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Near-death experiences and electrocardiogram patterns in out-of-hospital cardiac arrest survivors: a prospective observational study

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ABSTRACT

Aim. To determine the effect of several factors, that are a part of cardiac arrest and resuscitation, on the incidence of near-death experiences (NDEs).

Methods. We conducted a prospective observational study in the three largest hospitals in Slovenia in a consecutive sample of patients after out-of-hospital primary cardiac arrest. The presence of NDE was assessed with the self-administered Greyson's near-death experiences scale. The electrocardiogram pattern at the beginning of resuscitation was recorded. Main outcome measure was the presence of near-death experiences. Univariate analysis was used.

Results. The study included 52 patients. There were 42 (80.8%) males in the sample; median age ± standard deviation of the patients was 53.1 ± 14.5 years. Near-death experiences were reported by 11 (21.2%) patients. Patients with ventricular fibrillation had significantly less NDEs than other patients (12.2% vs. 54.5%, P = 0.006). Patients with pulseless electrical activity had significantly more NDEs than others (60.0% vs. 11.9%, P = 0.003). Patients with asystole and pulseless electrical fibrillation had significantly more NDEs than patients who had ventricular fibrillation and ventricular tachycardia (60.0% vs. 11.9%, P = 0.003). Patients with at least one defibrillation attempt had significantly less near-death experiences than others (62.5% vs. 13.6%, P = 0.007).

Conclusion. Our study found a possible correlation between electrocardiogram pattern in cardiac arrest patients and the incidence of near-death experiences. Further studies should address this problem in larger samples.

Key words: near-death experiences, electrocardiogram, heart arrest, incidence, prospective study, resuscitation

Introduction

Near-death experiences (NDEs) are described as deep psychological experiences with feelings of transcendence or mystical encounter that typically occur in persons close to death or in situations of intense physical or emotional danger. (1) Such situations are cardiac arrest, hypovolemic, septic or anaphylactic shock, coma due to brain trauma, brain haemorrhage, cerebrovascular insult, suicide attempt, and near-drowning. (2) However, the most appropriate condition for studying NDEs seems to be cardiac arrest because during

it a person is clinically dead (3) and therefore most close to death.

The incidence of NDEs in cardiac arrest patients is between 11 and 23%. (2,4-6) Previous studies have demonstrated a possible association between higher incidence of NDEs and younger patients, (2,5-7) higher partial pressure of oxygen in arterial blood (paO_2) (2) and previous NDEs. (6) Several theories have tried to explain the possible role of some physiologic factors in NDEs. Cerebral hypoxia or anoxia might be important because of their effect on the temporal and parietal parts of the brain and also on the prefrontal part of the cerebral cortex, which assumingly alters the perceptions of own body and induces mystical experiences. (8) Cerebral accumulation of carbon dioxide (CO_2) might also be important since CO_2 could induce unusual experiences in the form of bright light, visions, mystical experiences and out-of-body sensations. (4,9) Some authors also proposed a possible role of some endogenous (endorphins and serotonin) (9-11) and exogenous (ketamine, ether, LSD) (12,13) substances. The temporal lobe and limbic system could also play a role, mostly because it has already been demonstrated that the stimulation of these parts of the brain induces NDE-like experiences. (14,15) So far, none of the studies and theories have completely explained the phenomenon of NDEs.

The aim of this study was to investigate the association of various factors that are a part of cardiac arrest and resuscitation with the incidence of NDEs. An effect of blood gases and electrolytes on NDEs has already been demonstrated. (16) This article describes additional factors during cardiac arrest and resuscitation that could be important in the light of NDEs.

Table 1. The effect of some clinical characteristics of resuscitation on the incidence of NDEs.

Variable	N (%) of patients	N (%) of patients with NDEs	Pearson χ^2	P
Initial rhythm				
VF	41 (78.8)	5 (12.2)		
VT	1 (1.9)	0 (0)		
Asystole	4 (7.7)	2 (50.0)		
PEA	6 (11.5)	4 (66.7)	11.688	0.009
Initial heart rhythm				
VF	41 (78.8)	5 (12.2)		
VT, asystole, PEA	11 (21.2)	6 (54.5)	9.326	0.006
Initial heart rhythm				
VT	1 (1.9)	0 (0)		
VF, asystole, PEA	51 (98.1)	11 (21.6)	0.274	0.788
Initial heart rhythm				
Asystole	4 (7.7)	2 (50.0)		
VF, VT, PEA	48 (92.3)	9 (18.8)	2.162	0.193
Initial heart rhythm				
PEA	6 (11.5)	6 (60.0)		
Asystole, VF, VT	49 (88.5)	5 (11.9)	11.202	0.003
Initial heart rhythm				
VF/VT	42 (80.8)	5 (11.9)		
Asystole/PEA	10 (19.2)	6 (60.0)	11.202	0.003
Artificial heart massage				
Yes	45 (86.5)	9 (20.0)		
No	7 (13.5)	2 (28.6)	0.267	0.630
Defibrillation				
Yes	44 (84.6)	6 (13.6)		
No	8 (15.4)	5 (62.5)	9.690	0.007
Artificial ventilation				
Yes	45 (86.5)	9 (20.0)		
No	7 (13.5)	2 (28.6)	0.267	0.630

NDE, Near-death experiences; PEA, Pulseless electrical activity; PVT, Pulseless ventricular tachycardia; VF, Ventricular fibrillation.

Materials and methods

Study population and settings

This was a multicentre prospective observational study in out-of-hospital cardiac arrest survivors in Slovenia. We included the three largest hospitals in Slovenia (the Clinical Centre of Ljubljana, the Clinical Centre of Maribor and General Hospital of Celje) to which the majority of cardiac arrest survivors are transported after successful resuscitation in the field. The study was conducted from the beginning of January 2008 to the end of June 2009. The inclusion criteria were: 18 years or older, presence of cardiac aetiology for the cardiac arrest (as confirmed during resuscitation and later hospital work up), clinical death (defined as a cessation of breathing and effective cardiac output – electrocardiogram (ECG) patterns of ventricular fibrillation (VF), pulseless ventricular tachycardia (VT), pulseless electrical activity (PEA), and asystole, detected by pre-hospital resuscitation teams), post-resuscitation cerebral performance categories scale score of 1, (17) and the patients' informed consent.

The patients' informed consent was obtained. The National Medical Ethics Committee approved the study – No. 79/10/07.

Data collection

Data collection consisted of two parts. First, a member of a research team interviewed the patients and obtained the following data: sex, age, level of education, religious beliefs, previous NDEs, and fear of death before and

after cardiac arrest. The patients filled in a self-administered questionnaire about their NDE, (18) translated into Slovenian. The questionnaire consists of 16 questions about the cognitive, affective, paranormal, and transcendental component of NDEs. The questions could be answered on a three-point scale (from 0 to 2), with a minimum score of 0 and a maximum of 32. A total score of 7 or above defines the existence of a NDE. In the second part of the data collection, a member of a research team obtained the following data from the patients' files (only data, that is reported in this article, is described): time until the beginning of resuscitation, time until return of spontaneous circulation (ROSC), ECG pattern at first cardiac rhythm analysis, drugs used during resuscitation, the performance of artificial respiration, defibrillation and artificial heart massage.

Statistical analysis

To analyse the data, we used the statistical package for the social sciences, version 13.0 (SPSS Inc, Chicago, IL, USA). The limit of statistical significance was set at $P < 0.05$. Descriptive statistics were computed. Patients with a NDE score of 7 or above were assigned to the NDE group, others were assigned to the non-NDE group. (18) To identify statistically significant differences between variables, we used a χ^2 test.

Results

In the observed period of time, resuscitation was attempted in 426 patients. ROSC was observed in 178 (41.8%) patients. Out of that, 76 (43.0%) patients were discharged alive from hospital. Of those, 24 (31.6%) patients did not meet the inclusion criteria or were unwilling to cooperate. So, the study included 52 patients. NDEs were reported by 11 (21.2%) of them. The mean ± standard deviation of NDE score for all patients was 3.2 ± 5.0 points. The average NDE score for patients in the NDE group was 11.5 ± 4.4, and in the non-NDE group 0.9 ± 1.6 points. The average age of the patients was 53.1 ± 14.5 years. The average age of the patients in the NDE group was 57.9 ± 13.8, and in the non-NDE group 51.8 ± 14.6 years ($P = 0.217$). The average time until the beginning of resuscitation was 4.2 ± 3.7 minutes; 3.5 ± 3.6 for the NDE group and 4.3 ± 3.7 for the non-NDE group ($P = 0.479$). The average time until ROSC was 8.7 ± 5.6 minutes; 8.3 ± 6.7 minutes for the NDE group and 8.8 ± 5.3 for the non-NDE group ($P = 0.772$). In the majority of patients, ventricular fibrillation was found as the initial heart rhythm at the start of resuscitation (Table 1). Patients that had VF at the start of resuscitation had significantly less NDEs than other patients. Patients that had PEA at the start of resuscitation had significantly more NDEs than others. Patients that had asystole and PEA had significantly more NDEs than patients who had VF and VT. Patients with at least one attempt at defibrillation had significantly less NDEs than others (table 1). Other factors have not been associated with the incidence of NDEs (table 1).

During resuscitation, 39 (75.0%) patients received at least one of the following drugs: epinephrine, amiodarone, atropine, vasopressin, sodium bicarbonate, lidocaine, magnesium sulphate, erythropoietin and calcium gluconate. No drug received during the resuscitation affected the incidence of NDEs.

Discussion

Our study showed that, among other factors, (16) the ECG pattern at the beginning of resuscitation could also be an important association with the incidence of NDEs. So far, only two studies (4,19) demonstrated some sort of connection between NDEs and ECG pattern during cardiac arrest. One study was conducted among patients during heart catheterization. The NDEs were less likely to occur with Stokes-Adams attacks and with short episodes of ventricular fibrillation. (19) The second study, on a very small sample of patients, showed that three out of four patients with NDEs had VF/VT pattern, but statistical analysis was not performed. (4)

Previous studies showed that the partial pressure of end-tidal CO_2 ($petCO_2$) is significantly higher in patients with asphyxia cardiac arrest in comparison to patients with primary (cardiogenic) cardiac arrest. (20-22) Most commonly, VF/VT pattern corresponds to the primary (cardiogenic) cardiac arrest mechanism. On the other hand, asystole and PEA patterns are most often found in asphyxia cardiac arrest. (23-26) The asphyxia dying model can also be found in primary cardiac arrest, where it develops with pulmonary oedema and asphyxia. (27)

The principle findings of our study showed that patients with NDEs had a significantly higher $petCO_2$ in comparison to patients without NDEs. (16) Therefore we can assume that NDEs are more common in patients with an asphyxia cardiac arrest mechanism (with ECG pattern of asystole or PEA) or, as demonstrated in our study, in primary cardiac arrest patients with the asphyxia dying model. At the moment, we have no satisfactory explanation for the possible association between ECG pattern and the incidence of NDEs. The most likely explanation would be that the ECG pattern and NDEs are connected indirectly – through $petCO_2$.

Another possible explanation for our finding could be the connection between the severity of a life-threatening situation and NDEs. All previous studies showed that the survival rate of patients with VF/VT cardiac arrest pattern or with a pattern that required defibrillation was significantly higher in comparison to patients that had other ECG patterns. (28,29) One previous study of NDEs showed that the severity of a life-threatening situation is associated with a higher incidence of NDEs. (6) Therefore, the results of our study on the association between ECG pattern and the incidence of NDEs might confirm the assumption that more NDEs occur in patients who found themselves "closer to death" or have a lesser possibility for survival. (6)

The explanation for the result that the patients without any defibrillation attempt had more NDE most probably lies in the resuscitation protocol.

Namely, cardiac arrest victims with VF/VT must be defibrillated. (30)

The main strength of our study is its prospective design. With a consecutive recruitment of patients and the inclusion of three of the largest Slovenian hospitals, the selection bias was reduced as much as possible. The use of a standardised scale for NDEs ensures the consistency of NDEs reports. The number of patients in the sample group is the main weakness of our study. Therefore, some important differences might have been overlooked and the results should be interpreted with care. Also, we should bear in mind that our sample consisted only of patients that had a cardiogenic (primary) cardiac arrest and that the asphyxia complications after the primary cardiac arrest were not recorded. So, the assumption about the asphyxia ECG pattern and the incidence of NDEs should be interpreted with caution . Another limitation of the study is the lack of ECG monitoring throughout the whole period of resuscitation, that is, information about a possible ECG pattern change.

It is obvious that, based on the results of our study, we cannot claim that the ECG pattern in cardiac arrest patients at the start of resuscitation is a causative factor for NDEs. It is very much possible that the association between ECG pattern and the incidence of NDEs exists because of $petCO_2$ which has also been found to be associated with the incidence of NDEs. (16) However, our study demonstrated that ECG pattern might be important in the incidence of NDEs and if we take into account that two previous studies (4,19) reported a possible association, this finding surely deserves further investigation. NDEs are complex phenomena that have not yet been fully explained. Most probably, their existence cannot be explained by one factor or by one theory. That is why it is very important that different factors, which have already proved to be somehow connected to the incidence of NDEs, are further investigated.

Further studies should therefore concentrate on the possible role of ECG pattern in NDEs. They should also include patients with asphyxia cardiac arrest and the ECG pattern should be carefully monitored and recorded throughout the whole period of resuscitation. Obviously, much larger studies should be done in order to detect any true associations.

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