be published.

## **Appendix 2: Systematic Review search strings**

The following search string was used to search ASSiA, PiLOTS, EMBASE, PsycINFO and Ovid Medline: (cardiac OR myocardial OR heart attack OR heart disease OR cardiac arrest OR acute coronary syndrome\* OR coronary artery disease\* OR acute coronary disease OR acute coronary heart disease) OR (SU.EXACT.EXPLODE("Myocardial infarction") OR SU.EXACT.EXPLODE("Cardiovascular Diseases")) AND (\*traumatic stress OR post traumatic stress) OR (posttraumatic stress) AND all(risk factor\* OR predict\* OR vulnerability).

To search Science Direct the following search string was used: “cardiac OR myocardial infarction OR heart attack OR heart disease OR cardiac arrest OR acute coronary syndrome\* OR coronary artery disease OR acute coronary heart disease OR cardiovascular disease”. The following terms were then used to search within the results generated from this string: post traumatic stress OR posttraumatic stress OR \*traumatic stress.

## Appendix 3: Systematic Review Quality Criteria

### 1 – Confirmation of Myocardial Infarction

Well covered	Identified from information in medical records, confirming cardiac enzyme changes, ECG or angiogram results.
Adequately addressed	Identified by diagnosis of myocardial infarction only, reported in medical records.
Poorly addressed	Verbal confirmation only, medical records not used for confirmation.
Not addressed	MI not confirmed.
Not reported	
Not applicable	
Notes	

### 2 – Robust measures used to assess pain at time of MI

Well covered	Measures of pain that have good psychometrics e.g. McGill Pain Questionnaire
Adequately addressed	Likert scale or visual analogue scale used. Appropriate, specific questions asked re: pain.
Poorly addressed	Questions asked about pain experienced, but general, vague or non-specific, and no form of rating scale used to measure pain (i.e. yes/no, rather than rating scale).
Not addressed	Pain not measured.
Not reported	
Not applicable	
Notes	

### 3 – Robust measure of PTSD used in analyses with pain

Well covered	Robust diagnostic tool used. Reliable and valid measure, i.e. PDS, SCID, CAPS, PSS-SR, PTSD Inventory
Adequately addressed	Screening tool used. Reliable and valid measure, i.e. IES, IES-R
Poorly addressed	PTSD measured, but tool not valid or reliable for this population.
Not addressed	PTSD symptoms not measured.
Not reported	
Not applicable	
Notes	

**4 – Reducing bias in recall of pain severity**

Well covered	Prospective design – pain measured at time of MI i.e. during the hospitalisation period (Time A) and PTSD measured at Time B.
Adequately addressed	Retrospective design – pain and PTSD both measured after the MI hospitalisation period but within an adequate timescale (less than twelve months).
Poorly addressed	Retrospective – pain and PTSD both measured after the MI, a significant period of time after the MI event (more than twelve months)
Not addressed	
Not reported	
Not applicable	
Notes	

**5 – Appropriate analysis used for comparisons between pain around time of MI and subsequent PTSD**

Well covered	Analyses used are appropriate (enable identification of relationship between pain and PTSD, and appropriate for the sample size). Potentially confounding factors were statistically controlled for (young age, female gender).
Adequately addressed	Analyses used are appropriate (enable identification of relationship between pain and PTSD, and appropriate for the sample size). Potentially confounding factors were not statistically controlled for.
Poorly addressed	Analyses used are not appropriate (do not enable identification of link between pain and PTSD/ not appropriate for the sample size).
Not addressed	
Not reported	
Not applicable	
Notes	

**6 – Time between MI and PTSD measure – ability to confirm PTSD diagnosis rather than ASD (acute stress disorder)**

Well covered	PTSD measure is taken at least 1 month post MI
Adequately addressed	
Poorly addressed	PTSD measure is taken less than 1 month post MI
Not addressed	
Not reported	
Not applicable	
Notes	

### 7 – Sample size sufficient/Power for pain and PTSD comparisons

Well covered	Number of participants was sufficient to enable power of at least 0.8, where effect size was anticipated to be medium and alpha was 0.05.
Adequately addressed	Number of participants was sufficient to enable power of at least 0.7, where effect size was anticipated to be medium and alpha was 0.05.
Poorly addressed	Number of participants was only sufficient to enable power of less than 0.7, where effect size was anticipated to be medium and alpha was 0.05.
Not addressed	
Not reported	
Not applicable	
Notes	

### 8 – Relevant type of cardiac event (MI)

Well covered	Sample involves MI survivors only. If both MI survivors and patients with other conditions are involved in the study, the study reports on the link between pain and PTSD separately for MI survivors.
Adequately addressed	50% or more of the sample are MI survivors
Poorly addressed	Less than 50% of the sample are MI survivors.
Not addressed	
Not reported	
Not applicable	
Notes	

### 9 – Patients were representative of the wider clinical population

Well covered	Patients were recruited from a representative clinical setting and participants were reasonably representative of the wider clinical population.
Adequately addressed	Patients recruited in a clinical setting but probably substantial bias in those approached and/or amongst those who participated.
Poorly addressed	Patients recruited in a clinical setting but clear substantial bias in those approached and/or in those who participated.
Not addressed	Patients not recruited in a clinical setting or attempts not made to be representative of the wider clinical population.
Not reported	
Not applicable	
Notes	Attrition rates, response rates, recruitment setting, sampling method(Sampling method chosen would enable identification of a representative sample for this population; Sampling method chosen may have introduced a level of bias in the sample; Sampling method used is likely to have resulted in a significantly biased sample)

### 10. Measures taken to establish that PTSD is due to MI event

Well covered	Individuals with pre-MI PTSD are identified and excluded, or are considered in relation to the results found regarding PTSD post-MI (i.e. pre-MI PTSD group numbers are reported and the relationship between pre-MI PTSD and post-MI PTSD is statistically analysed and reported) <b>AND</b> participants instructed to complete PTSD measure specifically in relation to MI event.
Adequately addressed	Participants instructed to complete PTSD measure specifically in relation to MI event <b>OR</b> individuals with pre-MI PTSD identified and excluded, or are considered in relation to the results found regarding PTSD post-MI.
Poorly addressed	Pre-MI PTSD not screened for AND participants not instructed to complete PTSD measure in relation to MI event
Not addressed	Pre-MI PTSD not screened for AND participants not instructed to complete PTSD measure in relation to MI event
Not reported	
Not applicable	
Notes	

### 11. Measures taken to establish that pain is due to MI event rather than pre-existing pain conditions

Well covered	Measure of pain asks specifically about cardiac related pain <b>OR</b> pre-existing pain conditions (that are not cardiac related) are identified and excluded.
Adequately addressed	Pre-existing pain conditions (that are not cardiac related) are identified and controlled for (but not excluded).
Poorly addressed	Pre-existing pain conditions (that are not cardiac related) are not identified and/or controlled AND measure of pain does not ask specifically about cardiac related pain.
Not addressed	Pre-existing pain conditions (that are not cardiac related) are not identified and/or controlled AND measure of pain does not ask specifically about cardiac related pain.
Not reported	
Not applicable	
Notes	

#### Appendix 4: Systematic Review Excluded Studies

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