Eur Arch Psychiatry Clin Neurosci (1992) 241:241–246

European Archives of Psychiatry and Clinical Neuroscience

Development of a Rating Scale for Quantitative Measurement of the Alcohol Withdrawal Syndrome*

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Received May 10, 1991

Summary. The alcohol withdrawal syndrome consists of autonomic, neurological and mental symptoms. For its assessment, these symptoms have to be rated in a quantitative and valid manner. We developed a new rating scale for mild and moderate alcohol withdrawal states. Difficulty, discrimination coefficient, internal consistency, and the principal component analysis were assessed. External validation was tested on a separate sample of inpatients. Eight of 12 original items fulfilled test-theoretical criteria. From these a psychosensory and an autonomic factor have been extracted. This instrument can be used repeatedly for clinical assessment as well as for evaluation of the alcohol withdrawal syndrome in clinical drug studies.

Key words: Alcohol withdrawal syndrome – Rating scale

Introduction

One of the primary goals of alcoholism research is to understand the basis of various clinical phenomena, such as loss of control, craving, tolerance, physical dependence, causes of relapse, and genetic determinants, in order to develop more effective treatment strategies. The main problem in the clinical acute management of alcoholism is the assessment and the treatment of the withdrawal syndrome. So far, there have been no agreed criteria for assessing mild and moderate forms of the alcohol withdrawal syndrome.

The symptomatology comprises a complex syndrome of autonomic, neurological, and mental symptoms with major fluctuation over time [8, 17]. The assessment of this syndrome has to detect the different qualities of the disturbed organism in a manner which can be repeated with high frequency during the first days of acute withdrawal. Scales introduced for the diagnosis of alcohol abuse or alcohol dependence [7, 20] give no quantitative information about the severity of withdrawal symptoms. Special scales have therefore been developed by Knott et al. [13] and Bech et al. [3]. Yet both scales seem to have some shortcomings: Knott's scale is rather long and is not suited for repeated hourly measurements, while Bech's scale introduces different weights to different items which do not seem to be sufficiently justified. Shaw et al. [19] published a special 15-item clinical rating scale which was validated for trained nurses, the CIWA-A. He also used different weights for different items. These three scales were validated for trained nurses; unlike them our aim was to form a physician rating instrument.

One of the most important changes to be introduced into psychiatry practise is the use of operationalized diagnostic criteria and rules as already in DSM-III-R [1] and now prepared for ICD-10 [24]. The diagnostic conception in ICD-10 shows better congruence with those in DSM-III-R than with those in ICD 9 [5]. In the category mental and behaviour disorder due to psychoactive and other substance use, psychopathological syndromes resulting from use of alcohol are F 10 coded; 4th and 5th character codes are necessary for specifying the clinical condition, e.g. F10.30 uncomplicated withdrawal state, F10.31 withdrawal with convulsion. As yet the definition of the item operationalization is not finished. Winkler et al. [23] reported that in the section mental and behaviour disorder due to psychoactive and other substance use, a relatively low interrater reliability was found and demanded a special axis "psychoactive substance use", because many raters had difficulty in deciding whether disorders of this section should be regarded as a major or subsidiary diagnosis.

DSM-III-R [1] criteria for uncomplicated alcohol withdrawal require the cessation of prolonged heavy ingestion of alcohol followed by coarse tremor of the hands, tongue, or eyelids plus at least one of the following symp-

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* A part of this paper was presented at the 5th Congress of Biological Psychiatry, Berlin 1990

toms: nausea or vomiting, malaise or weakness, autonomic hyperactivity, anxiety, depressed mood or irritability, transient hallucinations or illusions, headache or insomnia. Sellers et al. stated [18] that as a diagnostic instrument the DSM-III-R alcohol withdrawal items are not operationally defined; hence the threshold criteria for specific items are untested.

During our scale development, clinical features associated with alcohol withdrawal were extracted from the literature [6, 10, 16]. Items which could be operationally defined and quantified were selected. The original scale comprised 12 items: "agitation", "tremor", "hyperhydrosis", "disorientation", "hallucination", "inattentiveness", "anxiety", "disturbance of contact", "disturbance of consciousness", "seizure activity during the last 24 h", "tachycardia", and "hypertension". These items were thought to be representative for the alcohol withdrawal syndrome and easy to measure hourly, except for the item seizure activity. The seizure activity during the last 24 h was included because of the clinical relevance.

Each item was explicitly defined on a four-point scale (see Table 1), except for the item "seizure activity" which was 0/1-scaled. The last hour before rating was defined as the reference period; only for alcohol withdrawal seizures was the reference period extended to the last 24 h. Items such as nightmares, sleep or eating disturbances, depressed or dysphoric mood were not included, because we wanted a serial assessment of withdrawal symptoms at frequent intervals. Salum [16] showed that 53% of her patients in an acute withdrawal state suffered from diseases of the digestive organs; gastric or duodenal ulcer was reported by 16%. We found the current state character of the items nausea and vomitus ambiguous and fluctuation could be unspecific; therefore these items were excluded.

As Busch and Frings [4] pointed out, it is difficult to choose an adequate dosage in mild and moderately pronounced withdrawal states, because valid and clinically practical predictors for the course of the withdrawal syndrome are not available so far. We therefore tried to develop a new physician rating instrument for assessing mild and moderate states of alcohol withdrawal, which could be repeatedly used for the control of medication and for the evaluation of drug effects in the therapy of this syndrome.

Methods

One hundred and six newly admitted drug-free inpatients with an acute alcohol withdrawal syndrome were included. All patients had a history of alcohol dependence according to DSM-III-R. Patients with coexisting abuse of sedatives or hypnotics were not included in the study; patients with full-blown alcohol delirium or other alcohol-related organic brain syndromes were also excluded. Eighty-four % were men, 16% were women, the mean age was 40, SD 6.5 years. The number of ratings used for test analysis is in the customary range for psychiatric ratings.

All ratings were carried out by clinically experienced residents of the Department of Psychiatry, University of Mainz. All statistical tests were calculated on a microcomputer by means of the "Kleiter Mikrostatistik Sammlung" (KMSS) [12]. For item reduction and test-scale analysis Lienert's criteria of goodness [15] were used: difficulty (= percentage of positive items), discrimination coefficient, internal consistency and external validity. It was assessed by principal component factor analysis whether all items were loading significantly on a general factor; varimax rotation was additionally introduced, in order to examine whether subscales could be separated. External validity was tested by a control group. A separate sample of 29 inpatients meeting the same inclusion and exclusion criteria was required. We used the amount of clomethiazol medication needed during the first 48 h of therapy according to good clinical judgement as a validation criterion and correlated this drug amount with the item scores and the sum score of the scale of the last rating before therapy. Other validation criteria were conceivable; for instance, Shaw et al. [19] established the validity of the CIWA-A by comparing the nurses' CIWA-A scores with a physician's three-point global rating of the severity of withdrawal at the time of initial patient assessment. The preexisting ratings for alcohol withdrawal state were only validated for use by trained nurses; therefore we did not want to use them because of different rating instructions.

Results

Table 1 demonstrates the 12 original items of our rating. Lienert [15] postulated that difficulty (= frequency of positive items) should range between 10% and 90%. According to this criterion, the items "disturbance of consciousness" and "seizure activity" had to be excluded; only 4.7% met the item "disturbance of consciousness" and only 6.6% met the item "seizure within the last 24 h". The remaining ten items showed sufficient discrimination coefficients (Table 2); the highest coefficient was found for the item "agitation" (0.73) and the lowest for the items "hypertension" (0.23) and "tachycardia" (0.39).

The principal component factor analysis of the ten-item scale did not reveal a general factor (Table 3). Eight of the ten items loaded sufficiently highly (>0.3); two items showed insufficient loadings: "hypertension" (0.18) and "tachycardia" (0.29). Both items were eliminated from the further analysis.

With this reduced pool of eight items, we were able to demonstrate a general factor in the principal component analysis (Table 3). After varimax rotation, a two-factor solution was found according to the Kaiser criterion (Table 3). The first factor comprised four psychosensory items (disorientation, hallucination, inattentiveness, disturbance of contact), the second factor included four autonomic and anxiety-related items (agitation, tremor, hyperhidrosis, anxiety).

The scale reduction from ten to eight items improved the discrimination coefficients for six of the eight items (Table 2): the highest coefficients were now found for "agitation" (0.71) and "tremor" (0.71), and the lowest for "hyperhidrosis" (0.46). Internal consistency of the eight-item scale proved to be high (odd-even-coefficient = 0.63, Kronbach's alpha = 0.78). External validation of the eight-item scale showed a high correlation ($r = 0.68$) between the sum score of the last rating before therapy and the cumulative drug dosage. The elimination of the items "hypertension" and "tachycardia" further increased this result: the correlation of the previous ten-item scale was markedly lower ($r = 0.50$).

Table 1. Items of the original scale

1. Disorientation	0 = none 1 = mild (full orientation, but sluggish answers) 2 = marked (blurred orientation in at least one quality) 3 = severe (disorientation in at least one quality)		
2. Hallucinations	0 = none 1 = mild (occasional, distancing possible) 2 = marked (frequent, sometimes distancing still possible) 3 = severe (nearly permanently, no distancing at all)		
3. Inattentiveness	0 = none 1 = mild (slip of the tongue, misunderstanding) 2 = marked (high suggestibility: string catching, reading) 3 = severe (spontaneous illusions)		
4. Disturbance of contact	0 = none 1 = mild (good contact with investigator, but not with environment) 2 = marked (sometimes poor contact with investigator) 3 = severe (no contact with investigator)		
5. Agitation	0 = none 1 = mild (feeling nervous) 2 = markded (physical restlessness) 3 = severe (absolut psychomotor agitation)		
6. Tremor	0 = none 1 = mild (extended fingers) 2 = marked (extended hands) 3 = severe (tremor of hands or body when resting)		
7. Hyperhidrosis	0 = none 1 = mild (palpable on hands and forehead) 2 = marked (visible on hands and forehead) 3 = severe (visible on total body)		
8. Anxiety	0 = none 1 = mild (reported on questioning only) 2 = marked (expressed by behaviour) 3 = severe (panic)		
9. Disturbance of consciousness	0 = none 1 = somnolence 2 = sopor 3 = coma		
10. Seizure-activity (last 24 h)	0 = no 1 = yes		
11. Tachycardia	0 = < 80 1 = 81–100 2 = 101–110 3 = > 120		
12. Hypertension (mm hg)		< 30 years	30–50 years	> 50 years
	0 =	120/80	130/85	140/90 until
	1 =	140/90	150/95	160/100 until
	2 =	160/100	170/105	180/110 until
	3 =	160/100	170/105	180/110 above

Discussion

In accordance with the clinical phenomenology, assessment of the alcohol withdrawal syndrome should consider autonomic, neurological, and mental symptoms (Table 4). Four of the 12 original items had to be eliminated from the scale The items "disturbance of consciousness" and "seizure activity" were eliminated in the first step of scale analysis because they were too seldom fulfilled. This could be due to the fact that only cases with mild and moderate alcohol withdrawal syndromes were involved in the study. This finding is in agreement with that of Hillbom and Hjelm-Jager [11] who found seizures in less than 10% of alcohol withdrawal states.

Surprisingly, the items "hypertension" and "tachycardia" had to be eliminated in spite of their well-accepted clinical relevance. Our data demonstrate that these items do not contribute to the quantification of the alcohol withdrawal syndrome, either concerning their discriminatory power and their factorial loading, or concerning their external validity. This confirms the findings of Sullivan et al. [21]. However, there is no doubt that these parameters might have great importance for controlling medical aspects of the alcohol withdrawal syndrome. Therefore, it would be interesting to evaluate the effects of circulatory active drugs like calcium channel blockers [2] or beta blockers in the therapy of the alcohol withdrawal syndrome.

Table 2. Indices for difficulty and discrimination coefficient of the 10- and 8-item solution

Item	Index of		
	difficulty (% of positive items)	discrimination coefficient	
		10 Items	8 Items
Agitation	76.42	0.73	0.71
Tremor	87.74	0.70	0.71
Hyperhidrosis	73.59	0.41	0.46
Tachycardia	50.00	0.39	–
Hypertension	58.49	0.23	–
Disorientation	18.87	0.49	0.63
Hallucinations	11.32	0.54	0.61
Inattentiveness	23.59	0.55	0.70
Anxiety	60.38	0.57	0.54
Disturbances of contact	19.81	0.48	0.66

The extracted psychosensory and autonomic factors correspond well with clinical experience in supervising alcoholics during detoxication. The psychosensory factor is measuring disturbances of perception and attention. These items fluctuate over time. On the contrary, cognition refers to complex and dynamic mental functions, such as reasoning, planning, organizing, concept formation, and problem solving. The majority of alcoholics are cognitively impaired during intoxication and for several weeks following detoxification. Generally, these impairments have been noted in visuospatial capacity, memory, abstracting ability, and learning ability [22]. It could be useful to test these long-lasting impairments together with our psychosensory and autonomic subscale for predicting and monitoring therapy response to different drug regimens.

Gross et al. [9] attempted to develop a standardized evaluation instrument for the alcohol withdrawal syndrome. However, their specific method did not gain wide acceptance, perhaps partly because it was lengthy, inconvenient and not validated. In spite of this criticism, most of the later developed instruments derived at least partly from the Gross scale.

Comparing our eight-item scale with Knott's scale [13], it is obvious that Knott's rating is more time-consuming because of its length (23 items). Furthermore, its handling is more difficult because of its different reference periods, e.g. 24 h (seizure-activity), 48 h (depression, muscle pain, pruritus etc.) or time of investigation (reflexes, tachycardia); therefore, it is not suited for short rating intervals of, for example 1 h.

Bech's eight-item scale has the same advantage of shortness as our's (Table 5). Six items are comparable in both scales: hyperhydrosis/sweating, tremor, agitation/motor activity, hallucinations, disorientation/clearness of consciousness, disturbance of consciousness/intensity of consciousness. Bech's item "temperature" was not part of our original item pool because of its more time-consuming assessment. The items tachycardia/pulse and disturbance of consciousness/intensity of consciousness were eliminated from our scale because of the above-mentioned statistical inadequacy. Our items "anxiety", "disturbance of contact" and "inattentiveness" are not included in Bech's scale, which to us seems to be a shortcoming; scale analysis, factor analysis and external validation in our data pool justify the inclusion of these three items in a scale which is intended to quantify mild and moderate states of the withdrawal syndrome.

It remains to be established whether the alcohol withdrawal syndrome is unspecific; this of course would be the precondition to also include patients suffering from multiple toxic agents in a scale analysis study, as Bech's group has done [3, 14]. We think that a scale developed for measuring alcohol withdrawal states should be tested in diagnostically homogeneous samples of pure alcoholics, an advantage with the Mainz Alcohol Withdrawal Scale (MAWS) has. It is noteworthy that only Sullivan et al. [21] who modified the CIWA-A scale, used the original rating as control. In our opinion it is important that further studies be made to compare the existing alcohol withdrawal symptom scales done by physicians and nurses, in order to determine the core symptoms for quantification of the alcohol withdrawal syndrome for DSM-IV. The number of ratings used in this study with $N = 106$ is in the customary range for psychiatric test analysis; psychologists demand for their tests higher numbers, therefore we cannot exclude a selection bias by our sample which may be considered to influence the interpretation of these data.

Table 3. Factor analysis of the 10- and 8-item scale and basic statistics

Item	Principal component		Orthogonal rotation		Mean, SD
	10 items	8 items	Factor 1	Factor 2	
Disorientation	0.78	0.76	0.88	0.01	0.35, 0.94
Hallucination	0.70	0.70	0.79	0.06	0.21, 0.64
Inattentiveness	0.83	0.82	0.84	0.21	0.26, 0.50
Disturbance of contact	0.80	0.77	0.76	0.23	0.23, 0.50
Agitation	0.60	0.65	0.29	0.69	1.14, 0.82
Tremor	0.54	0.58	0.21	0.76	1.73, 1.01
Hyperhidrosis	0.30	0.32	−0.01	0.62	0.93, 0.71
Anxiety	0.35	0.40	0.03	0.70	0.84, 0.81
Hypertension	−0.18				1.36, 1.46
Tachycardia	−0.29				0.80, 0.94

Table 4. Mainz-Alcohol-Withdrawal-Scale (MAWS)

1.Disorientation	0 = none 1 = mild (full orientation, but sluggish answers) 2 = marked (blurred orientation in at least one quality) 3 = severe (disorientation in at least one quality)
2.Hallucinations	0 = none 1 = mild (occasional, distancing possible) 2 = marked (frequent, sometimes distancing still possible) 3 = severe (nearly permanently, no distancing at all)
3.Inattentiveness	0 = none 1 = mild (slip of the tongue, misunderstanding) 2 = marked (high suggestibility: string catching, reading) 3 = severe (spontaneous illusions)
4.Disturbance of contact	0 = none 1 = mild (good contact with investigator, but not with environment) 2 = marked (sometimes poor contact with investigator) 3 = severe (no contact with investigator)
5.Agitation	0 = none 1 = mild (feeling nervous) 2 = markded (physical restlessness) 3 = severe (absolut psychomotor agitation)
6.Tremor	0 = none 1 = mild (extended fingers) 2 = marked (extended hands) 3 = severe (tremor of hands or body when resting)
7.Hyperhidrosis	0 = none 1 = mild (palpable on hands and forehead) 2 = marked (visible on hands and forehead) 3 = severe (visible on total body)
8.Anxiety	0 = none 1 = mild (reported on questioning only) 2 = marked (expressed by behaviour) 3 = severe (panic)

Table 5. Comparison of three different alcohol withdrawal scales

Banger et al.	Sullivan et al.	Bech et al.
Disorientation	Orientation and clouding of sensorium	Clearness of consciousness
		Intensity of consciousness
Hallucinations	Tactile disturbances Auditory disturbances Visual disturbances	Hallucinations
Inattentiveness		
Disturbance of contact		
Agitation	Agitation	Motor activity
Tremor	Tremor	Tremor
Hyperhidrosis	Paroxysmal sweats	Sweating
Anxiety	Anxiety	
	Nausea and vomiting	
	Headache, fullness in head	
		Pulse
		Temperature

Compared with the 15-item CIWA-A scale, our scale is shorter, containing only eight items. Each item of our scale is codified on a 0-3 scale compared with 0-7. Shaw et al. [19] used different weights of the items and different reference periods. Other authors [21] recognized these problems and modified and reduced the original CIWA-A scale. The brevity of their CIWA-Ar scale (Table 5) is comparable ot the MAES, but is also validated for nurses. Unlike our scale they included nausea/vomiting and headache. Three of ten items determine hallucinations, the item agitation neglect internal feeling of nervousness, is only related to observations; therefore this rating seems not to be suitable for mild and moderate alcohol withdrawal states. Most of the autonomic items occur in common as Table 5 shows, and differences are due to the psychosensory items. It would be interesting in further studies to compare both instruments in acute alcohol withdrawal, done by physicians and nurses. We consider it an advantage of our scale that we are able to extract two factors of the acute alcohol withdrawal, making it is possible to observe different effects of drugs in psychosensory and or autonomic dysfunction during withdrawal.

It can be summarized that the MAWS is a suitable instrument with which to quantify the alcohol withdrawal syndrome. It is easy to work with and it can be sequentially used to evaluate pharmacotherapy of the alcohol withdrawal syndrome in clinical drug studies.

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