The effects of dialectical behavioral therapy (DBT) on cognitive and emotional symptoms of adult ADHD: A randomized pilot study

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Abstract

Attention Deficits Hyperactivity Disorder (ADHD) is a developmental disorder with emotional and cognitive symptoms. This study aimed to investigate the effect of Dialectical Behavioral Therapy on cognitive and emotional aspects in adults ADHD. A quasi-experimental, pre-test/post-test design with a control group (waiting list) was applied. Participants were randomly selected for the study among the targeted patients who suffered from ADHD during adulthood (40 people). They were randomly assigned to waiting control list and experimental group (DBT). ASRS, Tower of London, Stroop test, Wisconsin sorting test, Continuous Performance Test, Eysenck Impulsivity Test and Difficulties in Emotion Regulation Scale (DERS) were used for assessment purposes. The data analysis was conducted by SPSS-23, using the MANCOVA method. the results showed that DBT was significantly effective in emotion regulation (31.4%), impulsivity (37.4%), Stroop scores (21.9%), attention and concentration (31.8%), and hyperactivity (41%) comparing to control group. However, there was no significant difference in sub-scales of the Tower of London, Wisconsin test and the attentional sub-scale of Adult ADHD Self-Report Scale (ASRS). : it can be inferred from this research that DBT can significantly reduce the emotional problems of an adult ADHD, whereas it is not very helpful for the cognitive aspects of this disorder.

Keywords: Adult ADHD, DBT, Impulsivity, Emotion regulation, Executive function, Attention.

Introduction

The Attention Deficits Hyperactivity Disorder (ADHD) is a neuropsychological disorder with several patterns of behavioral, cognitive, and emotional problems. It was proposed that ADHD is a disease in which certain regions of the brain (before or after birth) are damaged or it is a disease with certain heredity factors. ADHD is not exclusive to childhood period and it can last for years and continued to adulthood. Some researchers have shown that it can also emerge for the first time in the adulthood period. Adult ADHD is usually defined as excessive verbal or physical energy, often seen as a feeling of being tired less in daily activities. If you have adult ADHD, you may find it hard to follow directions, remember information, concentrate, organize tasks, and finish work on time. With regard to Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), adults should have at least five of the 18 core symptoms. Symptoms might look different at older ages. For example, in adults, hyperactivity may appear as extreme restlessness or wearing others out with their activity (DSM-5). ADHD causes significant employment, marital, social, and educational impairments. In addition, some studies revealed some kinds of impairments in self-regulation, compliance with rules and restrictions among patients with ADHD [1].

Researches have also shown that adult ADHD interferes with a wide range of executive functions. Executive functions refer to the ability of individuals to self-regulate the tasks and responsibilities, necessary for daily living. suggests that ADHD interferes with four main domains of neuropsychological functioning that are essential for learning, behavioral orientation, and task completion. These central domains include working memory, self-regulation in emotional stimulation, the internalization of speech and restructuring (the ability to create new solutions to the problem). In addition to these cognitive factors, managing frustration and balancing emotions is also a problem in adults with ADHD. These emotional problems can engulf the individual and impair his ability to take on existing responsibilities and control. Self–regulation ability

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in emotional/ motivational arousal is another important function which is used to predict the effective emotional state in appropriate times and response settings. This function is also impaired in ADHD and inappropriate reactions that might lead to interpersonal conflicts. In addition, the ability to regain control over one's emotions usually requires more time in these individuals than healthy counterparts [2]. This lack of control and understanding of emotional states can lead to disruption in the development of alternative viewpoints and problem-solving responses and the individual will not be able to respond effectively in emotional conflicts.

In cases where ADHD continues until adulthood, the affected person can experience a wide variety of symptoms in a new combination that can severely impair their function in a variety of areas. As people get older, their responsibilities and expectations naturally increase personally, professionally, and logically. Depending on the combination and severity of symptoms, different degrees of dysfunction can occur. Concluded that as people with ADHD become more mature, many of them develop different coping strategies to overcome their unique defects, but they still have difficulties managing the effects of these symptoms. Despite active coping, the symptoms of ADHD in adults can be much more destructive than children. Studied the characteristics of individuals with ADHD and found that adults with ADHD were more likely to be offenders, had lower levels of education, and were more likely to be in lower-level occupations [3]. The severity of the negative effects on academic achievement, employment and occupation, criminal behaviors, and psychological comorbidity disorders appear to be worsened by some of the symptoms, especially the inattention, hyperactivity, and impulsivity that occur concurrently. Such widespread problems that occur in different areas of a patient's life, can lead to poor self-esteem, frustration, and failure. Negative impact on social, academic, and occupational environments has been associated with high risk of depression, negative self-image, and low self-esteem.

Treatments for adult ADHD

The treatment of adults with ADHD should follow a multimodal and multidisciplinary approach, which includes psychoeducation, pharmacotherapy, cognitive behavior therapy (CBT) and coaching for ADHD and before treatment starts, all comorbidities must be stabilized. In the first European Consensus Statement psychostimulants (methylphenidate and dexamphetamine) were recommended as the first-line pharmacotherapy for adult ADHD. Although pharmacological treatment of ADHD is very effective, many patients continue to experience significant symptoms, some studies have shown that cognitive behavior therapy (CBT) can reduces ADHD-core symptoms. Moreover, current research does not fully support the efficacy of CBT as a sole treatment for adult ADHD [4].

Dialectical behavior therapy (DBT) has shown efficacy in treating disorders characterized by dysregulated emotions and behavior, including borderline personality disorder, substance abuse disorders and eating disorders. As ADHD patients show similar symptoms including impulsivity and emotion dysregulation, DBT may be efficacious in treating their problems. DBT was proposed as a holistic therapy with a combination of cognitive-behavioral strategies for emotion regulation with conscious mindfulness, resilience, and acceptance strategies that were adapted from Zen Buddha's teachings and practices.

In DBT approach, the patients develop their self-esteem through changing maladaptive behaviors. DBT also treats anomalous responses to emotional stimuli that occur by a unique combination of environmental and biological factors [5]. The process of change in DBT involves the analysis of ongoing and systematic behaviors of non-functional response mechanisms, including behavioral skills training, crisis management, cognitive reconstruction, and response-based strategies aimed at reducing emotional problems. The following areas are considered to be improved in a structured and instructive process: distress tolerance skills, emotion regulation skills, interpersonal effectiveness skills, and mindfulness skills. Several studies have shown that adults with ADHD have problems regarding these skills.

Aim of the present study

Copper In accordance with the literature briefly reviewed in this introduction, limited numbers of studies were found addressing ADHD symptoms applying DBT training protocol. Since these patients experience a wide range of symptoms, treatments should include the relief of symptoms in emotional, behavioral and cognitive functioning domains. Thus, the present study aimed to investigate the efficacy of DBT on wide range of cognitive functions, impulsivity control and emotion regulation. The main hypothesis of the study was that patients in the treatment group would express a significantly greater decline in impulsivity, and higher improvement in emotional regulation skills [6]. We also hypothesized that, after the end of treatment, patients would show more satisfactory quality of attention and decision making.

Method

Participants and research design

Copper This research is a quasi-experimental study, pre-test/ post-test design with a control group (waiting list). Forty participants were randomly selected for the study through targeted sampling method and were among the patients who suffered from adult ADHD. They were separated into experimental and control groups. We aimed to improve several symptoms of ADHD as the dependent variables (i.e. emotion regulation, impulsivity, attention and concentration and hyperactivity). DBT programs were considered as

the independent variable in our study. The assessments for entrance and evaluation of the effects were made through questionnaires and clinical interview. Before the intervention, both groups were asked to complete the related measures (pre-test). The participants in the experimental group (20 people) received DBT programs [7]. One week after the end of the therapy sessions the post-tests were carried out for both groups. Finally, the data were analyzed. After the end of the therapy sessions, patients in the waiting group received the therapy sessions of DBT program.

Before being admitted in our research program, participants underwent a clinical assessment interview conducted by two members of the treatment team and were given a written explanation of the study. The following inclusion criteria was considered: 1) receiving a diagnosis of attention deficit / hyperactivity disorder according to clinical interview (based on DSM-5 diagnostic criteria) by a clinical psychologist 2) aged between 18 to 45 years 3) ability to collaborate in the research project 6 months after its initiation 4) fill out a written informed consent form. The exclusion criteria were: 1) having a debilitating physical disorder 2) severe neurological disorders 3) history of substance abuse 4) antisocial personality disorder 5) simultaneously receiving other psychological treatments 6) not attending meetings for more than 3 consecutive sessions.

Before any intervention, informed consent was obtained from all participants. In addition, participants were assured about the confidentiality of personal information, respecting all members, and avoiding discrimination. We had no drop out during our study [8].

Materials

Adult ADHD self-reporting scale (ASRS)

The Adult ADHD self-report Scale (ASRS), developed by the World Health Organization (WHO) was used. The ASRS scale questions are consistent with the DSM-5 criteria for Attention Deficit/ Hyperactivity Disorder. This scale consists of two dimensions and eighteen questions divided into two parts A and B. Part A assesses the inattentive dimension and has 9 questions (questions 1 to 9) and part B evaluates the hyperactivity / impulsivity dimension with 9 questions (questions 10 to 18). This scale has a sensitivity of 87% and a specificity of 98.3% to 99.5% for the diagnosis of ADHD symptoms [9]. The reliability of the Persian version of this questionnaire was obtained 87% by Cronbach's alpha method and it has good and acceptable reliability and validity.

The tower of london test

Shallice developed this test to evaluate the planning ability of the patients who had frontal lobe injuries. The test consists of three bars fixed to a flat base and three beads of different sizes. The participant should convert the started position to the targeted position by moving the beads over the rods. Brain imaging studies suggest that the London Tower test is sensitive to frontal lobe damage. Most studies using the Tower of London test have assessed the ability of planning in people with ADHD and found significant differences between their performance compared to normal people. The validity of this test has been proven to measure individuals' planning. Reliability of this test has also been accepted and reported as 0.73. In this study, the software version developed by Sina Publication Institute in Iran [10]. The output results include the numbers of trials, the total time of the test, the delayed time for each part, the time of solving the puzzle, the numbers of error, a score for each puzzle and a total score point.The total score point was used for our final analysis.

Stroop test

This test was developed in 1935 by Ridley Stroop to measure selective attention and cognitive flexibility through visual processing. This test has been used in various researches in multiple clinical groups to measure response inhibition ability, selective attention, cognitive variability, and cognitive flexibility. In the Stroop test, 48 congruent and 48 incongruent color words are displayed in red, blue, yellow, green. The task of the participant is to determine word's apparent color regardless of the meaning. Participants should respond as quickly as possible. The stimulus presentation time on the display screen is 2 seconds with the inter-stimulus interval (ISI) of 800 milliseconds. Research on this test demonstrates the reliability and validity of this tool in measuring inhibition in adults and children. The validity of this test has been reported through retesting in the range of 0.80 to 0.9. Regarding to the manual form, this test has been translated for the Persian-speaking community. Appropriate reliability for this test ($r = 0.90$) was obtained using retest method after approximately 60 days. The software used in this research was developed by Sina Publication Institute in Iran. The output results included number of errors, number of no responses, number of correct responses, response time, interference number and interference time. In this study, we have used the interference time for our final analysis.

Wisconsin card sorting test (WCST)

The test offers a bunch of 64 cards and has four symbols in the form of triangles, stars, plus circles which are presented in four colors: red, green, yellow, and blue. None of the two cards look alike. The task of the participant is to place the cards under the original ones based on the rule for the original card.The participant receives feedback after each attempt. The two main indicators i.e. "Number of Classes Acquired" and "Number of Errors" show the participant's performance. This test is considered as one of the most sensitive tests for the frontal cortex. This test examines abstract reasoning, cognitive flexibility, strategic planning, organized searching, utilizing environmental feedback to shift cognitive sets, directing behavior toward achieving

a goal, and modulating impulsive responding. Three main scores are obtained in this test: Total number of errors, Perseveration errors and Non-perseveration errors. Lezak reported validity of this test for measuring cognitive deficits above 0.86 and validity of this test in Persian version was reported 0.85. For this study the digital version of WSCT was used which was developed by Sina Publication Institute in Iran. The output results were the number of classes, perseveration errors, correct responses, false responses, the total number of trial, other errors, total time of the test, the total number of trials for completing the first pattern, the responses on the conceptual stage, the percent of conceptual stage responses and the number of failure on pursuing a sequence. The total time of the test was used for final analysis.

Continuous performance test (CPT)

This test is known as the most common test for measuring continuous attention and response inhibition in individuals. Different types of this test are developed for research and therapeutic purposes. Developed a digital version of this test. The program includes 150 Persian characters, of which 30 of them (20%) are target stimuli. The time interval between the presentation of stimuli is 500 ms and the time of presentation of each stimulus is 150 ms. The coefficients of validity of the different parts of the test ranged from 0.59 to 0.93 [11].

Eysenck impulsivity test

This questionnaire had been developed based on the theory of personality traits. It has 54 questions measuring three factors of risk performance, impulsivity, and empathy that are answered with “yes” or “no” options. Each of the components of impulsivity, riskiness and empathy consists of 19, 16 and 19 questions, respectively. The Cronbach's alpha coefficients in this questionnaire ranged from 0.4 to 0.8. it has also had a good reliability and validity in Persian culture. The Seventh edition of this questionnaire was used in this study.

Difficulties in emotion regulation scale (DERS)

The difficulties in emotion regulation scaleis a 36-items tool that measures a person's levels of emotion regulation deficit in five-dimensional spectrum from 1 (almost never) to 5 (almost always) in the following six areas: nonacceptance of negative emotions, difficulties engaging in goal-directed behaviors, difficulties controlling impulsive behaviors, limited access to effective emotion regulation strategies, lack of emotional awareness, lack of emotional clarity. The psychometric properties of the Persian version of this scale have been investigated and confirmed in clinical and non-clinical samples. In this study, Cronbach's alpha coefficients for the overall score were obtained from 0.79 to 0.92. The reliability of this scale was from 0.71 to 0.87.

Treatment Protocol

The intervention group received 10 sessions of DBT focusing on the contents presented in table 1. The sessions were held 1 day per week within two and a half months. The treatment protocol was extracted from the Linehan’s original protocol, but there were some adaptations for ADHD which were introduced and carried out in Hesslinger.

Table 1. DBT sessions programs.

Session number	content
1	Clarification and introduction
2	Psycho education/ Learning the basic skills of tolerating chaos
3	Advanced Turbulence Skills: Using the Present Time
4	Basic skills of attention awareness/ mindfulness
5	Advanced mindfulness skills + Behavior Analysis
6	Basic Emotion Regulation Skills
7	Practicing 3 former modules in Impulse Control
8	Effective communication skills
9	Enhanced effective communication skills
10	Conclusion

Therapist

All sessions were held by a clinical psychologist who had been trained for this treatment.

Data Analysis

The data were analyzed via MANCOVA through SPSS-23.

Results

Demographic information

All the participants were in the ages between 18 to 45 years with the mean age of 28 years old in both genders (54% female and 46% male). None of them were illiterate and their educational level was between diploma and PhD but most of them were in bachelor level. All of them lived in Isfahan, Iran and were Farsi native speakers.

Descriptive statistics

Before starting the analyses, two groups were paired and were investigated via T-test. The results can be seen in Table 2.

Table 2. t test for equality of means.

	t	df	sig
ADHD/A	-2.426	38	0.2
ADHD/H	1.804	38	0.79
Emotion	0.536	38	0.59
Impulsivity	1.891	38	0.66
attention	0.516	38	0.6
Stroop	0.618	38	0.54
Wisconsin	-0.62	38	0.53
London	1.179	38	0.24

As shown in Table 2 using statistical t test the equality of

means is confirmed. The descriptive results including the mean and standard deviation scores of participants, in both groups and in two stages of pre-test/post-test, are presented .

Assumptions

To use MANCOVA we first checked whether the essential assumptions of normality distribution and homogeneity of variances of data via related tests. Both Shapiro-Wilk and Levine test were not significant which show the normality distribution and homogeneity of variances of data. So, we straightly use MANCOVA test for analyzing data. In following section, the results were reported in detail.

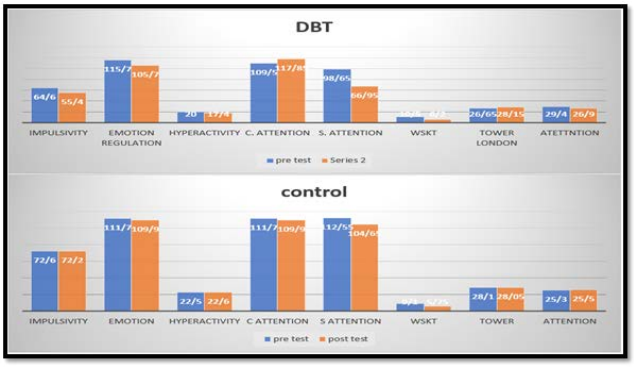
Multivariate analysis of covariance

The results of MANCOVA's analysis of post-test scores of emotion regulation, impulsivity, Stroop, London Tower, Wisconsin Sorting Test, attention and components of ADHD (inattention and hyperactivity) in the two experimental and control groups are presented.

there is an improvement in one of the variables including emotion regulation, impulsivity, Stroop, London Tower, Wisconsin Sorting Test, attention and components of ADHD (inattention and hyperactivity). (P = 0.001, 11.911 = F). Furthermore, the effect size is equal to .8. It means that around 80% of individual differences in the scores of study variables are related to the effect of group membership. In order to find the exact place of this significant difference, ANCOVA results are presented.

It is shown in Table 5 that DBT was significantly effective in improving some of the symptoms of ADHD such as emotion regulation (31.4%), impulsivity (37.4%), selective attention scores (21.9%), attention and concentration (31.8%), and hyperactivity (41%) comparing to control group. However, there was no significant difference in the components of the Tower of London, Wisconsin test and the attention part of ASRS. In figure 1 we can see the changing pattern of variables in both groups before and after the intervention.

Figure 1. Histogram diagram of research components in two groups and in two stages of pre-test and post-test.



As it is shown in figure 1, there is a difference in the histogram scores bar which shows the apparent changes in most variables in the intervention group compare to the control.

Discussion

This study aimed to evaluate the effect of DBT on reducing the adult ADHD symptoms. The results showed that, the selected treatment was effective in improving most of the ADHD symptoms such as emotion regulation, impulsivity, and hyperactivity, continues attention, and selective attention. The analyses showed no effective results related to some of the components of executive function such as the scores of Tower of London and Wisconsin Sorting Tests which respectively assess the ability of planning / management and cognitive flexibility/problem solving along with the inattention aspect of ADHD. Although, to the best of our knowledge, the present study is the first to study the effect of DBT on ADHD core symptoms. In some aspects postulated this efficacy. In the following we shall briefly present the obtained results for each of the emotional and cognitive elements of ADHD.

Emotional elements

Impulsivity

With regard to impulsivity, our findings revealed that DBT decreased the level of impulsive behaviors of the patients. Related to impulsivity, it can be inferred that as DBT sessions work on distress tolerance, the ability of participants increased for coping appropriately with situational requirements. Found that a behavioral measure of psychological distress tolerance, were significantly associated with impulsive behaviors in general. Distress tolerance is defined as the perceived or actual capacity to resist over disturbing and unpleasant situations, which is the same as what we see in impulsivity of individuals with ADHD. Furthermore, the other module of DBT, i.e. mindfulness skills, helped these patients to somehow be alert of what they are doing. Mindfulness is mostly defined as not to behaving automatically and without awareness, which we see reciprocally in impulsiveness.

Emotion regulation

Our results showed that DBT significantly increased emotion regulation skills. This finding is in line with the findings. Mindfulness techniques in DBT by alerting patients of what they are feeling and what they are doing will improve emotion regulation. Researchers suggested that difficulties accessing effective emotion regulation strategies may adversely affect the willingness and/or ability to tolerate distress. In addition, DBT directly target managing the uncomfortable emotions and the final one, interpersonal effectiveness skills, can be a mediating factor to keep patients away from emotional distress. According to Linehan mindfulness techniques in DBT teach patients to develop more awareness of their emotions, thoughts and behaviors, and thus, increase the level of self-control and the ability to manage emotions.

Hyperactivity

The results of the study also indicated that DBT significantly improved ADHD symptoms. The ADHD questionnaire had 2 part specifically evaluate the hyperactivity and attention of the patients. The results showed that participants benefited from DBT in improvement of hyperactivity but not attention. For explanation of this effect first we start from hyperactivation; literature shows that mindfulness exercises increase affective self-regulation, cognitive control and establish a deactivation in some brain region which is responsible for motor control. In other words, all these variables have a close relationship with hyperactivity. With regard to inattention symptom, DBT could not change it significantly in experimental group. It may be explained by the fact that in our study sample we had more female patient, more likely to be inattentive, in which they have more language problems and slower information processing, thus far talk therapies like DBT may not be much useful increasing attention abilities. The hypothesis is that adult whose attention is inconsistent would perform more poorly on listening comprehension, which requires sustained attention, during the therapy sessions. As a result, other types of treatment such as neurostimulation or neurocognitive may benefit more. In addition, studies have shown distinct genetic influences on ADHD subtypes that may influence the way of treatment.

Cognitive elements

Inattention

In the present study DBT was successful in improvement of continues and selective attention but we found no significant change in the attention scale of self-report questionnaire results which is in accordance with study. To explain this matter, first we can consider that ASRS (ADHD questionnaire) is a self-report list which assess the subjective assessment of ones attention. Along with this, we measured continues attention and selective attention via computerized program. If we say that the computerized programs evaluate the attention in core and during the act but the ASRS was just a report of what the patient think about her/his performance can explain this process, it is the difference between clinical result and statistical result. Maybe DBT was successful on improving attention but the participants didn't have this attitude toward their real performance. Another possible explanation is that we have several types of attention, and DBT was helpful for improving selective and continues attention. Also, in a task like Stroop test (selective attention) and CPT (continuous attention) other variables such as response inhibition might as well contribute to performance. Maybe the results of these tests were due to interactive effects of impulsivity and response control.

Executive function

Our findings revealed that continues performance test (CPT) and selective attention (Stroop test) were significantly improved after receiving DBT in experimental group. These results are in accordance with the result. One possible explanation may be that becoming mindful of an internal state or physiological function, such as one's breath, can improve abilities such as focused attention, working memory, and acceptance. In general, research suggests that mindfulness meditation training improves attention. In this way breathing and meditation techniques have been shown to stimulate theta brain wave activity which in turn help the brain to relax and reduce feelings of anxiety and improve attentional control.

Also we found no significant effect for two factors of executive function: ability of planning/management and cognitive flexibility/problem solving which were assessing via tower of London and WSKT. In their study, twenty ADHD patients randomized into an 8-week group-based mindfulness treatment. Self-reported ADHD and emotion dysregulation improved for the treatment group relative to the waitlist group over time with large effect sizes; however improvement was not observed for EF tasks. One possible explanation is related to the assessment tools in which daily EF deficits in ADHD are not captured by EF laboratory tasks.

Another explanation is that, maybe, as the focus of this type of intervention is on emotional control and there was no specific program on cognitive problems, so we didn't find any significant effect compared to control group in improving executive function of the participants. We can also claim that this proposal that improving emotionally can lead to better executive function was not approved in our study.

Conclusion

We reviewed that many researches showed the efficacy of DBT in treatment of most disorders which are characterized by impulsivity such as BPD, substance abuse and eating disorders. ADHD is also another type of disorders which have a very distinctive overlap with BPD. Several studies were carried out to investigate the efficacy of DBT on ADHD but there was no similar study to address the efficacy of DBT on both emotional and cognitive dimension separately. Our study showed that this kind of treatment can be helpful for improving emotional factors of ADHD, but we did not find any significant results regarding cognitive abilities. If we had used the total score for the whole subscale of ADHD, DBT was significantly effective, and this is the issue which is not mentioned in previous works. For instance, mindfulness skills, distress tolerance, emotion regulation and interpersonal effectiveness skills, all are in some way related to emotional factors. In summary, we can conclude a multimodal approach should be implicated in treatment of

this type of disorder. An integrative approach which targets the cognitive and emotional elements of this disorder can be very helpful.

Set against the strengths of our study, several limitations must be considered with regard to the results. One of the problems of this research was that the sample was specific to the city of Isfahan. Lack of follow-up to assess the persistence of therapeutic effects or to examine whether cognitive function improves over time was another limitation of the study. Therefore, it is suggested that in future research, these issues be considered to help generalize the results. It is also suggested to try and compare multimodal intervention for improving the ADHD symptoms.

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