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Diagnosis and treatment for child attention deficit and hyperactivity disorder by biofeedback electroencephalograph

Ge-Xin Li, Bin Wu, Shu-Ying Chang

Ge-Xin Li[1], Shu-Ying Chang[2], [1] Center of Health Examination, [2]Department of Neurology, General Hospital of Air-force, Beijing 100036, China
Bin Wu, Capital Normal University, Beijing 100037, China
Ge-Xin Li, Female, Han nationality, Born in 1950, in Beijing City, China, Bachelor of Tongji Medical College of Huazhong University of Science and Technology in 1982, Attending physician. Research direction: clinical psychology. shengyangtan@21cn.com
Telephone: +86-10-66928642 Fax: +86-10-66928642
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Abstract

AIM: To investigate the diagnostic and therapeutic effect for child attention deficit and hyperactivity syndrome.

METHODS: 60 children aged 6-10 years were selected (30 children with attention deficit associated with hyperkinetic syndrome in experiment group; 30 healthy children in control group). Electroencephalogram was recorded by A620 biofeedback ASSESSMENT procedure.

RESULTS: Experiment group was significantly different in θ/β from control group ($t = 5.525$, $P < 0.01$). There was no significant difference in θ/β between male and female children. So, θ/β could be used as a neurophysiological marker for diagnosis of attention deficit. 10 children received EEG biofeedback training and statistical data showed that brain function was improved by over 10 times of training.

CONCLUSION: The therapeutic effect of EEG biofeedback training is significant, but training must be persisted for more than 10 times.

INTRODUCTION

Attention deficit associated hyperkinetic disorder sydrome (ADHD) is a common mental health problem in children, which symptoms are obvious in years before entering school. If no suitable training was carried out, it will be sustained until adult[1] and seriously influence their studying, placement, and mental health, evoke their antisocial tendency, drug abuse and psychiatric problems[2]. In recent years, domestic scholars have paid great attention on diagnosis and treatment for ADHD and many studies have been carried out. At present, diagnosis of ADHD is evaluated from performance, academic achievement, social adaption. Although many scholars have noticed that ECG in ADHD children who presented with slow frequency is obviously different from healthy children, the objective basis for disorder of brain function is lack and there isn't diagnostic standard for ADHD by EEG. In this study, we used θ/β in EEG as neuroelectrophysiological quantitative marker for diagnosis of ADHD, at the same time, A620 biofeedback electroencephalograph was used to train ADHD children in order to explore effective training program and cycle.

MATERIALS AND METHODS

Materials

Subjects

In experiment group were 30 ADHD children diagnosed in other hospitals, China Child Center and our hospital. Their ages were 6-10 years and 21 male children and 9 female children were included. In control group was 30 healthy children receiving physical examination in China Child Center and our hospital. Their ages were 6-10 years and 20 male children and 10 female children were included.

Apparatus

Neurobiofeedback electroencephalograph (AUTOGENICS company, America) was used, Lianxiang computer, color display of 15 inch and HP color printer.

Software

AUTOGENICS software provided by AUTOGENICS company (America) was used as diagnosis procedure and NEUROFEEDBACK software as training procedure for ADHD children.

Methods

Diagnostic method

Hair must be cleaned before experiment and fasting be avoided. Skin was sterilized routinely. Recording electrode was laid at CZ position and two indifferent electrodes were laid at auricular lobules. When testing, testee was told to sit before display and counting numbers in display for 3 minutes, then testee performed simple mental arithmetic for 2 minutes. EEG was recorded. EEG powers at 4-8, 16-20, 13-21, 8-12 and 8-13 Hz and the ratio of power spectrum at each frequency were recorded. We selected 4-8, 13-21 Hz (θ/β) for comparison.

Training

10 ADHD children diagnosed by ASSESSMENT procedure received over 10 times of EEG biofeedback training. At first test, reasonable option was made according to specific condtions, inhibiting θ wave and increasing β wave. In training, picture puzzle, maze, swimming fish, cylinder picture, star war were displayed in screen. Only subjects concentrated their attention and achieved three options, play could be continued. To continue the play, subjects must decrease θ wave, increase β wave. When options were achieved or exceeded, a voice, "very good" would be heard to encourage subjects. Training scores were fed back at the real time. With processing of training, difficulties were increased continuously, at the same time, play became more exciting. Children received ASSESSMENT test at before training, 5 times, 10 times respectively and θ/β value was recorded for each test.

Statistical analysis: SPSS software was used to carry out t test and analysis of variance.

RESULTS

t test was carried out for θ/β value in 30 ADHD children (10±4) and 30 healthy children (5.5±2.0). There was a significant difference in the average between two groups ($t = 5.575$, $P < 0.01$). t test was carried out for θ/β value in 41 male children (7±4) and 19 female children (8±5). There was not significant difference in sex ($t = 0.359$, $P > 0.05$). 10 ADHD children received over ten times of EEG biofeedback training. Analysis of variance was carried out for θ/β values at before training (11±4), 5 times (8.4±2.6), 10 times (6.6±1.2) respectively. There was significant difference ($F = 7.265$, $P < 0.01$). Because of the significant difference by analysis of variance, comparison between two intervals were carried out. Seeing from table 4, brain function was improved after 5 times and 10 times of training, but there wasn't asignificant difference between before training and 5 times ($P > 0.05$). There wasn't also significant difference between 5 times and 10 times ($P > 0.05$). But a significant difference was found between before training and 10 times.

Table 1 Schaffer text

TIMES(T)	TIMES(J)	Average(T-J)	Standard error	*P*
0	5	3.1900	1.328	0.073
	10	4.9970	1.328	0.003
5	0	－3.1900	1.328	0.073
	10	1.8070	1.328	0.408
10	0	－4.9970	1.328	0.003
	5	－1.8070	1.328	0.408

DISCUSSION

Diagnosis and treatment for ADHD has aroused broad attention in society. In diagnosis, behavior evaluation commonly used at present is often limited by experience and knowledge of clinical doctors. EEG is an effective marker for clinical pathophysiological diagnosis and can reflect functional state of brain in some degree which is closely related to the development and maturity of brain. EEG can directly obtain signals of neural activity and reflect excitability of neurons via brain wave. Studies by LUbar indicate that there are many differences in cortex for differentiation between ADHD child and healthy child[3] . Domestic scholars have also studied the differences in EEG P300, EEG topography between ADHD child and healthy child[4] . But, traditional EEG analysis technique is limited in the direct dealing on electrical signals or some frequency parameters are added, so it is lack of parameter and marker with entity significance. While suggestion of θ(PW)/ β(PW) value provides a more accurate objective marker. θ wave of ECG in ADHD children consists of many components while β wave is the main reflecting concentration of attention and tension. In this study, θ/β value in normal children of 6－8 years old is about 5.5 while the value in ADHD children is higher. Electrical biofeedback training of brain on ADHD child has been adopted in America for more than 20 years[3] . By this method, θ wave was decreased while β wave increased, a firm operant conditioning was established so as to strengthen ability concentrating attention, prolong concentrating duration and decrease hyperkinetic tendency. In this study, the effect of biofeedback training on ADHD children is significant, but more than 10 times of training must be persisted. To consolidate therapeutic effect and avoid disappearance of conditioned reflex, training must be persisted for 40－80 times[3] . Although pains due to years of administration of drugs are eliminated by EEG biofeedback training, long-term training and costs are loads to family. Simple, portable and home electrical biofeedback instrument will be a gospel for ADHD children and their families and also the developing direction[5－7].

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应用脑电生物反馈仪诊断和治疗儿童注意力缺陷和多动症

李革新[1]、武 斌[2]、常蜀英[3](解放军空军总医院,[1]体检中心,[3]神经内科,北京市 100036;[2]首都师范大学,北京市 100037)
李革新,女,1949年生,北京市人,汉族,1974年同济医科大学毕业,副主任医师,科主任,主要从事儿童临床心理学的研究。

摘要

目的:探讨应用脑电生物反馈仪诊断和治疗儿童注意力缺陷和多动症的效果。

方法:以60名6－10岁儿童为研究对象。实验组30名已确诊为注意力缺陷伴多动症,对照组30名为正常儿童,两组儿童应用A620脑电生物反馈ASSESSMENT程序记录脑电图。

结果:实验组与对照组儿童θ/β比值差异有显著意义,$t=5.525$,$P<0.01$。男女生的θ/β比值无明显差异。据此说明θ/β比值可作为诊断注意力缺陷的一个神经生理指标。10名例接受脑电生物反馈训练,统计表明,10次以上训练例脑功能有明显改善。

结论:脑电生物反馈训练对ADHD儿童的效果是显著的,但必须坚持10次以上,才能取得成果。

主题词:生物反馈;轻微脑损伤综合征;心理疗法

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(Edited by Zhang Y)

本刊关于稿件统计学内容的要求

1. 设计

实验研究 □随机(完全/半/非);
□对照(有/无 类型:自身对照/标准对照/相互照/实验对照/安慰剂对照,其他需说明的类型);
□盲法(开放实验/单盲/双盲/三盲);
□研究类型(临床实验;自身配对设计、正交设计、析因设计、成组设计等)研究。

观察性研究 □以诊断/登记为依据,设立对照(回顾性/前瞻性、病例对照/队列)研究。

观察性研究 □以诊断/登记为依据,横断面/纵向观察研究。

2. 统计学分析

□软件包 □统计内容处理单位

定量资料 □单因素K水平/析因/具有重复测量设计资料采用*t*检验/方差分析
□组内治疗前后比较用配对*t*检验/方差分析
□组间比较用*t*检验/方差分析/*u*检验
□多组间两两比较用*q*检验
□不符合条件时用秩和检验/近似*t*检验

计数资料 □采用χ^2检验/确切概率法

等级资料 □采用秩和检验/Ridit分析

数值变量资料 □评价处理效应用Meta分析

直线相关回归 □采用*t*检验/方差分析

多因素分析 □采用Logistic回归/Cox回归

3. 对象

□实验设计 介绍随机分配方法(随机排列表法、随机数字表法、计算机产生随机数字)
□调查设计 介绍随机抽样方法(单纯随机抽样、系统抽样、整群抽样、分层抽样)

4. 结果

□说明统计方法 □说明*P*值(说明*P*值对应的统计值,如*t*、χ^2、*q*等)
□说明可信区间 □说明OR值

5. 统计图表应注意问题

□本刊采用三线表,如遇合计或统计学处理行(如*t*值、*P*值等),则在上面加一条分界横线。

应用脑电生物反馈仪诊断和治疗儿童注意力缺陷和多动症

作者： 李革新， 武斌， 常蜀英
作者单位： 李革新(解放军空军总医院体检中心,北京市,100036)， 武斌(首都师范大学,北京市,100037)， 常蜀英(解放军空军总医院神经内科,北京市,100036)

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背景:对注意缺陷多动障碍(attention deficit hyperactivity disorder,ADHD)儿童进行脑电诊断和脑电生物反馈治疗逐渐受到关注.目的:探讨脑功能诊断治疗仪对ADHD患儿诊断的精确性和治疗的疗效.设计:以ADHD患儿为研究对象的前瞻性观察对比研究.单位:一所市级医院的心理科.对象:选择2003-10/2004-5到鞍山市中心医院心理科多动症门诊就诊的儿童,共113例.纳入标准:年龄6～14岁到多动症门诊就诊的儿童.排除标准:患神经系统器质性疾病、广泛性发育障碍、精神发育迟滞、癫痫、精神病性障碍、听觉异常和视觉异常等疾病者.其中男88例,女25例,平均年龄为(10±3)岁.方法:应用A620全自动脑功能诊断治疗仪对113例儿童进行脑电检测,按照美国精神障碍诊断与统计手册第4版(DSM-Ⅳ)中ADHD的诊断标准对前来就诊的儿童进行诊断,计算脑电诊断的灵敏度、特异度;应用该仪器对27例ADHD患儿进行脑电生物反馈治疗,治疗前后检测患儿脑电波θ/β比值的变化,采用Conners儿童行为问卷评价治疗前后多动指数的变化.主要观察指标:脑电波θ/β比值,Conners多动指数.结果:脑电诊断ADHD的灵敏度为83.58%,特异度为82.61%;脑电生物反馈治疗后患儿的θ/β值为(8.26±4.05),较治疗前(12.38±7.96)明显下降(t=2.39,P<0.05);Conners多动指数治疗后为(12.05±8.63),较治疗前(24.73±10.96)显著下降(t=4.72,P<0.01).结论:脑电诊断的灵敏度和特异度均较高,可以辅助诊断ADHD;脑电生物反馈治疗能够明显改善ADHD患儿的脑电异常和多动症状.

2. 期刊论文 陈一心. 焦公凯. 王晨阳. 柯晓燕. 王民洁. 陈怡 脑电反馈治疗儿童注意缺陷多动障碍的疗效 -中国临床康复2004,8(18)

背景:脑电生物反馈治疗注意缺陷多动障碍(attention defici thyperactivity,ADHD)逐渐受到关注,但听觉和视觉注意分类研究报告较少.目的:探讨脑电反馈治疗ADHD的有效性.设计:随机、治疗前后自身对照研究.地点和对象:将南京脑科医院儿童心理卫生门诊符合美国精神障碍诊断与统计手册第4版标准的30例ADHD儿童作为研究对象.干预:由研究组成员对研究对象进行脑电生物反馈治疗,分别于治疗开始前、训练20次及40次后用整合视听连续执行测试(integrated visual and auditory continuous performance test,IVA-CPT)对患儿评定.主要观察指标:综合反应控制商数和综合注意力商数.结果:经过20次训练,息儿综合反应控制商数由87.38±15.71,上升到98.56±10.78(t=4.59,P<0.01),综合注意力商数由70.38±16.22,上升到88.94±16.37(t=4.68,P<0.01);经过40次训练,患儿综合反应控制商数上升到107.00±8.43(t=5.38,P<0.01),综合注意力商数上升到104.56±12.67(t=8.76,P<0.01),与训练前相比,各脑电反馈商数均有显著改善(P<0.01).结论:脑电反馈治疗对ADHD的疗效肯定,对有明显注意缺陷患儿训练时间要比多动一冲动为主患儿训练时间为多.

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