Research Article

LSD treatment in Scandinavia: the early enthusiasm and the resurgent interest

Jens Knud Larsen*

Larsen JK. LSD treatment in Scandinavia: the early enthusiasm and the resurgent interest. Clin Pharmacol Toxicol Res. 2018;1(2):13-18.

Background: Psychedelics such as LSD and psilocybin were widely used in psychiatry in the 1950s and in Scandinavia in the 1960s. However, in the mid-1960s, a wave of abuse resulted in international prohibition. New research has suggested that psychedelic treatment should be revisited.
Aims: The purpose of the present study was to explain the early interest for LSD treatment in Scandinavia in the light of the recent research with psychedelic drugs.
Methods: LSD case materials, with the medical records of 151 LSD-treated patients in the Danish State Archives, were carefully reviewed. In particular, the positive outcomes of LSD treatment in the LSD case material were closely studied. Results of new clinical research with psychedelics were counterbalanced with the reading of the LSD case material.
Results: LSD in Scandinavia was mainly used as a tool in psychoanalytical therapy to speed up the therapy. Chemical action on unconsciousness, insight, genes, stress coping and conditioned learning was emphasized as well. However, a most original, correct conception of LSD as an alternative to psychoanalysis was also claimed. Today the mechanisms of action of psychedelics are linked to understanding of the serotonin system, especially the 5-HT2 receptor family. This knowledge makes it easier to understand both the early and the renewed interest.
Conclusions: Before psychedelics are introduced in psychiatry again, much clinical research must be performed on their efficacy and safety, including the suggested ability to induce long-term changes in the adult personality.
Key Words: LSD, Psilocybin, LSD treatment, LSD mechanisms of action, Serotonin.

INTRODUCTION

Throughout the 1950s, LSD was widely used in animal and clinical studies in attempts to unravel the mysterious connection between behaviour and neurochemistry, and many psychiatrists and neuroscientists experimented with LSD by observing their own behaviours under the influence of the drug [1]. Although in the early years of work with LSD it was often recommended as an aid for psychotherapy and as an adjunct for the treatment of various psychiatric illnesses, including alcoholism and opiate dependency [1], the scope of its clinical and other uses went much further. No doubt in psychoanalytical circles, it was generally believed that certain drugs such as LSD could evoke unconscious material; therefore, this material became available for interpretation and therapy [2]. Thus, in the official Danish psychiatric textbook at that time, it was stated: "Using LSD, patients may develop a psychotic-like state, in the process of which they reveal much pathogenic material" [2,3]. Similarly, the official Norwegian psychiatric textbook stated that LSD could evoke "rich fantasies and even memories far back in childhood" [4]. A closer scrutiny of these ideas appeared in 2003 from a Norwegian commission (NOU), which unravelled the claims of unethical use of LSD in Norway [5].

In the late 1940s, the American Central Intelligence Service (CIA) searched for new methods to control consciousness and behaviour, and for a time, LSD was considered to be the best "truth serum". The first experiments on human subjects were found to be promising. However, the experiments were performed in violation of the Nuremberg code because they included insufficiently informed psychiatric patients, prisoners and others. In small dosages, LSD seemed to be able to disclose deep, nearly forgotten secrets. Additionally, LSD, according to psychiatric reports, could undermine well-established patterns of behaviour. The latter experience was assumed to indicate for the possibility of "brainwashing" [5,6].

To the best knowledge of the author, Scandinavian psychiatrists were not involved in the CIA experiments, although claimed [5,7]; however, in Norway, participation concerning Norwegian psychiatrists was rejected [5].

In the 1960s, LSD spread to college campuses and was used by persons attempting to enhance their perception or their intellectual or artistic creativity [1]; however, a wave of abuse resulted in international prohibition. Thus, in 1966, LSD was entered onto the list of euphoriant drugs in Denmark, and 8 years later, it was no longer registered as a medication [8].

Recent surveys of the short-term and long-term outcomes of LSD treatment in 151 Danish patients (the so-called LSD case materials) have documented a considerable risk of serious adverse effects of the treatment [2,9]. These circumstances make it highly relevant to understand why new research has suggested that psychedelic treatment might again be introduced in clinical psychiatry [10,11].

AIMS

The aims of the present study were to understand background, believes and motives in the 1950s and 1960s of Danish, Norwegian and Swedish therapists related to the use of LSD on their patients. With special reference to the treatment in Denmark, these incentives could be further illustrated by analyses of the LSD case materials.

MATERIALS AND METHODS

Danish, Norwegian and Swedish LSD therapists visited English and German centres for LSD treatment, and they also presented the results of LSD treatment in journals and reports and at national, Scandinavian and international meetings [2,8,9]. To investigate the conception of the mechanism of action of LSD treatment, a close reading of these materials [2,8] and of the principal publications from the visited European centres was performed. The Scandinavian and the European publications were not searched, selected or analysed in any unique way. Thus, no Medline, key-

Department Q, University Hospital of Aarhus, Denmark

Correspondence: Jens Knud Larsen, Guest Researcher, Department Q, University Hospital of Aarhus, Skovagervej 2, DK- 8240 Risskov, Denmark, E-mail: jens.knud.larsen@ps.rm.dk

Received: February 27, 2018, Accepted: March 3, 2018, Published: March 10, 2018

word or other search has been performed. Accordingly, principal publications are those publications, which according to the author are discussing mechanisms of action of LSD.

In Denmark, medical records and other case materials of 151 LSD-treated patients have been preserved in the Danish State Archives (LSD case materials). These materials consist of the data of those patients who complained that they were harmed by LSD treatment, per the LSD Damages Law, 1986 [12]. Detailed descriptions of the application procedures and the case work in the so-called LSD tribunal under the Ministry of Social Affairs from 1986 to 1988 have been published elsewhere [2,8,9]. However, the LSD case material has often included detailed clinical descriptions of the response to LSD treatment, making it possible to illustrate this response with clinical examples and tables. Inherently, with special reference to the present study, the selected clinical examples and the tables mainly address the positive outcomes of LSD treatment to understand the stimulus for applying or continuing it.

For each patient a questionnaire was filled out concerning diagnosis, possible side effects, including flashbacks, number of treatments, dosage of LSD, age, sex, duration of psychiatric disorder before LSD treatment, short-term and long-term outcome, consent and if treatment was terminated by the patient or the psychiatrist. Furthermore, a summary of the case story was written for each patient. A detailed description of the data collection has previously been published [2,8,9].

Concerning the resurgence of interest in LSD treatment, which has been seen in recent years, this interest stands in striking contrast to the conclusion in a 20-year-old handbook of drug therapy in psychiatry: “its therapeutic value is far from proven, and there seems to be no basis for employing it in the treatment of any psychiatric or behavioural disorder at the present time” [1]. Therefore, the findings and ideas for the new research are counterbalanced the old findings and conceptions of the mechanisms of action in the discussion section.

RESULTS: CONCEPTIONS OF MECHANISM OF ACTION

European centres

The psychiatrists at Powick Hospital in England recognized three types of LSD experiences:

1. Generalized non-specific images, such as a sense of lightness of the body, the appearance of coloured patterns and other hallucinatory experiences;

2. The recall and re-living of forgotten memories and experiences of childhood; and

3. The experiencing of archaic, interpersonal images similar “in nature to those experiences of the collective unconscious” [13].

LSD was considered to be the best “recaller of the past”, and its function was “to disturb the interaction of unconscious and conscious mental processes, thus setting in motion a train of psychic events the course of which is determined by the patient´s own psychological milieu” [14]. The theory was advanced that LSD exerts a selective action on the genes, which might be the “seat” of repressed memories [15]. Furthermore, it was concluded that LSD treatment might be of the utmost importance in psychotherapy as a method for avoiding the extensive time necessary for a full psychological analysis [15].

The German psychiatrist Hanscarl Leuner understood LSD treatment as a method to speed up psychoanalysis and distinguished psycholytic therapy from psychedelic therapy [16]. In psycholytic therapy, doses of LSD (30-200 micrograms) were used, while in psychedelic therapy, high doses of LSD (400-1500 micrograms) were used. Additionally, psychedelic therapy is without foundation in psychological theories and might act by a “symptomatic cure for a change of behaviour not further defined”, Leuner suggested. Psycholytic therapy, in contrast, was believed to act by “activation and deepening of the psychoanalytic process” [17]. According to Leuner, the effect of LSD treatment might be attributed to four components:

1. Activation of unconscious material with loosening of the defence mechanisms;

2. Obtaining of real insight;

3. Activation of transference (to the psychoanalyst); and

4. The occurrence of synthetic experiences of a mythical-magical character with a feeling of having acquired additional strength [16].

Danish centres

The Danish psychiatrist Thorkil Vanggaard understood (psychoanalytic) psychotherapy and LSD treatment as alternative strategies. In the process of psychoanalysis, the therapist, in teamwork with the patient, disrupts repression and defence mechanisms, Vanggaard claimed, mainly by working on transference and defences and by interpretation [18]. Under the influence of LSD, the capacity for transference is also suspended, Vanggaard further claimed, by chemical action on the brain, the mechanism of which is unknown. Thus, psychoanalytic psychotherapy is ineffective under the influence of LSD [18]. Vanggaard understood the therapeutic factor of LSD treatment to be the patient’s own “vis medicatrix naturae”. This factor, Vanggaard suggested, became activated when the chemical influence of LSD had eliminated the patient’s defence and repression mechanisms so that pathogenic material might be subjected to processing by these curative strengths [18,19].

The Danish psychiatrist Einar Geert-Jørgensen, the pioneer of LSD treatment in Denmark, was convinced of the curative value of LSD treatment and opposed the international warnings [20,21]. He was, however, unable to explain the mechanism of action. In particular, he was not convinced that (psychoanalytical) psychotherapy in connection with LSD treatment was necessary to yield favourable results [21]. Geert-Jørgensen suggested that LSD treatment possibly might affect central mechanisms in the conditioned reflexes. Neurotic behaviour is thus eliminated from the responsible engrams, he further suggested; “consequently, the disintegration (caused by LSD) will be replaced by organized mental reactions” [22].

The Danish psychiatrist Mogens Hertz considered anxiety during LSD sessions to be one of the greatest mental strains; the psychotherapy recommended was supportive and reassuring [23]. In a study of 12 LSD-treated patients, he found a constant rise of basal plasma cortisol concentrations. The stress situation varied from severe to slight: “The most stressed patients complained of being in a helpless situation and showed paradoxical reactions. Many of them also complained about a lack of will, dependency (suggestibility) and indifference”. However, the curative potential of LSD was considered to be related to adaptation to these stress responses, although these responses were found to be similar “to those reported on in experiments with sensory deprivation and brainwashing” [23,24].

Norwegian centres

The Norwegian psychiatrist Gordon Johnsen used LSD for five indications [25,26]:

1. As an exploratory, diagnostic aid, for example, to differentiate between genuine and psychogenic transvestism;

2. As an aid for deep (psycho) analysis, partly to break through resistance and thereby save time and partly to give the patient emotional insight and speedier abreaction;

3. As an aid in patients described as therapy-refractory to other methods, such as those severe character neuroses, the sexually perverse, and psychopaths;

4. As a last treatment after a long course of analytical psychotherapy with dream analysis; and

5. As a means to attain existential shifts in patients with alcoholism, addiction, and psychopathic tendencies.

The Norwegian psychiatrist Randolf Alnæs especially focused on the potentials of psycholytic therapy with high dosages of LSD of up to 500 micrograms. In his "biochemistry" of the consciousness, he speculated on the mechanisms of action. He agreed with the suggestion that LSD creates a psychological "shock" with a total change in perception, and he believed that LSD interferes with the "conditioned reflexes, in a way that facilitates extinction and reconditioning of behaviour, a sort of positive form of 'brain-washing', when this is conducted in a 'therapeutic way". Additionally, Alnæs discussed the therapeutic value of the transcendental and cosmic experiences in psycholytic therapy, compared with the psychotherapeutic insight facilitated by LSD [27].

Table 1: Contemporary proposals of the mechanisms of action of LSD: Scandinavian psychiatrists and their British and German tutors.

	Speeding up psychoanalysis	Alternative to psychoanalysis	Chemical action	Psychedelic experiences	Suggestion
Vanggaard		Elimination of defence mechanisms	On unconsciousness		
Sandison	Saving time		On genes		
Leuner	Main purpose			Mythical experiences	
Geert-Jørgensen	Unnecessary		On conditioned learning		
Hertz			On coping with stress		
Johnsen	Saving time		In therapy-refractory patients		
Alnæs			On conditioned learning	Cosmic experiences	
Kaij			Pharmacological effect on insight		Influence on transference

Swedish centres

The Swedish psychiatrist Lennart Kaij stated that the mode of action of LSD is unknown, although likely due to a pharmacological effect. This impact on the mind is successively accompanied by radical changes in experience and insight, he suggested [28]. Similarly, Kaij acceded to the psychotherapeutic potential of LSD, as suggested by Leuner above [16,17]. Kaij, however, also called attention to the bias of possible influences on transference. Thus, he observed many of the reported dramatic LSD recoveries as the results of strong suggestive effects [28,29].

In Table 1, the contemporary proposals of the mechanisms of action of LSD are summarized.

The acute positive outcomes of LSD treatment in the LSD case material

As published elsewhere 52 patients (34%) of the Danish LSD case materials had positive outcomes of LSD treatment [2,9]. In these cases, the observed or reported improvements were transient and only lasted during the LSD treatment or for a short while after the termination of the treatment. Mainly, symptoms of anxiety and depression improved. Often, the improvement was not of the quality normally seen in psychiatry, characterized simply by a decrease in the mental symptoms being treated. Thus, one patient with an unspecified neurotic condition improved with LSD treatment; however, under the influence of LSD, she had strong obsessions of killing her husband and children. Another patient was described by his wife as not being the same person as before LSD treatment, although his neurotic symptoms improved transiently. Moreover, a young female patient realized that her depressive symptoms improved with LSD treatment; nevertheless, she considered the LSD treatment to be a mistake because she was left with a "broken mind due to the LSD hell". Finally, a 31-year-old male patient described the acute response to LSD treatment in his own words.

The patient had been sick for 15 years, suffering from character neurosis with additional abuse of drugs and alcohol. He went through 7 LSD treatments with a maximal dose of 110 micrograms. At the 7th treatment, the following was stated in the medical case record: "Feeling well, is very unstable for the time being, with ups and downs. The patient lies quiet, still in bed, thinking, 'I feel great'. After LSD treatment, he was suffering from frightening dreams and nightmares and had become more soft-hearted, as well as his addictive behaviours worsening. He was awarded 200.00 DKK in compensation (80% of maximum compensation) because his mental health was already rather poor before the LSD treatment".

The next case story illustrates the rather routine use of psychedelics in a case of psilocybin treatment of a middle-aged, severely sick, female mental patient.

At the age of 44 years old, the patient underwent 16 treatments with psilocybin at a maximal dose of 32 mg. Since she was 18 years old, she had suffered from depression, and at the age of 35 years old, she was granted a disability pension. More than 10 years before psychedelic treatment, the diagnosis was changed first to anancastic neurosis and soon after to schizophrenia. She had tried various treatments, such as ECT, insulin coma, methylphenidate, chlorpromazine and most recently perphenazine. With psilocybin, she improved transiently and appeared in her manner freer, almost giddy and better than in many years. She was awarded 100.000 DKK (40%) in compensation because she had been severely sick before psychedelic treatment. Psilocybin treatment was considered to have had little influence on the course of the mental disorder, although risky in this patient.

Table 2 shows the outcomes of 20 of the 52 patients (34%) who improved transiently with LSD treatment. In all 20 patients LSD-inflicted harms at follow-up many years later were registered. In the remaining 32 patients, who also responded well to LSD treatment, the data presented in the table are often missing, which is why only the subgroup of 20 patients has been described. However, 2 patients with beneficial effects on sexual dysfunction have been excluded as well. The diagnoses were established per the 6th and 8th editions of the International Classification of Diseases, which was used in the 1960s, when LSD treatment was conducted [30,31].

The LSD tribunal routinely approved indications for LSD treatment as defined by the diagnosis, although it frequently could be concluded that the diagnoses were wrong according to clinical descriptions of the cases and the choices of treatment. For instance, in a patient diagnosed as

suffering from character neurosis, the later prescription of lithium indicated the possible alternative diagnosis of manic-depressive disorder.

Table 2: Clinical and demographic data including other lifetime treatment data in a subgroup of 20 out of the overall 52 patients, who responded well to LSD-treatment in the 1960s in Denmark and applied for LSD inflicted damage under the 1986 LSD Damages Law. In all 20 patients LSD-inflicted harms were registered at long-term follow-up (Improved means recovered according to observed or reported data, some improvement indicates reduction of symptoms, but not recovery; and exaltation may be an indication of hypomania).

Age: Years sex (F, M)	Duration of mental disorder: Years	Indication: Diagnosis	Number of treatments: N Max dose: LSD (micrograms), Psilocybin (mg P)	Comments	Other biological treatment
29 (F)	4	Anxiety neurosis	12 (–$)	Improved	ECT*, TCA*,MAOH*
43 (M)	16	Depression	24 (200)	Improved	AP*
23 (F)	1/2	Anancastic neurosis	15 (550)	Some improvement	AP*
29 (F)	Début	Character neurosis	19 (170)	Some improvement	Benzodiazepines
31 (M)	15	Character neurosis	7 (110)	Some improvement	Unknown
26 (F)	1/2	Depressive neurosis	30 (–$)	Exaltation	Unknown
34 (F)	4	Character neurosis	>50 (–$)	Some improvement	TCA*, Li*, AP*
35 (F)	2	Anxiety neurosis	18 (330)	Improvement	Insulin-coma
45 (M)	6	Anxiety neurosis	5 (– $)	Exaltation	Unknown
47 (M)	10	Anxiety neurosis	5 (–$)	Some improvement	Unknown
48 (F)	26	Character neurosis	9 (250)	Improved	ECT*
43 (F)	25	Anancastic neurosis	16 (32 P)	Exaltation	AP*, ECT*, Insulin-coma
23 (F)	1	Anxiety neurosis	15 (200)	Exaltation	AP*, Benzodiazepines
27 (M)	8	Character neurosis	34 (300)	Improved	MAOH*, Benzodiazepines
22 (M)	4	Depressive neurosis	20 (400)	Some improvement	TCA*
42 (M)	2	Depression	19 (270)	Improved	TCA*
22 (F)	1/2	Character neurosis	18 (–$)	Some improvement	TCA*, AP*
50 (M)	1	Unspecified neurosis	18 (270)	Some improvement	Unknown
20 (F)	2	Anorexia nervosa	12 (100)	Improved	TCA*
37 (F)	10	Unspecified neurosis	29 (200)	Some improvement	TCA*,MAOH*, Benzodiazepines

*AP: Antipsychotics; TCA: Tricyclic Antidepressants; MAOH: Monoamine Oxidase Inhibitors; Li: Lithium; ECT: Electro-convulsive Treatment. $-No information on dose.

DISCUSSION

The present study with its historical and retrospective design implies certain limitations about the interpretation of the data. Also, the economic motive for applying for compensation for LSD-inflicted damage shall be mentioned. The LSD Damages Law defined a so-called reversed burden of proof. Thus, all LSD treated patients were awarded economic compensation independent of harm or not of the LSD treatment [2,8,9,12]. In the present paper, however, the economic motive is only a minor bias, as we are dealing with a subpopulation of LSD treated patients, who had a short-term positive outcome of the LSD treatment. Without the reversed burden of proof some patients of this subpopulation of patients might not have applied for compensation and we had missed important data. However, as previously published in only 5/151 patients (<4%) no LSD-inflicted harms were found at long-term follow-up [2]. None of these few patients were among the 20 patients with a transient or short-term recovery, as documented in the Results section.

Most of the Scandinavian researchers and their tutors in LSD treatment were dedicated psychotherapists and were mainly influenced by psychoanalytical ideas. On the one hand, they attempted to explain the positive outcome in psychoanalytical terms [13-18,21-28]; on the other hand, they also introduced other explanations for the benefits of LSD, such as coping with stress and chemical action on conditioned learning [21,24,27]. Vanggaard understood LSD treatment to be an alternative to psychoanalysis and was supported in this point of view by his own experience [18,19] and by the observations at Powick Hospital. In his follow-up study at this hospital from 1964, only one of 22 patients received systematic psychotherapy [32], although at Powick Hospital, psychotherapy earlier had been described as an integrated part of LSD treatment [14].

At that time in the 1960s, the modern psychopharmacological era had already started. In Denmark, the first publications on the use of chlorpromazine appeared in 1954, one year after the marketing of the drug, and from the 1950s, the antidepressant effects of monoamine oxidase inhibitors and tricyclic antidepressants were known [33]. Thus, it is little wonder that Kaij proposed a pharmacological effect, however, on insight (in the psychoanalytical understanding) [27]. To what extent Scandinavian LSD researchers were involved in introducing modern psychopharmacological drugs into their psychiatric practises is unknown.

With the psychopharmacological era, new standards for introducing new treatments were established, and as Oram wrote, "the emphasis on controlled clinical trials frustrated the progress of LSD psychotherapy research" [34]. Interestingly, this point of view had already in 1966 been expressed by Retterstøl: "…this approach to therapy [with LSD] should neither be rejected out of hand as crazy nor accepted and applied in an uncritical manner, but it should be subjected to careful study under closely controlled conditions" [35]. The whole matter could, however, be more complex because Oram, in a recent paper, revealed that the decline in LSD research in the United States was not clearly related to regulation by the Food and Drug Administration (FDA) [36].

With the discovery in the 1950s of serotonin (5-HT, 5-hydroxy-tryptamine) in the mammalian brain and subsequently of its role as an essential neurotransmitter [37], we are today much better prepared to explain the mechanisms of action of LSD than in the 1960s. Among the multiple classes of 5-HT receptors, much attention has been paid to the 5-HT2 receptor family. As summarized, 5-HT2 receptors are major targets for a wide array of psychoactive drugs, ranging from non-classical antipsychotics, anxiolytics and antidepressants, which have 5-HT2 antagonistic action, to hallucinogens such as LSD, which are agonists of 5-HT2 receptors [36]. LSD and other psychedelics also interact agonistically and antagonistically with dopamine D1 and D2 receptors [38,39].

In their rather positive review of how classical hallucinogens might be introduced into the treatment of anxiety and depressive disorders, Baumeister et al. clearly stated that hallucinogens alter the functioning of the serotonergic system but not in the same manner that current antidepressants do [38]. With classical antidepressants, delayed recovery starting three weeks after starting them is a common experience [40]. This phenomenon has been explained as being due to autoregulation of the serotonin receptors [41]. A similar delay in onset of action has not been seen or reported with psychedelics. In addition, from the literature as from the LSD case material, the response appears to occur much more rapidly [10,11], with a start after 4-8 h, when the hallucinogenic effect has disappeared [39]. Thus, in a small open study of 12 patients with treatment-resistant depression, Carhart-Harris et al found that depressive symptoms markedly reduced 1 week and 3 months after 2 psilocybin treatments were administered at an interval of one week [11]. However, the matter has been little examined and requires further investigation.

Another aspect is the occurrence of flashbacks, linked to the 5-HT2A receptor [38], which in the LSD case material was shown to occur in 69% of the patients, all of them being severely mentally ill [2]. In 1983, Abraham stated that sensitivity to aftereffects, i.e., flashbacks from LSD, was related to a family history of major mental disorders [42]. In the study by Carhart-Harris et al., no aftereffects of the 2 psilocybin treatments were observed or reported [11]; however, further investigations are needed.

Additionally, the quality of the changes in psychedelics compared to classical antidepressants requires further investigation, and in general, the types of mental changes that psychedelics cause in psychiatric patients should be clarified, as well as whether these changes are reversible. It is likely too early to designate the clinical effects of psychedelics as purely of an antidepressant and an anti-anxiety nature; they are as much stimulants due to their agonistic effects on dopamine receptors and 5-HT2 receptors. In healthy volunteers, MacLean et al found changes in the personality domain of openness one year after high-dose treatment with psilocybin (max 40 mg) [43], although only in those participants who had mystical experiences with treatment. The authors concluded that "the findings suggest a specific role for psilocybin and mystical-type experiences in adult personality changes" [43].

In cancer care, two randomized, controlled trials, which were recently published, found evidence of positive effects of small doses of psilocybin on anxiety and depression [44,45]. However, it remains unclear whether data from cancer research can be transferred to general psychiatry.

CONCLUSIONS

In conclusion, the use of psychedelics such as LSD and psilocybin in psychiatry remains a clinical and scientific challenge. The early enthusiasm, mainly within psychoanalytical circles, was reinforced by the recovery of difficult to treat cases, such as patients suffering from obsessive-compulsive neurosis. Although many therapists at that time suspected a chemical action of the brain as a key to understanding the mechanism of action, they never introduced a coherent biological theory. With the discovery of the serotonin system and, many years later, the clarification of the function of serotonin in the brain, the acute and long-term effects of LSD can be explained. Perhaps this understanding, developed in highly specialized laboratories, is a key to understanding the resurgence of interest in using psychedelics clinically in selected patient populations. However, before psychedelics are introduced in psychiatry again much clinical research must be carried out on efficacy and safety and finally on the psychological quality of a positive response to the treatment. Clinical examples such as case stories of the present study and research [19,43] have pointed at long-lasting changes of the adult personality.

ACKNOWLEDGEMENT

The author wants to thank Professor, DMSc Per Bech, Psychiatric Research Unit, Hillerød, Denmark, for reading the manuscript and offering good advice.

DISCLOSURE OF INTERESTS

The author declares no conflicts of interests.

REFERENCES

1. Bernstein JG. Handbook of drug therapy in psychiatry, 3rd edition. St. Louis: Mosby; 1995.
2. Larsen JK. Neurotoxicity and LSD treatment: a follow-up study of 151 patients in Denmark. Hist Psychiatry. 2016;27:172-89.
3. Strömgren E. Psykiatri. 8th edition. Copenhagen: Munksgaard. 1964; in Danish.
4. Kringlen E. Psykiatri. 7th edition. Oslo: Gyldendal Norsk Forlag. 2001; in Norwegian..
5. Norges offentlige utredninger. Granskning av påstander om uetisk medisinsk forskning på mennesker [The public accounts of Norway. The investigation of claims of unethical research on humans]. Oslo: Statens Forvaltningstjeneste. 2003; in Norwegian.
6. Martin L, Shlain B. Acid dreams. The complete social history of LSD. Pan Books 1992.
7. Larsen AF. De sprængte sind. Hemmelige forsøg med LSD [The broken minds. Secret experiments with LSD]. Copenhagen: Informations Forlag. 1985; in Danish.
8. Larsen JK. LSD treatment in Danish psychiatry. Bibl Læger 2013;205:224-65 in Danish.
9. Larsen JK. LSD treatment in Scandinavia: Emphasizing indications and short-term outcome of 151 patients in Denmark. Nord J Psychiatry 2017;71:489-95.
10. Tupper KW, Wood E, Yensen R, et al. Psychedelic medicine:a re-emerging therapeutic paradigm. CMAJ Open. 2015;187:1054-9.
11. Carhart-Harris RL, Bolstridge M, Rucker J, et al. Psilocybin with psychological support for treatment-resistant depression: an open-label feasibility study. Lancet Psychiatry 2016 Jul;3(7):619-27.
12. LSD Damages Law. Law on compensation for damages by LSD-treatment. Christiansborg Slt: Law no 219;April 23rd,1986.
13. Sandison RA. Psychological aspects of the LSD treatment of the neuroses. J Ment Sci.1954;100:508-15.
14. Sandison RA, Spencer AM, Whitelaw JDA. The therapeutic value of lysergic acid diethylamide in mental illness. J Ment Sci. 1954;100:491-507.

15. Sandison RA, Whitelaw JDA. Further studies in the therapeutic value of lysergic acid diethylamide in mental illness. J Ment Sci. 1957;103:332-43.
16. Leuner H, Holfield H. Ergebnisse und Probleme der Psychotherapie mit Hilfe von LSD-25 und verwandten Substanzen. Psychiat Neurol. 1962;143:379-91.
17. Leuner H. Present state of psycholytic therapy and its possibilities. The use of LSD in psychotherapy and alcoholism. New York:The Bobbs-Merril Company Inc. 1968;p.101-16.
18. Vanggaard T. Redegørelse vedr. T. Vanggaards fire besøg på Powick Hospital i årene 1961-1964 og for LSD-behandlingen på Rigshospitalets psykiatriske afdeling. Bilag [Appendix] 2. in: Redegørelse for LSD-sagens forløb [Explanation of the course of the LSD case]. Copenhagen: Rigsarkivet. 1985; in Danish.
19. Brandrup E, Vanggaard T. LSD-treatment in a severe case of compulsive neurosis. Acta Psychiatr Scand. 1977;55:27-41.
20. Rinkel M. Psychedelic drugs. Am J Psychiatry. 1966;122:1415-6.
21. Geert-Jorgensen E. Further observations regarding hallucinogenioc treatment. Acta Psychiatr Scand. 1968;44 Suppl 203:195-200.
22. Geert-Jørgensen E. Hallucinogenbehandling II. Månedskr Prakt Lægegern. 1973;51:365-76 in Danish.
23. Hertz M. Observationer og indtryk fra et års arbejde med LSD. Nord Psyk Tidsskr.1962;16:103-8. in Danish.
24. Hertz M. The mechanism of the LSD treatment as viewed from the aspect of learning processes. The use of LSD in psychotherapy and alcoholism. The Bobbs-Merrill Company Inc.1968;p.661-9.
25. Johnsen G. Three years experience with the use of LSD as an aid in psychotherapy. Acta Psychiatr Scand 1964;40 Suppl 180:383-8.
26. Johnsen G. Indications for psycholytic treatment with different types of patients.The use of LSD in psychotherapy and alcoholism. The Bobbs-Merrill Company Inc. 1968;p.333-40.
27. Alnæs R. Therapeutic application of the change in consciousness produced by psycholytica. Acta Psychiatr Scand. 1964;40 Suppl 180:397-409.
28. Kaij L. Om psykolyticas terapeutiska verkningssätt. Nord J Psychiatry 1965;19:480-9: in Swedish.
29. Kaij L. LSD-behandling av neuroser. Sven Lakartidn. 1963;60:926-32 in Swedish.
30. World Health Organisation (WHO). Manual of the International Statistical Classfication of Diseases. Injuries and Causes of Death. 6th edn (ICD-6) Geneva:WHO. 1949.
31. World Health Organisation (WHO) Manual of the International Classification of Diseases (ICD-8).Geneva:WHO.1965.
32. Vanggaard T. Indications and counter-indications for LSD treatment. Acta Psychiatr Scand. 1964;40:427-37.
33. Rosenberg R. Den psykofarmakologiske udvikling 1950-1970 [Psychopharmacological development 1950-1970]. In: Kragh JV, ed. Psykiatriens historie i Danmark [Psychiatry's history in Denmark]. Copenhagen: Hans Reitzels Forlag. 2008;p.263-90;in Danish..
34. Oram M. Efficacy and enlightment:LSD psychotherapy and the drug amendments of 1962. J Hist Med Allied Sci.2014;69:221-50.
35. Retterstøl NN, Hallucinogener. Tidsskr Nor Laegeforen 1966;86:53-5:in Norwegian.
36. Oram M. Prohibited or regulated? LSD psychotherapy and the United States Food and Drug Administration. Hist Psychiatry. 2016;27:290-306.
37. Giovanni GD. Serotonin in the pathophysiology and treatment of CNS disorders. Exp Brain Res. 2013;230:371-3.
38. Baumeister d; Barnes G, Giaroli G, et al. Classical hallucinogens as antidepressants? A review of pharmacodynamics and putative clinical roles. Ther Adv Psychopharmacol. 2014;4:156-69.
39. Passie T, Halpern JH, Stichtenoth DO, et al. The pharmacology of lysergic acid diethylamide: a review. CNS Neurosci Ther. 2008;14:295-314.
40. Bech P, Allerup P, Reisby N, et al. Assessment of symptom change from improvement curves on the Hamilton depression scale in trials with antidepressants. Psychopharmacology 1984;84:276-81.
41. Pineyro G, Blier P. Autoregulation of serotonin neurons:role in antidepressant drug action. Pharmacol Rev. 1999;51:533-91.
42. Abraham HD. Visual phenomenology of the LSD flashback. Arch Gen Psychiatry. 1983;40:884-9.
43. MacLean KA, Johnson MW, Griffiths RR. Mystical experiences occasioned by the hallucinogen psilocybin lead to increases in the personality domain of openness. J Psychopharmacol. 2011;25:1453-61.
44. Ross S, Bossis A, Guss J, et al. Rapid and sustained symptom reduction following psilocybin treatment for anxiety and depression in patients with life-threatening cancer: A randomized controlled trial. J Psychopharmacol. 2016;30:1165-80.
45. Griffiths RR, Johnson MW, Carducc MA, et al. Psilocybin produces substantial and sustained decreases in depression and anxiety in patients with life-threatening cancer:A randomized double-blind trial. J Psychopharmacol. 2016;30:1181-97.