ABOUT JTEHS

The Journal of Toxicology and Environmental Health Sciences (JTEHS) is published monthly (one volume per year) by Academic Journals.

The Journal of Toxicology and Environmental Health Sciences (JTEHS) is an open access journal that provides rapid publication (monthly) of articles in all areas of the subject such as toxic genomics, enzyme inhibition, drug overdose, Children’s Environmental Exposure Research Study etc.

The Journal welcomes the submission of manuscripts that meet the general criteria of significance and scientific excellence. Papers will be published shortly after acceptance. All articles published in JTEHS are peer-reviewed.

Contact Us

Editorial Office: jtehs@academicjournals.org

Help Desk: helpdesk@academicjournals.org

Website: http://www.academicjournals.org/journal/JTEHS

Submit manuscript online http://ms.academicjournals.me/
Editors

Dr. Hazem Mohammed Ebraheem Shaheen
Department of Pharmacology, Faculty of Veterinary Medicine, Damanhur University, Behera – Dalangat – Elbostan, Egypt

Dr. Jianbo Xiao
College of Life & Environment Science, Shanghai Normal University 100 Guilin Rd, Shanghai 200234, PR China

Dr. Adriana Maria Neghina
Victor Babes University of Medicine and Pharmacy Biochemistry Department
2 Eftimie Murgu Square
RO - 300041, Timisoara Romania

Dr. Rouabhi Rachid
Biology Department
University of Tebessa 12000. Algeria.

Prof. YongXun Pang
Endemic center, Harbin Medical University 157 BaoJian Road, NanGang District, Harbin, P. R. China

Dr. M.Mahadeva Swamy
Mysore – 570 006, Karnataka, India

Dr. Shashank Shah
"40/29 Bhonde Colony, 14 Shwe Off Karve Road, Erandwane, Pune, Maharashtra, India

Dr. Necati Celik
Karadeniz Technical University, Dept. of Phys. 61080 Trabzon, Turkey

Prof. Yangfeng Wu
"Suite B1302, No 6, Zhichunlu Rd., Haidian District, Beijing, 100088, China

Dr. Ashim Kumar Biswas
Department of Livestock Products Technology, COVS, Ludhiana- 141004 (Punjab) India

Dr. Ilia Yarmoshenko
Institute of Industrial Ecology of Ural Branch of Russian Academy of Sciences 620219 S. Kovalevskoy Str., 20, Ekaterinburg, Russia

Dr. Šifa Türkoğlu
Cumhuriyet University, Faculty of Art and Science, Department of Biology, Sivas, Turkey

Dr. Juan Antonio Riesco Miranda
Pneumology Department. San Pedro Alcantara Hospital Cáceres Spain

Dr. Norazmir Md Nor
Department of Nutrition & Dietetics Faculty of Health Sciences MARA University of Technology Puncak Alam Campus42300 Puncak Alam Selangor, Malaysia

Dr. Helal Ragab Moussa
Bahnay, Al-bagour, Menoufia, Egypt

Prof. Dr. Mamdouh Moawad Ali
33 El-Tahrir Street, Dokki 12622, Cairo, Egypt

Reza Hosseinzadeh
Shahid Beheshty Ave., Urmia University, Jahad-E-Daneshgahi, P. O. Box No. 165, Urmia, Iran

Moustafa Hossein El-Naggar
Biological Sciences, Faculty of Science, King Abdulaziz University, Jeddah, KSA

Hasan TÜRKEZ
Division of Molecular Biology and Genetics, Faculty of Science, Erzurum Technical University, Erzurum, Turkey
Lactate and creatine phosphokinase as potential independent predictors of organophosphorus poisoning severity in Zagazig University Hospital Patients, Egypt
Manar H. Arafa, Nashwa M. Shalaby and Hebatallah H. Atteia
Full Length Research Paper

Lactate and creatine phosphokinase as potential independent predictors of organophosphorus poisoning severity in Zagazig University Hospital Patients, Egypt

Manar H. Arafa1*, Nashwa M. Shalaby1 and Hebatallah H. Atteia2

1Department of Forensic Medicine and Clinical Toxicology, Faculty of Medicine, Zagazig University, Zagazig, Skarkia, Egypt.
2Department of Biochemistry, Faculty of Pharmacy, Zagazig University, Zagazig, Skarkia, Egypt.
3Department of Pharmaceutical Chemistry, Faculty of Pharmacy, University of Tabuk, Tabuk, Kingdom Saudi Arabia.

Received 14 September, 2017: Accepted 6 October, 2017

This study aimed to assess the correlation of serum lactate and creatine phosphokinase (CPK) levels, and their association with severity of organophosphorus poisoning in order to use one of them or both as tools in predicting prognosis. This study was conducted over one year and 68 organophosphate (OP)-poisoned patients were enrolled. Clinical severity of cases was categorized according to Peradeniya organophosphorus poisoning (POP) scale. Levels of serum acetyl choline esterase (AChE), serum CPK and serum lactate were measured on admission (0 h), 6 and 24 h post-ingestion. The results showed a high statistically significant difference between cases and control regarding AChE, CPK and lactate on admission. Also, there was high statistically significant difference regarding AChE, CPK and lactate among different categories of cases on admission, 6 and 24 h post admission. In addition, there was a statistically significant increase among different categories of POP scale regarding the quantity of atropine used in management of cases. Regarding oximes and stay in ICU, there was a statistically significant increase in severe poisoned patients when compared with moderate poisoned ones. A significant negative correlation was observed between AChE and severity of poisoning as well as significant positive correlation between CPK and lactate. It is concluded that serum CPK and serum lactate can be used as predictors of outcomes in OP poisoning and helps in determining cases that need follow up. Serum CPK and serum lactate can be used as predictors of outcomes in OP poisoning and helping in determining the cases that need follow up.

Key words: Organophosphorus poisoning, serum lactate, predicting prognosis, serum, admission.

INTRODUCTION

The World Health Organization (WHO) estimates the incidence of pesticide poisoning to be three million cases per year, leading to more than 250,000 deaths annually (WHO, 2016). Organophosphate (OP) poisoning is

*Corresponding author. E-mail: manar_arafa@hotmail.com, Tel: 002-0114113006.

Author(s) agree that this article remain permanently open access under the terms of the Creative Commons Attribution License 4.0 International License.
considered to be a frequent reason for admission in hospitals and intensive care units (ICU) in developing countries (Senarathna et al., 2012). Organophosphate (OP) insecticides are a group of insecticides acting on the enzyme, acetylcholinesterase (AChE). They irreversibly inactivate this enzyme which is essential for nerve function in insects, humans and many other animals. They also affect this enzyme in variable ways, contributing to their potential for poisoning (International Programme on Chemical Safety, 2016). Clinical features of OP are attributed to specific effects on muscarinic, nicotinic and central nervous system (CNS) receptors. This can result in diverse symptoms and signs (Peter and Cherian, 2000) depending on amount used and route of exposure (Eddleston et al., 2008). The common mode of presentation includes CNS symptoms which may include anxiety, confusion, seizures and coma. The muscarinic effects include diaphoresis, diarrhea, gastrointestinal cramps, urination, miosis, blurred vision, bradycardia, bronchorrhea, bronchospasm, emesis, lacrimation and excessive salivation. Other muscarinic effects may include muscle fatigue, fasciculation, paralysis, respiratory muscle weakness, tachycardia and hypertension. Nicotinic features include fasciculation, paresis or paralysis (Sen et al., 2014). Cardiac arrhythmias, including heart block and QTc prolongation, are occasionally observed in OP agents poisoning (Wang et al., 1998). Late onset polyneuropathy can also occur following OP poisoning (Aygun et al., 2003; Genel et al., 2003).

The inhibition of AChE is the main mechanism of cholinergic crisis, leading to stimulation of both muscarinic and nicotinic receptors. Muscarinic effects include excessive salivation, lacrimation, urination, diarrhea, gastrointestinal cramps, vomiting, pupil constriction, blurred vision, bradycardia, as well as wheezes. Nicotinic manifestations include fasciculation and paralysis (Sen et al., 2014). Peradeniya organophosphorus poisoning (POP) is a simple scale used to assess the severity of poisoning based on the symptoms at presentation. Patients with a high score on the POP scale have a high rate of morbidity and mortality (Senanayake et al., 1993).

Elevation of lactate level is not clearly defined but most studies use range between 2.0 and 2.5 mmol/L (Krusc et al., 2011) whereas, "high" lactate has been defined to be more than 4 mmol/L in many studies (Howell et al., 2007; Cox et al., 2012; Shapiro et al., 2005; Callaway et al., 2009). On the other hand, the "normal value" may vary depending on the assay used. The terms lactate and lactic acid are often used mutually but lactate (the component measured in blood) is strictly a weak base while lactic acid is the corresponding acid. "Lactic acidosis" is oftentimes used clinically to describe the elevation of lactate level but should be reserved for cases where there is acidosis pH < 7.35 (Luft et al., 1983).

Creatine phosphokinase (CPK) is an enzyme present in different tissues and cells. It catalyses the conversion of creatine and utilizes adenosine triphosphate (ATP) to create phosphocreatine (PCr) and adenosine diphosphate (ADP). It is checked in blood tests not only as a marker of damage of CK-richtissue especially skeletal muscle, but also brain, photoreceptor cells of the retina, hair cells of the inner ear, spermatozoa and smooth muscle (Wallimann and Hemmer, 1994). Agarwal et al. (2007) reported elevated level of CPK in serum of poisoning patients and for this reason, it may be used as a biomarker of OP poisoning.

Lactate levels are often used as alternative indicator for severity of illness severity and to measure response to therapy. Many medications and toxins are associated with elevated lactate (Reade et al., 2012). Patients with elevated lactate levels may be at higher risk for significant morbidity and mortality, and need a systematic approach for both diagnosis and treatment (Andersen et al., 2013).

Although, till now, few researches have shown that serum cholinesterase (ChE) and CPK level estimations are useful in diagnosis of acute phase OP poisoning, they do not show any relation of these biomarkers to the severity of OP poisoning (Goswamy et al., 1994; Aygun, 2002). Therefore, this study aimed to assess the correlation between serum lactate and CPK levels and their association with the severity of OP poisoning, hoping to use these markers as predictors of OP severity, as AChE is a diagnostic tool but these are prognostic more than diagnostic; furthermore, their availability and cheapness is more than that of AChE in developing countries.

MATERIALS AND METHODS

Study population

This case control study was conducted on consecutive organophosphorus (OP) poisoned patients, admitted in Zagazig University Hospitals from December 2015 to November 2016. They were presented within 6 h of OP ingestion and were diagnosed with acute OP intoxication from history and clinical examination. The cases were suffering from nausea, vomiting, diarrhoea, salivation, urination, sweating, copious secretions, bradycardia, hypotension, miosis, wheezing, chest crepitation, weakness, fasciculation, cramps, paralysis, coma and respiratory failure. According to POP score (Senanayake et al., 1993), patients were classified into three categories based on clinical parameters: 0 to 3, mild poisoning; 4 to 7, moderate poisoning; 8 to 11, severe poisoning groups (Table 1).

Exclusion and inclusion criteria

Patients who were presented later than 6 h of poisoning and those having diabetes mellitus, thyroid disease, chronic heart diseases and hepatic or renal failure, as well as patients subjected to cholinergic or sympatholytic drugs or any other medications for chronic disease were excluded. According to these exclusion criteria, only 68 OP-poisoned patients were enrolled in this study.
Table 1. The Peradeniya organophosphorus poisoning scale.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupil size</td>
<td>≥2 mm</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>&lt;2 mm</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Pinpoint</td>
<td>2</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>≥20/min</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≥20/min with central cyanosis</td>
<td>2</td>
</tr>
<tr>
<td>Heart rate</td>
<td>&gt;60/min</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>41 to 60/min</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&lt;40/min</td>
<td>2</td>
</tr>
<tr>
<td>Fasciculation</td>
<td>Present, generalized/continuous</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Both generalized and continuous</td>
<td>2</td>
</tr>
<tr>
<td>Level of consciousness</td>
<td>Impaired response to verbal commands</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No response to verbal commands</td>
<td>2</td>
</tr>
<tr>
<td>Seizures</td>
<td>Absent</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Present</td>
<td>1</td>
</tr>
</tbody>
</table>

They were (35) males and (33) females, with mean age of 26.5 ± 2.3 years, presented within 6 h from the exposure to OP compound and had most of the previous clinical findings mentioned previously. All patients received airway control, decontamination, O₂ therapy and administration of antidotes; atropine and pralidoxime and other routine treatment. Seventy healthy individuals (age- and sex-matched) served as a control group. Informed consents from all patients and approval letter from the Ethical Committee for Research (Institutional Review Board 'IRB'), Faculty of Medicine, Zagazig University were obtained.

On admission to the emergency department (0th h) and at 6th and 24th h after admission, 5 ml of venous sample was collected from study participants. The blood samples were centrifuged at 3000 rpm for 10 min and serum was collected. Measurements of serum acetyl cholinesterase (ACHE), CPK and lactate levels were performed and correlated with the severity of poisoning according to POP scale. The required treatments including atropine and oximes for management as well as duration of hospital stay were determined.

Biochemical analysis

Determination of serum acetyl cholinesterase

Serum acetylcholinesterase (ACHE) activity was determined colorimetrically according to the method of Ellman et al. (1961). The reaction was done twice for each sample in the same time. Briefly, 4 ml solution containing 4 mM tris buffer (pH = 7.4), 40 mM MgCl₂, 0.1 mM × 10⁻⁴ M DTNB (colouring reagent), and 0.2 mM × 10⁻⁴ M of S-butrylthiocholine iodide (substrate) were pre-incubated at 37°C for 10 min with coupling. 20 µl of plasma samples was added into each tube of the aforementioned substrate solution. The mixture was vortexed and absorbances of produced yellow colour were read spectrophotometrically at 1 min interval for 3 min at 412 nm. Blank was run parallel to each sample without addition of substrate. Activity was expressed as U/l.

Determination of serum creatine phosphokinase (CPK)

Kinetic determination of CPK is based upon the fact that it catalyses the reversible transfer of a phosphate group from phosphocreatine to ADP. This reaction is coupled to those catalyzed by hexokinase (HK) and glucose-6-phosphate dehydrogenase (G6P-DH). The rate of NADPH formation can be measured photometrically, and proportional to the catalytic concentration of CK present in the sample (Gerhardt and Waldenström, 1979). The reaction was performed by addition of 40 µl serum to 1 ml of the working reagent by mixing and incubation for 2 min. Absorbances were read at 1 min intervals, thereafter for 3 min. The difference between absorbances and the average absorbance differences per min were calculated.

Determination of serum lactate

Lactate is oxidized to pyruvate and hydrogen peroxide (H₂O₂) by lactate oxidase (LOX). In the presence of peroxidase (POD), hydrogen peroxide reacts with 2,4,6-tribromo-3-hydroxybenzoic acid (THB) and 4-aminoantipyrine (4-AAP) to form a red quinoneimine dye. Serum L-lactate level can be measured colorimetrically where lactate is oxidized to lactate oxidase (LOX) to generate pyruvate and hydrogen peroxide (H₂O₂) which then interacts with 2,4,6-tribromo-3-hydroxybenzoic acid (THB) and 4-aminoantipyrine (4-AAP) in the presence of peroxidase (POD) to
Table 2. Personal data among the control and OP cases groups.

<table>
<thead>
<tr>
<th>Data</th>
<th>Control group</th>
<th>Cases group</th>
<th>t</th>
<th>P-value (significance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>25.9 ± 3.5</td>
<td>26.5 ± 2.3</td>
<td>26.5</td>
<td>NS (&gt; 0.05)</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>37/33</td>
<td>35/35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NS, Non-significant.

Table 3. Laboratory parameters of control and cases groups on admission.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control (N=70)</th>
<th>Cases on admission (N=68)</th>
<th>t</th>
<th>P-value (significance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum AChE (U/L)</td>
<td>9511.44 ±1533.21</td>
<td>2430.49 ±1137.9</td>
<td>30.58</td>
<td>HS (&lt;0.0001)**</td>
</tr>
<tr>
<td>Serum CPK (U/L)</td>
<td>92.4 ±18.15</td>
<td>345.4±128.6</td>
<td>16.05</td>
<td>HS (&lt;0.00001***</td>
</tr>
<tr>
<td>Serum lactate (mmol/L)</td>
<td>0.586 ± 0.35</td>
<td>2.59± 0.7</td>
<td>21.08</td>
<td>HS (&lt;0.00001***</td>
</tr>
</tbody>
</table>

HS, Highly significant.

Table 4. Association between POP score and quantity of atropine required.

<table>
<thead>
<tr>
<th>Atropine</th>
<th>Mild (n=22)</th>
<th>Moderate (N=16)</th>
<th>Severe (N=30)</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine (Number of ampoules)</td>
<td>2.6±1.3</td>
<td>19.4±4.4</td>
<td>45.54±7.5</td>
<td>401.29</td>
<td>&lt; 0.0001***</td>
</tr>
</tbody>
</table>

*Significant.

form a red quinoneimine dye. The color intensity of the former red dye is directly proportional to the lactate concentration and can be determined by measuring the increase in absorbance at 546 nm. The reaction was carried out by mixing 10 µl of serum with 1 ml of the working reagent. The mixture was then incubated for 5 min at 37°C (Field et al., 1996).

Statistical analysis

The collected data were statistically analyzed using SPSS program version 15. Quantitative data were summarized as mean ± standard deviation (X ± SD). Qualitative data were summarized as percentage. Test of significance for qualitative data was X² (chi-square) test. Test of significance for quantitative data was done using ANOVA and student t tests for comparison between groups’ means. Pearson test was used to evaluate the correlation between two variables. Logistic regression analysis was performed to determine the independent predictors of variables. The significance level was considered at p value < 0.05.

RESULTS

There was a non-significant difference between OP poisoned cases and controls regarding the personal data (Table 2). The results showed a high statistically significant difference between cases and control on admission regarding AChE, CPK and lactate levels (Table 3). Figure 1 shows that there was a high statistically significant difference (p<0.0001) in AChE activity among different POP categories of severity: mild, moderate and severe cases on admission, 6 and 24 h post admission. As shown in Figure 2, a high statistically significant difference (p<0.0001) regarding CPK was observed among different POP categories of severity on admission, 6 and 24 h post admission. Figure 3 shows a high statistically significant difference (p<0.0001) regarding lactate among different POP categories of severity: mild, moderate and severe cases on admission 6 and 24 h post admission. There was a high statistically significant increase among different POP categories regarding the quantity of atropine used in management of cases (Table 4). Table 5 shows a highly significant increase in oximes used in treatment and duration needed for stay in ICU of severe cases when compared with moderate ones.

A negative correlation was observed between AChE and severity of poisoning while there was a positive correlation among CPK, lactate and severity of poisoning (Table 6 and Figures 4 to 6). When all significant variables (AChE, CPK and lactate) are introduced to multiple regression analysis (the model), the variables that remained significant (the strongest significant) in the model were lactate and CPK. Therefore, lactate and CPK seem to be significant determinant factors for prediction of OP poisoning (Table 7).
**Table 5.** Association between POP score and quantity of oximes required and duration of hospital stay.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Moderate (N=6)</th>
<th>Severe (N=24)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oximes</td>
<td>6.5 ± 1.4</td>
<td>17.5 ± 3.31</td>
<td>7.88</td>
<td>&lt;0.0001***</td>
</tr>
<tr>
<td>Stay time in ICU</td>
<td>2.2 ± 0.68</td>
<td>7.1 ± 2.1</td>
<td>5.53</td>
<td>&lt;0.0001***</td>
</tr>
</tbody>
</table>

***Significant.

**Figure 1.** AChE of the studied groups at 0, 6 and 24 h post admission.

**Figure 2.** CPK of the studied groups at 0, 6 and 24 h post admission.
DISCUSSION

Organophosphate compounds are considered the most commonly used pesticides in agriculture field. Because it’s wide usage and easy accessibility, poisoning with these pesticides has emerged as an important health hazard especially in developing countries (Han and Cui, 2010).

It has been shown by Senanayeke et al. (1993) that the POP score can efficiently portend the severity, morbidity and mortality of OP poisoned cases. This scale uses elevated respiratory rate (>20/min) and the presence of cyanosis. This approach is likely to cause difficulties as severe OP poisoning may cause either central respiratory depression with bradypnia, a reduced respiratory rate or tachypnea in the condition of bronchorrhea, bronchoconstriction or respiratory muscle weakness (Eddleston et al., 2006).

In this study, the results show a significant decrease in AChE activity with increasing degree of severity on admission, 6 and 24 h post admission as well as a negative correlation between AChE and severity of poisoning. In accordance with these results, Sen et al. (2014) concluded that serum AChE serves as a diagnostic parameter for OP poisoning and correlates with the severity but it cannot be used as a prognostic biomarker.

According to Bhattacharyya et al. (2011), CPK levels
were correlated with the severity of the OP poisoning, as the severity increases, the CPK levels were increased and were found to be maximum in the severe form of OP poisoning. Sen et al. (2014) reported also that serum CPK shows a strong degree of positive correlation with the severity of poisoning and can be used as a predictor of outcome in OP poisoning. In line with this, serum CPK results of this study showed that there were a statistically significant increase among different categories of severity (mild, moderate and severe) on admission, 6 and 24 h post admission as well as a strong positive correlation between CPK activity and the severity of poisoning.

Intermediate syndrome (IMS) is nominated because it occurs in the interval between the end of the acute

---

**Figure 4.** Correlation between AChE and severity in the study groups.

**Figure 5.** Correlation between CPK and severity in the study groups.
Evaluation of the blood lactate level is generally used in diagnosis and management of the patients with signs and symptoms of sepsis or shock and is a sign of tissue hypoperfusion (Kompanje et al., 2007). The role of blood lactate level has been studied as a prognostic factor in drug and chemical poisoning too (Dell’Aglio et al., 2009; Seidowsky et al., 2009; Manini et al., 2010; Mégarbane et al., 2010; Inoue et al., 2008; Lee et al., 2012).

The current study detected a high statistically significant elevation in serum lactate levels with increased category of severity on admission, 6 and 24 h post admission as well as a strong positive correlation between lactate and severity of poisoning.

According to Lionte et al. (2016), lactate and Glasgow Coma Scale (GCS) can be used to predict morbidity and mortality after systemic poisons exposure. Tang et al. (2016) reported that 6-h post-admission high blood lactate levels, low blood pH, and low lactate clearance rates were independent prognostic factors identified for OP poisoning. This also keep up with Maignan et al. (2014), who stated that, some indicators such as toxicological history, GCS, QT interval, and serum lactate level, proved to be useful to distinguish between low and high acuity poisoned patients with deliberate drug poisoning, in order to avoid excessive morbidity after a retrospective analysis. In the same manner, Besli et al. (2010) identified a positive correlation between lactate and carboxyhemoglobin (COHb) levels and detected higher lactate levels in patients with neurological findings. Sokal and Kralkowska (1985) reported that lactate levels of patients with severe CO poisoning are significantly higher than mild poisoning. Inoue et al. (2008) reported also that initial lactate levels may be associated with

The mechanisms of hyperlactatemia including hypoperfusion lead to cellular hypoxia, increased activity of Na⁺/K⁺- ATPase in normoxia, increased pyruvate and lactate due to increased anaerobic glycolysis, decreased lactate clearance, muscle hyperactivity due to seizures, and impaired electron transfer and oxidative phosphorylation (Benaissa et al., 2003; Hulme and Sherwood, 2004; Jorens et al., 2004; Gunnerson, 2005).

Figure 6. Correlation between lactate and severity in the study groups.
clinical course and outcome. So, they suggested that it
can be used as a good marker for clinical course.
Furthermore, Moon et al. (2011) suggested that the first
lactate value is an independent factor for the change of
mental status in CO poisoning and determining the need
for intensive medical treatment, and it may be useful in
predicting prognosis. In contrast to these results, Rishu
et al. (2013) and Nichol et al. (2010) reported that blood
lactate level has been reported to be a poor prognostic
factor predicting death in hospital and ICU-admitted
patients.

Regarding management of cases, doses of atropine
used for patient's treatment here showed a high
statistically significant increase among different
categories of POP scale with increased degree of
severity. Likewise, there was a highly significant increase
in oximes doses used in treatment of severe cases when
compared with moderate cases and also a significant
increase in duration of stay in ICU between both
categories. This coincides with the report of Rehiman et
al. (2008) which showed that the total amount of atropine
needed to treat patients and also mean duration of
hospital stay increased with POP scale degree of
severity.

Conclusion

Serum CPK activity and lactate levels can be used as
biomarkers in stratifying severity of acute OP poisoning,
as they are cheap, easily available, especially in
developing countries where EChE and BChE are not
widely available in most of the laboratories. Also, serum
cholinesterase levels have no prognostic value in acute
organophosphate poisoning. Thus, a grading system to
identify high-risk patients based on this measurement is
most likely unreliable. The only disadvantage in using
CPK activity and serum lactate level as predictors is that,
the other causes of their elevation is strictly ruled out.

Limitations

One of the limitations in the present study is that serial
measurements were not done. To substantiate the
findings, more multicentric studies with larger sample size
has to be conducted.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the support and help
provided by all the staff of Department of Internal
Medicine, Department of Anesthesiology and Intensive
Care Unit, Zagazig University Hospitals.

REFERENCES

Agarwal SB, Bhatnagar VK, Agarwal A, Agarwal U, Venkaiah K, Nirag
organophosphate insecticide poisoning patients in India. Internet J.
Toxicol. 4:1
Andersen LW, Mackenhauer J, Roberts JC, Berg KM, Cocchi MN,
Donnino MW (2013). Etiology and therapeutic approach to elevated
Aygun D (2002). Serum Acetylcholinesterase and Prognosis of Acute
Organophosphorus poisoning. J. Toxicol: Clin. Toxicol. 40(7):903-
910.
Aygun D, Onar MK, Altintop BL (2003). The clinical and
electrophysiological features of a delayed polyneuropathy developing
subsequently after acute organophosphate poisoning and it's

plasma lactate a useful marker in the evaluation of pure carbon
Creatine Phosphokinase: A Probable Marker of Severity in
Organophosphorus Poisoning. Toxicol. Int. 18(2):117-123
Serum lactate and base deficit as predictors of mortality in
normotensive elderly blunt trauma patients. J. Trauma Acute Care
Cox K, Cocchi MN, Salciccioli JD, Carney E, Howell M, Donnino
MW (2012). Prevalence and significance of lactic acidosis in diabetic
Dell'Aglio DM, Perino LJ, Kazzi Z, Abramson J, S schwartz MD, Morgan
level, and metformin concentrations in survivors versus nonsurvivors:
823.
Predicting outcome using butyrylcholinesterase activity in
Eddleston M, Mohamed F, Davies JO, Eyer P, Worek F, Sheriff MH,
Buckley NA (2006). Respiratory failure in acute organophosphorus
and rapid colorimetric determination of acetylcholinesterase activity.
Biochem. Pharmacol. 7(2):88IN191-9095.
Field M, Block JB, Levin R, Rall DP (1996). Significance of blood lactate
elevations among patients with acute leukemia and other neoplastic
Genel F, Arslanoglu S, Urban N, Dogan M, Altihan F (2003). Late-onset
distal polyneuropathy due to acute organophosphate intoxication
Gerhardt W, Waldenström J (1979). Creatine kinase B-Subunit activity
25(7):1274-1280.
Failure in Organophosphorus and Carbamate poisoning. Heart &
abnormalities in the intensive care unit – epidemiology. Crit. Care
9(5):508-516
Han L, Cui X (2010). Application of intestinal protection in adjuvant
therapy of severe organophosphorus poisoning. Shi Yong Yao Wu
Yu Lin Chuang 13:154-156.
Occult hypoperfusion and mortality in patients with suspected


Journal of Toxicology and Environmental Health Sciences

Related Journals Published by Academic Journal:

- Journal of Clinical Pathology and Forensic Medicine
- Journal of Infectious Diseases and Immunity
- Journal of Clinical Virology Research
- Clinical Reviews and Opinions
- Medical Case Studies
- Medical Practice and Reviews