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Effectiveness use of melatonin in examining auditory brainstem response in children

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Abstract

Background: Auditory brainstem responses (ABRs) testing is required to assess auditory function in children. This is usually done on an outpatient basis and the anesthesia method used in the test should allow deep sleep while avoiding general anesthesia that requires special monitoring, a special staff member and the availability of a special operating room, many anesthesia methods have been used with the risk of respiratory depression and side effects. Objective: We aim to evaluate the efficacy and usefulness of melatonin in anesthesia for children undergoing auditory brainstem responses testing. Materials and methods: We have included 104 babies over the age of seven months for whom the electrical response of the brain is tested under the influence of melatonin. We excluded patients with severe comorbidities who require special monitoring or general anesthesia. After approval, parents were given directions to prepare their child for testing. The dose of melatonin needed to stimulate sleep was adjusted for a full bilateral feedback response to the infant's age. Rustle: We calculated the success rate of full binary ABR, sleep delay, and sleep quality for 104 children were referred for ABR testing. The delay in sleep was variable by an average of 30 minutes. The quality of sleep was described as continuous. Conclusions: Melatonin has advantages over normal sleep and reduced sleep delay without adverse effects or risk of respiratory depression. It is an effective and useful anesthesia method for outpatient ABRs

Introduction:

Auditory Brainstem Responses (ABR) test is required to assess auditory function in children, and one of its requirements is deep sleep to avoid effects that may reduce the accuracy of ABR., and anesthesia is required to reach deep sleep. ABRs are usually performed on an outpatient basis. Several anesthesia methods have been used to avoid general anesthesia that requires the availability of an operating room, dedicated staff and special monitoring after the test [1]. Melatonin It is an endogenous hormone that induces natural sleep and has previously been successfully used in electrophysiological tests and magnetic resonance imaging (MRI) in children, and many anesthesia methods have been described in the literature such as the use of chloralhydrate, or pentobarbital with alimemazine [2,3,17].

Chlorhydrate is the most widely accepted sedative for young children undergoing tests such as magnetic resonance imaging (MRI) and ABR testing, however, Avlonitou et al. have been observed. and others have complications in 20% of children such as hyperactivity, vomiting, rash as well as shortness of breath (0.5%) or apnea (0.2%). Pentobarbital is another common sedative used, but it can cause balance disturbances and a long sleep [12].

In this study, we aim to evaluate the effectiveness of melatonin as an anesthesia method for children undergoing auditory brainstem responses as a primary endpoint, and also whether a method of anesthesia is viable in terms of time and sleep delay in an outpatient setting.

Materials and Methods

Study Design

We conducted a study of all children referred to Al Amal and Al hayat Hearing Center for an electrical brain response test from January 2024 to July 2024.

Study sample

We have included 104 babies over the age of seven months forwhom the electrical response of the brain is tested under the influence of melatonin. We excluded patients with severe comorbidities who require special monitoring or general anesthesia. Consent has been obtained from one of the child's parents. We have informed parents to use melatonin, a natural hormone commonly used to treat jet lag and insomnia. But also, in electrophysiological tests for children in many other countries but not yet in Iraq

Protocol

After approval, parents were given directions to prepare their child for testing. Parents were encouraged to wake up early for the child and avoid napping before the test, especially during transportation to the center. They were asked to bring their hungry and tired child to the center and bring a bottle or snack for testing. The dose of melatonin needed to stimulate sleep was adjusted for a full bilateral feedback response to the infant's age. We gave melatonin orally either in a bottle or in a small snack at a dose of 2 to 5 mg for children ages 1 to 3 years and 5 to 10 mg for children ages 3 to 6 years. A second dose was given after 30 minutes If the child fails to sleep.

ABR Test

The ABR test was performed in a quiet and dark room by an otolaryngologist with the help of a trained hearing examiner. ABR Chirp test was performed. The skin was cleaned, and a special gel was used to improve the impedance of the skin of the electrode. To facilitate testing and reduce movements that can wake the infant, patches are placed before the infant is put to sleep. We performed ABR tests by clicking at 500, 1000, 2000 and 4000 Hz. The ABR test was performed on the right side first, then on the left side. We started with a noise level of 70 dB. If necessary, increase the sound level to 100 dB or lower it to a minimum of 20 dB. The investigation was terminated as soon as the auditory response test was completed.

Melatonin took between 15 and 30 minutes to take effect, and the duration of ABR tests ranged from 10 to 30 minutes, with an average of 15 minutes. The average total time required to complete the examination, from achieving sleep, to placing electrodes and

completing the ABR test, was 33 minutes, and the success of the ABR tests was determined by the presence of an ABR response by the presence of a V wave. The wave was V is absent in 12 ears (6 left ears and 6 right ears), except for patients who failed to complete their ABR tests. As shown in Figure 1

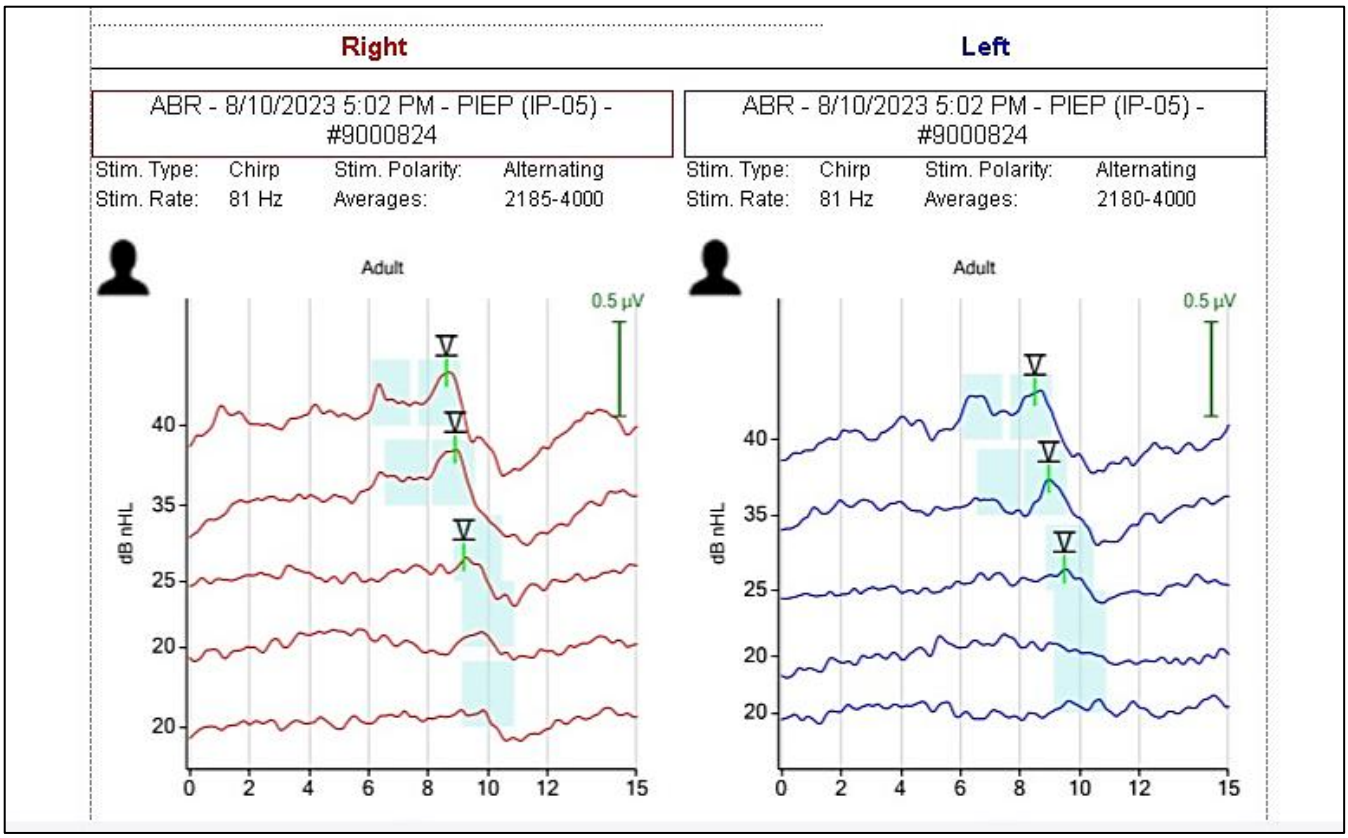

Fig 1: *ABR test results for a patient diagnosed with bilateral hearing loss.*

RESULTS

104 children were referred to Al Amal and Al Hayat Hearing Center assessment hearing testing either due to language delays or behavior problems. All patients were candidates for dual auditory hearing testing under the influence of melatonin during sleep. All children were successfully tested in both ears, had a sex ratio of 4.5 (males to females), and the average age was 2 years and 9 months, ranging from 7 months to 7 years. Sleep delay was highly variable, ranging from 15 minutes to 70 minutes, andsleep quality was described as either persistent in 91 children (87.50%) or intermittent in 13 children (12.50%) requiring either simple feeding in 3 cases or a second dose of melatonin after 30 minutes in 4 children whose sleep duration ranged from 20 minutes to 90 minutes. The average recording time required to take a full bilateral ABR test was 15 to 25 minutes. ABR testing on more than 100 patients showed severe to deep bilateral hearing loss in 55 children (55,752%) as in Table 1. Besides one case of vomiting in a 3-year-old infant that occurred immediately after waking up and disappeared spontaneously, no other side effects were observed in our study. Figure 1

Table1. The degree of hearing loss in each ear in the ABR tests.

	Normal hearing	Mild Hearing Loss	Moderate Hearing Loss	Severe Hearing loss	Profound Hearing Loss
Right ear	5	8	12	10	18
Left ear	5	9	10	11	16
Total	10	17	22	21	34

The results in table 2 show characteristics of patients and sleep duration induced by melatonin.

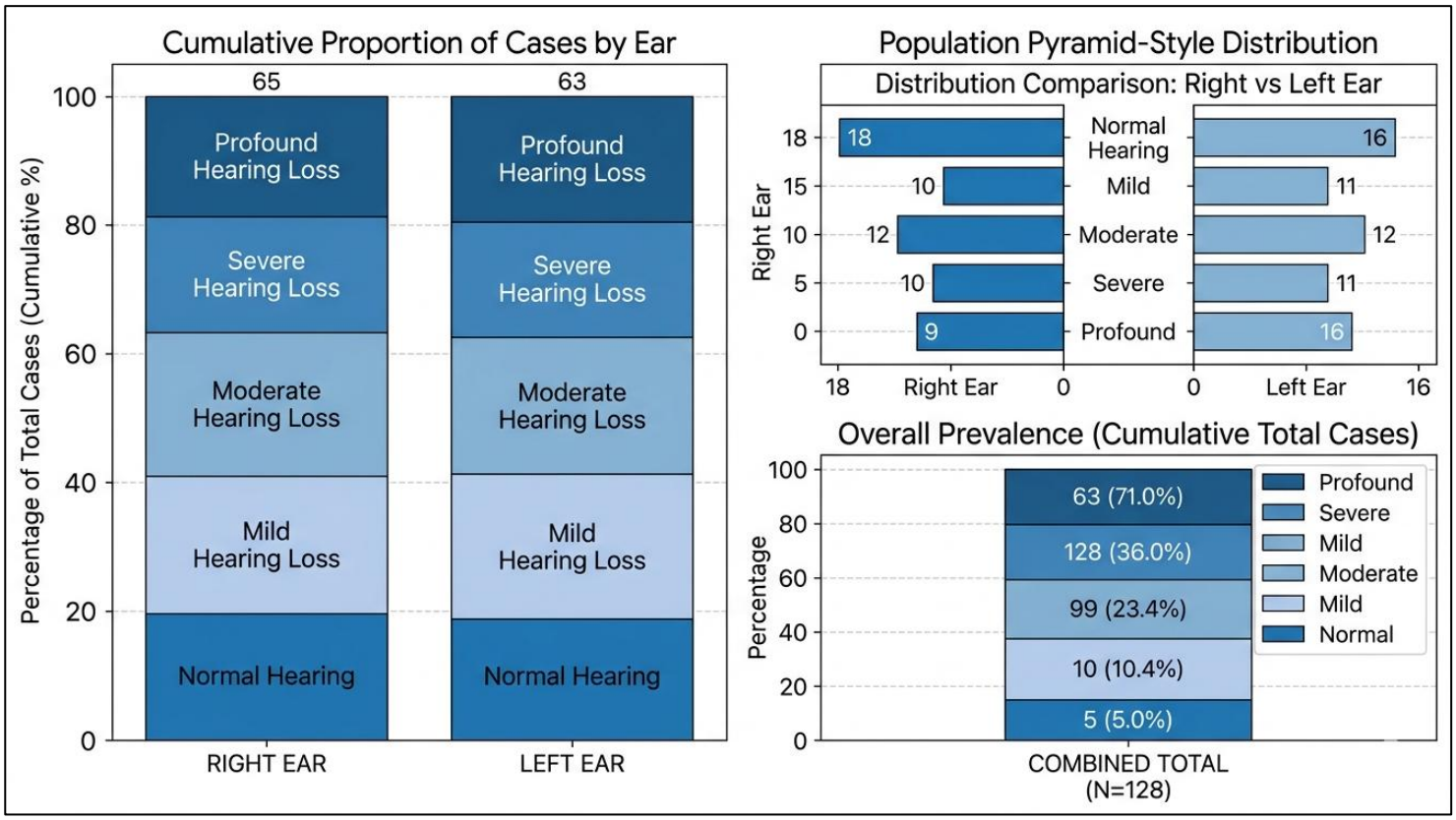

Fig2: *Multi-perspective analysis of hearing loss distribution by severity and ear*

Table 2. Characteristics of patients and sleep duration induced by melatonin .

Variables	Total
Age	2.9 YA
Male	(n=70) 67.31%
female	(n= 34) 32.69%
Sleep duration	55 min
Quiet sleep	83.65% n=87
Few awakenings but remained asleep	16.35 n=17
Dosage	
1 dose	87.50% n=91
2 dose	12.50% n= 13

DISCUSSION

One of the tests for children and newborns is auditory brainstem responses is an objective test of hearing loss that is routinely performed. It evaluates hearing thresholds at high frequencies ranging from 2000 to 4000 Hz. This test requires deep sleep-in children to avoid infant movement and muscle activities that generate effects and reduce the accuracy of this auditory stem response test. Infants over the age of one year need sleep, and several protocols have been used for anesthesia before the Pediatric Auditory Stem Response test. General anesthesia is an effective method, but These materials have been used for anesthesia in auditory tests, electroencephalography or radiological examination of children [4-6]. The rectal use of pentobarbital and alimazine also allowed 89.8% auditory and auditory steady state responses to be performed. Chloral hydrate has also been widely used, but they require special monitoring of heart rate, blood pressure, oxygen saturation and breathing [5]. While using these molecules, the patient may experience many adverse events after discharge from the hospital including motor imbalance, gastrointestinal symptoms, irritability, and insomnia [4]

Melatonin, unlike the aforementioned drugs, is a natural endogenous hormone secreted by the pineal gland, and usually plays an important role in regulating the circadian rhythm through the increase in darkness and decrease in light [9], at physiological doses (0.1-0.3 mg), melatonin promotes the onset and maintenance of sleep, reduces sleep delay and increases sleep quality to improve overall sleep time. Despite the many other properties of melatonin as an antagonist for oxidation, anti-inflammatory, antitumor and anticonvulsant, the most important use of exogenous melatonin is to treat sleep disorders and flight delays. In the pediatric category, the main uses of melatonin are sleep disorders, delayed sleep phase syndrome, all sleep disorders associated with autism spectrum disorders and mental and neurological conditions [7], melatonin use was allowed at 55% through successful MRI scanning in children at a dose of 10 mg without risk of respiratory depression, and sleep deprivation improved its effectiveness [8]. Melatonin is a good alternative to drug anesthesia

in children undergoing EEG without significant side effects and without affecting the quality and reliability of registration. [16]

In children, the main uses of melatonin are dyssomnia, delayed sleep syndrome, all sleep disorders related to autism spectrum disorders, mental and neurological conditions. [10,13]

The hypnotic effect of melatonin justified its use as a calming agent to obtain the natural sleep needed in electrophysiological tests or as a pre-anesthetic for general anesthesia [11,15]

Finally, melatonin can be useful for ABR screening in children with and without comorbidities. It is also possible that sequential testing is allowed for those at risk of progressive hearing loss.

In our country, Iraq, early diagnosis and rehabilitation of hearing loss remains a major national problem. The introduction of melatonin-induced sleep as an alternative to general anesthesia for ABR tests in children will have a significant impact on the organization of hospitals and staff availability and also on the liberalization of operating rooms for other priorities. It will reduce the waiting time for ARB testing in children. When all ABRs are performed under general anesthesia which requires specialized staff and operating room availability, as far as we know, this study is the first in our country because we are the first to use melatonin-induced sleep for ABR tests for all patients without comorbidities.

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فعالية استخدام الميلاتونين في فحص استجابة جذع الدماغ السمعية لدى الأطفال

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الخلاصة:

يعد اختبار استجابات جذع الدماغ السمعية (ABR) ضروريًا لتقييم وظائف السمع لدى الأطفال. يُجرى هذا الاختبار عادةً في العيادات الخارجية، ويجب أن تسمح طريقة التخدير المستخدمة فيه بنوم عميق مع تجنب التخدير العام الذي يتطلب مراقبة خاصة، ووجود فريق طبي متخصص، وغرفة عمليات مجهزة. وقد استُخدمت العديد من طرق التخدير مع ما يصاحبها من مخاطر تثبيط التنفس وآثار جانبية. الهدف: نهدف إلى تقييم فعالية الميلاتونين وجدواه في التخدير للأطفال الذين يخضعون لاختبار استجابات جذع الدماغ السمعية. المواد والأساليب: شملت الدراسة 104 أطفال رُضّع تزيد أعمارهم عن سبعة أشهر، حيث تم اختبار الاستجابة الكهربائية للدماغ لديهم تحت تأثير الميلاتونين. استبعدنا المرضى الذين يعانون من أمراض مصاحبة خطيرة تتطلب مراقبة خاصة أو تخديرًا عامًا. بعد الموافقة، تم تزويد أولياء الأمور بتعليمات لإعداد أطفالهم للاختبار. تم تعديل جرعة الميلاتونين اللازمة لتحفيز النوم بما يتناسب مع عمر الرضيع، وذلك للحصول على استجابة ثنائية كاملة. رَسْل: قمنا بحساب معدل نجاح اختبار استجابة جذع الدماغ السمعية الثنائي الكامل، وتأخر النوم، وجودة النوم لـ 104 أطفال أُحيلوا لإجراء اختبار استجابة جذع الدماغ السمعية. تفاوت تأخر النوم بمعدل 30 دقيقة. وُصفت جودة النوم بأنها مستمرة. الخلاصة: يتميز الميلاتونين بمزايا تفوق النوم الطبيعي، ويقلل من تأخر النوم دون آثار جانبية أو خطر تثبيط التنفس. وهو طريقة تخدير فعالة ومفيدة لإجراء اختبارات استجابة جذع الدماغ السمعية للمرضى الخارجيين.