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Assessment of Behavioral Problems in Children Pre- and Post-Cochlear Implant: An Egyptian Study

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Objective The present study aimed to detect the behavioral problems pre- and post-cochlear implantation in comparison to normal hearing group to be able to manage these problems to get more benefit from using cochlear implants.

Methods A case-control study included 53 children was done. They were divided into 2 groups, the control group included 28 healthy volunteers with normal hearing and the case group included 25 children with severe to profound hearing loss, fitted for cochlear implantation. The Arabic Child Behavior Checklist (CBCL) was used to detect different behavioral problems in both groups. Case group children were followed up and reassessed again by CBCL 3 months later after cochlear implantation.

Results There were highly significant differences regarding total scores of internalizing and externalizing domains of empirically based CBCL between the control group and the case group after cochlear implants (p=0.001). There were non-significant differences in children within case group (pre- and post-cochlear implantation) regarding emotional and behavioral problems on both empirically based and Diagnostic and Statistical Manual of Mental Disorders-based CBCL.

Conclusion For better results, it is necessary to include a specialist of psychosomatic medicine in the cochlear rehabilitation teamwork.

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Keywords Hearing impaired; Cochlear implantation; Behavioral problems; CBCL.

INTRODUCTION

Before cochlear implants (CIs), children with (severe to profound sensory neural) hearing loss (HL) had limited, or no auditory detection and discrimination, and thus is reflected on their language.[1] In Egypt, the prevalence of hearing impairment in Egypt is 16.0%, with similarity in gender.[2] The CI improves speech perception[3] and developing either receptive or expressive language.[4] The progress of children using CIs depend on several factors as: the residual hearing, age of the child at the time of the operation, age of onset of HL, the strategy of mapping, family cooperation, mode of communication, intellectual level, type of CI device, experience in rehabilitation with the CI, and frequency of rehabilitation.[5]

Although the CIs increased self-sufficiency and stabilized family and social relationships,[6] there were externalizing behavior problem as aggression, hyperactivity, conduct problems[7] and emotional and peer problems.[8] Also, there were internalizing behavioral problems such as anxiety, withdrawal behavior, attention problems, thought, and depression.[9] The frequency of behavioral problems in profoundly HL children without CIs is 16% higher than in a Dutch normative sample of normal-hearing peers.[10] Parents suffer from stress-related to child conditions more than stress related to parent personality.[11] The frequency of behavioral problems is unknown up till now; these frequencies ranged from 9%[12] to 20%–30%.[13] Chao et al.[14] reported that children implanted at the early age get fewer behavioral problems.

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Child Behavior Checklist (CBCL) is a reliable and valid tool aims to distinguish different psychological problems. This Arabic version of CBCL was developed by Selim and Ismail[15] and was evaluated through the original English version of CBCL by Achenbach and Rescorla.[16] CBCL was classified into empirically based and Diagnostic and Statistical Manual of Mental Disorders (DSM)-based evaluations. The empirically based evaluation was divided into internalizing and externalizing domains. The internalizing domain measures emotional problems; emotionally reactive, anxious/depressed, withdrawn/depressed, and somatic complaints. The externalizing domain measures behavioral issues: attention problem and aggressive behavior syndrome scales, sleep problems and other symptoms. The DSM-based evaluation (CBCL) was classified into affective problems, anxiety problems, pervasive developmental problems, and attention-deficit/hyperactivity problems, and oppositional defiant problems.

The present study aimed to detect the behavioral problems pre- and post-cochlear implantation in comparison to normal hearing group to be able to manage these problems to get more benefit from using CIs.

METHODS

Study design

A case control study was done on Egyptian children aged from 2–5 years old. The case group consisted of 25 children, having bilateral severe to profound sensorineural HL, all of them were prepared for cochlear implantation; these children were recruited from Wadi El Nil and Beni-Suef University Hospitals. The control group consisted of 28 healthy volunteer children with normal hearing, recruited from ordinary nurses and schools. All children in this study were subjected to semi-structured sheets of Psychiatric, Otorhinolaryngology, Neurology, and Phoniatrics clinics, Beni-Suef University. All children included in this study had the same socio-economic status. All parents agreed to participate in the study and provided an informed written consent. Children with autistic spectrum disorders, developmental disabilities, congenital anomalies, auditory neuropathy, and chronic medical diseases that interfere with regular rehabilitation were excluded. Ethical consideration done according to the instructions of the scientific research ethical committee, in the form of informed written consent from the caregiver. Ethical approval was permitted from the Ethical Committee of Faculty of Medicine, Beni-Suef University (FM-BSU REC) at 7/9/2021.

Preoperative preparation of children for case group

Case group consisted of 25 children with history of bilateral congenital severe to profound sensorineural HL, diagnosed by auditory brain stem response (ABR) and they were using bilateral hearing aids for at least three months attending regular auditory and language rehabilitation with poor response, so they were shifted to cochlear implantation.

A semi-structured neurology clinical sheet was fulfilled by all parents, including personal and family history. Prenatal history was taken to exclude hereditary causes of HL, Rubella infection in first trimester of pregnancy, other congenital complications, or other clinical evidence of brain damage. Perinatal history was also documented, and complications of labor and birth, and birth asphyxia were excluded. Postnatal history including history of meningitis, severe infection in infancy, neonatal jaundice, or septicemia, and convulsive disorder, were all excluded. History of developmental milestones: no evidence of reduced gross motor milestones. History of immunization was evaluated; all were on time with no complications.

Also, pre-operative oto-rhino-laryngeal examination was conducted including complete oto-rhino-laryngeal clinical examination and otoscopic examination to determine the status of ear canal, tympanic membrane, and middle ear. Pre-operative high-resolution CT scan of the temporal bone was done to evaluate the patency of the cochlea, identification of congenital malformations, and assessment of the surgical anatomy. Also, pre-operative MRI of the vestibule-cochlear complex was done to provide information regarding the integrity of the auditory nerves and other soft tissue. All children had nonverbal IQ not less than 80.

Surgical procedure

These children were implanted prelingually (non-verbal) and received a unilateral CI before the age of 5 years. Surgical files stated that they have full electrode insertion. All children with CIs were regular in their mapping program, and audiological reports revealed that they had a satisfactory aided response with their cochlear implantation (below or equal to 30 dB HL).

Postoperative follow-up

Post-operative auditory and language rehabilitation program was done focusing on the development of auditory skills, receptive language, and expressive language. Post-operative high-resolution CT scan was mandatory to recognize malposition of the electrode array.

Assessment tool: the Child Behavior Checklist Arabic version

The Arabic version of the CBCL (1½–5 years) questionnaire was introduced by expert clinical psychologist. The answers were taken by the parents and scored manually. The control group was assessed once, and the case group was as-

sessed twice: 1st assessment was during preoperative preparation, shortly before surgical intervention, 2nd assessment was done after 3 months of cochlear implantation. Unfortunately, 11 cases were dropped out after the surgical intervention, so the 2nd assessment was done only on 14 cases.

Statistical analysis

The collected data was revised, coded, tabulated, and introduced to a PC using Statistical Package for Social Science (SPSS 25.0 for windows; IBM Co., Armonk, NY, USA, 2017). Data were presented and suitable analysis was done according to the type of data obtained for each parameter. Descriptive statistics of scale variables was done in the form of mean± standard deviation. Comparison between groups was done using independent t-test. Qualitative variables were presented as number and percent. Comparison between groups was done using Fisher's exact or chi-squared test. The follow up of the DSM-based CBCL categories in the cases underwent cochlear implantation after 3 months was conducted using McNemar for binary variables and Cochrane test for more than two categories. The significance level was assessed as follows; p-value>0.05 was considered insignificant, p-value≤0.05 was considered significant.

RESULTS

This study was conducted on 2 stages: 1st stage included 53 Egyptian children presented in two groups: control group; 26 boys and 2 girls, with a mean age (3.5±0.9 years). Case group (pre-operative group): 25 children with a mean age of (3.5±0.6 years). 2nd stage: Intra correlation assessment to the case group (post-operative assessment done after a period of 3 months). There were no statistically significant differences between both groups regarding age & sex and this reflected proper matching (Table 1).

CBCL empirically based was applied on the control group and the pre-operative group. Regarding internalizing domain, emotionally reactive sphere, they showed statistically significant difference. Also, regarding anxious/depressed, withdrawn/depressed, and somatic complaints, they showed highly significant differences. Concerning externalizing domain, attention problem was insignificant, and aggressive behavior showed significant difference. However, the sleep problems were insignificant. There were highly significant differences according to total internal and external scales.

Table 1. Demographic data of the studied groups

Items	Controls (N=28)	Pre-operative group (N=25)	p-value
Age (yr)	3.5±0.9	3.5±0.6	0.802
Sex			0.092
Male	26 (92.8)	19 (76.0)	
Female	2 (7.2)	6 (24.0)	

Values are presented as mean±standard deviation or number (%)

The DSM-based CBCL showed a highly significant difference between the control group and the pre-operative group regarding affective problems, anxiety problems, pervasive developmental problems, attention-deficit/hyperactivity problems, and oppositional defiant problems.

CBCL empirically based was applied on the pre-operative & the post-operative groups and revealed that there were non-significant differences regarding internalizing domain that measures emotional problems; emotionally reactive, anxious/depressed, withdrawn/depressed, and somatic complaints. Also, there were non-significant differences regarding the externalizing domain that measures behavioral issues, attention problem, aggressive behavior, and sleep problems. Total scores of internalizing and externalizing domains were non-significant.

Regarding the DSM-based CBCL, there was non-significant difference between the pre-operative and the post-operative assessments regarding affective problems, anxiety problems, pervasive developmental problems, attention-deficit/hyperactivity problems, and oppositional defiant problems.

DISCUSSION

Hearing-impaired (HI) children suffer from behavioral problems more than their normal hearing peers, especially internalizing and externalizing behavior problems;[8] however, other cross-sectional studies showed that there were no differences between them and explained that the fact that the CI children have a longer duration of implant use, 80% of them were using CI more than five years.[14] Previous study reported that after five years of CI use, the CI children were considered as independent as their hearing age mates.[17]

The current research suggested that hearing impairment affects both emotional and behavioral skills especially in severe to profound HI children (Tables 2 and 3), with significant and highly significant differences between the pre-operative group and the control group. Another research proved not only these results but demonstrated higher rates of internalizing problems.[10] CBCL empirically based and DSM based were applied on the pre-operative & the post-operative groups and revealed that there were non-significance differences statistically, but there is a difference in the number of reported cases (Tables 4 and 5) as following: In emotional and aggressive behavior, the reported cases decreased. In anxious, somatic complaints and attention, the reported cases increased, matched with the study done by Huttunen and Välimaa,[17] they men-

tioned that the most serious problems in behaviors of the children with CI were related to social relations and attention, as reported by their parents. In affective problems & anxiety problems, the reported cases were increased. In contrast to pervasive developmental problems, the reported cases decreased clinically.

Regarding the post-operative group, the more oral language acquisition, the better parent-child communication, the less behavioral, social, and emotional problems.[9] Another research reported that preschoolers with CIs after one year of CI use were like their hearing age-mates on (CBCL),[18] and this explains why there is no relief of behavior problems in the post-operative group in this current study. Our study results clarify that first year after cochlear implantation is critical and these children need intensive language and behavioral habilitation to improve their problems.

The behavioral problems were associated with delayed language and/or age at cochlear implantation,[19] and affected positively by development of oral language and auditory experience. Although parents of CI children experienced greater stress than parents of peer's children[11] and that's because a positive view toward the outcomes of CI.[20] The social-cognitive competence and emotional self-regulation were supported by language. Therefore, the lack of understanding of the audito-

Table 2. Comparison between the control group and the pre-operative group as regards empirically based Child Behavior Checklist findings

Item	Controls (N=28)	Pre-operative group (N=25)	p-value
Emotionally reactive			0.045*
Normal	21 (75.0)	14 (56.0)	
Borderline	7 (25.0)	6 (24.0)	
Clinical	0 (0)	5 (20.0)	
Anxious			<0.001*
Normal	25 (89.3)	11 (44.0)	
Borderline	3 (10.7)	7 (28.0)	
Clinical	0 (0)	7 (28.0)	
Somatic complaints			<0.001*
Normal	28 (100)	14 (56.0)	
Borderline	0 (0)	8 (32.0)	
Clinical	0 (0)	3 (12.0)	
Withdrawn			<0.001*
Normal	21 (75.0)	12 (48.0)	
Borderline	7 (25.0)	2 (8.0)	
Clinical	0 (0)	11 (44.0)	
Sleep problem			0.098
Normal	28 (100)	22 (88.0)	
Borderline	0 (0)	1 (4.0)	
Clinical	0 (0)	2 (8.0)	
Attention problem			0.131
Normal	15 (53.6)	19 (76.0)	
Borderline	3 (10.7)	3 (12.0)	
Clinical	10 (35.7)	3 (12.0)	
Aggressive behavior			0.034*
Normal	24 (85.7)	15 (60.0)	
Borderline	0 (0)	3 (12.0)	
Clinical	4 (14.3)	7 (28.0)	
Internal			<0.001*
Normal	19 (67.9)	5 (20.0)	
Borderline	6 (21.4)	2 (8.0)	
Clinical	3 (10.7)	18 (72.0)	
External			0.003*
Normal	24 (85.7)	11 (44.0)	
Borderline	0 (0)	2 (8.0)	
Clinical	4 (14.3)	12 (48.0)	

Values are presented as number (%). *p-value is significant

Table 3. Comparison between the control group and the pre-operative group as regards Diagnostic and Statistical Manual of Mental Disorders-based Child Behavior Checklist

Item	Control (N=28)	Pre-operative group (N=25)	p-value
Affective problems			<0.001*
Normal	28 (100)	11 (44.0)	
Borderline	0 (0)	3 (12.0)	
Clinical	0 (0)	11 (44.0)	
Anxiety problems			<0.001*
Normal	28 (100)	16 (64.0)	
Borderline	0 (0)	1 (4.0)	
Clinical	0 (0)	8 (32.0)	
Pervasive developmental problems			<0.001*
Normal	28 (100)	4 (16.0)	
Borderline	0 (0)	4 (16.0)	
Clinical	0 (0)	17 (68.0)	
Attention-deficit/hyperactivity problems			0.003*
Normal	28 (100)	18 (72.0)	
Borderline	0 (0)	5 (20.0)	
Clinical	0 (0)	2 (8.0)	
Oppositional defiant problems			0.003*
Normal	28 (100)	18 (72.0)	
Borderline	0 (0)	2 (8.0)	
Clinical	0 (0)	5 (20.0)	

Values are presented as number (%). *p-value is significant

Table 4. Inter-comparison between the pre-operative group & the post-operative group regards empirical-based Child Behavior Checklist

Item	Pre-operative (N=14)	Post-operative (N=14)	p-value
Emotional			0.881
Normal	9 (64.3)	10 (71.4)	
Borderline	2 (14.3)	2 (14.3)	
Clinical	3 (21.4)	2 (14.3)	
Anxious			0.470
Normal	4 (28.6)	5 (35.7)	
Borderline	6 (42.9)	3 (21.4)	
Clinical	4 (28.6)	6 (42.9)	
Somatic complaints			0.526
Normal	8 (57.1)	6 (42.9)	
Borderline	5 (35.7)	5 (35.7)	
Clinical	1 (7.1)	3 (21.4)	
Withdrawn			0.815
Normal	6 (42.9)	7 (50.0)	
Borderline	2 (14.3)	1 (7.1)	
Clinical	6 (42.9)	6 (42.9)	
Sleep problem			>0.999
Normal	12 (85.7)	12 (85.7)	
Borderline	2 (14.3)	2 (14.3)	
Clinical	0 (0)	0 (0)	
Attention problem			0.256
Normal	13 (92.9)	10 (71.4)	
Borderline	1 (7.1)	2 (14.3)	
Clinical	0 (0)	2 (14.3)	
Aggressive behavior			0.697
Normal	8 (57.1)	10 (71.4)	
Borderline	1 (7.1)	1 (7.1)	
Clinical	5 (35.7)	3 (21.4)	
Other			
Normal	14 (100)	14 (100)	
Borderline	NA	NA	
Clinical	NA	NA	
Internal (T)			0.351
Normal	2 (14.3)	4 (28.6)	
Borderline	0 (0)	1 (7.1)	
Clinical	12 (85.7)	9 (64.3)	
External (T)			0.487
Normal	6 (42.9)	8 (57.1)	
Borderline	1 (7.1)	2 (14.3)	
Clinical	7 (50.0)	4 (28.6)	

Values are presented as number (%). NA, not applicable

Table 5. Follow-up of Diagnostic and Statistical Manual of Mental Disorders-based Child Behavior Checklist findings in the pre-operative group and the post-operative group

Item	Pre-operative group (N=14)	Post-operative group (N=14)	p-value
Affective problems			0.509
Normal	7 (50.0)	4 (28.6)	
Borderline	2 (14.3)	3 (21.4)	
Clinical	5 (35.7)	7 (50.0)	
Anxiety problems			0.264
Normal	8 (57.1)	4 (28.6)	
Borderline	1 (7.1)	3 (21.4)	
Clinical	5 (35.7)	7 (50.0)	
Pervasive developmental problems			0.404
Normal	2 (14.3)	5(35.7)	
Borderline	2 (14.3)	2 (14.3)	
Clinical	10 (71.4)	7 (50.0)	
Attention-deficit/hyperactivity problems			>0.999
Normal	11 (78.6)	11 (78.6)	
Borderline	3 (21.4)	3 (21.4)	
Clinical			
Oppositional defiant problems			0.827
Normal	10 (71.4)	11 (78.6)	
Borderline	2 (14.3)	1 (7.1)	
Clinical	2 (14.3)	2 (14.3)	

Values are presented as number (%)

ry and linguistic of social and emotional language interferes with the understanding of people, culture, emotions, and social rules.[21] This explains that why profoundly HI children had social and emotional problems[22] and exhibit behavioral problems.[23] Language delay may be the main cause of behavior disturbance in CI children.[24]

There is no doubt about the positive influence of cochlear implantation on our candidates, especially on the sleep problem, which is a common symptom in deaf children. Pierzycki et al.[25] suggested that CI users may experience a relief in tinnitus persistence but not complete elimination of tinnitus or tinnitus-related distress. Emotional or behavioral problems presented in 10% of HI children and referred for professional help.[25] So, the presence of specialist of psychosomatic medicine in the teamwork may lead to better results during cochlear rehabilitation.[26] Theunissen et al.[24] reported that the behavioral problems increased when the cochlear implanted children admitted in special educational settings for the deaf than those in mainstream education. So, parents and teachers need psychological support and training to prevent or remediate emotional and behavioral problems in those children.[27]

Currently, CIs can develop access to different sound and expressive language communication (speech recognition and perception to develop expressive language),[28] when the implantation done early before the age of 12 months.[29] Several studies found that the behavioral problems in CI children get better with enhancement of language and communication skills.[30] In addition, some studies found that there were a little pit of behavioral problems in children with CI similar to their normal-hearing peers.[31]

Both studies explain our results regarding the negative effect of language disability on the children self-esteem and their behaviors.[21,24] One of our setbacks in the current study is early reassessment of the language and behavioral skills of the children after cochlear implantation, whereas the short period of language habilitation isn't enough to make effective changes in language or behavior of them.

In conclusion, children with CIs showed higher significant scores of internalizing and externalizing problems on empirically based CBCL compared to their normal hearing peers. Also, they showed high significant scores on DSM-based CBCL as affective problems, anxiety problems, pervasive developmental problems, attention-deficit/hyperactivity problems, and oppositional defiant problems. However, there were non-significant differences in in pre-operative and post-operative groups as regards emotional and behavioral problems on both empirically based and DSM-based CBCL. So, for better results, it is necessary to include a specialist of psychosomatic medicine in the cochlear rehabilitation teamwork.

Availability of Data and Material

The datasets generated or analyzed during the study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: all authors. Data curation: all authors. Formal analysis: all authors. Funding acquisition: all authors. Investigation: all authors. Methodology: all authors. Project administration: all authors. Resources: all authors. Software: all authors. Supervision: all authors. Validation: all authors. Visualization: all authors. Writing—original draft: all authors. Writing—review & editing: all authors.

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