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SHORT COMMUNICATION/COMMUNICATION BRÈVE

Startle and blink reflex in high functioning autism

Sursaut et réflexe de clignement dans l'autisme de haut niveau

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Summary An important clinical feature of autism is the presence of atypical responses to sensory stimuli. In this study, we investigated if high functioning autistic patients had abnormalities in the blink reflex and the startle reaction to auditory or somatosensory stimuli. Fourteen patients aged between 7 and 16 years were included in the study. We found a longer latency of the blink reflex, an increased duration and amplitude of the auditory startle reaction and a lower presence rate of the somatosensorial startle reaction in autistic patients. To better define the sensorial characteristics of the disease could improve the therapeutic management of children with autism spectrum disorder.

MOTS CLÉS
Autism ;
Réflexe de clignement ;
Réflexe de sursaut

Résumé Une importante caractéristique clinique de l'autisme est l'atypie de certaines réponses à des stimuli sensitifs ou sensoriels. Dans cette étude effectuée chez des patients autistes de haut niveau, nous avons exploré le réflexe de clignement et la réaction de sursaut à des stimuli auditifs ou somatosensoriels. Quatorze patients âgés de 7 à 16 ans ont été inclus. Nous avons trouvé un allongement de la latence du réflexe de clignement, une augmentation de la durée et de l'amplitude de la réaction de sursaut aux stimuli auditifs et une réduction du taux d'obtention de la réaction de sursaut aux stimuli somatosensoriels chez ces patients autistes. Le fait de mieux définir les caractéristiques sensorielles de la maladie pourrait améliorer la prise en charge thérapeutique des enfants souffrant d'un trouble du spectre autistique.

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Introduction

An atypical response to sensory stimuli is an important clinical feature of autism, and is included in the recent DSM V as one of the diagnostic criteria for autism spectrum disorders (ASD) [8]. It can manifest as hypo- or hyper-reactivity to any or all kinds of sensory modalities, the most common being auditory. The modality and degree of atypical responses vary amongst patients. The atypical sensory reactions such as overreaction to sounds or light touch may interfere with the learning and communication process of these children. Therefore, it is important to take this into consideration in the therapeutic management of ASD.

The causative mechanism of these atypical sensory reactions is not fully understood. It may be due to defects at the level of peripheral sensory receptors, or to conduction problems from the receptors to the cortex, or defects associated with attention, memory and perception [14]. Cortical regions, particularly prefrontal cortex, are reported to play a role in multisensory processing that also comprises subcortical regions, including the brainstem, cerebellum and thalamus [12].

Electrophysiological assessment of the blink reflex (BR) is a standard method that is commonly used for the evaluation of brainstem function. Auditory startle reflex (ASR) is a brainstem reflex which is elicited by auditory stimuli and recorded mainly from the facial and neck muscles, as well as the whole body. Startle reflex can also be obtained through somatosensorial stimuli (SSR) [1]. Brainstem circuits play a role in both responses. The central structure involved in the reflex is the caudal reticular nucleus in the pons [7].

Considering the presence of atypical sensory reactions in combination with possible brainstem pathology in ASD, we investigated abnormalities in BR and startle reaction in a group of high functioning autistic patients. The startle reaction was elicited to both auditory and somatosensorial stimuli (ASR, SSR) to study the respective effects of these different modalities of stimulation.

Methods

Fourteen patients (12 males, 2 females) aged between 7 and 16 years (mean: 11.8 ± 3.5) were included in the study. The control group was consisted of 19 age- and gender-matched typically developing children. Informed consent forms were obtained from families of all participants. Diagnosis of autism was based on DSM V criteria, and symptom severity was rated using the childhood autism rating scale (CARS). To determine intelligence level, the Wechsler Intelligence Scale for Children-Revised (WISC-R) was used by a psychologist. The patients who scored between 30 and 36 on CARS and 65 on WISC-R performance score were included in the study. The mean values of WISC-R scores were 79.1 ± 22.1 for general intelligence quotient (IQ), 90.3 ± 17.7 for performance IQ, and 71.4 ± 26.7 for verbal IQ.

BR was recorded on the orbicularis oculi (OO) muscle following supraorbital nerve stimulation (OO-reflex [supraorbital]). It has three components: ipsilateral R1 and R2, and contralateral R2 (R2C). An electrical stimulus of 0.2 ms duration was delivered at an intensity of three times that of R2 threshold. The stimulus was given randomly as five consecutive bursts with a minimum interval of 20 seconds in order to prevent habituation. The filter settings were 3 kHz high cut and 20 Hz low cut. Onset latencies of R1, R2 and R2C responses were measured and the mean values of the five responses for each parameter were calculated.

For the ASR, after determining of the hearing thresholds, the monophasic 100 μs tone burst auditory stimulus was delivered bilaterally through earphones as 8 bursts, with an intensity of 105 dB HL and at random intervals of 2—5 minutes. The stimulus was planned to be delivered as 8 bursts; however, it was interrupted if the child could not tolerate the test regardless of the completeness of the stimuli. We increased the stimulus duration by 50 ms every 2 stimuli so as to prevent habituation. Surface EMG recordings were obtained over OO, sternocleidomastoid (SCM) and biceps brachii (BB) muscles after each stimulus. The reflex was evaluated in three parts: OO-reflex [auditory], SCM-reflex [auditory], and BB-reflex [auditory]. Latencies, durations, amplitudes and presence rates were calculated.

Somatosensory startle was recorded by stimulating the ipsilateral median nerve at the wrist. An electrical stimulus of 0.2 ms duration was delivered at an intensity of twice the level that evoked a motor response of maximum amplitude in APB. We recorded OO, SCM and BB responses to median nerve stimulation and calculated the latencies and presence rates of OO-reflex [median], SCM-reflex [median], BB-reflex [median]. The response was accepted as present if obtained with an amplitude over 50 μV for two trials. The procedure was stopped if the child could not tolerate the test. We used a method modified from previous studies [11], since there was no standardized method for measuring SSR.

The statistical significance level was defined as $P < 0.05$.

Results

The results are summarized in Table 1.

BR: the patients had increased R2 and R2C latencies, but there was no difference for R1 latency.

ASR: four children from the study group and one child from the control group did not complete the test (8 stimulation bursts) due to intolerance. Amplitude and duration of ASR in SCM and BB were significantly increased in patients, whereas no difference was found in ASR latency between patients and controls. The presence rate of ASR in BB was higher in patients, whereas the presence rates of ASR in OO and SCM were similar in both groups.

SSR: there was no significant difference between patients and controls regarding the latencies of SSR in OO, SCM, or BB. Conversely, the presence rates of these responses in all three muscles were reduced in patients compared to controls. Amplitude and duration of the SSR were disregarded because of these low rate of present responses.

Discussion

In this study, we found prolonged R2 and R2C latencies of the BR, increased amplitude and duration of ASR in SCM and BB, and lower presence rates of SSR in children with ASD.

The R1 component of the BR is a stable response whereas the later R2 is a more unstable response. R2 may be

Table 1 Reflex results in controls and patients.

	Controls	Patients	*P*
Blink reflex			
Latency (ms)			
Left R1	10.1 ± 0.7	10.6 ± 1.1	0.138
Right R1	10.6 ± 0.7	10.8 ± 1.2	0.558
Left R2	32.2 ± 3.9	41.5 ± 12.0	***0.022***
Right R2	33.1 ± 4.2	42.7 ± 13.2	***0.013***
Left R2C	33.7 ± 4.5	43.9 ± 11.9	***0.005***
Right R2C	34.3 ± 3.7	46.8 ± 14.9	***0.017***
Auditory startle reflex			
Latency (ms)			
OO	35.4 ± 6.8	39.2 ± 7.9	0.112
SCM	75.9 ± 22.9	76.7 ± 50.2	0.198
BB	93.8 ± 26.2	123.1 ± 86.0	0.570
Amplitude (μV)			
OO	60.5 ± 19.5	89.9 ± 61.2	0.422
SCM	63.0 ± 39.4	137.3 ± 78.9	***0.011***
BB	68.8 ± 32.4	159.4 ± 27.9	***0.035***
Duration (ms)			
OO	261.6 ± 91.9	276.4 ± 136.3	0.770
SCM	297.8 ± 311.4	564.3 ± 469.8	***0.045***
BB	131.0 ± 74.6	541.7 ± 383.6	***0.006***
Presence rate (%)			
OO	100	100	
SCM	88.2	80	
BB	26.6	53.3	
Somatosensory startle reflex			
Latency (ms)			
OO	51.6 ± 6.2	51.7 ± 10.7	0.815
SCM	77.7 ± 15.2	91.3 ± 31.2	0.362
BB	121.0 ± 29.5	79.5 ± 8.5	0.06
Presence rate (%)			
OO	73.3	46.6	
SCM	43.7	21.4	
BB	25	21.4	

For the blink reflex: R1 and R2 responses ipsilateral to the stimulation and R2 response contralateral to the stimulation (R2C). OO: orbicularis oculi muscle; SCM: sternocleidomastoid muscle; BB: biceps brachii muscle; Mean± are presented. Statistically significant differences ($P < 0.05$) between controls and patients are indicated in bold italics.

influenced by suprasegmental factors, cortical dysfunction and cognitive factors [6]. The similar latencies of R1 between patients and controls in our study rule out a peripheral pathological change, while the longer latencies of R2 suggest an anatomical or functional pathological change that could affect pontomedullary pathways. Brainstem dysfunction and its potential impact on atypical sensory responsiveness in autism have been investigated in several studies. Although some previous autopsy and MRI studies found neuroanatomical brainstem abnormalities in ASD patients, their clinical significance is still not clear [2,4,5,10]. Considering the involvement of brainstem pathways in producing the R2 response, the long latencies of R2 in our patients could mean brainstem dysfunction.

While there were no differences between patients and controls regarding ASR latencies, the duration and amplitude of ASR in SCM and BB were significantly increased in patients. Previous studies have generally used OO recordings to study ASR [3]. There is limited data available regarding ASR in other muscles. A recent study reported increased startle response to weak auditory stimuli in children with ASD to which typically developing children did not react [13]. Increased ASR duration and amplitude in our study suggests a more generalized startle response and hyperreactivity of these children. An overreaction of four patients in the ASD group prevented them from completing the test due to intolerance.

The SSR has not been widely investigated and clearly defined, but its circuit is thought to be similar to that of ASR [1]. We found higher presence rates in typically developing children than that was found in the previous reports of adult cases [1,9]. The presence rate of the SSR was lower for the three muscle recordings in ASD patients compared to controls. In patients, the BR, which was elicited by an electrical stimulus like SSR, also showed reduced excitability (prolonged latency). Conversely, the presence rate of ASR, which was elicited by an auditory stimulus, was increased in ASD patients compared to controls. This

suggests a clear difference between responsiveness of ASD patients to electrical versus auditory stimuli. The different pattern may reflect the enhanced sensitivity of autistic patients to auditory stimuli. This is also consistent with the clinical finding that auditory sensitivity is the most common atypical sensory reactivity reported in ASD. The tactile reaction of ASD patients may include hyper-responsiveness to certain stimuli in combination with hypoalgesia [12]. The lower reactivity to electrical stimuli found in SSR and BR may be related to hypoalgesia. However, the underlying mechanism of the altered sensory responsiveness in ASD is still not clear. Brainstem reflex responses may differ according to stimulation modalities in children with ASD. To better define the sensorial characteristics of the disease could improve the therapeutic management.

Disclosure of interest

The authors declare that they have no competing interest.

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