The near-death experience: a cerebellar method to protect body and soul. Lessons from the Iboga-Healing-Ceremony in Gabon

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Abstract

The root bark of the Iboga shrub (Tabernanthe Iboga) is used in Gabon (Central Africa) to induce a near-death experience for spiritual and psychological purposes. The pharmacology of ibogaine, a psychoactive indole alkaloid extracted from the bark, has been extensively investigated because of its anti-addictive qualities. This current review of these studies and neuroscientific approaches to the near-death experience compared with field studies of traditional African rituals has generated new insights into the neurological correlates and the psychological effects and after-effects of the near-death experience.

Ibogaine stimulates the cerebellar fastigial nucleus in the same manner as ischemia and leads to a medium-term protection of the brain against glutamate induced neurotoxicity. At the same time, it induces changes of the autonomic nervous and the cardiovascular system, which serve the overcoming of the danger of life: Iboga-intake and ischemia both lead to slowing of EEG activity (dominance of theta- and delta-waves), a stimulation of the limbic system, and a dominance of a phylogenetically older branch of the vagus nerve, originating in the dorsal motor nucleus, which lowers the metabolic rate of the body.

As a conclusion, the near-death experience seems to be the result of a dominance of phylogenetically and ontogenetically old neurological structures and brain waves, which are allowed to show their (para) psychological abilities in absence of cortical dominance. If parts of the neocortex are still active and permit observation and memory performance, the experience can be integrated within the personality. The new learned peaceful state of vagal and subcortical dominance can be actively self-induced.

Implications of this model for alternative healing are discussed.
Introduction

In the Republic of Gabon in Central Africa, an initiation ritual is performed with the consumption of the root bark of the Iboga-shrub and is supported by an ingenious musical accompaniment. Gabonese healers expect the person to be initiated to experience a “vision” of “death and rebirth” (1-4). Reports of Europeans being initiated and Gabonese people interviewed by ethnologists show all the typical elements of a near-death experience: a life review, out-of-body experience and floating over various landscapes, an encounter with deceased, gliding through a tunnel into an ulterior world, and an encounter with a divine entity – finally the arrival at a point of no return, which is not to be surpassed by the living, and the return to life (1-4). Also, Gabonese expectations of a successful initiation coincide with the research results of the effects of near-death experiences: acceptance of responsibility and reduction of dependencies, increase in spirituality and reduced fear of death, as well as a new love for people and environment are unanimously observed as effects of the encounter with death (5-9). Lommel et al. were able to prove these effects in a longitudinal study. In this study, patients, who had a near death experience related to cardiac arrest, were compared with a control group (also with heart failure, but without recollection). The observed psychological differences between both groups in their study were more pronounced after eight years of follow-up than after two years (10).

However, the causes of these effects remain unclear. Neurological attempts to formulate an explanation hold the endorphins responsible for the exalted mood during the near-death experience (11-13). The visions are presumed to be caused by a disengagement of external stimuli (13-14) and a cerebral increase in activity (11): In particular, an over activation of the temporal lobe (11,13,15) and the hippocampus (11,14,16). Blanke et al. report they could provoke an out-of-body experience of a woman with a diagnosis of epilepsy by electric stimulation of the right angular gyrus (17). On the other hand, Woerlee holds malfunction of several brain areas (prefrontal cortex, motor cortex, parietal cortex, angular gyrus, amygdala and hippocampus) caused by ischemia and resuscitation responsible for near-death experiences during cardiac arrest (18). Reader explains the near-death experience as a parasympathetic response to an excessive sympathetic stimulation caused by the extreme stress in situations of danger (19). Jansen proposes that the near-death experience serves to protect the brain from the effects of ischemia by blocking NMDA type glutamate receptors (13).

Studies about near-death experiences have several limitations because of their unexpected occurrence, the priority of live-saving measures (18) and the impossibility to communicate with the near-death experiencer. The Iboga-vision is, on the contrary, provoked in a controlled situation with a specific musical and psychological accompaniment. In addition, ibogaine, the most important psychoactive alkaloid of the Iboga-shrub, has been extensively pharmacologically investigated in animal studies.
because of its putative anti-addictive properties. Though classified as an illegal drug in the United States and most European countries, it is used by self-help groups and private clinics to cure addiction (20).

**Research questions**

It was the aim of our study to gain new insights into neurological correlates of near-death experiences integrating the results of a literature review of neuroscience with ethnological investigations and own field studies in the region of Lambaréné (Gabon) in the years of 1999-2005. Through a comparison of international science and traditional knowledge in a qualitative study-design we aimed at gathering a maximum of possible information about the topic. Our research questions were:

- Are Iboga visions and near-death experiences based on a common neurological mechanism?
- Can ibogaine research help to detect structural changes in brain function during a near-death experience?
- Are there neurological correlates for the personality changes after near-death experiences and after Iboga-visions?

**Results: Pharmacology and physiology of the near-death experience under Iboga**

**A cerebellar emergency program**

Through an unknown mechanism, ibogaine induces a rhythm of 8-12 Hz in the inferior olive. This rhythm leads to enhanced synaptic excitation in cerebellar Purkinje-cells through a glutamatergic pathway. Glutamate, the most important excitatory neurotransmitter can produce 'excitotoxicity' in Purkinje cells (21-22). Certain groups of cells, normally inhibiting the fastigial nucleus, are especially vulnerable to neurodegeneration. If inhibition through these cells fails, the fastigial nucleus induces neuroprotective mechanisms in the brain. (23-26). It could be presumed that this mechanism serves as a protection in case of ischemia.

Welsh et al discovered that ibogaine in very high concentration caused patterns of cell degeneration in rats that mimic global ischemia (21).

Although the death of Purkinje cells in rats could only be demonstrated after large doses of ibogaine (28), the protective properties are presumably effective with smaller doses. Using a model of mild ischemia in sheep fetuses, Harding et al. were able to demonstrate...
that despite the loss of almost all activity in Purkinje cells, no obvious cellular damage was seen (29). This ischemic preconditioning also seems to stimulate the fastigial nucleus thereby inducing protection against subsequent ischemic insults (30). Reis et al. could reduce the infarct volume after focal ischemia by up to 50% after electrical stimulation of the fastigial nucleus, a protective effect that could be observed for weeks (26).

It can be concluded that Ibogaine induces this type of protective reaction against (prospective) oxygen deprivation in the brain. Parallels can be drawn to near-death experiences, which might occur in situations of real as well as anticipated ischemia, for example during a fall or roll-over of a car (31-32).

The model we suggest here fits well with the results of a very recent study carried out by Schutter and coworkers, who could induce an out-of-body experience by transcranial stimulation of the Cerebellum (33).

**The induction of a hippocampal theta rhythm**

Enhanced release of the stimulating neurotransmitter glutamate, which can be neurotoxic not only for Purkinje-cells is claimed to be the first danger in case of ischemia (34-35). Presumably as a measure of protection, higher cerebral functions are reduced under oxygen deprivation, indicated by a gradual slowing of EEG activity (18,36,37).

In case of mild or beginning ischemia, a theta rhythm of 5-6 Hz in human beings (38) is intensified (36,39). Similarly, ibogaine also increases this rhythm (40), probably through its stimulating effect on the fastigial nucleus (25). Schutter and van Honk were able to induce it by transcranial stimulation of the Cerebellum (41). During the Gabonese initiation ceremony additional augmentation of the theta rhythm results from the polyrhythmic ritual mouth bow (in male initiations) and harp music (in female initiations), which is played in an absolutely constant measure of 5-6 Hz (42).

Theta rhythms with a frequency spectrum of 4-8 Hz are generated in different parts of the hippocampus (43) and develop in humans within the first years of their life. They become dominant in the wake-EEG at the age of 6-7 years (44). Alpha activity shows a slower onset and becomes dominant in puberty (45). While theta rhythms serve the formation of episodic memories and the encoding of new information, alpha rhythms serve to memorize semantic matters (46).

Normally, slower rhythms in the brain are inhibited by faster ones. This blockage is supposed to be more distinct in fearful people (47-48). However, in the setting of ischemia this relation is reversed and normal inhibitions are removed thereby inducing neuroprotection and allowing extraordinary ways of thinking. Since it can be assumed
that the recall of memories is facilitated by the same EEG frequencies that were present
during memory formation, we hypothesize that the phase of dominance of the theta
rhythms is responsible for the episodic life review in near-death experiences. After
consumption of ibogaine this phase lasts for several hours and enables the confrontation
with childhood problems, which is psycho-therapeutically guided by the healers.

The induction of a cerebral delta-rhythm

In the course of ischemia, a transition to delta-waves can be observed (31,36), a
frequency spectrum (0.5 – 4 Hz) also induced by ibogaine (49).

Gabbard was able to observe a transition from theta to delta-waves in the EEG of adults,
who were able to self-induce an out-of-body experience in a motionless rest position
(50). Whinnery observed the same effect in pilots, who had near-death experiences
during fast accelerations (31).

Delta-rhythms, which in adults normally only occur during fatigue or sleep, dominate
the wake EEG of reptiles (51,52). Wettach interprets these delta wave patterns in
human’s wake EEG as a shift of the brain to evolutionary older structures (53), which
are more resistant to ischemia than the neurocognitive networks of mammals (18,54).

Delta-rhythms also dominate the wake EEG in newborns (44). Jacobs and Nadel claim
that the hippocampus and the hippocampal theta-rhythm are not yet functioning in
infants and therefore they are not able to memorize information about space and time
(55). This could offer one explanation for the special performance of space and time
during the near-death experience.

A transition from theta to delta-rhythms is also facilitated by the Gabonese ceremonial
music during the induction of a possession-trance (42). Characteristic features of this
trance, as observed by Bourguignon in several African cultures (56) are strange
behavioral patterns, as if belonging to another person (interpreted as being “possessed”
by a ghost), the inability to speak and a subsequent amnesia. We interpret the loss of the
cortical functions of speech and memory as indication for dominance of subcortical
networks during this possession-trance.

Maintaining neocortical functions

In contrast to the possession-trance, the ability to memorize and the ability to verbally
communicate are preserved during the Iboga-“vision”. The access to neocortical
functions also seems to be intact during near-death experiences as indicated by clearly
structured and linguistically formulated memories, even though in most cases during the
experience, because of the circumstances, no verbal exchange with the environment
takes place. The mechanism for the maintenance of the cortical function is unclear. Certain cerebral functions however, especially those of the prefrontal lateral cortex, seem to be responsible for the suppression of motor responses (57) which is observed under Iboga (2) and during near-death experiences (31) and seems to be reasonable in case of ischemia to save energy (18).

In Gabon the maintenance of the cortical functions is considered to be therapeutically very important. During the Iboga initiation ceremony the healers constantly demand a verbal communication about the observed matters and their possible meanings and request target-oriented activities in the "hereafter". Only a remembered vision is considered successful. Therewith new spiritual contents of the unconsciousness as well as knowledge of interior processes are opened to the consciousness, and conditions are prepared to transfer them into long-term memory. The vision symbolizes with the elements of the tunnel, divine light and “point of no return” the fight of the body for survival and the “re”birth.

That cortical functions are not always maintained, might be the reason why near-death experiences are rare. Lommel et al. found, that 80% of patients did not remember anything after cardiac arrest (10).

The acquisition of “vagal competence”

The near-death, like other spiritual experiences consists not only of images but also strong emotions that are experienced as being exceptional. These may be recalled later and felt as long-term shaping (6-9).

In emergency situations the fastigial nucleus influences the brain but also breathing, heart-rate and other autonomic parameters (58-63). Ischemia causes bradycardia, reduced respiratory rate and metabolism (64-65). Ibogaine has the same effects, additionally a decrease of body temperature and extreme slowdown of body movements could be observed (2,20,66).

According to Porges’ polyvagal theory, the different emotions of higher mammals are made possible through a complicated cooperation of the two antagonists of the autonomic nervous system, the sympathetic and vagal system (67,68). Phylogenetically old reptiles have only an energy saving mode (vagal excitement) and an activity mode (sympathetic excitement) (69) whereas higher reptiles and mammals have two vagal branches: the evolutionary older one, originating in the dorsal motor nucleus of the nervus vagus and a second branch, originating in the nucleus ambiguous. This “new vagus” is connected with neuromuscular regions, for example the facial muscles and therefore allows different emotions and forms of communication (sucking and tasting,
head movement and mimicking, call-outs and the coordination of breathing and heart-rate).
The “old” energy saving vagus is dominant in mammals only in extreme situations of danger (67,68). Humans need it presumably mainly at birth.

This exceptional vagal stimulation during near-death experience might explain that the situation is perceived as completely new and beyond comparison with other “real” experiences. The similarity to ischemia during birth is reflected in the Gabonese description, that one dies and is reborn.

If the new feeling of vagal dominance is connected with cerebral networks, the initiated or near-death experienced can recall the feelings of the experience later and continuously activate a new awareness of life. We suppose that meditation initiates similar processes of conscious influence on the autonomic nervous system. Benson et al. showed that Buddhist monks were able to reduce their need for oxygen - by up to 70% (70).

This ”vagal competence” could also be effective psychologically. Sahar et al. discovered that patients with a post traumatic stress disorder demonstrate a stronger sympathetic activation than a control group when presented with a mathematical problem. This demonstrates they were unable to use the vagal system adequately for their own relaxation (71).

Trauma-victims, who have experienced extreme situations of helplessness and often dissociations, even out-of-body experiences seem to generally inhibit vagal reactions. The Iboga vision might enable them to experience a massive vagal reaction in a situation of safety and therefore make it once again available for their own experience. In case of depression, which is also accompanied by a sympathetic over-reaction (72), Mash et al. were able to demonstrate an improvement after ibogaine treatment using a self-rating depression scale (73).

**The induction of neurogenesis in the hippocampus**

In Gabon the night of the vision is only the beginning of the healing-process. The traditional initiation may last several weeks. After the consumption of Iboga, the person to be initiated will be sheltered from the outer world for several days and is accompanied by healers. He is in a state of regression and relives childhood phases. Hereby he is continuously accompanied by healers and other initiated persons in the processing of the experiences (1).

The psychological changes could be based on neurological changes as the brain responds after ischemia (74) or epilepsy (75) with increases in neurogenesis in the hippocampus.
These changes last for several weeks, consistent with the period of retreat in the traditional initiation ceremony (74). This could be important because long-term stress or trauma result in a reduction of hippocampal volume (76-78) which could also be shown in cases of depression (79) and alcohol dependency (80). Hippocampal neurogenesis also seems to be part of the effect of electro convulsive therapy (81) and antidepressants (82). Gould was able to confirm these effects in a study using rats: a relatively small population of immature new cells could exert a substantial functional influence over the hippocampal function (83).

Keeping the person isolated and in permanent company of healers after the initiation ceremony in Gabon in the period of neurogenesis, which lasts several weeks (74) may serve to consolidate personality changes. Gabonese healers always emphasize how important it is not to “forget” the initiation. To our knowledge, impacts of aftercare on the long-term effects of near-death experiences have not yet been investigated. However, based on extensive clinical experience, Clark emphasizes the importance of a sensitive and respectful treatment of near-death experienced in the hospital setting (84).

**Conclusions**

Iboga-induced visions and the near-death experience seem to be attributed to a common neuronal mechanism. They result from a protective cerebellar reaction against a real or anticipated oxygen deprivation, which can be induced pharmacologically in the fastigial nucleus. We presume that cortical influences (the belief that death is impending) may also be a possible cause.

In the resulting exceptional state the brain reduces its activity and re-activates infantile brain-rhythms and networks that are exceptionally resistant to oxygen deprivation.

The near-death experience is therefore the result of a dominance of phylogenetically and ontogenetically old neurological structures and brain waves, which are allowed to show their (para)psychological abilities in absence of cortical dominance. Our study permits the conclusion that not the neocortex, but older structures are leading in spiritual performance. Neocortical structures seem to inhibit these processes under normal circumstances.

However, only when parts of the cortex are no longer inhibiting but are still active (permitting observation and memory performance) can the experience be integrated within the personality.
Implications for alternative healing

During an ibogaine-induced or “natural” near-death experience the adult person relives a condition of massive vagal dominance that is not normally at his disposal. To experience a life threatening situation in a peaceful and beatified manner can heal basic life fears. In Gabon initiation is induced in cases where an individual has a problem with the deceased. Many people who had near-death experiences have also solved a problem with the after-life: the fear of death. Interestingly enough, in both cases, personality changes are not induced by resolving or reliving life-problems, but by a transcendental experience. This is a potential, which is neglected in Western psychotherapy.

But near-death experiences do not always cause personality changes. For African healers, aftercare is as important as the vision itself, an approach that fits with studies about neurogenesis after life-threatening situations. Near-death experiencers usually lack this period of retreat and counseling and only casually (particularly if they are hospitalized) have the time to consolidate and integrate their experiences in a comprehensive atmosphere without the demands of daily life. Considering the high number of near-death experiences in Western societies (Knoblauch found 4% NDE-reports in a representative survey in Germany (85)) aftercare should be a therapeutic concern.

Aftercare and the importance of the spiritual experience are also underestimated in ibogaine therapies against drug-addiction performed by private clinics in several industrial countries. Although drug addicts often report elements of near-death experiences after the intake of ibogaine (86), these are neglected by the pharmacological research or are considered as being disturbing and without influence on the success of the therapeutic process (20). Glick and co-workers even developed an Iboga alkaloid congener to treat addiction, which is expected not to be “hallucinogenic” (87).

We propose that in further research, physiology and spirituality should no longer be considered apart from each other. The physiology of spiritual experiences and concomitant spiritual phenomenon of physiological processes are worthy of further investigation. The results could offer new psychotherapeutic approaches in the future.
Ibogaine  Ischemia  Belief to die  Gabonese ritual music

Lower activity of Purkinje cells  
Activation of fastigial nucleus  
Autonomous nervous system: Vagal dominance

Slowing of brain waves:  
Theta-rhythm 5-6 Hz  
Delta-rhythm 0.5-4 Hz

Change of cerebral functions  Resistence against ischemia  Life reviews?

Figure: Neurogenic pathways of the near-death experience

References


17. Blanke O, Ortigue, S, Landis T, Seeck M. Stimulating illusory own-body perceptions. The part of the brain that can induce out-of-body experiences has been located. *Nature*. 2002;419:269


25. Golanov EV, Reis DJ. Neuroprotective electrical stimulation of cerebellar fastigial nucleus attenuates expression of periinfarction depolarizing waves (PDIs) and inhibits cortical spreading depression. Brain Res. 1998;818:304-315


56. Bourguignon E. *Possession*. Ohio: Chandler and Sharp; 1976


62. Lutherer LO, Lutherer BC, Dormer KJ, Janssen HF, Barnes CD. Bilateral lesions of the fastigial nucleus prevent the recovery of blood pressure following hypotension induced by hemorrhage or administration of endotoxin. *Brain Res*. 1983;269:251-257


70. Benson H, Malhotra MS, Goldman RF, Jacobs GD, Hopkins PJ. Three case reports of the metabolic and electroencephalographic changes during advanced buddhist meditation techniques. *Behav Med*. 1990;16(2):90-95


78. Driessen M, Hermann J, Stahl K et al. Magnetic resonance imaging volumes of the hippocampus and the amygdala in women with borderline personality disorder and early traumatization. Arch Gen Psychiatry. 2000;57(12):1115-1122


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