
NEAR-DEATH EXPERIENCES IN CLINICAL SETTINGS: EVIDENCE OF TRANSCENDENCE OR CONSTRUCT OF THE BRAIN?

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(Received 21 February 2025, revised 7 May 2025)

Abstract

The study of near-death experiences (NDEs) persists as an important area of research for understanding consciousness, brain function, and the possibility of an afterlife. Unlike spontaneous NDEs, which occur in uncontrolled environments, NDEs in clinical settings, even those associated to medical procedures such as hypothermic circulatory arrest, cardiac arrest resuscitation, ketamine administration, or anesthesia, offer a unique opportunity for systematic study. Although there are important commonalities between both types of NDEs, including out-of-body experiences, tunnel vision, and encounters with perceived entities, neurological models suggest that this phenomenon may be explained by hypoxia, hypercapnia, neurotransmitter surges, or altered brain activity. Additionally, psychological theories, including memory construction and expectation, further challenge the notion that NDEs provide definitive evidence of an afterlife. However, reports of veridical perception and altered states of awareness during clinical death continue to provoke debate. This paper critically examines the literature on NDEs in clinical settings, exploring their phenomenology, neurological correlates, and implications for consciousness studies and life after death. Future research integrating neuroimaging, large-scale longitudinal studies, and cross-cultural comparisons will be essential for advancing the field.

Keywords: Near-death experiences (NDEs), consciousness studies, neurophysiology, afterlife debate

1. Introduction

Near-death experiences (NDEs) have long intrigued scientists, philosophers, and the general public due to their profound psychological, physiological, and existential implications. NDEs are defined as subjective experiences occurring when an individual is close to death or in situations of imminent physical danger, often involving common elements such as a sensation of leaving the body, a tunnel of light, feelings of peace, or encounters with deceased loved ones [1]. These phenomena have been documented across cultures

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and historical periods, suggesting a universal aspect to their occurrence despite differences in personal beliefs and cultural contexts.

Several studies have been conducted in order to explore the phenomenon when it is triggered by medical procedures, or occurs in controlled clinical environments. For example, the AWARE (AWAREness during REsuscitation) trial investigated reports of conscious experiences during cardiac arrest [2]. This study identified cases of verifiable awareness during periods of clinical death. The implications of these experiences extend beyond the immediate medical and psychological domains, reaching into broader debates about consciousness and the possibility of an afterlife. One of the most contentious questions is whether NDEs provide evidence that consciousness can exist independently of the brain. Advocates for this perspective [3] argue that cases of veridical perception during cardiac arrest, when measurable brain activity is absent, challenge materialist models of consciousness. From a different perspective, skeptics argue that all NDE features can be explained by neurological and psychological mechanisms. For example, experiences such as tunnels of light and euphoria can be the result of hypoxia, hypercapnia, or neurotransmitter surges in a dying brain [4]. The debate is further complicated by philosophical considerations. Theories of dualism, which posit the separation of mind and body, gain some support from reports of NDEs. However, these theories remain controversial, as alternative explanations based on emergent properties of neural networks continue to dominate scientific discourse.

This paper focuses on a specific subset of NDEs, those which occur in clinical settings, such as through the use of ketamine, cardiac arrest resuscitation, or other medical interventions. These cases offer a controlled environment to examine the phenomenon, providing unique opportunities to explore their nature and significance. By critically reviewing the existing literature, this paper pursues to address the central question about NDEs: Are these experiences a mere construct of the brain or legitimate evidence of an afterlife?

2. The Scientific Significance of NDEs in Clinical Settings

Unlike spontaneous, naturally occurring, NDEs which occur in clinical settings offer a more controlled environment and enable researchers to study the conditions under which such experiences arise. Some of these experiences are intentionally or unintentionally elicited during medical interventions, such as deep hypothermic circulatory arrest, cardiac arrest resuscitation, anesthetic administration, or experimental drug use. These experiences are frequently associated with physiological disruptions or alterations in brain function. Regardless the triggering factor, clinically induced NDEs seem to exhibit a very similar phenomenology to the main features reported in spontaneous cases, and, despite the differences, the shared phenomenology suggests that both types of NDEs may arise from similar underlying mechanisms [5]. Recurrent elements in these experiences include out-of-body experiences (OBEs), wherein individuals describe a sense of detachment from their physical body and the ability to observe it from an external perspective. Many accounts also refer to the perception of

moving through a tunnel toward a bright, often comforting light, profound feelings of peace, love, and transcendence, often described as ineffable. Encounters with perceived entities, such as deceased relatives, religious figures, or indistinct beings, are also commonly reported, as is the occurrence of a life review, characterized by a vivid, emotionally charged recollection of significant life events. These elements were systematically compiled and categorized by Greyson [6] in the development of his Near-Death Experience Scale, which remains nowadays a widely used tool for the study of NDEs.

However, while NDEs observed in clinical settings share many core features with spontaneous NDEs, notable differences must be acknowledged [7]. Spontaneous NDEs, which often occur in unexpected life-threatening situations, such as accidents, tend to be less uniform, often lacking reliable documentation, while those cases that occur in more predictable contexts, provide researchers with an opportunity to study the phenomenon in real time, systematically applying consistent methodologies, such as neuroimaging and physiological monitoring which facilitates the collection of objective data on the neural and psychological correlates of NDEs. Additionally, the predictability of these cases reduces variability, making it easier to isolate factors like oxygen deprivation or neurotransmitter activity, which are hypothesized to contribute to the experience. This approach provides a more rigorous framework for investigating the underlying mechanisms of NDEs and assessing their implications for concepts of consciousness and life after death.

3. Methodological Approaches and Findings in the Study of NDEs in Clinical Settings

The study of NDEs, particularly in clinical environments, benefits from a multidisciplinary approach, combining experimental techniques from neuroscience, psychology, and medical science.

Advances in neuroimaging, especially in functional magnetic resonance imaging (fMRI) and electroencephalography (EEG), have provided valuable insights into the physiological understanding of NDEs. In an EEG study, the authors explored brain activity during induced cardiac arrest in rats, revealing a surge in gamma wave coherence shortly after cardiac arrest [5]. This burst of activity suggested a potential mechanism for the heightened sensory experiences reported in NDEs. In humans, neuroimaging techniques used in ketamine studies have provided clues about the brain areas implicated in the phenomenon. For example, reduced activity in the default mode network (DMN) has been observed using fMRI during ketamine-induced dissociation [8]. This finding supports the hypothesis that disruption of the DMN, which is involved in self-referential thought, could contribute to out-of-body experiences and other NDE characteristics.

Neurochemical research has studied mainly the role of serotonin in NDEs. A review of the effects of serotonergic psychedelics, particularly psilocybin, on human consciousness revealed that psilocybin can induce deep alterations in perception and cognition, including experiences of unity, timelessness, and ego

dissolution, phenomena that closely mirror the core features of reported NDEs [9]. The author of the study proposed that the activation of serotonin 2A receptors by psilocybin leads to these changes in consciousness, providing insight into the neurobiological mechanisms underlying both psychedelic experiences and NDEs. Similarly, a double-blind, placebo-controlled study [10] with 13 participants, administered intravenous N,N-Dimethyltryptamine (DMT), also a potent serotonergic psychedelic. Using the Near-Death Experience Scale, the authors found that DMT significantly increased NDE-like experiences compared to placebo, including OBEs, tunnel movement, encounters with entities, and feelings of profound peace. These findings suggest a phenomenological overlap between DMT-induced states and NDEs, further supported by correlations with ego dissolution and mystical-type experiences.

Hypothermic circulatory arrest (HCA) is a medical technique in which the body temperature is lowered to 15–20°C to temporarily halt blood circulation and brain activity during complex cardiac and neurosurgical procedures, in order to decrease metabolic demand and preventing ischemic injury. In a prospective observational analysis, the authors [11] explored the incidence of NDEs in patients undergoing thoracic aortic surgery with (N=67) and without (N=27) HCA. Among the 67 cases that involved HCA, the average arrest duration was approximately 27 minutes and mean body temperature 23.7°C during the procedure. Postoperatively, patients were interviewed using the Greyson NDE scale to assess any recollections from their period of unconsciousness. Notably, none of the patients reported experiences indicative of NDEs. The authors suggest that factors such as anesthesia or the methods used for NDEs evaluation might have influenced these findings, leaving the question of whether HCA can trigger NDEs unresolved.

In a study conducted in order to compare the nature of NDEs memories to memories of real and imagined events in coma survivors, with and without NDEs, and a control group of healthy participants, the authors [12] assessed parameters like sensory details, clarity, emotional intensity, and self-referential information in recalled memories, using a modified version of the Memory Characteristics Questionnaire [13]. The results showed that NDEs memories contained more vivid sensory and emotional details than both real and imagined event memories, suggesting that individuals perceive them as exceptionally real and immersive, despite their non-physical occurrence. These findings support the idea that NDEs are neurologically and psychologically distinct experiences, rather than simple hallucinations or imagined events.

Large-scale investigations have systematically documented patient reports of awareness during cardiac arrest, such as the AWARE studies. The AWAREness during REsuscitation (AWARE I) study was a multicenter study aimed to examine the cognitive and physiological aspects of NDEs, with a specific focus on verifying claims of OBEs and awareness during cardiac arrest. The methodology involved placing visual targets in hospital areas where cardiac arrests commonly occurred, such as emergency rooms and intensive care units, to test whether patients reporting OBEs could accurately describe these hidden images. Additionally, the study collected data on brain activity, oxygen levels, and patient

recall of events during resuscitation. The findings of the AWARE I study revealed that among 2,060 cardiac arrest survivors, 9% reported experiences consistent with NDEs, and 2% described OBEs with specific visual or auditory details. However, none of the participants were able to identify the hidden visual targets, leaving the question of the validity of OBEs unresolved [2].

The AWARE II study [14] was carried out during cardiac arrest and cardiopulmonary resuscitation settings. The study used real-time EEG monitoring, cerebral oxygenation tracking, and independent audiovisual testing of explicit and implicit awareness. The study was conducted across 25 hospital sites, integrating in-hospital cardiac arrest cases and complemented its findings with a cross-sectional analysis of community cardiac arrest survivors. A total of 567 patients were enrolled in the study, with 53 survivors (9.3%) achieving successful resuscitation. Of these, 28 (52.8%) participated in interviews to assess their recall of awareness and cognitive experiences. The authors report four categories of experiences: 1) CPR-induced consciousness, observed in 7.1% of survivors; 2) consciousness in the immediate post-resuscitation period, also reported in 7.1%; 3) dream-like states, noted in 10.7%; and 4) transcendent recalled experiences of death, described by 21.4%. The study's complementary community group, involving 126 survivors, supported these classifications while identifying an additional category, delusional experiences attributed to misinterpretation of medical events.

Despite significant cerebral ischemia (mean $rSO_2 = 43\%$), EEG analyses revealed patterns of normal brain activity, including delta, theta, and alpha waves, indicative of potential consciousness. These patterns were observed as long as 35 to 60 minutes into CPR. This finding notably challenges prior assumptions regarding the absence of brain activity during prolonged ischemia and suggests the possibility of network-level cognitive activity resuming under certain conditions. While the low survival rates limited the scope, this study provides critical insights as it signals the potential for cognitive and conscious processes to occur during cardiac arrest, with EEG activity serving as a biomarker of lucidity, awareness, and recalled experiences of death. These results have profound implications for our understanding of NDEs, suggesting that the emergence of normal EEG activity may reflect a neurobiological basis for these phenomena. Thus, this study contributes significantly to the growing body of research on consciousness during life-threatening events, providing a robust foundation for further exploration of cognitive activity in extreme physiological states.

4. Challenges and Limitations in NDEs Research

An obvious limitation in the study of NDEs is their inherent subjectivity, as these experiences are deeply personal and experiential, relying on individuals' accounts of what they perceived during periods of clinical distress or medical intervention. NDEs narratives are liable to be shaped by memory, emotional interpretation, and cultural or religious background [15]. These experiences are typically recalled after a person has recovered from a critical event, and the stress associated with the event or subsequent medical interventions could influence

memory accuracy [16]. This issue is intensified by the fact that many individuals report their experiences long after the event, increasing the potential for reconstruction rather than direct recollection of their experience.

In addition, while most studies of NDEs in clinical contexts are conducted under interventions already necessary for medical purposes (e.g., anesthesia or cardiac resuscitation), inducing these experiences purely for research purposes may be seen as exploitative or unnecessarily risky [2]. The deliberate induction of NDE-like states, involving the use of drugs such as ketamine, or medical procedures such as cardiac arrest simulations, while offering controlled conditions for study, raise ethical concerns that limit their exploration. This ethical tension has limited the scope of experimental studies, resulting in a reliance on observational or retrospective methods.

Another central debate concerning these experiences is about their validity as reliable proxies for spontaneous NDEs. Critics argue that the artificial conditions under which these experiences are given, especially when they are induced by medical procedures, may not fully replicate the complexity or authenticity of spontaneous, naturally occurring NDEs [7]. For example, while ketamine-induced dissociative states share features with NDEs, such as out-of-body sensations and euphoria, they lack other common elements like a life review or encounters with deceased individuals [17]. For many authors, the reliability of cases given within the clinical context as analogs of spontaneous experiences remains controversial as, although they provide valuable data, the controlled nature of their induction and study may exclude essential elements of the spontaneous NDE, such as the existential or spiritual context often associated with real-life brushes with death.

5. Neurological and Psychological Explanations for NDEs: A Critical Perspective

5.1. Neuroscientific Theories of NDEs: Brain-Based Mechanisms

Neurological explanations for NDEs propose that these phenomena arise as the result of the specific physiological processes occurring in the brain during periods of extreme stress, oxygen deprivation, or other life-threatening events. One of the most cited mechanisms is hypoxia, a lack of oxygen in the brain. Hypoxia has been observed to produce sensations similar to those described in NDEs, like tunnel vision, euphoria, and even out-of-body experiences. It has been observed that fighter pilots exposed to high-G forces, resulting in transient hypoxia, reported sensations similar to NDEs, including visual phenomena and a sense of detachment from their bodies [18].

A related condition, referred to as hypercapnia, which are elevated levels of carbon dioxide in blood, has also been linked to NDE-like sensations. In a well conducted study [19], it was found that patients who experienced higher carbon dioxide levels during cardiac arrest were more likely to report NDEs, in support of the hypothesis that altered blood gas levels may trigger the vivid perceptual and emotional experiences associated with NDEs.

Neurotransmitter activity, particularly surges in serotonin and endorphins, has also been studied in relation to NDEs. During life-threatening situations, these neurochemicals are released in the brain as part of the body's stress response, potentially producing feelings of euphoria, peace, and altered perception of time, also core features of reported NDEs [5]. Furthermore, studies on ketamine, an NMDA receptor antagonist, have shown that its effects mimic many aspects of NDEs, providing additional support to a neurochemical basis of the experiences [17].

5.2. Psychological Perspectives on NDEs: Memory, Expectation, and Coping

From a psychological perspective, some authors interpret NDEs as constructs of the mind, shaped by memory, expectation, and coping mechanisms in response to extreme stress or trauma. One widely accepted explanation is memory construction, wherein individuals retrospectively interpret their experiences based on cultural narratives or personal beliefs about death and the afterlife [16]. In parallel, expectations can also play a central role in shaping these experiences. Studies have shown that cultural and religious backgrounds influence the nature of these experiences. For example, Christians often report encountering a tunnel of light or Jesus, while Hindus may describe meeting Yama, the god of death [15]. Such variability supports the idea that NDEs are shaped by pre-existing belief systems rather than representing a universal phenomenon.

Another psychological explanation focuses on NDEs as coping mechanisms. During moments of extreme stress or the perceived threat of death, the brain may create comforting illusions to reduce fear and provide a sense of peace. This aligns with Vail et al.'s terror management theory, which suggests that our brain uses psychological strategies to mitigate existential anxiety in the face of mortality [20].

5.3. Critiques and Skepticism in Near-Death Experience Research

While the study of NDEs has grown in reputation, it remains subject to skepticism. Critics frequently highlight problems of reproducibility, noting that many studies rely on anecdotal reports, difficult to verify or replicate in controlled settings. For example, the AWARE study, despite its rigorous methodology, identified only a small number of verifiable NDE cases, leading some to question the generalizability of its findings. Moreover, selection bias also poses a challenge, as researchers are accused of focusing on cases with the most vivid or extraordinary experiences, neglecting reports that are more consistent with mundane physiological explanations [7].

Skeptics also warn that NDEs research is hindered by confirmation bias, with some researchers seeking evidence to support pre-existing beliefs about the afterlife or consciousness. Some authors [4], caution that such biases can distort interpretations, leading to conclusions that favor transcendental explanations over more parsimonious neurological or psychological models.

6. Interpreting the Evidence: Do NDEs Reveal More Than Brain Activity?

The study of NDEs under the controlled conditions of clinical settings takes us to confront one of the most profound questions in human history: Do these experiences provide a view to an afterlife, or are they merely sophisticated illusions generated by a distressed brain?

Proponents of the afterlife hypothesis argue that NDEs reveal more than just the neurochemical reactions of a dying brain, as the universality of these experiences across cultures, together with their remarkable coherence and transformative effects, suggests that they may be more than mere hallucinations. One of the most compelling challenges to a purely materialist explanation of the phenomenon are reports of veridical perception, where individuals claim to have accurately observed details of their surroundings during cardiac arrest, when measurable brain activity is absent. Additionally, the consistency of NDE reports, despite variations in cultural context, suggests a deeper reality underlying these experiences. Undoubtedly, cultural and religious influences shape the interpretation of NDEs, however, the core elements, like out-of-body experiences, encounters with a bright light, feelings of peace, and meeting deceased individuals, are remarkably stable across populations. If these were culturally constructed hallucinations, we might expect a far greater divergence in reports. The persistence of these common features raises the possibility that NDEs are tapping into a universal aspect of human consciousness, perhaps an afterlife.

Despite these arguments, the case for a neurological and psychological explanation of NDEs remains robust. One of the best supported explanations is hypoxia, or oxygen deprivation in the brain. Along the same line, neurotransmitter activity can play a significant role in the explanation of NDEs. For example, research on ketamine shows how artificially altering the brain chemistry can induce dissociative states nearly identical to NDEs, including feelings of detachment from the body and encounters with non-human entities [17]. In a similar way, the release of serotonin and endorphins in moments of extreme stress or trauma may produce the feelings of euphoria and peace commonly reported in NDEs [5]. In general, the findings of neurophysiological studies suggest that these experiences may be the result of a highly adaptive response of the brain to extreme physiological stress.

Psychological models further support the argument that NDEs are subjective constructions rather than objective glimpses into an afterlife. The memory construction hypothesis [16] suggests that the brain, in an effort to make sense of chaotic or traumatic events, constructs internally consistent narratives that later manifest as vivid recollections of an NDE. Additionally, the expectation model [15] proposes that the existence of culturally specific variations in NDE reports, such as Hindu experiences of encountering Yama, the god of death, versus Christian visions of Jesus, further supports the neurological hypothesis.

A particularly significant challenge to the afterlife hypothesis is the failure of veridical perception studies to produce consistent, reproducible results. The AWARE studies were designed to test whether individuals undergoing NDEs could perceive hidden targets during cardiac arrest. However, while some patients

reported awareness during resuscitation, no conclusive evidence supported their ability to perceive external stimuli beyond what could be explained through conventional sensory processes.

While the debate remains intensely polarized, some researchers propose an intermediary perspective, the possibility that NDEs reveal aspects of consciousness that transcend current scientific understanding, even if their phenomenology is not related to the afterlife. This hypothesis is in tune with emerging research in quantum consciousness theories [21], that suggest that consciousness may be more fundamental than previously assumed, potentially extending beyond the brain. Although speculative, these ideas open the door to the possibility that NDEs reflect a deeper reality of mind and existence that neuroscience has yet to grasp.

Additionally, the transformative impact of NDEs should not be ignored, regardless of their ultimate origin, even if these experiences are generated entirely by the brain, their profound psychological and existential effects raise important questions about the nature of self-awareness, perception, and human search for meaning. Whether or not NDEs are windows to an afterlife, they undeniably provide individuals with experiences that rewrite their understanding of existence.

7. Conclusions

The study of NDEs in clinical settings, while offering controlled conditions and valuable research possibilities for scientists, do not definitively resolve the question of whether consciousness can exist independently of the brain or whether these experiences are genuine glimpses of an afterlife. Although reports of veridical perception and transformative experiences suggest something beyond materialist explanations, the wealth of neuroscientific and psychological evidence provides substantial alternative explanations. The failure of veridical perception studies to consistently support the afterlife hypothesis, combined with the ability to replicate NDE-like states through neurochemical manipulation, suggests that these experiences are likely grounded in brain function rather than providing contact with an afterlife. Yet, this conclusion does not diminish the significance of NDEs. Whether viewed as illusions of a dying brain or as glimpses into another realm, NDEs challenge our understanding of consciousness, mortality, and the nature of human experience. Future research, particularly in neuroimaging and consciousness studies, will be crucial in unraveling the mysteries that these profound experiences continue to present.

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