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RESEARCH ARTICLE

Simple visual reaction time in sickle cell disease patients of pediatric age group

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ABSTRACT

Background: Reaction time (RT) test can be simple or choice or recognition type. RT test has been widely used in literature, but the changes seen, if any is not documented in pediatric age group of sickle cell patients. **Aims and Objectives:** The aim of this study is to record changes in visual RT (VRT) in sickle cell patients of pediatric age group as compared to controls. **Materials and Methods:** The study was a cross-sectional analytic study with a comparative group. The study group consisted of sickle cell patients of pediatric age group. Simple RT was measured. Unpaired *t*-test-two tailed was used to find the difference if any. Cohen'd was also calculated. **Results:** There was a statistically significant difference between cases and comparative group. Mean ± standard deviation (SD) of controls was 0.58 ± 0.12, whereas mean of ± SD of cases was 0.85 ± 0.30. Cohen's d was 1.16. **Conclusion:** There was a statistically significant difference between cases and controls depicting that simple VRT test is prolonged in sickle cell disease patients of pediatric age group of this study.

KEY WORDS: Sickle Cell Disease; Simple Visual Reaction Time; Cohen's d

INTRODUCTION

Reaction time (RT) can be defined as time interval between presentation of stimulus and appearance of appropriate voluntary response in a person, usually expressed in milliseconds.[1-3] Speed of flow of neurophysiological, cognitive, and information process created by the action of stimulus on the sensory system is reflected through RT.[1,4] Three types of RT can be described, namely, simple RT[5,6] in which we respond to one stimulus and one response, choice RT[5-8] in which we respond to multiple stimulus and multiple response, and recognition RT (go/no-go task)[5,9] in which we have to respond to some stimulus and not respond to others. Documented mean visual RT (VRT) is approximately 180-200 milliseconds.[10,11] In literature, sickle cell has been extensively dealt with, and VRT has been utilized for various conditions in different age groups. However, the literature on the study of simple VRT in sickle cell pediatric patients has not been yet reported. In view of this research gap analysis, this study was planned with the objective to record changes in VRT in sickle cell patients of pediatric age group as compared to controls.

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MATERIALS AND METHODS

The study design was a cross-sectional analytical study with comparison group. Sample size was taken as 12 in sickle cell disease group and 12 in comparative group. This was considered as a pilot study, and sample size was decided as per "Rule of 12" for pilot study.[12-14] Sickle cell patients were taken in the study group in the age group of 5-15 years.

Comparative group consisted of children of the same age group without sickle cell disease. VRT was measured before Visual evoked potential tests using audio-visual reaction timer, Medisystems, Haryana, India. There are two sides in the instrument: Operator side and subject side. There are four switches and four LED's on both sides, namely, red, blue, yellow, and green colors. The time taken by the subject to switch off the switch of the glowing light is measured in LCD meter as the RT in seconds. This instrument measures simple RT. The subjects were given practice sessions, and the lowest of the final three readings were taken. Ophthalmic examination was performed by ophthalmologists after the VRT, and the protocol was that if the participant had refractive error or obvious signs of retinal and optic nerve involvement, the data of those participants were excluded. Ophthalmic examination was conducted after the VRT since complete ophthalmic examination requires dilatation of fundus and that would alter the VRT. Statistical test applied was unpaired *t*-test which was two-tailed using Instat Graphpad. The data were expressed as mean ± standard deviation (SD), and the analysis was done at 99% confidence interval with significance at $P < 0.01$. Cohen's d was also calculated.

RESULTS

Table 1 summarizes that there is a statistically significant difference of VRT between cases and controls.

DISCUSSION

VRT is the time taken to react to a visual stimulus by an individual and acts as a reliable indicator of processing rate of sensory stimuli by central nervous system and its motor response leading to the execution of a task.[15,16]

The present study was planned to record any simple VRT changes in cases of sickle cell disease in pediatric age group as compared to controls. As no literature is available on simple VRT changes in pediatric age group of sickle cell patients, this pilot study was undertaken. Mean (SD) of cases was 0.85 ± 0.30 and mean (SD) of control was 0.58 ± 0.12 (Table 1). There was a statistically significant difference between cases and comparative group ($P < 0.01$). Effect size when calculated, Cohen's d was 1.16 which comes under "very large" [0.8: Large, 0.5: Medium, and 0.2: Small[17] which was expanded[18] for "d" as 0.01: Very small, 0.2: Small, 0.5: Medium, 0.8: Large, 1.2: Very large, and 2.0: Huge). Ophthalmic examination was found to be normal with no ocular findings in pediatric sickle cell disease patients.

Table 1: Mean±SD of visual in cases as compared to controls

Groups	Mean±SD	*t*	Significance at *P*<0.01	Cohen's d
Cases	0.85±0.30	2.846	*P*<0.01, significant	1.16
Controls	0.58±0.12			

SD: Standard deviation, RT: Reaction time

In the present study, it was a simple RT test, but there were four color switches to be operated, any one at a time leading to increase in complexity. It is not just a single key to be pressed every time. In this study, when the operator/researcher pressed a red light button, the light on the subject's side would be on, but the subject had to recognize the color and then switch off the light by pressing the corresponding switch below the color switch. One explanation for the mean of VRT to be 580 ms can be the "memory drum theory." The memory drum theory predicts that there is an increase in simple RT with complexity of the response to be initiated.[19,20]

RT consists of perception time + motor time.[21,22] In VRT, the components include reception of light by photoreceptors to relay and transmission in optic nerve to preparation and execution of motor response.[21] In sickle cell disease, there occurs sickling of erythrocytes. Sickling of erythrocytes within small vessels leading to occlusion of vessels, leading to ischemia furthering neovascular proliferation may be the reason for the ophthalmic manifestations of sickle cell disease.[23] Optic nerve involvement may also occur as a sequelae to ischemia in sickle cell patients.[24] Significantly increased VRT in pediatric sickle cell patients in the absence of any ocular symptoms or ocular findings may point toward the subclinical involvement of the visual transmission pathway which should be explored further.

The simple VRT reported in the present study is parallel to the study by Kiselev[25] in which mean VRT in 5-year-old children was 580 ms ± 144 and 6 years old was 467 ± 85. However, it is not in accordance with Bhakare P who reported mean VRT as 0.26 ± 0.067.[26]

Strength of the Study

In the extensive literature search, this pilot study conducted can serve as a baseline research to explore further the VRT in pediatric sickle cell patients.

Limitations

As there was no literature available on simple VRT in pediatric sickle cell patients, this pilot study was undertaken. This study included a small sample size due to which grouping of participants as per age could not be performed.

CONCLUSION

In the present study, simple VRT was significantly increased in sickle cell pediatric age group patients as compared to controls.

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