Evoked Potentials in Infants with Congenital Heart Diseases

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ABSTRACT

BAEPs and SEPs are non invasive tests which could use to clarify the effect of cyanosis on CNS in infants with congenital heart diseases. The absolute latency of wave III was prolonged in both cyanotic and acyanotic infants and the I-III inter-peak latency were also prolonged in the cyanotic group compared to control group. The previous changes could not be correlated to the presence of heart failure or chest infection, but were significantly correlated to neurological affection in the cyanotic group. The conduction time of the SEPs thalamic wave was delayed in the cyanotic group only but was not correlated to neurological affection, heart failure or chest infection. There is a significant negative correlation between EF% and wave V latency in BAEPs and between the EF% and the cortical latency in SEPs as well as between O2 saturation and Erb's potential latency in the cyanotic group which indicate that both chronic hypoxemia and poor contractility of the cardiac muscles may play a role in retarded brain stem maturation as a result of retardation in the myelination process of the brain stem. (Egypt J. Neurol. Psychiat. Neurosurg., 2005, 42(1): 165-175).

INTRODUCTION

The true incidence of congenital heart disease (CHD) is difficult to determine accurately. It has been estimated that approximately 0.8% of life birth is complicated by cardiovascular malformation¹. Neurodevelopmental abnormalities are common in young infants with CHDs and are often present before open heart surgery. They were observed in 38% of 72 infants with CHD and were significantly associated with arterial oxygen saturation < 85%. Those developmental concerns are clinically underappreciated².

Evoked potential testing is a non invasive way to assess the integrity of the sensory pathway of the nervous system which could detect structural and functional damage³. A review of the literature reveals that brainstem conduction abnormalities in auditory brainstem evoked potentials are associated with neuromotor impairment; however, there are many false negative studies. Sensitivity and specificity are consistently high for somatosensory evoked potentials in term newborns; however correlations with outcome in premature infants are controversial. Several studies have compared neonatal findings on neuroimaging studies and evoked potentials, and concordant results between these two tests are highly predictive. Evoked potentials are sensitive prognostic tools in young infants at risk for developmental disability⁴,⁵.

Aim of work:

The objective of this study was to determine whether infants with congenital heart diseases demonstrate evoked potential abnormalities and to examine the association between these abnormalities and the presence of risk factors and oxygen saturation level.
PATIENTS AND METHODS

Patients:

Forty three infants ranging in age from one to twenty-four months were recruited in this study divided into:

Study group (group 1):

Thirty three infants who had congenital heart diseases from both sexes recruited from the outpatient clinic of the New Children Hospital and the cardiology clinic of Abo-Erlrish Hospital. They sub-classified into:

Group 1a formed of fourteen infants with acyanotic CHD and Group 1b nineteen infants with cyanotic CHD.

Control group (group 2):

Ten infants were recruited from Abo-Erlrish hospital clinics with no major abnormalities.

Exclusion criteria:

Severely ill cyanotic infants who needed immediate Raskined operation or who had very low O₂ saturation level.

Methods:

Each infant from both groups was subjected to the following:

* Meticulous history taking; personal data (age, weight & height) family history (consanguinity, other sibling affected), prenatal history and history of cyanosis, apnea spells, recurrent chest infection, squatting and others.

* Clinical examination: pulse felt both radial and femoral, blood pressure measurements from both upper and lower limb, visceromegaly and accompanying extra cardiac lesions, auscultation of the chest.

* Chest plain X-ray.

* Laboratory investigation: hemoglobin, hematocrit %, RBC count, WBC count, platelet count, partial pressure of oxygen (PaO₂) and O₂ saturation.

* Full echocardiographic studies using M mode, 2D, colored Doppler done with SSA-270A Toshiba sono and "Hp" Hewlett Packard 5500 carried in the cardiology clinic in Abo-Erlrish Hospital.

* Evoked potential studies carried in the Clinical Neurophysiology Unit for both brain stem auditory evoked potentials (BAEPs) and median nerve short latency somatosensory evoked potentials (SEPs).

BAEPs:

The stimuli used to elicit the BAEPs were clicks of rarefaction polarity at rates 1/sec. and between 60-80 dB in intensity which were generated by 100 us rectangular pulses and delivered monaurally through infant earphones.

Recording BAEPs was started while the infant was awake but some cases felt asleep after lactation. Sampling was manually disconnected whenever there were excessive movement's artifacts on the monitoring oscilloscope.

Responses to 2000 stimuli were averaged for each run. At least 2 runs were made for each ear to test consistency of the response.

Routine recording electrodes were placed at vertex (Cz) as active, ipsilateral ear lobe as reference and contra-lateral ear lobe as ground.

SEPs:

Percutaneous electrical stimulation of the median nerve was done using bipolar disc electrodes 3 cm apart applied between the mid palm and the wrist with the cathode being proximal creating an electrical pulse 100 us in duration at 2.8/sec for 250 stimuli in each test.

The intensity of the stimulus was just enough to produce minimal twitches of the corresponding thumb.

The first recording electrode was applied to the corresponding Erb's point just above the mid clavicular point. If no response could record the electrode was replaced at the anterior axillary point. The second electrode was over the second cervical spinous process and the third one 1 cm lateral and behind the C3 or C4 point according to the international 10-20 system of EEG electrodes placement.
The reference electrodes as applied to Fz and the ground between the stimulating and recording electrodes.

Statistical analysis:
Quantitative data were presented as mean ± SD and range. Qualitative data as percentage were also used.
For comparison of two groups the student's t-test and CHI square test were used.
Pearson correlation was calculated to measure the degree of association between two variables. All calculated P-values were two sided. P-value less than 0.05 was considered significant and less than 0.01 highly significant.

RESULTS

Results of history taking:
1. Consanguinity:
   It was positive in 5/14 patients (35.7%) of the acyanotic group and 6/19 patients (31.6%) of the cyanotic group.
2. Other affected sibling:
   It was positive in 4/14 patients (28.6%) of the acyanotic and 2/19 patients (10.5%) of the cyanotic group.
3. Recurrent cases in the family (other than sibling):
   It was positive in 3/14 patients (21.4%) of the acyanotic and in 3/19 patients (15.8%) of the cyanotic.

Results of clinical examination:
1. Symptoms of heart failure:
   They were present in 9/14 patients (64.3%) of the acyanotic group and in 4/19 patients (21.1%) of the cyanotic one.
2. Recurrent chest infection:
   It was present in 8/14 patients (57.1%) of the acyanotic group and in 7/19 patients (36.8%) of the cyanotic group.
3. Neurological affection:
   In the form of hypertonia, jitteriness, decreased motor power and/or delayed mental development. It was present in 2/14 patients (14.3%) of the acyanotic and in 14/19 patients (73.7%) of the cyanotic group. [P-value =0.003, highly significant.]

Laboratory data of the patients groups:
Laboratory data of the acyanotic group are summarized in table (1). Laboratory data of the cyanotic group are summarized in table (2). O₂ saturation % and partial O₂ pressure (PaO₂ mmHg) levels in all groups. They are summarized in table (3).

Echocardiography results:
From the numerous data collected from the echocardiography we will stress on the fraction shorting (FS) and ejection fraction (EF) which both measure the degree of contractility of the cardiac muscles (Table 4).

BAEPs results:
The mean latencies (in msec) of waves I, III and V, the mean of the inter peak latency of I-III, III-V and I-V and the amplitude ratio of waves I/V of the 3 groups are summarized in table (5) and figure (1).

Statistical relevance of BAEPs:
There was no significant statistical difference between cyanotic and acyanotic groups regarding the absolute latencies, inter peak latencies and the amplitude ratio.
There was a significant statistical difference between the cyanotic and control groups regarding the absolute latency of wave III (P= 0.024) and inter peak latency I-III (P= 0.015).
There was a significant statistical difference between the acyanotic and control groups regarding the absolute latency of wave III (P= 0.012).

Comparative studies:
BAEPs results in infants with neurological affection:
The mean latencies of waves I, III and V and the inter peak latencies between waves I-III, III-V and I-V and the amplitude ratio of wave I/V in
infants with neurological affection of both acyanotic (2/14) and cyanotic groups (14/19) are summarized in table (6), figure (2).

There is significant statistical difference regarding the absolute latency of wave III (P=0.026), the I-III inter peak latency (P=0.027) and the amplitude ratio I/V (P= 0.049) towards the cyanotic group.

**BAEPs results in infants with heart failure:**

BAEP results in infants with heart failure of both acyanotic (9/14) and cyanotic groups (4/19) are summarized in table (7).

Statistical studies showed no significant difference regarding the absolute latencies, inter peak latencies and amplitude ratio.

**BAEPs results in relation to the presence of chest infection:**

Table (8) shows the BAEP results in infants with chest infection in both acyanotic and cyanotic groups. There is no significant difference between the results of the cyanotic and acyanotic groups.

**Correlation between echo data, O2 saturation, PaO2 and BAEPs:**

In acyanotic group there is a significant negative correlation between EF and O2 saturation (P= 0.041).

In cyanotic group there is significant negative correlation between EF and absolute latency of wave V (P= 0.049)

**SEPs results:**

The mean latencies of the Erb's, cervical, thalamic and cortical potentials and the interpeak latency of the Erb's-cervical, cervical-cortical and Erb's-cortical of the 3 groups are summarized in table (9) and figure (3).

**Statistical relevance of SEPs:**

There was significant statistical difference between the cyanotic and acyanotic groups regarding the absolute cervical latency (P=0.033) and a highly significant difference regarding the thalamic latency (P=0.001).

There was a significant statistical difference between the cyanotic and normal control group regarding the absolute thalamic latency (P=0.019).

Regarding the absolute Erb's potential latency there was apparent difference between the cyanotic and the control groups but did not reach the significant statistical relevance (P=0.056).

There was no significant statistical difference between the acyanotic and normal control group.

**Comparative studies:**

- **SEPs results in relation to the presence of neurological affection:**
  Table (10) shows the mean latencies of Erb's, cervical, thalamic and cortical potentials and the interpeak latencies between Erb's-cervical, cervical-cortical and Erb's-cortical in both acyanotic (2/14) and cyanotic (14/19) infants.
  There was no statistical significant difference between cyanotic and acyanotic groups (Figure 4).

- **SEPs results in relation to the presence of heart failure:**
  Table (11) shows the SEPs in infants with heart failure in acyanotic (9/14) and cyanotic groups (4/19). There was also no statistical significant difference between cyanotic and acyanotic groups.

- **SEPs results in relation to the presence of chest infection:**
  There was also no statistical significant difference between cyanotic and acyanotic groups.

**Correlation between echo data, O2 saturation, PO2 and SEP results:**

In acyanotic group there is negative significant correlation between EF and O2 saturation (P= 0.049).

In cyanotic group there is significant negative correlation between EF and absolute cortical latency (P= 0.033) as well as between O2 saturation and absolute Erb's latency (P= 0.043).
Table 1. Laboratory data of the acyanotic group.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Normal</th>
<th>Decreased</th>
<th>Increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB</td>
<td>78.9 %</td>
<td>21.1 %</td>
<td>-----</td>
</tr>
<tr>
<td>HCT</td>
<td>78.9 %</td>
<td>21.1 %</td>
<td>-----</td>
</tr>
<tr>
<td>RBCs count</td>
<td>78.9 %</td>
<td>21.1 %</td>
<td>-----</td>
</tr>
<tr>
<td>WBCs count</td>
<td>52.6 %</td>
<td>-----</td>
<td>47.4 %</td>
</tr>
<tr>
<td>Platelets count</td>
<td>100 %</td>
<td>-----</td>
<td>-----</td>
</tr>
</tbody>
</table>

Table 2. Laboratory data of the cyanotic group.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Normal</th>
<th>Decreased</th>
<th>Increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB</td>
<td>48.1 %</td>
<td>29.6 %</td>
<td>22.3 %</td>
</tr>
<tr>
<td>HCT</td>
<td>62.9 %</td>
<td>14.8 %</td>
<td>22.2 %</td>
</tr>
<tr>
<td>RBCs count</td>
<td>48.1 %</td>
<td>29.6 %</td>
<td>22.3 %</td>
</tr>
<tr>
<td>WBCs count</td>
<td>88 %</td>
<td>8 %</td>
<td>4 %</td>
</tr>
<tr>
<td>Platelets count</td>
<td>57.6 %</td>
<td>34.7 %</td>
<td>7.7 %</td>
</tr>
</tbody>
</table>

Table 3. O₂ saturation % and PaO₂ mmHg level in all groups.

<table>
<thead>
<tr>
<th>O₂ sat %</th>
<th>Normal</th>
<th>Acyanotic</th>
<th>Cyanotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>97</td>
<td>90</td>
<td>47.2</td>
</tr>
<tr>
<td>Max/min</td>
<td>99/95</td>
<td>95/85</td>
<td>55/40</td>
</tr>
<tr>
<td>PaO₂</td>
<td>Normal</td>
<td>Acyanotic</td>
<td>Cyanotic</td>
</tr>
<tr>
<td>Mean</td>
<td>83</td>
<td>80</td>
<td>37.5</td>
</tr>
<tr>
<td>Max/min</td>
<td>108/83</td>
<td>85/75</td>
<td>45/30</td>
</tr>
</tbody>
</table>

Table 4. Echocardiographic data collected from patient groups.

<table>
<thead>
<tr>
<th></th>
<th>FS range</th>
<th>FS mean±SD</th>
<th>EF range</th>
<th>EF mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>acyanotic</td>
<td>30-40%</td>
<td>35.3±3.3</td>
<td>60-70%</td>
<td>65.5±6.9</td>
</tr>
<tr>
<td>cyanotic</td>
<td>40-50%</td>
<td>45.2±4.3</td>
<td>80-85%</td>
<td>84.4±8.3</td>
</tr>
</tbody>
</table>

Table 5. BAEPs results from all groups.

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>III</th>
<th>V</th>
<th>I-III</th>
<th>III-V</th>
<th>I-V</th>
<th>I/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.73±0.29</td>
<td>4.26±0.41</td>
<td>5.98±0.68</td>
<td>2.53±0.34</td>
<td>1.72±0.59</td>
<td>4.25±0.83</td>
<td>1.16±1.97</td>
</tr>
<tr>
<td>Acyanotic</td>
<td>1.68±0.26</td>
<td>3.88±0.45</td>
<td>5.85±0.35</td>
<td>2.20±0.41</td>
<td>1.97±0.52</td>
<td>4.17±0.48</td>
<td>1.02±1.92</td>
</tr>
<tr>
<td>Cyanotic</td>
<td>1.70±0.28</td>
<td>3.97±0.34</td>
<td>5.77±0.49</td>
<td>2.27±0.36</td>
<td>1.80±0.38</td>
<td>4.07±0.45</td>
<td>1.30±0.79</td>
</tr>
</tbody>
</table>
Table 6. BAEPs results in infants have neurological affection of both acyanotic and cyanotic groups.

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>III</th>
<th>V</th>
<th>I-III</th>
<th>III-V</th>
<th>I-V</th>
<th>I/V ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acyanotic</td>
<td>1.64±0.20</td>
<td>3.50±0.33</td>
<td>5.58±0.40</td>
<td>1.86±0.41</td>
<td>1.88±0.40</td>
<td>3.94±0.54</td>
<td>1.95±2.05</td>
</tr>
<tr>
<td>Cyanotic</td>
<td>1.67±0.32</td>
<td>3.82±0.35</td>
<td>5.62±0.53</td>
<td>2.15±0.36</td>
<td>1.80±0.42</td>
<td>3.95±0.68</td>
<td>1.38±1.77</td>
</tr>
</tbody>
</table>

Table 7. BAEPs results in infants with heart failure of both acyanotic and cyanotic groups.

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>III</th>
<th>V</th>
<th>I-III</th>
<th>III-V</th>
<th>I-V</th>
<th>I/V ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acyanotic</td>
<td>1.59±0.44</td>
<td>3.70±0.91</td>
<td>5.44±1.26</td>
<td>2.11±0.83</td>
<td>1.74±0.59</td>
<td>3.85±1.12</td>
<td>1.96±1.90</td>
</tr>
<tr>
<td>Cyanotic</td>
<td>1.48±0.48</td>
<td>3.66±1.16</td>
<td>5.30±1.67</td>
<td>2.18±0.69</td>
<td>2.64±1.29</td>
<td>3.96±1.17</td>
<td>2.14±1.77</td>
</tr>
</tbody>
</table>
Table 8. BAEPs in infants with chest infection in both acyanotic and cyanotic group.

<table>
<thead>
<tr>
<th>Group</th>
<th>I</th>
<th>III</th>
<th>V</th>
<th>I-III</th>
<th>III-V</th>
<th>I-V</th>
<th>I/V ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acyanotic</td>
<td>1.60±0.24</td>
<td>3.85±0.24</td>
<td>5.69±0.43</td>
<td>2.25±0.61</td>
<td>1.84±0.40</td>
<td>4.09±0.49</td>
<td>1.73±1.39</td>
</tr>
<tr>
<td>Cyanotic</td>
<td>1.67±0.60</td>
<td>3.87±0.44</td>
<td>5.76±0.52</td>
<td>2.18±0.40</td>
<td>1.89±0.42</td>
<td>4.09±0.62</td>
<td>1.72±1.33</td>
</tr>
</tbody>
</table>

Table 9. SEPs results in all groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Erb's</th>
<th>cervical</th>
<th>thalamic</th>
<th>cortical</th>
<th>Erb's-cervical</th>
<th>Cervical-cortical</th>
<th>Erb's-cortical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>9.18±1.37</td>
<td>13.41±1.52</td>
<td>19.04±1.5</td>
<td>21.31±3.55</td>
<td>4.2</td>
<td>7.9</td>
<td>12.1</td>
</tr>
<tr>
<td>Acyanosis</td>
<td>9.85±2.09</td>
<td>13.72±1.26</td>
<td>18.40±2.04</td>
<td>21.72±4.60</td>
<td>3.87</td>
<td>8.0</td>
<td>11.87</td>
</tr>
<tr>
<td>Cyanosis</td>
<td>10.07±1.09</td>
<td>13.58±2.14</td>
<td>20.79±3.05</td>
<td>21.58±4.13</td>
<td>3.51</td>
<td>8.0</td>
<td>11.51</td>
</tr>
</tbody>
</table>

![Fig. (3): SEPs in all tested groups.](image)

Table 10. SEPs in infants with neurological affection of both acyanotic and cyanotic groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Erb's</th>
<th>Cervical</th>
<th>Thalamic</th>
<th>Cortical</th>
<th>Erb's-cervical</th>
<th>Cervical-cortical</th>
<th>Erb's-cortical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acyanotic</td>
<td>9.53±1.18</td>
<td>13.50±1.93</td>
<td>19.28±2.91</td>
<td>22.67±4.19</td>
<td>3.97</td>
<td>9.17</td>
<td>13.14</td>
</tr>
<tr>
<td>Cyanotic</td>
<td>9.99±1.17</td>
<td>13.28±1.34</td>
<td>20.51±2.12</td>
<td>20.62±4.43</td>
<td>3.29</td>
<td>7.34</td>
<td>10.63</td>
</tr>
</tbody>
</table>
DISCUSSION

Children with congenital heart defects commonly have ongoing neurologic, motor, and developmental deficits before as well as after surgical correction. The cause is multifactorial and includes brain injury before, during, and after heart surgery.6 Neurological affection presented as hypertonia, depressed motor and mental development, jitteriness, lethargy, weak suckling and depressed functional skills5 which are more obvious in cyanotic than acyanotic infants.

In newborns, neurobehavioral abnormalities were documented in >50% before surgery, with abnormalities persisting in most after surgery. In infants, neurodevelopmental abnormalities were observed in 38% before surgery. There was a significant association between preoperative and postoperative neurodevelopmental status, with status remaining unchanged in most. Newborns with acyanotic heart lesions were more likely to demonstrate neurologic compromise than those with cyanotic defects. For infants, arterial oxygen saturations <85% were significantly associated with an abnormality.2 In the present study arterial O2 saturation with mean 47.2% in the cyanotic group was highly associated with neurological defects.

Evoked potentials can reflect various patterns of brain injury or mal-development. They evaluate the functional integrity of the ascending neuraxis and have proven prognostic value for a range of functional deficits. SEP abnormalities in particular have excellent sensitivity and specificity with respect to neurodevelopment outcome at school entry.7 BAEP is a useful indicator of brain stem function6 as the time of conduction is modified by

Table 11. SEPs in infants with heart failure in both acyanotic and cyanotic groups.

<table>
<thead>
<tr>
<th></th>
<th>Erb’s</th>
<th>Cervical</th>
<th>Thalamic</th>
<th>Cortical</th>
<th>Erb’s-cervical</th>
<th>Cervical-cortical</th>
<th>Erb’s-cortical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acyanotic</td>
<td>9.54±1.21</td>
<td>13.53±1.56</td>
<td>19.65±2.63</td>
<td>21.25±4.49</td>
<td>3.99</td>
<td>7.72</td>
<td>11.71</td>
</tr>
<tr>
<td>Cyanotic</td>
<td>9.90±2.01</td>
<td>13.28±1.87</td>
<td>19.91±2.77</td>
<td>22.64±4.17</td>
<td>3.38</td>
<td>9.36</td>
<td>12.74</td>
</tr>
</tbody>
</table>
the presence of neurological damage. In the present work the absolute latency of wave III was prolonged in both cyanotic and acyanotic infants and the I-III inter-peak latency was also prolonged in the cyanotic group compared to normal group. The previous changes could not be correlated to the presence of heart failure or chest infection, but were significantly correlated to neurological affection in the cyanotic group.

In 1992, BAEPs were carried out in 70 children with CHD from one month to four years in age and it was found that I-V inter peak latency of the cyanotic group was more prolonged than that of the control group and that of the acyanotic group. There was also significant negative correlation between the I-V interpeak latency and oxygen saturation and partial oxygen pressure.

Okutan et al. studied BAEPs in 45 children with CHD (23 cyanotic & 22 acyanotic) and compared the results to 30 healthy individuals. The results of BAEPs were similar in acyanotic and normal control while the cyanotic patients below 1 year of age had prolonged I-V interpeak latencies and also showed a significant negative correlation with arterial oxygen saturation and partial oxygen pressure.

In the present work there was a significant negative correlation between EF% and wave V latency in the cyanotic group which indicate that both chronic hypoxemia and poor contractility of the cardiac muscles may play a role in retarded brain stem maturation as a result of retardation in the myelination process of the brain stem suggesting the presence of significant positive correlation between risk factors: condition at birth, severity of the neurological affection, encephalopathy and the abnormalities in BAEPs.

Several investigators had carried BAEPs intra-operatively in infants during open heart surgery and reported increase in the BAEPs latencies and decrease in amplitude with reduction in the core temperature during the induction of hypothermia. The effect of hypothermia was reversed completely for latency and partially for amplitude with re-warming suggesting that the neural activity had not recovered completely.

In the present study the conduction time of the SEPs thalamic wave was delayed in the cyanotic group only but was not correlated to neurological affection, heart failure or chest infection. There was a significant negative correlation between the EF% and the cortical latency as well as between O2 saturation and Erb's potential latency which could indicate that both chronic hypoxemia and poor contractility of the cardiac muscles may play a role in SEPs affection.

Limperopoulos et al. underwent preoperative somatosensory evoked potential recordings in twenty-seven newborns and 31 infants with CHD. Results indicate that preoperative somatosensory evoked potential abnormalities were common in newborns (41%) but not in infants (13%) with congenital heart defects. All newborns with abnormal somatosensory evoked potentials had abnormal neurological examinations both preoperatively and again 1 year after open heart surgery. Moreover, standardized developmental assessments 1 year following surgery indicate that all newborns with somatosensory evoked potential abnormalities had developmental deficits in one or more domains. Somatosensory evoked potential abnormalities in the preoperative period are common in newborns with congenital heart defects, and are strongly predictive of persistent developmental delay later.

Prediction of outcome for neonatal intensive care unit graduates is clinically useful to counsel families effectively and target those who may benefit from early interventions. Evoked potentials have a proven prognostic value of neurologic outcomes in early childhood; however, their long-term predictive validity remains to be determined. The objective of Majnemer and Rosenblatt (2000) prospective study was to determine the long-term predictive value of three neonatal neurological assessments: brainstem auditory evoked potentials, somatosensory evoked potentials, and the Einstein Neonatal Neurobehavioral Assessment Scale. Seventy-eight high-risk newborns and 28 healthy controls were recruited and were assessed in the newborn period.
using these tests. At 8 to 9 years of age, 42 subjects and 13 controls were re-evaluated for developmental progress using a range of psychologic, sensorimotor, and neurologic measures. Findings indicated that the somatosensory evoked potential was the most accurate at predicting outcome at school age, with high specificity (83-100%) across all domains tested and good sensitivity (80-100%) for intellectual performance and sensorimotor abilities. The brainstem auditory evoked potential was limited by false-negative results, whereas the neonatal neurobehavioral assessment yielded many false-positive results. This study provides new evidence that associations between neonatal somatosensory evoked potentials and developmental sequel continue to be significant at school age.13

REFERENCES

الملخص العربي

العوائق العصبية تتزايد بصورة ملحوظة في الأطفال المصابين بعوب القلب الخلقية خاصة النوع المصحوب بالزرقة.

الجدول المقارن بين مجموعتين من الأطفال دون عوائق عصبية في كل من الجماعتين عدد بيئتهم، فملاحظة تأثير العوائق على نمو وتطور الجهاز العصبي المركزي وتقييم دور الجهد المترقب السمسي والعصبي في تشخيص هذه العوائق.

تمت الدراسة على 34 طفل تواجع أعمارهم بين شهر واحد و 24 شهر لديهم عوائق خلقية في القلب. 19 منهم لديهم زرقة و14 ليس لديهم زرقة بالإضافة إلى 10 أطفال طبيعيين كمجموعة ضابطة. كل من هؤلاء الأطفال تم تحصينه إحصائياً، معملياً، رقمياً، أتمت على القلب، وعوائق صوتية للقلب بالإضافة إلى الجهاز العصبي المركزي والعصبي للعصب الأولية.

وقد وجد في نتائج البحث:

- عوائق عصبية في 14 طفل لديهم زرقة و 2 فقط من 14 طفل ليس لديهم زرقة.

في نتائج الدراسة تم توثيق أن عوائق عصبية تتأثر بشكل سلبي عند الأطفال المصابين بعوب القلب الفقري في مجموعتين مقارنة بالبشر الطبيعيين. كما تم فحص هذا العلاقة بين عوائق، وعوائق عصبية، وعوائق عصبية في مجموعتين مقارنة بالبشر الطبيعيين.

وقد وجد عوائق عصبية في الأطفال المصابين بعوب القلب الفقري في مجموعتين مقارنة بالبشر الطبيعيين. كما تم فحص هذا العلاقة بين عوائق عصبية، وعوائق عصبية في مجموعتين مقارنة بالبشر الطبيعيين.

وقد وجد عوائق عصبية في الأطفال المصابين بعوب القلب الفقري في مجموعتين مقارنة بالبشر الطبيعيين. كما تم فحص هذا العلاقة بين عوائق عصبية، وعوائق عصبية في مجموعتين مقارنة بالبشر الطبيعيين.

ومع ذلك، فإن العوائق العصبية في الأطفال المصابين بعوب القلب الفقري تتأثر بشكل سلبي عند الأطفال المصابين بعوب القلب الفقري في مجموعتين مقارنة بالبشر الطبيعيين. كما تم فحص هذا العلاقة بين عوائق عصبية، وعوائق عصبية في مجموعتين مقارنة بالبشر الطبيعيين.