Near-death experience in survivors of cardiac arrest: a prospective study in the Netherlands

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Summary

Background Some people report a near-death experience (NDE) after a life-threatening crisis. We aimed to establish the cause of this experience and assess factors that affected its frequency, depth, and content.

Methods In a prospective study, we included 344 consecutive cardiac patients who were successfully resuscitated after cardiac arrest in ten Dutch hospitals. We compared demographic, medical, pharmacological, and psychological data between patients who reported NDE and patients who did not (controls) after resuscitation. In a longitudinal study of life changes after NDE, we compared the groups 2 and 8 years later.

Findings 62 patients (18%) reported NDE, of whom 41 (12%) described a core experience. Occurrence of the experience was not associated with duration of cardiac arrest or unconsciousness, medication, or fear of death before cardiac arrest. Frequency of NDE was affected by how we defined NDE, the prospective nature of the research in older cardiac patients, age, surviving cardiac arrest in first myocardial infarction, more than one cardiopulmonary resuscitation (CPR) during stay in hospital, previous NDE, and memory problems after prolonged CPR. Depth of the experience was affected by sex, surviving CPR outside hospital, and fear before cardiac arrest. Significantly more patients who had an NDE, especially a deep experience, died within 30 days of CPR (p<0·0001). The process of transformation after NDE took several years, and differed from those of patients who survived cardiac arrest without NDE.

Interpretation We do not know why so few cardiac patients report NDE after CPR, although age plays a part. With a purely physiological explanation such as cerebral anoxia for the experience, most patients who have been clinically dead should report one.

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Introduction

Some people who have survived a life-threatening crisis report an extraordinary experience. Near-death experience (NDE) occurs with increasing frequency because of improved survival rates resulting from modern techniques of resuscitation. The content of NDE and the effects on patients seem similar worldwide, across all cultures and times. The subjective nature and absence of a frame of reference for this experience lead to individual, cultural, and religious factors determining the vocabulary used to describe and interpret the experience.[1]

NDE are reported in many circumstances: cardiac arrest in myocardial infarction (clinical death), shock in postpartum loss of blood or in perioperative complications, septic or anaphylactic shock, electrocution, coma resulting from traumatic brain damage, intracerebral haemorrhage or cerebral infarction, attempted suicide, near-drowning or asphyxia, and apnoea. Such experiences are also reported by patients with serious but not immediately life-threatening diseases, in those with serious depression, or without clear cause in fully conscious people. Similar experiences to near-death ones can occur during the terminal phase of illness, and are called deathbed visions. Identical experiences to NDE, so-called fear-death experiences, are mainly reported after situations in which death seemed unavoidable: serious traffic accidents, mountaineering accidents, or isolation such as with shipwreck.

Several theories on the origin of NDE have been proposed. Some think the experience is caused by physiological changes in the brain, such as brain cells dying as a result of cerebral anoxia.[2–4] Other theories encompass a psychological reaction to approaching death,[5] or a combination of such reaction and anoxia.[6] Such experiences could also be linked to a changing state of consciousness (transcendence), in which perception, cognitive functioning, emotion, and sense of identity function independently from normal body-linked waking consciousness.[7] People who have had an NDE are psychologically healthy, although some show non-pathological signs of dissociation.[7] Such people do not differ from controls with respect to age, sex, ethnic origin, religion, or degree of religious belief.[1]

Studies on NDE[1,3,8,9] have been retrospective and very selective with respect to patients. In retrospective studies, 5–10 years can elapse between occurrence of the experience and its investigation, which often prevents accurate assessment of physiological and pharmacological factors. In retrospective studies, between 43%[8] and 48%[1] of adults and up to 85% of children[10] who had a life-threatening illness were estimated to have had an NDE. A random investigation of more than 2000 Germans showed 4·3% to have had an NDE at a mean age of 22 years.[11] Differences in estimates of frequency and uncertainty as to causes of this experience result from varying definitions of the phenomenon, and from inadequate methods of

research.[12] Patients' transformational processes after an NDE are very similar[1,3,13–16] and encompass life-changing insight, heightened intuition, and disappearance of fear of death. Assimilation and acceptance of these changes is thought to take at least several years.[15]

We did a prospective study to calculate the frequency of NDE in patients after cardiac arrest (an objective critical medical situation), and establish factors that affected the frequency, content, and depth of the experience. We also did a longitudinal study to assess the effect of time, memory, and suppression mechanisms on the process of transformation after NDE, and to reaffirm the content and allow further study of the experience. We also proposed to reassess theories on the cause and content of NDE.

Methods
Patients
We included consecutive patients who were successfully resuscitated in coronary care units in ten Dutch hospitals during a research period varying between hospitals from 4 months to nearly 4 years (1988–92). The research period varied because of the requirement that all consecutive patients who had undergone successful cardiopulmonary resuscitation (CPR) were included. If this standard was not met we ended research in that hospital. All patients had been clinically dead, which we established mainly by electrocardiogram records. All patients gave written informed consent. We obtained ethics committee approval.

Procedures
We defined NDE as the reported memory of all impressions during a special state of consciousness, including specific elements such as out-of-body experience, pleasant feelings, and seeing a tunnel, a light, deceased relatives, or a life review. We defined clinical death as a period of unconsciousness caused by insufficient blood supply to the brain because of inadequate blood circulation, breathing, or both. If, in this situation, CPR is not started within 5–10 min, irreparable damage is done to the brain and the patient will die.

We did a short standardised interview with sufficiently well patients within a few days of resuscitation. We asked whether patients recollected the period of unconsciousness, and what they recalled. Three researchers coded the experiences according to the weighted core experience index.[1] In this scoring system, depth of NDE is measured with weighted scores assigned to elements of the content of the experience. Scores between 1 and 5 denote superficial NDE, but we included these events because all patients underwent transformational changes as well. Scores of 6 or more denote core experiences, and scores of 10 or greater are deep experiences. We also recorded date of cardiac arrest, date of interview, sex, age, religion, standard of education reached, whether the patient had previously experienced NDE, previously heard of NDE, whether CPR took place inside or outside hospital, previous myocardial infarction, and how many times the patient had been resuscitated during their stay in hospital. We estimated duration of circulatory arrest and unconsciousness, and noted whether artificial respiration by intubation took place. We also recorded type and dose of drugs before, during, and after the crisis, and assessed possible memory problems at interview after lengthy or difficult resuscitation. We classed patients resuscitated during electrophysiological stimulation separately.

We did standardised and taped interviews with participants a mean of 2 years after CPR. Patients also completed a life-change inventory.[16] The questionnaire addressed self-image, concern with others, materialism and social issues, religious beliefs and spirituality, and attitude towards death. Participants answered 34 questions with a five-point scale indicating whether and to what degree they had changed. After 8 years, surviving patients and their partners were interviewed again with the life-change inventory, and also completed a medical and psychological questionnaire for cardiac patients (from the Dutch Heart Foundation), the Utrecht coping list, the sense of coherence inquiry, and a scale for depression. These extra questionnaires were deemed necessary for qualitative analysis because of the reduced number of respondents who survived to 8 years follow-up. Our control group consisted of resuscitated patients who had not reported an NDE. We matched controls with patients who had had an NDE by age, sex, and time interval between CPR and the second and third interviews.

Statistical analysis
We assessed causal factors for NDE with the Pearson χ^2 test for categorical and t test for ratio-scaled factors. Factors affecting depth of NDE were analysed with the Mann-Whitney test for categorical factors, and with Spearman's coefficient of rank correlation for ratio-scaled factors. Links between NDE and altered scores for questions from the life-change inventory were assessed with the Mann-Whitney test. The sums of the individual scores were used to compare the responses to the life-change inventory in the second and third interview. Because few causes or relations exist for NDE, the null hypotheses are the absence of factors. Hence, all tests were two-tailed with significance shown by p values less than 0·05.

Results
Patients
We included 344 patients who had undergone 509 successful resuscitations. Mean age at resuscitation was 62·2 years (SD 12·2), and ranged from 26 to 92 years. 251 patients were men (73%) and 93 were women (27%). Women were significantly older than men (66 vs 61 years, p=0·005).The ratio of men to women was 57/43 for those older than 70 years, whereas at younger ages it was 80/20. 14 (4%) patients had had a previous NDE. We interviewed 248 (74%) patients within 5 days after CPR. Some demographic questions from the first interview had too many values missing for reliable statistical analysis, so data from the second interview were used. Of the 74 patients whom we interviewed at 2-year follow-up, 42 (57%) had previously heard of NDE, 53 (72%) were religious, 25 (34%) had left education aged 12 years, and 49 (66%) had been educated until aged at least 16 years.

296 (86%) of all 344 patients had had a first myocardial infarction and 48 (14%) had undergone more than one infarction. Nearly all patients with acute myocardial infarction were treated with fentanyl, a synthetic opiod antagonist; thalamonal, a combined preparation of fentanyl with dehydrobenzperidol that has an antipsychotic and sedative effect; or both. 45 (13%) patients also received sedative drugs such as diazepam or oxazepam, and 38 (11%) were given strong sedatives such as midazolam (for intubation), or haloperidol for cerebral unrest during or after long-lasting unconsciousness.

	WCEI score*	n
A No memory	0	282 (82%)
B Some recollection	1–5	21 (6%)
C Moderately deep NDE	6–9	18 (5%)
D Deep NDE	10–14	17 (5%)
E Very deep NDE	15–19	6 (2%)

WCEI=weighted core experience index. NDE=near-death experience. *A=no NDE, B=superficial NDE, C/D/E=core NDE.

Table 1: **Distribution of the 344 patients in five WCEI classes***

234 (68%) patients were successfully resuscitated within hospital. 190 (81%) of these patients were resuscitated within 2 min of circulatory arrest, and unconsciousness lasted less than 5 min in 187 (80%). 30 patients were resuscitated during electrophysiological stimulation; these patients all underwent less than 1 min of circulatory arrest and less than 2 min of unconsciousness. This group were only given 5 mg of diazepam about 1 h before electrophysiological stimulation.

101 (29%) patients survived CPR outside hospital, and nine (3%) were resuscitated both within and outside hospital. Of these 110 patients, 88 (80%) had more than 2 min of circulatory arrest, and 62 (56%) were unconscious for more than 10 min. All people with brief cardiac arrest and who were resuscitated outside hospital were resuscitated in an ambulance. Only 12 (9%) patients survived a circulatory arrest that lasted longer than 10 min. 36% (123) of all patients were unconsciousness for longer than 60 min, 37 of these patients needed artificial respiration through intubation. Intubated patients received high doses of strong sedatives and were interviewed later than other patients; most were still in a weakened physical condition at the time of first interview and 24 showed memory defects. Significantly more younger than older patients survived long-lasting unconsciousness following difficult CPR (p=0·005).

Prospective findings
62 (18%) patients reported some recollection of the time of clinical death (table 1). Of these patients, 21 (6% of total) had a superficial NDE and 41 (12%) had a core experience. 23 of the core group (7% of total) reported a deep or very deep NDE. Therefore, of 509 resuscitations, 12% resulted in NDE and 8% in core experiences. Table 2 shows the frequencies of ten elements of NDE.[1] No patients reported distressing or frightening NDE.

During the pilot phase in one of the hospitals, a coronary-care-unit nurse reported a veridical out-of-body experience of a resuscitated patient:

"During a night shift an ambulance brings in a 44-year-old cyanotic, comatose man into the coronary care unit. He had been found about an hour before in a meadow by passers-by. After admission, he receives

Elements of NDE[1]	Frequency (n=62)
1 Awareness of being dead	31 (50%)
2 Positive emotions	35 (56%)
3 Out of body experience	15 (24%)
4 Moving through a tunnel	19 (31%)
5 Communication with light	14 (23%)
6 Observation of colours	14 (23%)
7 Observation of a celestial landscape	18 (29%)
8 Meeting with deceased persons	20 (32%)
9 Life review	8 (13%)
10 Presence of border	5 (8%)

NDE=near-death experience.

Table 2: **Frequency of ten elements of NDE**

artificial respiration without intubation, while heart massage and defibrillation are also applied. When we want to intubate the patient, he turns out to have dentures in his mouth. I remove these upper dentures and put them onto the 'crash car'. Meanwhile, we continue extensive CPR. After about an hour and a half the patient has sufficient heart rhythm and blood pressure, but he is still ventilated and intubated, and he is still comatose. He is transferred to the intensive care unit to continue the necessary artificial respiration. Only after more than a week do I meet again with the patient, who is by now back on the cardiac ward. I distribute his medication. The moment he sees me he says: 'Oh, that nurse knows where my dentures are'. I am very surprised. Then he elucidates: 'Yes, you were there when I was brought into hospital and you took my dentures out of my mouth and put them onto that car, it had all these bottles on it and there was this sliding drawer underneath and there you put my teeth.' I was especially amazed because I remembered this happening while the man was in deep coma and in the process of CPR. When I asked further, it appeared the man had seen himself lying in bed, that he had perceived from above how nurses and doctors had been busy with CPR. He was also able to describe correctly and in detail the small room in which he had been resuscitated as well as the appearance of those present like myself. At the time that he observed the situation he had been very much afraid that we would stop CPR and that he would die. And it is true that we had been very negative about the patient's prognosis due to his very poor medical condition when admitted. The patient tells me that he desperately and unsuccessfully tried to make it clear to us that he was still alive and that we should continue CPR. He is deeply impressed by his experience and says he is no longer afraid of death. 4 weeks later he left hospital as a healthy man."

Table 3 shows relations between demographic, medical, pharmacological, and psychological factors and the frequency and depth of NDE. No medical, pharmacological, or psychological factor affected the frequency of the experience. People younger than 60 years had NDE more often than older people (p=0·012), and women, who were significantly older than men, had more frequent deep experiences than men (p=0·011) (table 3). Increased frequency of experiences in patients who survived cardiac arrest in first myocardial infarction, and deeper experiences in patients who survived CPR outside hospital could have resulted from differences in age. Both these groups of patients were younger than other patients, though the age differences were not significant (p=0·05 and 0·07, respectively).

Lengthy CPR can sometimes induce loss of memory and patients thus affected reported significantly fewer NDEs than others (table 3). No relation was found between frequency of NDE and the time between CPR and the first interview (range 1–70 days). Mortality during or shortly after stay in hospital in patients who had an NDE was significantly higher than in patients who did not report an NDE (13/62 patients [21%] *vs* 24/282 [9%], p=0·008), and this difference was even more marked in patients who reported a deep experience (10/23 [43%] *vs* 24/282 [9%], p<0·0001).

Longitudinal findings
At 2-year follow-up, 19 of the 62 patients with NDE had died and six refused to be interviewed. Thus, we were able to interview 37 patients for the second time. All

	Frequency of NDE			Depth of NDE (n=62)
	NDE (n=62)	No NDE (n=282)	p	
Categorical factors				
Demographic				
Women	13 (21%)	80 (28%)	NS	0·011
Age* <60 years	32 (52%)	96 (34%)	0·012	NS
Religion† (yes)	26 (70%)	27 (73%)	NS	NS
Education†‡ Elementary	10 (27%)	15 (43%)	NS	NS
Medical				
Intubation	6 (10%)	31 (11%)	NS	NS
Electrophysiological stimulation	8 (13%)	22 (8%)	NS	NS
First myocardial infarction	60 (97%)	236 (84%)	0·013	NS
CPR outside hospital§	13 (21%)	88 (32%)	NS	0·027
Memory defect after lengthy CPR	1 (2%)	40 (14%)	0·011	NS
Death within 30 days	13 (21%)	24 (9%)	0·008	0·017
Pharmacological				
Extra medication	17 (27%)	70 (25%)	NS	NS
Psychological				
Fear before CPR†§	4 (13%)	2 (6%)	NS	0·045
Previous NDE	6 (10%)	8 (3%)	0·035	NS
Foreknowledge of NDE†	22 (60%)	20 (54%)	NS	NS
Ratio-scaled factors				
Demographic				
Age (mean [SD], years)*	58·8 (13·4)	63·5 (11·8)	0·006	NS
Medical				
Duration of cardiac arrest (mean [SD], min)	4·0 (5·2)	3·7 (3·9)	NS	NS
Duration of unconsciousness (mean [SD], min)	66·1 (269·5)	118·3 (355·5)	NS	NS
Number of CPRs (SD)	2·1 (2·5)	1·4 (1·2)	0·029	NS

Data are number (%) unless otherwise indicated. CPR=cardiopulmonary resuscitation. NS=not significant (p>0·05). *3 missing values. †n=74 (data from 2nd interview, 35 NDE, 39 no NDE). ‡2 missing values. §10 missing values.

Table 3: **Factors affecting frequency and depth of near-death experience (NDE)**

patients were able to retell their experience almost exactly. Of the 17 patients who had low scores in the first interview (superficial NDE), seven had unchanged low scores, and four probably had, in retrospect, an NDE that consisted only of positive emotions (score 1). Six patients had not in fact had an NDE after all, which was probably because of our wide definition of NDE at the first interview.

We selected a control group, matched for age, sex, and time since cardiac arrest, from the 282 patients who had not had NDE. We contacted 75 of these patients to obtain 37 survivors who agreed to be interviewed. Two controls reported an NDE consisting only of positive emotions, and two a core experience. The first interview after CPR might have been too soon for these four patients (1% of total) to remember their NDE, or to be willing or able to describe the experience. We were therefore able to interview 35 patients who had had an affirmed NDE, and 39 patients who had not.

Only six of the 74 patients that we interviewed at 2 years said they were afraid before CPR (table 3). Four of these six had deep NDE (p=0·045, table 3). Most patients were not afraid before CPR, as the arrest happened too suddenly and unexpectedly to allow time for fear.

Significant differences in answers to 13 of the 34 items in the life-change inventory between people with and without an NDE are shown in table 4. For instance, people who had NDE had a significant increase in belief in an afterlife and decrease in fear of death compared with people who had not had this experience. Depth of

Life-change inventory questionnaire	p
Social attitude	
Showing own feelings	0·034
Acceptance of others*	0·012
More loving, empathic*	0·002
Understanding others*	0·003
Involvement in family*	0·008
Religious attitude	
Understand purpose of life*	0·020
Sense inner meaning of life*	0·028
Interest in spirituality*	0·035
Attitude to death	
Fear of death*	0·009
Belief in life after death*	0·007
Others	
Interest in meaning of life	0·020
Understanding oneself	0·019
Appreciation of ordinary things	0·0001

NDE=near-death experience. 35 patients had NDE, 39 had not had NDE. 1 value missing for patients wih NDE in all categories; *2 values missing for patients with NDE (ie, n=33).

Table 4: **Significant differences in life-change inventory-scores[16] of patients with and without NDE at 2-year follow-up**

NDE was linked to high scores in spiritual items such as interest in the meaning of one's own life, and social items such as showing love and accepting others. The 13 patients who had superficial NDE underwent the same specific transformational changes as those who had a core experience.

8-year follow-up included 23 patients with an NDE that had been affirmed at 2-year follow-up. 11 patients had died and one could not be interviewed. Patients could still recall their NDE almost exactly. Of the patients without an NDE at 2-year follow-up, 20 had died and four patients could not be interviewed (for reasons such as dementia and long stay in hospital), which left 15 patients without an NDE to take part in the third interview.

All patients, including those who did not have NDE, had gone through a positive change and were more self-assured, socially aware, and religious than before. Also,

Life-change inventory questionnaire	2-year follow-up		8-year follow-up	
	NDE (n=23)	no NDE (n=15)	NDE (n=23)	no NDE (n=15)
Social attitude				
Showing own feelings	42	16	78	58
Acceptance of others	42	16	78	41
More loving, empathic	52	25	68	50
Understanding others	36	8	73	75
Involvement in family	47	33	78	58
Religious attitude				
Understand purpose of life	52	33	57	66
Sense inner meaning of life	52	25	57	25
Interest in spirituality	15	–8	42	–41
Attitude to death				
Fear of death	–47	–16	–63	–41
Belief in life after death	36	16	42	16
Others				
Interest in meaning of life	52	33	89	66
Understanding oneself	58	8	63	58
Appreciation of ordinary things	78	41	84	50

NDE=near-death experience. The sums of all individual scores per item are reported in the same 38 patients who had both follow-up interviews. Participants responded in a five-point scale indicating whether and to what degree they had changed: strongly increased (+2), somewhat increased (+1), no change (0), somewhat decreased (–1), and strongly decreased (–2). Only in the reported 13 (of 34) items in this table were significant differences found in life-change scores in the interview after 2 years (table 4).

Table 5: **Total sum of individual life-change inventory scores[16] of patients at 2-year and 8-year follow-up**

people who did not have NDE had become more emotionally affected, and in some, fear of death had decreased more than at 2-year follow-up. Their interest in spirituality had strongly decreased. Most patients who did not have NDE did not believe in a life after death at 2-year or 8-year follow-up (table 5). People with NDE had a much more complex coping process: they had become more emotionally vulnerable and empathic, and often there was evidence of increased intuitive feelings. Most of this group did not show any fear of death and strongly believed in an afterlife. Positive changes were more apparent at 8 years than at 2 years of follow-up.

Discussion

Our results show that medical factors cannot account for occurrence of NDE; although all patients had been clinically dead, most did not have NDE. Furthermore, seriousness of the crisis was not related to occurrence or depth of the experience. If purely physiological factors resulting from cerebral anoxia caused NDE, most of our patients should have had this experience. Patients' medication was also unrelated to frequency of NDE. Psychological factors are unlikely to be important as fear was not associated with NDE.

The 18% frequency of NDE that we noted is lower than reported in retrospective studies,[1,8] which could be because our prospective study design prevented self-selection of patients. Our frequency of NDE is low despite our wide definition of the experience. Only 12% of patients had a core NDE, and this figure might be an overestimate. When we analysed our results, we noted that one hospital that participated in the study for nearly 4 years, and from which 137 patients were included, reported a significantly (p=0·01) lower percentage of NDE (8%), and significantly (p=0·05) fewer deep experiences. Therefore, possibly some selection of patients occurred in the other hospitals, which sometimes only took part for a few months. In a prospective study[17] with the same design as ours, 6% of 63 survivors of cardiac arrest reported a core experience, and another 5% had memories with features of an NDE (low score in our study); thus, with our wide definition of the experience, 11% of these patients reported an NDE. Therefore, true frequency of the experience is likely to be about 10%, or 5% if based on number of resuscitations rather than number of resuscitated patients. Patients who survive several CPRs in hospital have a significantly higher chance of NDE (table 3).

We noted that the frequency of NDE was higher in people younger than 60 years than in older people. In other studies, mean age at NDE is lower than our estimate (62·2 years) and the frequency of the experience is higher. Morse[10] saw 85% NDE in children, Ring[1] noted 48% NDE in people with a mean age of 37 years, and Sabom[8] saw 43% NDE in people with a mean age of 49 years; thus, age and the frequency of the experience seem to be associated. Other retrospective studies have noted a younger mean age for NDE: 32 years,[9] 29 years,[6] and 22 years.[11] Cardiac arrest was the cause of the experience in most patients in Sabom's[8] study, whereas this was the case in only a low percentage of patients in other work. We saw that people surviving CPR outside hospital (who underwent deeper NDE than other patients) tended to be younger, as were those who survived cardiac arrest in a first myocardial infarction (more frequent NDE), which indicates that age was probably decisive in the significant relation noted with those factors.

In a study of mortality in patients after resuscitation outside hospital,[18] chances of survival increased in people younger than 60 years and in those undergoing first myocardial infarction, which corresponds with our findings. Older people have a smaller chance of cerebral recovery after difficult and complicated resuscitation after cardiac arrest. Younger patients have a better chance of surviving a cardiac arrest, and thus, to describe their experience. In a study of 11 patients after CPR, the person that had an NDE was significantly younger than other patients who did not have such an experience.[19] Greyson[7] also noted a higher frequency of NDE and significantly deeper experiences at younger ages, as did Ring.[1]

Good short-term memory seems to be essential for remembering NDE. Patients with memory defects after prolonged resuscitation reported fewer experiences than other patients in our study. Forgetting or repressing such experiences in the first days after CPR was unlikely to have occurred in the remaining patients, because no relation was found between frequency of NDE and date of first interview. However, at 2-year follow-up, two patients remembered a core NDE and two an NDE that consisted of only positive emotions that they had not reported shortly after CPR, presumably because of memory defects at that time. It is remarkable that people could recall their NDE almost exactly after 2 and 8 years.

Unlike our results, an inverse correlation between foreknowledge and frequency of NDE has been shown.[1,8] Our finding that women have deeper experiences than men has been confirmed in two other studies,[1,7] although in one,[7] only in those cases in which women had an NDE resulting from disease.

The elements of NDE that we noted (table 2) correspond with those in other studies based on Ring's[1] classification. Greyson[20] constructed the NDE scale differently to Ring,[1] but both scoring systems are strongly correlated (r=0·90). Yet, reliable comparisons are nearly impossible between retrospective studies that included selection of patients, unreliable medical records, and used different criteria for NDE,[12] and our prospective study.

Our longitudinal follow-up research into transformational processes after NDE confirms the transformation described by many others.[1–3,8,10,13–16,21] Several of these investigations included a control group to enable study of differences in transformation,[14] but in our research, patients were interviewed three times during 8 years, with a matched control group. Our findings show that this process of change after NDE tends to take several years to consolidate. Presumably, besides possible internal psychological processes, one reason for this has to do with society's negative response to NDE, which leads individuals to deny or suppress their experience for fear of rejection or ridicule. Thus, social conditioning causes NDE to be traumatic, although in itself it is not a psychotraumatic experience. As a result, the effects of the experience can be delayed for years, and only gradually and with difficulty is an NDE accepted and integrated. Furthermore, the longlasting transformational effects of an experience that lasts for only a few minutes of cardiac arrest is a surprising and unexpected finding.

One limitation of our study is that our study group were all Dutch cardiac patients, who were generally older than groups in other studies. Therefore, our frequency of NDE might not be representative of all cases—eg, a higher frequency could be expected with

younger samples, or rates might vary in other populations. Also, the rates for NDE could differ in people who survive near-death episodes that come about by different causes, such as near drowning, near fatal car crashes with cerebral trauma, and electrocution. However, rigorous prospective studies would be almost impossible in many such cases.

Several theories have been proposed to explain NDE. We did not show that psychological, neurophysiological, or physiological factors caused these experiences after cardiac arrest. Sabom[22] mentions a young American woman who had complications during brain surgery for a cerebral aneurysm. The EEG of her cortex and brainstem had become totally flat. After the operation, which was eventually successful, this patient proved to have had a very deep NDE, including an out-of-body experience, with subsequently verified observations during the period of the flat EEG.

And yet, neurophysiological processes must play some part in NDE. Similar experiences can be induced through electrical stimulation of the temporal lobe (and hence of the hippocampus) during neurosurgery for epilepsy,[23] with high carbon dioxide levels (hypercarbia),[24] and in decreased cerebral perfusion resulting in local cerebral hypoxia as in rapid acceleration during training of fighter pilots,[25] or as in hyperventilation followed by valsalva manoeuvre.[4] Ketamine-induced experiences resulting from blockage of the NMDA receptor,[26] and the role of endorphin, serotonin, and enkephalin have also been mentioned,[27] as have near-death-like experiences after the use of LSD,[28] psilocarpine, and mescaline.[21] These induced experiences can consist of unconsciousness, out-of-body experiences, and perception of light or flashes of recollection from the past. These recollections, however, consist of fragmented and random memories unlike the panoramic life-review that can occur in NDE. Further, transformational processes with changing life-insight and disappearance of fear of death are rarely reported after induced experiences.

Thus, induced experiences are not identical to NDE, and so, besides age, an unknown mechanism causes NDE by stimulation of neurophysiological and neurohumoral processes at a subcellular level in the brain in only a few cases during a critical situation such as clinical death. These processes might also determine whether the experience reaches consciousness and can be recollected.

With lack of evidence for any other theories for NDE, the thus far assumed, but never proven, concept that consciousness and memories are localised in the brain should be discussed. How could a clear consciousness outside one's body be experienced at the moment that the brain no longer functions during a period of clinical death with flat EEG?[22] Also, in cardiac arrest the EEG usually becomes flat in most cases within about 10 s from onset of syncope.[29,30] Furthermore, blind people have described veridical perception during out-of-body experiences at the time of this experience.[31] NDE pushes at the limits of medical ideas about the range of human consciousness and the mind-brain relation.

Another theory holds that NDE might be a changing state of consciousness (transcendence), in which identity, cognition, and emotion function independently from the unconscious body, but retain the possibility of non-sensory perception.[7,8,22,28,31]

Research should be concentrated on the effort to explain scientifically the occurrence and content of NDE. Research should be focused on certain specific elements of NDE, such as out-of-body experiences and other verifiable aspects. Finally, the theory and background of transcendence should be included as a part of an explanatory framework for these experiences.

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Clinical picture: Amiodarone-induced pulmonary mass and cutaneous vasculitis

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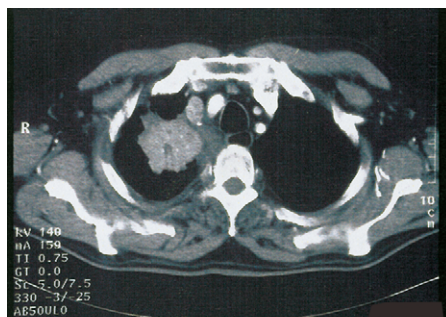
A 67-year-old man presented with haemoptysis and macular erythema on both legs. He had longstanding congestive heart failure and was treated with quinapril, digitalis, furosemide and phenprocoumon. He had been taking amiodarone for 4 years to treat unsustained bouts of ventricular tachycardia. An isolated pulmonary mass of 5 cm in diameter with central necrosis was found in the right upper lobe with extrinsic compression of the corresponding bronchus (figure, upper). Transbronchial biopsies showed no abnormalities, the skin biopsy showed lymphocytic vasculitis of the small capillaries. Antibody screening and urinalysis were normal. On follow-up the mass decreased, new infiltrates appeared and the TSH level increased to 37 mU/L (normal 0·1–4). The diagnosis of amiodarone-induced pulmonary mass and cutaneous vasculitis was confirmed by complete resolution of the infiltrates within 4 months after cessation of amiodarone therapy.

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