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The Initiation of Neonatal Deafness Screening by the Pediatric Team at the Neonatology Department of Marrakech University Hospital Experience and Challenges

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Abstract

Introduction: *Deafness is the most common sensory deficit at birth (1/1000).In Morocco, epidemiological data are rare and unpublished and the neonatal screening program for congenital diseases will be reinforced by neonatal screening for congenital deafness, hence the interest of our pilot work in this area.*

Objective: *is to initiate screening for neonatal deafnessby pediatriciansusingTHEoto-induced acoustic emissions (OEAP).*

Materials and Methods: *This is a prospective study spread over two months (February and March 2023), concerning newborns hospitalized in neonatal intensive care (RN) and those examined in the delivery suites (SC) of the Mohammed VI University Hospital in Marrakech. Screening is done by two OEAP tests. If the first test was negative, a second was carried out during the first control consultation or after invitation.*

Results: *519 newborns were successfully screened (49.8% were girls and 51.2% were boys), 459 (88.43%) at the post-partum level and 60 (11.57%) at the of the RN. The average age at screening was 2.1 days. 56.6% of cases showed a positive response from the first test compared to a unilateral or bilateral negative response in 43.4% of cases. Of these 225 newborns, 87 (38.6%)[57 from SC and 30 from RN]responded to our invitation and they benefited from a second test within our service with an average delay of 18.5 days[7 days, 30 days]. Geographical and social constraints represented the major excuses for not returning to hearing testing. This second test made it possible to obtain a favorable bilateral response in 78.16% of cases. A unilateral or bilateral lack of response was noted in 21.84% of patients. The latter were sent to the ENT department for the realization of an auditory evoked potential and their results will be communicated to us later. Regarding hospitalized patients, they all have at least 2 risk factors for deafness. The use of ototoxic medications and hospitalization for more than 48 hours represent the most common risk factors (93% and 88%) in our series.*

Conclusion: *Our preliminary evaluation, revealing alongside its results several technical and organizational challenges, shows that early detection of neonatal deafness deserves to be continued in our establishment as well as on a national scale.*

Keywords: Newborn, Deafness, Screening, Risk Factors, Oto-Emission

Introduction

Deafness is the most common sensory deficit at birth. It affects approximately 1 to 2 newborns per thousand births [1]. In children at risk, its prevalence is considerably higher, it is of the order of 1 to 4 percent births [2, 3]. Deafness in children differs from that in adults because it disrupts the development of the child's communication, language and cognitive faculties and their social relationships [4]. To reduce the consequences of this

handicap, several screening techniques allowing an objective, reliable and rapid assessment of the functioning of the ear and auditory pathways have been developed. Among them, induced otoacoustic emissions (OEAP) is the most used [5]. This technique must be included in the systematic examination of any child in the same way as other devices. In Morocco, there is no systematic screening for neonatal deafness whether in children at risk or children without risk factors [4]. These screenings, if carried out, are not of an organized nature. Epidemiological data concerning neonatal deafness in our country are rare and unpublished. In this context, the national neonatal screening program for congenital diseases will be reinforced by neonatal screening for congenital deafness, hence the interest of our pilot work in this area, which will improve detection and intervention strategies for newborns. Born at risk of hearing loss. This work is the result of collaboration between the ENT, neonatal intensive care and maternity services of the Mohammed VI University Hospital. It took place in three stages, the first two concerned the screening of deafness, the third is the diagnosis confirmation stage.

Objective

The primary objective of our study was to initiate screening for neonatal deafnessby pediatriciansusingTHEOEAP and to assess the feasibility and relevance of carrying out such screening in our context with a view to its generalization nationally.

Materials and Methods

This is a prospective study spread over two months, between February and March 2024, concerning newborns hospitalized in neonatal intensive care (RN) and those examined in the delivery suites (SC) of the maternity ward of the Mohammed VI University Hospital from Marrakech. Screening is done by two OEAP tests. If the first test was negative, a second was carried out during the first control consultation or after invitation. We referred newborns with two negative tests to theotolaryngologylaryngology of the Mohammed VI University Hospital of Marrakechfor additional support. Concerning the risk factors we used those adopted bythe Joint Committee on Children's Hearing (CMAE) of the American Academy of Pediatrics (AAP). Data collection was based onan anonymous operating sheet. The statistical analysis of the data was carried out with Microsoft Office Excel 2016, then used and analyzed using SPSS®18 softwares. Qualitative variables are expressed as percentages and quantitative variables are expressed as averages with limits.

Results

519 newborns were successfully screened. 49.8% were girls and 51.2% were boys, 459 (88.43%) were seen at the postpartum level and 60 patients or 11.57% at the RN level. The overall average age of screening was 2.1 days,6.3 days for the RN and 1.12 days at the SC level. 294 cases (56.6%) showed a positive response from the first test compared to a unilateral or bilateral negative response in 225 cases (43.4%) [190 from the SC and 35 from theRN] of these 225 newborns, only 87 (38.6%) [57 from SC and 30 from RN] responded to our invitation and they benefited from a second test within our service with an average delay of 18.5 dayswith extremes ranging from 7 days to 30 days. Geographical constraints (distance, accessibility, means of transport, etc.), economic and social constraints represented the major excuses for not returning to hearing testing in our series. This second test made it possible to obtain a favorable bilateral response in 68 newborns (78.16%). A unilateral or bilateral lack of response was noted in 19 patients (21.84%), including 13 (68.42%) for the RN and 6 (31.58) at the SC level. The latter, having a negative test, were sent to the ENT department to perform an auditory evoked potential under general anesthesia and their results will be communicated to us later. Regarding hospitalized patients, they all have at least 2 risk factors for deafness. The use of ototoxic medications and hospitalization for more than 48 hours represent the most common risk factors (93% and 88% respectively) in our series.

Discussion

The perception of the world around the human being cannot be done without the senses and it is essentially hearing which facilitates communication and promotes psycho-affective development and social interactions and integration into society [4]. Worldwide, more than 5% of the world's population, or 466 million people (34 million childrens), suffer from hearing impairment. Permanent bilateral neonatal deafness (SPBN) affects between 800 and 1000 newborns each year in France [1]. Its incidence is estimated in the Auvergne-Rhône-Alpes region at 1.2‰ per 115,000 newborns [2]. In 2050, more than 900 million people will have this type of disability. In Morocco its incidence is estimated at 600 children per year [3]. Our work represents the first assessment of its kind in our country and region. Untreated hearing loss impacts the social and economic development of communities and countries. A case of deafness detected and treated is equivalent to 400,000 dollars saved for society. The World Health Organization (WHO) estimates that approximately 60% of cases of hearing loss in children could be avoided through preventive measures [4]. Neonatal hearing loss can be stable or progressive. It often results from injury to the ear, rarely from injury to the auditory nerve, and very rarely from injury to the central nervous system. The fight against this anomaly is based on interventions relating to prevention, screening and early treatment as well as rehabilitation. Neonatal screening for deafness would contribute to the reduction of neurosensory and disabling morbidities in children. Several studies have evaluated its systematic feasibility by OEAP and the attitude of parents towards such screening [4]. In France, maternity screening has been organized since April 2012 [6]. The Moroccan Ministry of Health plans its gradual implementation with a view to extending it to all regions and it will be supported by the provision of systematic examinations during early childhood [4]. In our service this screening is done after the agreement of one of the two parents. The second test is done freely after a telephone call from the parents after having clearly explained its role and its necessity as well as its ease, tolerance and safety. This problem makes it necessary to develop reliable diagnostic techniques to avoid medical wandering and diagnostic delay, and rapid enough for the screening of a large population [6]. In France, early auditory evoked potentials (EAEPs) in air conduction (AC) by clicks remain the gold standard in the diagnosis of deafness compared to automated otoacoustic emissions [7, 8]. The search for auditory steady state responses (ASSR) in CA is sometimes also used at the confirmation stage with the possibility of simultaneous evaluation of the hearing threshold on frequencies 0.5 to 4 kHz, for both ears [9]. In children, such a presentation would lead to interactions in the cochlea or auditory pathways altering the reliability of the measurements [6]. The validity of ASSR in chil-

dren in conduction oosseous hearing loss (CO) is discussed and this technique alone does not allow us to suggest conductive hearing loss (ST) [9]. There is a risk of diagnostic error linked to transient deafness in infants, common in the first months [7]. In our work, the screening was based on the search for OEAPs in an automated manner with a qualitative result of the OEAP type present or absent, the data is based on an algorithm fixed and integrated into the device. We respected several conditions during our screening : The newborn must be calm, ideally asleep : inactive and silent. The external ear canal must be patent (absence of organic debris in the external ear canal and absence of fluid in the middle ear). The correct positioning of the probe in the external acoustic meatus and the intrinsic (breathing, snoring, sucking) and extrinsic (room, surroundings) sound levels must be low. A normal otoscopy is necessary for the correct measurement of OEAP. Its role is preponderant in the search for anomalies in the external ear and/or the middle ear [10]. Congenital deafness is often detected late. Saccording to a study, the average age at the time of the announcement of the diagnosis is 3.7 years which is very late, the same study highlighted the possible predominance of genetic causes of sensorineural deafness in children in Morocco, and highlights the need to improve policies for the prevention of infectious diseases and screening for neonatal deafness [4]. Like several teams, we tried to carry out the first test after the second day of life [11]. It is preferable to delay the test by the OEAP as much as possible, especially when it comes to newborns hospitalized in an intensive care unit, to allow premature babies to get as close as possible to the term of 35 weeks. It is true that obtaining OEAP is not dependent on the term beyond 29 weeks, but the more the child grows, the more we move away from the problems of fluctuation in obtaining OEAP depending on the presence or not an effusion in the middle ear or vernix caseosa in the external ear canal. Indeed, according to Doyle, the rates of positive tests increase considerably between testing before 12 hours and after 36 hours of life. This rate goes from 26% before 12 hours to 78% after 36 hours [12]. According to Panosetti, this rate increases from 67% for a first test carried out between 24 and 48 hours, to 95.1% when it is carried out between the 4th and 5th day of life [12]. The duration of the test is a significant factor to take into account, particularly on the scale of mass screening. In the literature this duration varies between 2 and 7 minutes [13]. In our experience, the average time to test both ears was 5.2 minutes, including setup time and the time required for the test itself. Unlike our study, on all the newborns studied by Morlet et al. 83.6% of newborns had a positive test while 16.4% had a negative test [14]. Ayache et al found a positive test in 86.56% and negative in 11.36% of newborns [15]. The incidence of positive tests reached 88.64% in the series by Hess et al versus 11.36% of negative tests [16]. 82.7% was the incidence of positive tests reported by Panosetti et al [17]. Our results can be explained by the significant noises secondary to the significant activity in the departments where we carried out the tests. After the first screening test, 87 patients (38.6%) presented to the service for the second screening test. Performing a second test makes it possible to reduce the calculated false positive rate. This rate is frequently due to the presence of seromucous otitis, the occurrence of which is frequent in premature babies and newborns hospitalized in neonatal intensive care [12]. Clemens et al demonstrate in a prospective study that the false positive rate decreases considerably after a second test [18]. Gravel reports a summons rate of 2% after the second test versus 6.6% after the first test, which represents a significant difference [19]. Aidan reports a much higher summons rate, 16.75%, but which decreases significantly after the second screening test to 0.63% [12]. In the literature, the prevalence of deafness in newborns at risk varies between 1 and 4%. In the series by Hess and his team, 13 at-risk newborns out of 942 were diagnosed deaf after PEA, i.e. a prevalence of 1.4% [12]. This prevalence amounts to 4.36% for the German team from Sitka, since 10 children at risk were diagnosed as deaf out of 229 studied [12]. In 2007, in a Dutch multivariate study conducted by Hille et al the prevalence of deafness in children at risk was 3.2%. This rate is much lower among French teams [20]. Ayache and his team at Amiens University Hospital report a prevalence of 0.93% [12]. Morlet reports a result similar to the latter ; 0.91% [21]. The prevalence of deafness in our series was 2.3%. In our series we studied the risk factors for neonatal deafness issued by the Joint Committee on Childhood Hearing (CMAE) of the American Academy of Pediatrics (AAP) are the criteria retained by the entire international community. We find : family history of deafness, prematurity, neonatal jaundice, use of hot therapy [9, stay in neonatology, Assisted ventilation for more than 24 hours or ECMO (blood oxygenation by extracorporeal circuit), bacterial meningitis, maternal-fetal infections, ototoxic medications mainly including aminoglycosides (gentamycin, tobramycin), alone or combined with diuretics of the loop (furosemide) and craniofacial anomalies. To this list, we added other factors explored in our study, namely : parental consanguinity, congenital hypothyroidism, the notion of obstructed delivery and early neonatal infection. To facilitate the study, we have divided these factors into three groups according to their occurrence in relation to the time of birth : Prenatal factors, Perinatal factors, Postnatal factors. In Europe and America, the main arguments cited against systematic screening at birth by OEAP is the number of false positives, which induces an additional cost due to the need to test these babies again and parental anxiety. In our study, socio-demographic constraints and parents' lack of information constitute the main obstacles to this screening. In his work, Hess reports a loss to follow-up rate of 2.01%, and 1.9% death after the first test [12]. The French teams, for their part, deplore a higher rate of loss to follow-up. Morlet reports having lost follow-up of 4.18% of patients to be re-tested [12]. This rate is 6.87% for Ayache and his team [12].

Conclusion

The evolution of hearing aid technologies, particularly cochlear implants, has prompted reflection on the need for early detection of deafness. Advances in cochlear implants have opened up new possibilities for helping children with deafness regain some quality of life. This therefore raises the question of the importance of identifying deafness at the earliest stages in order to enable rapid and effective intervention.Our preliminary assessment,very limited in time,revealing alongside its results several technical and organizational challenges, shows that early detection of neonatal deafness is possible and desirable in our context and that it deserves to be continued in our establishment as well as on a national scale for all newborns in particular, those at risk. It is also importantto raise awareness among health professionals, parents and decision-makers about the importance of this screening and to put in place effective programs to ensure that all children can benefit from this opportunity.

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