Management of organic phosphorus poisoning using a pupillometer: a case report

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Author contribution
RI: wrote and drafted the manuscript. KA measured the drug concentration. GS, YN, YM, SY, HS, MW, and MH helped draft the manuscript. All authors read and approved the final manuscript.

Learning points for physicians
Dyscoria is a common symptom of organic phosphorus poisoning. Unlike the penlight method, the quantitative pupillometer can detect dyscoria. Neurologic pupil index - the pupil contraction percentage measured by a pupillometer, is useful in evaluating the condition that arises from ingesting high levels of organic phosphorus.

Case Report
A 77-year-old man was brought to our hospital emergency room (ER) for pesticide self-poisoning as a means of suicide. The patient was lucid upon presentation at the ER with a respiratory rate of 20 breaths per minute, blood pressure of 138/60 mmHg, pulse rate of 78 per minute. Other symptoms were not observed. We conducted a penlight exam to assess the pupils but did not observe any abnormality. Fenitrothion was detected in the gastric juice and a low level of acetylcholinesterase (ChE) was found in the blood. He was addicted to Organic phosphorus poisoning. We administered 2-pyridine aldoxime methiodide (2-PAM) and the patient was admitted to the ICU. Sudden stridor and dyspnea were observed within 3 days of hospitalization. The patient was intubated. After continuous administration of atropine sulfate for 2 days, stridor disappeared. Respiratory state improved after 8 days of hospitalization and the patient was removed from the ventilator. As measures of breath and hemodynamics became stable, the patient was discharged from the ICU after 14 days (Figure 1). We observed
the pupil using a pupillometer until ICU discharge. The normal pupil size without photic stimulation (SIZE) and the minimum pupil diameter (MIN) values ranged from 4–6 mm until 6 days of hospitalization. The constriction % or percentage change (CH) was 10% or less and light reflex was detected consistently. The CH improved after the 7th day of hospitalization and increased to 10% or more on the 8th day. The neurological pupil index (NPi) improved subsequently with CH. An upward trend for NPi, CH, and ChE was eventually observed.

Discussion

The organic phosphorus poisoning inhibits an effect of the acetylcholinesterase (AChE). And the most common symptoms are found in approximately 75% of cases for a miosis [1]. Respiratory symptoms, tachycardias, mydriases are symptoms to be found relatively a lot.

We do not observe any abnormality of a pupil diameter upon arrival at the hospital. A respiratory failure develop after three days of hospitalization. SIZE of the pupillometer of this time shows a mydriasis at 5.7mm. Other measurements decrease with NPi 0.5, 1% of CH remarkably. The pupillometer is a precision, a reproducibility device and cannot measure NPi, the number such as the CH by the pen light method [2]. The possibility that NPi and the CH quickly reflect the condition of a patient that is addicted to organic phosphorus is suggested.

For the organic phosphorus poisoning, the optimal medication method of the drug is not established. The nucleus of the treatment is atropine sulfate and 2-PAM. As for the administration start and the increase and decrease of the atropine, it is used as an indication an airway discharge, a pupil diameter, a sweat rate, breath sounds [3,4]. The decision of the effect of treatment in the present is determined in this way by a symptom. This thinks with one reason why the optimal medication method of the drug is not established.

At ICU, the pupil diameter changes at 5·6mm and are not available in a judgment of the remission exacerbation of the symptom. But NPi and the CH measured by a pupillometer, and they reflect an effect of treatment for administration of atropine sulfate and the end of the artificial respiration. Thus, NPi and The CH are thought to reflect the remission exacerbation of the symptom and the therapeutic effect.

Conclusion

The pupillometry by the pupillometer is useful for organic phosphorus poisoning. It may be available in the judgment of a start and the withdrawal of atropine because we
objectively can confirm the pupillary minute change that we cannot measure by the pen light method.

**Acknowledgments**: Nil
References


**Figure 1. Blood and eye evaluation throughout hospitalization**

Monitoring of the blood levels of ChE and eye parameters throughout hospitalization. The black arrows on top represent the duration of treatment with 2-PAM and atropine and duration of ventilator support. The blood ChE levels did not return to normal. SIZE
and MIN increased and, on the 3rd day after hospitalization, all parameters except LAT decreased subsequently with the deterioration of the breath state. As the condition of the patient stabilized, CV, MCV, and DV were slightly improved but CH and NPi were significantly improved.

**Abbreviations**

2-PAM: 2-pyridine aldoxime methiodide, NPi: Neurological pupil index, ChE: acetylcholinesterase, SIZE: normal pupil size without photic stimulation, MIN: minimum pupil diameter, CH: constriction %, CV: constriction velocity, MCV: maximum constriction velocity, LAT: latency, DV: dilation velocity
<table>
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<th>day</th>
<th>1</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<td>0.6</td>
<td>1</td>
<td>0.8</td>
<td>0.9</td>
<td>1.3</td>
<td>1.8</td>
<td>1.1</td>
<td>1.5</td>
<td>1.7</td>
<td>3.1</td>
<td>3.7</td>
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<tr>
<td>SIZE(mm)</td>
<td>3.95</td>
<td>5.68</td>
<td>6.17</td>
<td>5.4</td>
<td>4.93</td>
<td>4.43</td>
<td>4.7</td>
<td>5.62</td>
<td>5.12</td>
<td>5.61</td>
<td>5.07</td>
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<td>MIN(mm)</td>
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<td>5.63</td>
<td>5.73</td>
<td>5.17</td>
<td>4.67</td>
<td>4.25</td>
<td>4.15</td>
<td>5.06</td>
<td>4.74</td>
<td>4.77</td>
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<td>CH(%)</td>
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<td>7</td>
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<td>CV(mm/sec)</td>
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<td>1.14</td>
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<td>1.28</td>
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<td>LAT(sec)</td>
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<td>DV(mm/sec)</td>
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<td>0.06</td>
<td>0.02</td>
<td>0.29</td>
<td>0.22</td>
<td>0.2</td>
<td>0.4</td>
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<td>0.59</td>
<td>0.76</td>
<td>1.07</td>
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<td>ChE(U/L)</td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
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140x120mm (300 x 300 DPI)