



A qualitative and quantitative study of the incidence, features and aetiology of near death experiences in cardiac arrest survivors

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Abstract

Aim: To carry out a prospective study of cardiac arrest survivors to understand the qualitative features as well as incidence, and possible aetiology of near death experiences (NDEs) in this group of patients. *Method:* All survivors of cardiac arrests during a 1 year period were interviewed within a week of their arrest, regarding memories of their unconscious period. Reported memories were assessed by the Greyson NDE Scale. The postulated role of physiological, psychological and transcendental factors were studied. Physiological parameters such as oxygen status were extracted from the medical notes. Patients' religious convictions were documented in the interviews and hidden targets were used to test the transcendental theories on potential out of body claims. Those with memories were compared to those without memories. *Results:* 11.1% of 63 survivors reported memories. The majority had NDE features. There appeared to be no differences on all physiological measured parameters apart from partial pressure of oxygen during the arrest which was higher in the NDE group. *Conclusions:* Memories are rare after resuscitation from cardiac arrest. The majority of those that are reported have features of NDE and are pleasant. The occurrence of NDE during cardiac arrest raises questions about the possible relationship between the mind and the brain. Further large-scale studies are needed to understand the aetiology and true significance of NDE. © 2001 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: Cardiac arrest; Death; Near death experiences

Resumo

Objectivo: Levar a cabo um estudo prospectivo em sobreviventes de paragem cardíaca para compreender as características qualitativas dos episódios de morte eminente assim como avaliar, neste grupo de doentes, a sua incidência e possível etiologia. *Método:* Para avaliar as recordações do período de inconsciência, durante o período de um ano foram entrevistados todos os sobreviventes, na semana que se seguiu à paragem cardíaca. As recordações relatadas foram avaliadas pela escala de episódios de morte eminente de Greyson. Foram estudados os papéis postulados de diversos factores psicológicos, fisiológicos e transcendentais. Parâmetros fisiológicos, como oxigenação, foram obtidos dos registos médicos. Foram documentadas as convicções religiosas dos doentes, e foram usadas nas entrevistas questões escondidas para testar as teorias transcendentais de potenciais recordações de separação do corpo. Foram comparados os doentes que apresentavam recordações com os que não as apresentavam. *Resultados:* 11.1% de 63 sobreviventes relataram recordações. A maioria tivera características de episódios de morte eminente. Não pareceram existir diferenças em todos os parâmetros fisiológico medidos, à excepção da pressão parcial de oxigénio durante a paragem, que era mais elevada no grupo com episódios de morte eminente. *Conclusões:* As recordações são raras após ressuscitação de paragem cardíaca. A maioria daquelas que foram relatadas tiveram características de episódios de morte eminente e foram agradáveis. A ocorrência de episódios de morte eminente durante a paragem cardíaca levanta questões acerca da possível relação entre os cérebro e espírito. São necessários mais estudos e em maior escala, para compreender a etiologia e o verdadeiro significado dos episódios de morte eminente. © 2001 Elsevier Science Ireland Ltd. Todos os direitos reservados.

Palavras chave: Paragem cardíaca; Morte; Episódio de morte eminente

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1. Introduction

In the 1970s it was reported that many people who were near death but survived described similar unusual experiences [1]. This led to a number of retrospective studies [1–5]. Subjects described seeing tunnels, lights, deceased relatives, a perception of separation from the body (out of body experience), and often apparently had these experiences at a time when they were unconscious. These experiences are lucid and often have life changing effects. They are now commonly termed the ‘near death experience’ (NDE). Explanations of these experiences have ranged from regarding them as either confusional hallucinations or fabrication, to confirmation of the existence of life after death [6]. More than 20 years later the debate on NDEs still continues. Most authors now accept that they do occur and are not fabrication.

Accounts of NDE’s have been found in many different cultures and throughout historical time, for example they are described in Plato’s Republic [7], in a 15th century painting [8], in 19th century accounts of survivors of Swiss mountaineering accidents [9] and more recently, by survivors of a Chinese earthquake [10]. Much research has now been done on this subject, including NDEs in children [11–14]. The youngest case in the literature has been reported in a 6-month-old baby [15]. A survey in the US in the 1980s has shown that the NDE is widely distributed and is reported to have occurred in 8 million Americans [16].

There are currently three different sets of explanations for the occurrence of NDEs: (1) physiological or pharmacological processes accompanying the process of dying; (2) a psychological response to the perceived threat of death; (3) a transcendental experience in the same category as the mystical (peak) experiences described by Bucke [17] and later by Maslow.

Many physiological and pharmacological cerebral mediators have been proposed to account for the experiences, although none have yet been shown to be responsible for the phenomenon. These include endorphins [18,19], cerebral hypoxia [20], hypercarbia [21], various drugs in particular hallucinogenic agents such as ketamine and phen-cyclidine [22], the NMDA receptor [22], serotonin pathways [23], activation of the limbic system [24,25], and temporal lobe anoxic seizures [26].

The argument in favour of a psychological explanation is based on observations made from retrospective cases indicating that NDEs may have occurred in those who have not been physically close to death [27] or in those who have experienced such a phenomena just before a life threatening accident in which they did not lose consciousness [28]. Other studies have indicated cultural differences between NDEs, although some of the core features are similar [29–31].

The authors have collected approximately 750 retrospective cases of near death and/or out of body experiences. It is never clear from the accounts whether an experience occurred before, during or on recovery from a period of unconsciousness. To date there have been no published prospective studies looking at the incidence or the subjective experiences and correlating these with objective physiological measurements.

It was therefore decided to set up a pilot prospective study to assess the frequency and possible causes of NDEs in cardiac arrest survivors. Cardiac arrest survivors were used as models, as the experience has been frequently reported after cardiac arrests. These patients are resuscitated using a standard protocol, and thus are given similar drugs and resuscitative procedures. Moreover the mental state of cardiac arrest survivors is the closest model to that of a dying brain. This is due to the fact that cardiac arrest patients by definition exhibit two out of three criteria required to pronounce an individual dead (no cardiac output, no spontaneous respiratory effort) and usually in the clinical setting of an arrest they develop all three (fixed dilated pupils¹) due to the loss of brainstem activity [32,33].

2. Method

Over a 1-year period all survivors from cardiac arrests on the medical, emergency, and coronary care units of Southampton General Hospital were identified and interviewed while in hospital. The main hospital switchboard keeps records of all cardiac arrest calls and these were used to identify

¹ It must be pointed out that atropine and epinephrine (adrenaline) which are often administered in cardiac arrests may cause dilated pupils that appear to be fixed. However in a cardiac arrest, brainstem activity is rapidly lost which would lead to the loss of pupillary reflexes irrespective of any administered drugs.

the patients. The local ethics committee approved the study protocol. The inclusion criteria for the study were: (1) cardiac arrest survivor on any of the medical/emergency or coronary care units; (2) age over 18; (3) mental test score of 10/10 (based upon the 10 point mini mental test and aimed to exclude any potentially confused patient); (4) agreement to the interview by the medical and nursing staff caring for the patient; (5) informed consent by all patients before being interviewed.

Patients were told that the researchers were interested in finding out more about any memories recalled by those who had been in a coma following a cardiac arrest and were asked an open question regarding any memories occurring during unconsciousness. Any experiences reported were recorded and analysed. No direct or specific questions were asked regarding near death, out of body or any related experiences.

The experiences were assessed according to the Greyson NDE scale [34]. The Greyson scale is a standardised 16 point questionnaire used to assess the core components of the NDE. A score of 7 or over has been accepted as compatible with a NDE. This was used to allocate the patients' replies into: (a) 'near death experience'/study group; and (b) 'non near death experience'/control group.

Possible physiological and pharmacological causes of the NDE considered were hypoxia and hypercarbia, electrolyte disturbances, administered drugs and specific cardiac dysrhythmias. (Certain electrical rhythms, such as asystole are associated with a higher fatality rate and one might expect to find a higher association of such rhythms with NDEs.) The oxygen, carbon dioxide, sodium and potassium levels obtained from arterial blood gas analysis and peripheral blood taken during the arrest were extracted from the medical notes. Records of drugs administered around the period of the arrest, and of any abnormality of cardiac rhythm during the arrest were also noted. The only psychological factors investigated were the patients' particular religious backgrounds and whether they were practising members of their faith. They were not asked about their fear of death at the time of the arrest.

There are retrospective anecdotal accounts of patients who during a NDE have described 'seeing', as if from a position on the ceiling, resuscitation processes which took place while they were 'unconscious', and which they could not have seen

from their position on the bed. Some of these claims have later been verified by the medical and nursing staff present [35]. In order to test prospectively the possible veridical nature of out of body experiences, boards were suspended from the ceiling of the wards prior to the commencement of the study. These had various figures on the surface facing the ceiling which were not visible from the floor. If out of body experiences are indeed veridical, anybody who claimed to have left their body and be near the ceiling during resuscitation attempts would be expected to identify those targets. If, however, such perceptions are psychological, then one would obviously not expect the targets to be identified.

3. Results

During the 1 year period 63 patients survived and were interviewed. Of those, 56 (88.8%) had no memory recall of their period of unconsciousness; the remaining seven survivors (11.1%) had some memory. These patients' memories were then assessed using the Greyson NDE scale. According to this criterion four patients (6.3%) had had NDEs. The other three patients (4.8%) did not fulfil the criteria required for a NDE. Interestingly, however, the memories of two (3.2%) out of those three had some features of a NDE (including feelings of peace or seeing deceased relatives) but not enough to pass the Greyson criterion. Only one person (1.6%) had a memory but showed no features of a NDE.

3.1. *Mental states of the cardiac arrest survivors*

The patients are divided into three groups: (a) those with no memory, these will not be discussed further; (b) those whose memories were consistent with a NDE (Tables 1 and 2); (c) those whose memories were inconsistent with a NDEs (Table 3).

3.2. *The NDE group*

The frequencies of the different features recalled by those in the NDE group were tabulated. All four patients in the NDE group sensed a point of no return. Three of the four also experienced

Table 1
Features recounted by near death experience (NDE) patients

Gender	MTS ^a	Features	Greyson score	Religious views
<i>Patient 1</i>				
Male	10/10	Feelings of peace/pleasantness	2	Non practicing
		Feelings of joy	2	Catholic and Pagan
		Felt a sense of harmony	1	
		Saw a bright light	2	
		Heightened senses	2	
		Encountered a mystical being (not recognised)	2	
		Encountered a barrier or point of no return.	2	
			Total 13/32	
<i>Patient 2</i>				
Female	10/10	Heightened understanding about herself/others	1	Non practicing C of E
		Feelings of peace and pleasantness	1	
		Feelings of joy	1	
		Feeling of harmony	1	
		Felt aware of things as if by extra sensory perception	1	
		Lost awareness of body	1	
		Entered some other world	1	
		Saw deceased relative	2	
		Came to a point of no return	1	
			Total 10/32	
<i>Patient 3</i>				
Male	10/10	Time speeded up	2	Non practicing C of E
		Feelings of peace/pleasantness	1	
		Feelings of joy	1	
		Saw a bright light	2	
		Heightened senses	1	
		Entered another world	2	
		Came to a border of no return	1	
			Total 10/32	
<i>Patient 4</i>				
Female	10/10	Time speeded up	2	Non practicing C of E
		Saw a bright light	2	
		Aware of things as if by extra sensory perception	1	
		Lost awareness of body	1	
		Felt as if encountered deceased relative (father)	2	
		Came to a border of no return	2	
			Total 10/32	

^a Mini mental state test score.

seeing a bright light, and feelings of peace, pleasantness and joy. Two of the four saw deceased relatives, entered a new domain, felt that time had speeded up, lost awareness of their bodies, experienced harmony and had heightened senses. Two features of the Greyson Scale, having heightened understanding and encountering a mystical being, were only experienced by one of the four patients. None of the patients experienced the out of body phenomenon (Tables 1 and 2).

All the NDE group were Christians. However, none of them described themselves as practising members and nor did they see a figure during their NDE specifically related to Christianity.

One of the four also described himself as a Pagan. As no one claimed to have had an out of body experience during this study there was no opportunity to test the veridical nature of these experiences. Finally it was noted that none of those who had a NDE found it to be traumatic.

Table 2
Frequency of Greyson scale features of near death experience (NDE) group

Greyson scale features	No.	%
1 Came to point/border of no return	4	100
2 Feelings of peace and pleasantness	3	75
3 Feelings of joy	3	75
4 Saw a bright light	3	75
5 Lost awareness of body	2	50
6 Awareness as if by extra sensory means	2	50
7 Entered another domain	2	50
8 Saw deceased relatives	2	50
9 Felt harmony	2	50
10 Felt that time speeded up	2	50
11 Feelings of heightened senses	2	50
12 Heightened sense of understanding	1	25
13 Encountered a mystical being (not recognised)	1	25

3.3. Those without an NDE but with memories

The frequencies of the features recalled by those not in the NDE group were also tabulated. Two of the three patients experienced some features of the NDE, while the third had a confusional experience with no NDE features (Table 3).

3.4. Physiological changes during cardiac arrest

Physiological factors (arterial blood gases, electrolytes) as well as pharmacological factors (administered drugs) were assessed. For the purposes of this section those who had a NDE ($n = 4$) made up the study group. Those who had no memory

Table 3
Features recounted by the non near death experience (NDE) patient group

Feature(s) recalled	Greyson score
<i>Patient 1</i>	
Thoughts speeded up	1
Senses more vivid than usual	1
Saw deceased relatives	2
	Total 4/32
<i>Patient 2</i>	
Heightened sense of peace	2
	Total 2/32
<i>Patient 3</i>	
Saw some unknown people jumping off a mountain	0
	Total 0/32

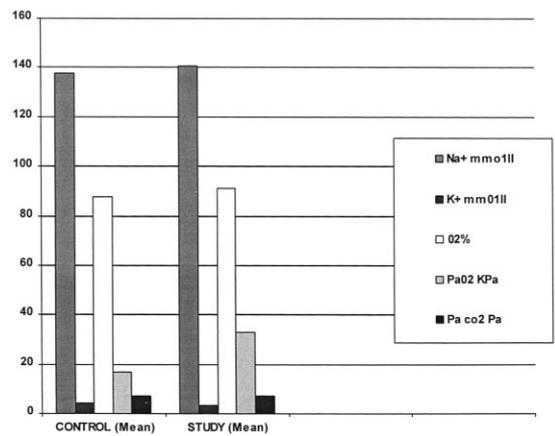


Fig. 1. Comparison of mean blood measures. Columns 1–5 control group; 6–10 study group. Columns 1, 2, 6 and 7: mean peripheral blood levels of sodium and potassium mEq/l. Column 3 and 8: O₂ saturations. Columns 4 and 9: partial pressure of oxygen, kPa. Columns 5 and 10 partial pressure of CO₂ kPa in arterial blood.

($n = 56$) together with those who had a memory but did not fulfil the criteria of a NDE ($n = 3$) made up the control group.

As only four patients were enrolled in the study (NDE) group, the numbers were not sufficient for statistical significance testing, so only the mean and standard deviation of the arterial blood gas results, electrolyte levels and cardiac rhythms in the two groups are described. Three of the four people in the NDE group had pulseless VT/VF, the fourth was in asystole (control figures: $V_F/V_T = 36$, asystole = 7, not recorded in medical notes, or not available = 16)² (If during the resuscitation the cardiac rhythm changed the initial rhythm is stated). Interestingly, those who had a NDE had a PaO₂ level (33.1 (S.D. 18.37) kPa) which was double the control group (16.8 (S.D. 11.73) kPa). The administered drugs were not compared further as all patients followed a standard resuscitation protocol.

3.5. Comparison of blood parameters

There was little difference between the mean sodium, potassium and CO₂ levels (Fig. 1).

² Unlike the blood parameters which were recorded from the time of the initial stay of the cardiac arrest patients on the ward some of the cardiac rhythms were recorded retrospectively, and unfortunately not all the medical notes were retrieved.

4. Discussion

This prospective study suggests that the incidence of memories after a cardiac arrest and resuscitation is 11.1%. Of these, 6.3% had lucid memories and a similar mental state, consistent with the previously described NDE and scored above 7 on the Greyson NDE scale. The features were dissimilar to those of confusional hallucinations, as they were highly structured, narrative, easily recalled, and clear. 4.8% had memories which did not reach the Greyson criteria (score below 7) and of these, 1.6% had a memory which had none of the accepted features of the NDE.

NDEs occurred in the sample in a small minority of cardiac arrest survivors. Nobody found the experience to be distressing, rather it was described as pleasant. A continuum of NDE phenomena was found: although 4.8% of the patients did not reach the Greyson criteria, their experiences were essentially similar to the NDE group. Only one patient had experiences which clearly lay outside those of the NDE, and appeared more typical of a confusional episode. In this series, NDE phenomena characterized the mental states of the majority of patients who were unconscious and reported memories during cardiac arrest.

In this study possible physiological causative factors could not be investigated adequately in view of the relatively small number in the study (NDE) group. Nevertheless it was interesting that patients in the study group had higher oxygen levels than those in the control group. This may simply be a skewed result due to the low patient numbers. Alternatively it may indicate that patients who had NDEs had better oxygenation during the resuscitation, allowing better cortical function. Provided that blood oxygen levels reflect cerebral oxygen levels, the findings suggest that in this cardiac arrest model, cerebral anoxia may not be an important causative factor in these experiences, and indeed may mitigate against them. There is support for this in other models of the NDE, where psychological causes are thought to trigger the experience such as in those occurring just before a major accident, the cerebral circulation is not compromised and hypoxia cannot be a factor. However, it would be unwise, with such small numbers, to draw any significant conclusion from this finding.

It is not clear whether the experiences of patients, who report that they have 'left their bodies' and viewed their own resuscitation procedures are veridical or are hallucinations. Some patients do appear to have obtained information which they could not have obtained during unconsciousness [35]. If this is so, it would suggest that some element of human consciousness is capable of separating from the body and obtaining information at a distance [36–38]. However, it is also possible that the information that they report may have been gained from ordinary sensory sources. In this study, no out of body experiences occurred. The authors know of no prospective studies which have helped clarify this point.

The data suggests that in this cardiac arrest model, the NDE arises during unconsciousness. This is a surprising conclusion, because when the brain is so dysfunctional that the patient is deeply comatose, the cerebral structures which underpin subjective experience and memory must be severely impaired. Complex experiences such as are reported in the NDE should not arise or be retained in memory. Such patients would be expected to have no subjective experience (as was the case in 88.8% of patients in this study) or at best a confusional state if some brain function is retained. Even if the unconscious brain is flooded by neurotransmitters [18,19,22] this should not produce clear, lucid remembered experiences, as those cerebral modules which generate conscious experience and underpin memory are impaired by cerebral anoxia. The fact that in a cardiac arrest loss of cortical function precedes the rapid loss of brainstem activity lends further support to this view.

An alternative explanation would be that the observed experiences arise during the loss of, or on regaining, consciousness. However, it is unlikely that the NDE arises either when the cortical modules are failing, that is, during the process of becoming unconscious, or when the cortical modules are coming back on line, that is, when consciousness is returning. Experiences arising during loss of consciousness in fainting arise in conjunction with ongoing mental experience at the beginning of the episode [39] and there were no reports from the subjects which suggested that this was the case. The EEG data during fainting shows a gradual slowing of the cerebral rhythms with the appearance of delta activity before finally, in a

minority of cases, the EEG becomes flat [40]. In the case of cardiac arrest, the process is accelerated, with the EEG showing changes within a few seconds [32]. The transition from consciousness to unconsciousness is thus rapid, appearing immediate to the subjects. Experiences which occur during the recovery of consciousness are confusional, which these were not. Further data to confirm the timing of the experience is clearly required.

This study indicates that the NDEs following cardiac arrest are relatively rare and that they probably occur during 'unconsciousness'. Of the memories which do apparently occur during 'unconsciousness', the majority have features of the NDE. The study has confirmed the stereotyped nature of the NDE. For an adequate prospective sample to be collected so that both the psychological (including out of body experiences) and physiological aspects of the experience can be looked at in detail, a multi-centre trial is needed.

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