# The Recovery Rate of Pseudocholinesterase in Organophosphate Poisoned Geriatric Patients

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A Master's Thesis
Submitted to the Department of Medicine
and the Graduate School of Yonsei University
in partial fulfillment of the
requirements for the degree of
Master of Medical Science

Seung Min Park

July 2012

This certifies that the master's thesis of
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July 2012

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# 국 문 요 약

## 노인 유기인제 중독 환자에서 콜린에스테라제의 회복 속도

**배경 및 목적 :** 자살과 비의도적인 사고로 인한 유기인계 중독에 의한 사망률이 높은 추세이며, 중증도를 평가하기 위한 인자로 혈장 콜린에스테라제의 활성도를 활용하고 있다. 본 연구에서는 유기인제 중독에서 연령에 따른 혈장 콜린에스테라제의 변화의 차이를 알아보고 사망에 영향을 미치는 요인을 분석하여, 유기인제 중독 치료에 기초자료로 제공하고자 한다.

**방법 :** 2000년 1월 1일부터 2008년 12월 31일까지 유기인제 중독으로 응급의료센터로 내원한 환자를 대상으로 65세 이상의 노인군과 64세 이하의 청 장년군으로 분류하여 일반적 특성, 임상적 특성의 차이를 분석하였다.

**결과 :** 환자는 총 118명으로 노인군 34명, 청장년군 84명이었다. 임상증상에 따른 Namba 중증도는 노인군이 청장년군에 비해 높았으며($p$=.028), 시간 경과에 따라 혈장 콜린에스테라제의 회복속도의 변화가 노인군이 청장년군에 비해 느렸다($p$=.000). 기관내삽관 시행률($p$=.030), 흡인성 폐렴 발생률($p$=.010), 쇼크 발생률($p$=.006), 호흡성 합병증 발생률($p$=.027), 중추신경계 이상 발생률($p$=.006), 사망률($p$=.012) 모두 노인군이 유의하게 높았다.

**결론 :** 유기인제 중독 환자 중 노인군이 청장년군보다 혈장 콜린에스테라제의 회복속도가 저조하였고, 기관내삽관 시행률, 흡인성 폐렴 발생률, 쇼크 발생률, 중추신경계 이상 발생률, 중증도가 높았다.

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핵심어 : Organophosphate, pseudocholinesterase level, geriatrics

# Chapter 1. Introduction

The agricultural organophosphate pesticides, which are widely used to eradicate harmful insects, have developed since the two World Wars after multiple compounds were compounded in 1936(Schrader G, 1950). As this agricultural chemical is commonly used by people, we often find so many patients hospitalized to emergency room because of committing suicide or being poisoned unintentionally. To those people, the toxicity of organophosphate pesticides comes from the overstimulation or shut-off of neurotransmission from the central and peripheral nervous systems when this organophosphate pesticides act as an inhibiter against irreversible cholinesterase and the acetylcholine is accumulated in synapses (Namba et al, 1971).

In the central nervous system, the accumulation of acetylcholine may cause anxiety, tremor, headache, delirium, convulsions, coma, etc, and the muscarinic effect in some sympathetic nerve endings including parasympathetic nerve endings and sweat glands many cause gastrointestinal complications such as miosis, increased secretion, nausea, diarrhea and bradycardia. With the nicotinic effects in neuromuscular junctions between the ganglion in sympathetic nervous system and the somatic nerves, there may be some hyperactivity in sympathetic (nervous) system or fasciculation and muscle helplessness. As organophosphate pesticide-poisoned patients may suffer from impotent or paralyzed respiratory muscle, excessively increased endotracheal secretion, addiction-related complications, or even respiratory insufficiency syndrome by absorption of gut contents or pneumonia, breathing apparatus are often required for mechanical ventilation(Du Toit PW et al, 1998).

The death rate by the addiction to the organophosphate was reported at 10~86% around the world, but has been reduced to 10~20% with the drug treatment including atropine and pralidoxime(2-PAM) and the intensive ICU care including mechanical ventilation for respiratory failure(Gunnell & Eddleston, 2003). However, despite the development of such critical care medicine, the death rate by the organophosphate addiction is still higher than other drug intoxications(Ha et al, 1998). In the organophosphorous pesticide poisoning, plasma cholinesterase activity is known to be a prognostic factor to determine the severity of clinical symptoms, but there have been few studies on the factors affecting the cholinesterase activity.

Therefore, this study aims to divide the organophosphate poisoned patients into two groups: 65 years or more(elderly group) and 64 years or less(middle-aged adults), and compare the cholinesterase level, vital signs, duration of hospitalization, and test results between the two groups to find out the differences in the variation of cholinesterase level by age and look at the factors affecting their death.

# Chapter 2. Methodology

## 2.1. Subjects

The subjects who participated in this study were patients who were hospitalized into the emergency medical station from Jan. 1, 2000 to Dec. 31, 2008 because they were addicted to organophosphates. Among them, patients under 18 years of age, patients with liver cirrhosis, with tumors, with worsened nutritional status, and with infection were excluded.

## 2.2. Methods

The medical records of patients who were hospitalized because of organophosphate poisoning were collected retrospectively, and the patient data were collected regarding patient's general characteristics(age, gender, etc), addictive characteristics(poisoning mechanism, amount of poisoning, place of poisoning, etc), and clinical characteristics(emergency treatment, physical examination and symptoms, inspection data, clinical outcomes, etc).

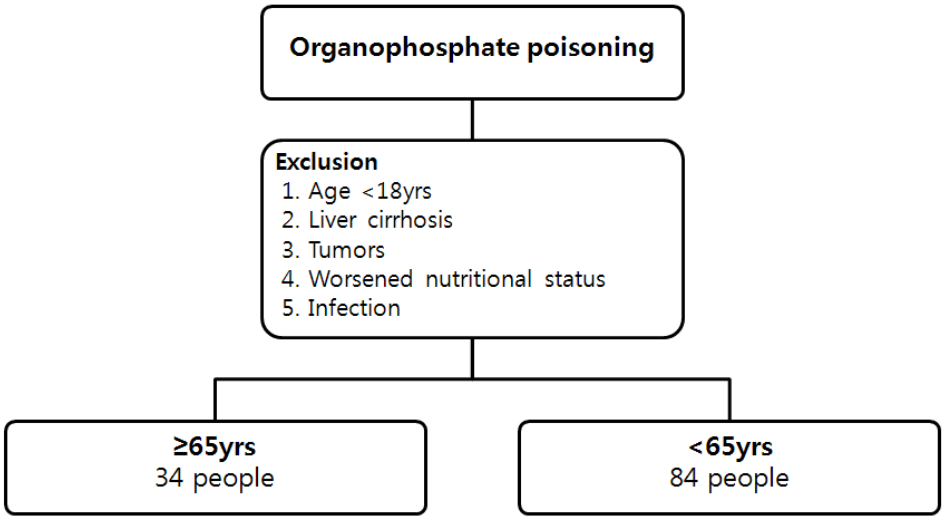


Figure 1. Subject patients

## 2.3. Data Analysis

For data analysis, all patient participants were divided into two groups: (1) the group of patients over the age of 65 years or more and (2) the group of patients under the age of 64 years or less to determine the differences between general characteristics and clinical characteristics, and T-Test, Repeated Measure ANOVA, and Mann-Whitney were used to compare the differences between the factors such as gender, cause of addiction, vital signs, amount of addiction, variation in cholinesterase level, incidence of aspiration pneumonia, rate of intubation, incidence of shock, and mortality.

For statistics program, SPSS windows 18.0 versions was used. If p-value was 0.05 or less, it was seen as having a significant value.

# Chapter 3. Results

## 3.1. Patient's General Characteristics

A total of 118 patients(34 geriatric patients and 84 middle-aged patients) participated in this experiment. For the age, the average age of geriatric patients was 71 years and that of middle-aged patients was 48. For the gender, there were 22 males in geriatric group(64.7%) and 56 males in middle-aged group(66.7%), which appeared insignificant($p$=.839).

For the reasons why they were poisoned, both 27 geriatric patients(79.4%) and 63 middle-aged patients(75.0%) showed the highest suicide rate, which was statistically insignificant($p$=.573). For the dose that they were addicted, the geriatric group showed 113mL and the middle-aged group 154mL, which appeared insignificant($p$=.012).

In the way that they were addicted, 34 geriatric patients and 84 middle-aged patients were all addicted orally. After Namba's severity test by clinical symptom, 25 geriatric patients(75.8%) and 40 middle-aged patients(49.3%) suffered from severe poisoning($p$=.028).

In the initial stage of vital signs, blood gas test, and electrolyte test, there was no difference between geriatric group and middle-aged group(Table 1).

Table 1. Patient's General Characteristics

| Category<br>N(%), Mean±SD(Median) | Geriatric patients<br>(N=34) | Non-geriatric<br>patients (N=84) | *p*-value |
|---|---|---|---|
| Sex(male : female) | 22(64.7) : 12(35.3) | 56(66.7) : 28(33.3) | 0.839 |
| Cause of ingestion | | | |
| Suicide | 27(79.4) | 63(75.0) | |
| Accidental | 4(11.8) | 16(19.0) | 0.573 |
| Other | 3(8.8) | 5(6.0) | |
| Amount of ingestion(mL) | 120.00±58.68(113) | 201.59±165.00(154) | 0.012* |
| Oral ingestion | 34(100.0) | 84(100.0) | |
| SBP(mmHg) | 144.03±45.42(150) | 136.98±33.22(137.25) | 0.416 |
| DBP(mmHg) | 80.59±21.94(77) | 81.80±21.09(81.23) | 0.781 |
| PR(/minute) | 91.24±21.92(94) | 98.52±20.83(95.5) | 0.093 |
| RR(/minute) | 20.31±5.27(20.25) | 19.95±3.99(20.03) | 0.739 |
| BT(℃ | 35.86±0.83(36.03) | 36.16±0.70(36.08) | 0.055 |
| Lactate | | | |
| ER visit | 5.71±3.62(5.33) | 4.80±3.18(4.22) | 0.189 |
| >24hr | 3.58±2.22(3.06) | 2.46±1.54(2.25) | 0.125 |
| Chief complaint | | | |
| CNS symptoms | 27(21.9) | 49(58.3) | |
| Pulmonary symptoms | 3(8.8) | 12(14.3) | |
| GI symptoms | 3(8.8) | 18(21.4) | 0.288 |
| General weakness | 0(0.0) | 1(1.2) | |
| Other | 1(2.9) | 4(4.8) | |
| Namba Clinical | | | |
| Mild poisoning | 5(15.2) | 19(23.5) | |
| Moderate poisoning | 3(9.1) | 22(27.2) | 0.028* |
| Severe poisoning | 25(75.8) | 40(49.3) | |

** : $p<.001$, * : $p<.050$

* Chief complaint
① CNS symptoms (mental confusion/headache/dizziness/seizure/coma)
② Pulmonary symptoms (dyspnea/bronchorrhea/aspiration)
③ GI symptoms(diarrhea/abdominal pain)

* Namba
① Mild poisoning : s-choline 20~50%, able to amblate, fatigue, headache dizziness etc.. Tx-atropine 1mg
② Moderate poisoning :s-choline 10~20%, unable to ambulate, dysarthria, general weak, miosis etc. Tx-at every 1~2mg
③ Severe poisoning :s-choline <10%, unconscious. reduced PLR, severe miosis, rale, cyanosis. Tx- at every 5mg.

## 3.2. The rate of recovery of Pseudocholinesterase level

To determine the variation in Pseudocholinesterase level, all participants were measured at the immediate hospitalization, 1 day, 3 day, 5 day, 10 day, 15 day, and 20 day, repeatedly.

Geriatric patients were measured shortly after hospitalization 662.00±1613.09 (213.5), 1 day 464.69±702.56(186), 3 day 490.68±580.58(194), 5 day 768.78±823.92(554), 10 day 1219.43±1158.03(891), 15 day 1382.82±1202.77(1434), 20 day 1759.25±829.78(1820.5), and middle-aged patients shortly after hospitalization 898.44±846.74(188), 1 day 816.35±1448.02(199), 3 day 1093.5±1491.34(478), 5 day 1388.27±1076.23(1269), 10 day 2281.42±1503.25(2328), 15 day 3230.47±1853.35(2993.5), and 20 day 4369.32±2278.23(3931.5)(Table 3)(Fig 2).

At 3 day, middle-aged group's Pseudocholinesterase level recovered, whereas geriatric group's recovery rate of Pseudocholinesterase level was still lower(Figure 2).

After repeated measures of Pseudocholinesterase level between geriatric group and middle-aged group, there was a significant change in Pseudocholinesterase level over time($p$=.000); the reciprocal action between the two groups was significant; there was a difference in the variation in Pseudocholinesterase level($p$=.022).

Table 2. Pseudocholinesterase Level by Age

| ategory | Geriatric patients (N=34) | Non-geriatric patients (N=84) | *p*-value |
|---|---|---|---|
| ER Visit | 662.00±1613.09(213.5) | 898.44±846.74(188) | .516 |
| 1day | 464.69±702.56(186) | 816.35±1448.02(199) | .102 |
| 3day | 490.68±580.58(194) | 1093.5±1491.34(478) | .006* |
| 5day | 768.78±823.92(554) | 1388.27±1076.23(1269) | .007* |
| 10day | 1219.43±1158.03(891) | 2281.42±1503.25(2328) | .002* |
| 15day | 1382.82±1202.77(1434) | 3230.47±1853.35(2993.5) | .000** |
| 20day | 1759.25±829.78(1820.5) | 4369.32±2278.23(3931.5) | .000** |

** : $p<.001$, * : $p<.050$

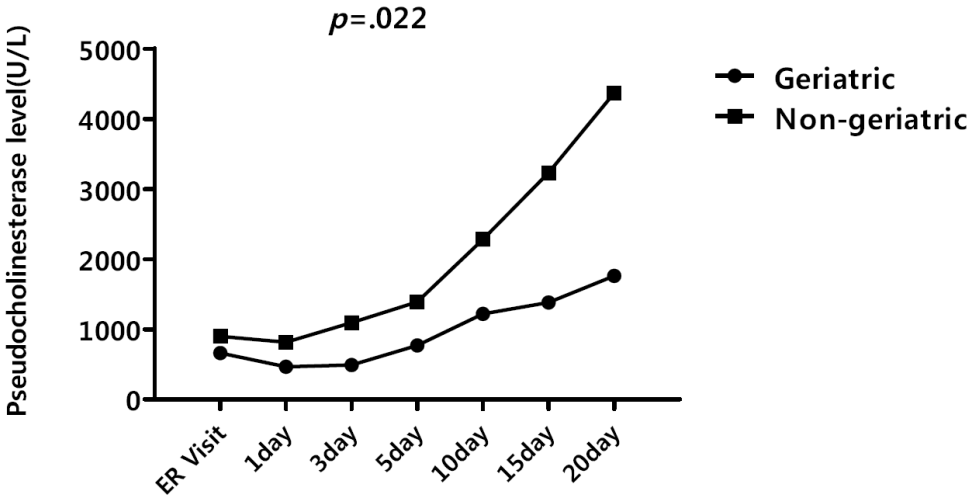


Figure 2. Variation in Pseudocholinesterase Level by Age

Table 3. Comparison of Repeated Measures of Pseudocholinesterase Level by Age

| Effect | F | Hypothesis degree of freedom | Error degree of freedom | *p*-value |
|---|---|---|---|---|
| **Pseudocholinesterase level** | 15.754 | 6.000 | 27.000 | .000** |
| **Pseudocholinesterase level * Group** | 3.014 | 6.000 | 27.000 | .022* |

** : $p<.001$, * : $p<.050$

## 3.3. Clinical Characteristics(Treatment)

After comparing the incidence rate of intubation, 27 geriatric patients(79.4%) and 49 middle-aged patients(58.3%) were found. The geriatric group had intubation significantly($p$=.030)(Table 4).

5 geriatric patients(14.7%) received dopamine among inotropic agents more than 9 middle-aged patients(10.7%), which was significant($p$=.030).

There was no difference in place of first aid, lavage, irrigation, charcoal, and atropine(Table 4).

Table 4. Clinical Characteristics(Treatment)

| Category | Geriatric patients (N=34) | Non-geriatric patients (N=84) | p-value |
|---|---|---|---|
| **Place of first aid** | | | |
| **Primary hospital** | 19(55.9) | 53(63.1) | |
| **This hospital** | 15(44.1) | 26(31.0) | 0.179 |
| **Nothing done** | 0(0.0) | 5(6.0) | |
| **Lavage** | | | |
| **Yes** | 13(38.2) | 31(37.3) | 0.928 |
| **No** | 21(61.8) | 52(62.7) | |
| **Irrigation** | | | |
| **Yes** | 20(58.8) | 50(60.2) | 0.887 |
| **No** | 14(41.2) | 33(39.8) | |
| **Charcoal** | | | |
| **Yes** | 19(40.4) | 46(51.7) | 0.211 |
| **No** | 28(59.6) | 43(48.3) | |
| **Intubation** | | | |
| **Yes** | 27(79.4) | 49(58.3) | 0.030* |
| **No** | 7(20.6) | 35(41.7) | |
| **Use of inotropic agents (within 12 hours)** | | | |
| **Dobutamine** | 1(2.9) | 1(1.2) | |
| **Dopamine** | 5(14.7) | 9(10.7) | |
| **NE** | 0(0.0) | 1(1.2) | 0.030* |
| **Combined** | 4(11.8) | 0(0.0) | |
| **None** | 24(70.6) | 73(86.9) | |
| **Use of atropine** | | | |
| **Use** | 16(100.0) | 38(97.4) | 0.518 |
| **None** | 0(0.0) | 1(2.6) | |

** : $p<.001$, * : $p<.050$

## 3.4. Clinical Characteristics(Severity and complications)

After analyzing the incidence rate of aspiration pneumonia, 12 geriatric patients(46.2%) and 13 middle-aged patients(19.7%) were found. As the difference was significant($p$=.010)(Table 5).

After analyzing the incidence rate of shock, 16 geriatric patients(47.1%) and 18 middle-aged patients(24.2%) were found. As the difference was significant($p$=.006)(Table 5).

5 geriatric patients(14.7%) and 9 middle-aged patients(10.7%) received dopamine among inotropic agents. The difference was significant($p$=.030)(Table 4).

After analyzing the incidence rate of respiratory complications, 26 geriatric patients(81.3%) and 48 middle-aged patients(59.3%) were found. As the difference was significant, hypothesis 5 was supported($p$=.027)(Table 5).

After analyzing the incidence rate of CNS depression, 14 geriatric patients(43.8%) and 15 middle-aged patients(18.5%) were found. As the difference was significant, hypothesis 6 was supported($p$=.006)(Table 5).

After X-ray findings, there was no difference in cardiomegaly and pulmonary edema(Table 5).

Table 5. Clinical Characteristics(Severity and complications)

| Category | Geriatric patients (N=34) | Non-geriatric patients (N=84) | *p*-value |
|---|---|---|---|
| **Chest X-ray** | | | |
| **Cardiomegaly** | | | |
| **Yes** | 7(26.9) | 14(21.2) | 0.703 |
| **No** | 19(73.1) | 52(78.8) | |
| **Pulmonary edema** | | | |
| **Yes** | 12(46.2) | 21(31.8) | 0.197 |
| **No** | 14(53.8) | 45(68.2) | |
| **Aspiration pneumonia** | | | |
| **Yes** | 12(46.2) | 13(19.7) | 0.010* |
| **No** | 14(53.8) | 53(80.3) | |
| **Shock** | | | |
| **Yes** | 16(47.1) | 18(24.2) | 0.006* |
| **No** | 18(52.9) | 66(78.6) | |
| **Complications** | | | |
| **Respiratory(pneumonia, failure, ARDS)** | | | |
| **Yes** | 26(81.3) | 48(59.3) | 0.027* |
| **No** | 6(18.8) | 33(40.7) | |
| **CNS depression** | | | |
| **Yes** | 14(43.8) | 15(18.5) | 0.006* |
| **No** | 18(56.3) | 66(81.5) | |

** : $p<.001$, * : $p<.050$

## 3.5. Clinical Characteristics(Outcomes of Emergent Trearment)

After analyzing the length of stay in ICU, the geriatric group stayed for 9 days and the middle-aged group for 8 days. The difference was insignificant($p$=.741).

As a result of emergent treatment, 30 geriatric patients(88.2%) and 73 middle-aged patients(86.9%) were hospitalized to ICU, which was insignificant($p$=.123), and for the length of stay, the geriatric group stayed for 15 days and the middle-aged group for 13 days, which was insignificant($p$=.431)(Table 6).

Table 6. Clinical Characteristics(Outcomes of emergent treatment)

| Category | Geriatric patients (N=34) | Non-geriatric patients(N=84) | p-value |
|---|---|---|---|
| **Outcomes** | | | |
| **Admitted to general ward** | 2(5.9) | 3(3.6) | 0.606 |
| **Admitted to ICU** | 30(88.2) | 73(86.9) | |
| **Transfer** | 0(0.0) | 3(3.6) | |
| **Discharged willfully** | 2(5.9) | 2(2.4) | |
| **Discharged** | 0(0.0) | 2(2.4) | |
| **Others** | 0(0.0) | 1(1.2) | |
| **Total days of hospital treatment** | 18.79±21.62(15) | 17.51±17.86(13) | 0.741 |
| **Days of treatment in ICU** | 14.71±19.23(9) | 10.56±10.47(8) | 0.242 |

## 3.6. Clinical Characteristics(Treatment and prognosis)

After analyzing the incidence rate of mortality, 8 geriatric patients(27.6%) and 8 middle-aged patients(10.0%) were found($p$=.012)(Table 7).

In the outcome after hospitalization, 1 geriatric patient6(47.1%) and 67 middle-aged patients(79.8%) were discharged after full recovery; 8 geriatric patients(23.5%) and 9 middle-aged patients(10.7%) discharged at their wills; 2 geriatric patients (5.9%) and 1 middle-aged patient(1.2%) died within a week; 1 geriatric patient(2.9%) and 1 middle-aged patient(1.2%) died within 24 hours; 7 geriatric patients(20.6%) and 6 middle-aged patients(7.1%) were found hopeless($p$=.027)(Table 7).

Table 7. Clinical Characteristics(Treatment and prognosis)

| ategory | Geriatric patients (N=34) | Non-geriatric patients (N=84) | *p*-value |
|---|---|---|---|
| Outcome | | | |
| Discharged after full recovery | 16(47.1) | 67(79.8) | |
| Mortality within 24hours | 1(2.9) | 1(1.2) | |
| Mortality within a week | 2(5.9) | 1(1.2) | 0.012* |
| Against discharge | 8(23.5) | 9(10.7) | |
| Hopeless | 7(20.6) | 6(7.1) | |
| Survival | | | |
| Survival | 21(72.4) | 72(90.0) | 0.027* |
| Non-survival | 8(27.6) | 8(10.0) | |

** : $p<.001$, * : $p<.050$

## 3.7. Comparison of Pseudocholinesterase Level Depending on Namba's Severity

Organophosphate poisoned patients were classified by Namba's severity depending on their clinical symptoms. In all patients, 24 patients were mildly poisoned, 25 moderately poisoned, and 65 severely poisoned(Table 1).

After repeated measures of Pseudocholinesterase level depending on the Namba's severity, there was a significant change in Pseudocholinesterase level over time ($p$=.000); the reciprocal action was significant between the two groups; and there was a difference in patterns of variation in Pseudocholinesterase level($p$=.000)(Table 8)(Fig 3).

Therefore, Namba's severity affected the patterns of variation in Pseudocholinesterase level.

Table 8. Pseudocholinesterase Level Depending on Namba's Severity

| Category | Mild poisoning (N=24) | Moderate poisoning (N=25) | Severe poisoning (N=65) | *p*-value |
|---|---|---|---|---|
| ER Visit | 1606.17±2645.98(314.5) | 549.08±597.51(240) | 651.66±1670.89(165) | 0.057 |
| 1day | 804.44±856.30(460.5) | 772.04±928.12(246.5) | 683.35±1504.24(180.5) | 0.926 |
| 3day | 1430.80±1835.37(1111) | 908.00±1016.85(386.5) | 816.79±1290.04(388) | 0.286 |
| 5day | 1229.46±924.34(1139) | 1344.70±1290.24(1012.5) | 1174.83±989.48(1015) | 0.829 |
| 10day | 2277.10±1555.68(2115) | 2222.17±1580.81(2103.5) | 1820.72±1444.70(1578) | 0.501 |
| 15day | 3249.29±2085.29(2839) | 3665.50±1841.58(4061.5) | 2285.95±1769.59(2052) | 0.077 |
| 20day | 7999.00±1063.49(7999) | 5134.25±2179.96(5097.5) | 2506.83±1469.12(2418.5) | 0.000* |

** : $p<.001$, * : $p<.050$

Table 9. Comparison of Repeated Measures of Pseudocholinesterase Level by Namba's Severity

| Effect | F | Hypothesis degree of freedom | Error degree of freedom | *p*-value |
|---|---|---|---|---|
| **Cholinesterase level** | 25.025 | 6.000 | 26.000 | 0.000** |
| **Cholinesterase level * Group** | 5.371 | 12.000 | 52.000 | 0.000** |

** : $p<.001$, * : $p<.050$

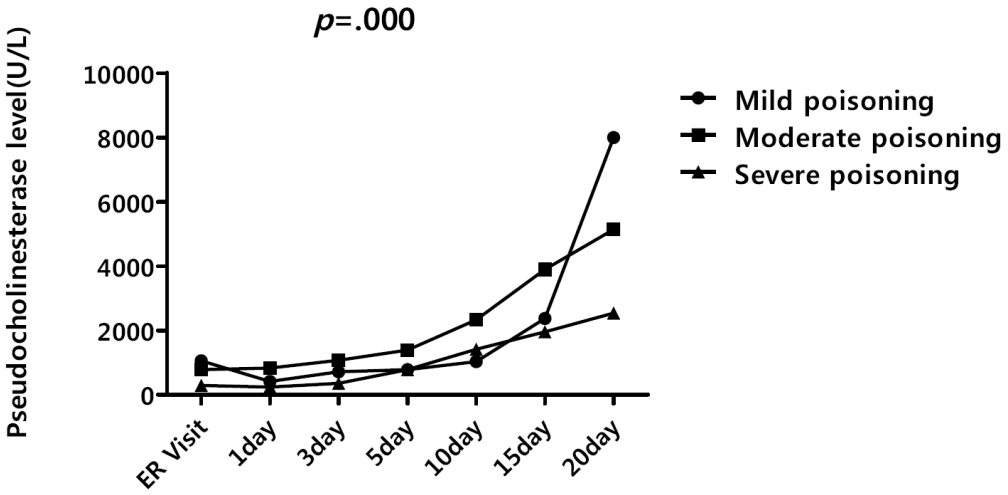


Figure 3. Variation in Pseudocholinesterase Level Depending on Namba's Severity

## 3.8. Analysis of Patients Who Died

A total of 16 patients died: 9 geriatric patients and 8 middle-aged patients. In gender, there were 10 males and 6 females.

The average systolic blood pressure was 114.50mmHg; average diastolic blood pressure 66.18mmHg; average lactate 7.48.

The mean duration of hospitalization was 11.13 days; the longest period of hospitalization 36 days; and in the type of death, 13 patients were hopeless, 2 died within 24 hours, and 1 within a week(Table 10).

Table 10. Analysis of the Characteristics of the Patients Who Died

| No | Age (year)/ sex | Dose | Route of addiction | SBP (mmHg) | DBP (mmHg) | lactate | days of hospital treatment | Cholinesterase level | | | | | | | Outcome |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | ER Visit | 1day | 3day | 5day | 10day | 15day | 20day | |
| 1 | 35/M | 200 | oral | 158 | 92 | 5.11 | 36 | 1,886 | 1,543 | 2,262 | 2,486 | 2,328 | 4,148 | 5,511 | hopeless |
| 2 | 54/F | - | oral | 80 | 5 | 9.30 | 3 | 92 | 73 | - | - | - | - | - | hopeless |
| 3 | 66/M | 200 | oral | 48 | 38 | 18.01 | 3 | 663 | 792 | 968 | - | - | - | - | Mortality within a week |
| 4 | 24/F | - | oral | 86 | 41 | 6.29 | 1 | 520 | - | - | - | - | - | - | Mortality within 24hours |
| 5 | 89/F | - | oral | 119 | 77 | 4.68 | 15 | 226 | 324 | 79 | 82 | 86 | 120 | - | hopeless |
| 6 | 80/M | 100 | oral | 150 | 70 | 5.83 | 36 | 259 | 111 | 186 | 294 | 666 | 1,519 | 2,037 | hopeless |
| 7 | 69/F | - | oral | 162 | 92 | 12.20 | 19 | 83 | 72 | 90 | 122 | 252 | 290 | - | hopeless |
| 8 | 41/F | 20 | oral | 110 | 70 | - | 8 | 1,336 | 2,663 | 3,012 | 3,242 | - | - | - | hopeless |
| 9 | 71/M | - | oral | 135 | 65 | 8.11 | 1 | 3,320 | 3,198 | - | - | - | - | - | hopeless |
| 10 | 74/M | - | oral | 63 | 42 | 8.38 | 1 | 126 | - | - | - | - | - | - | hopeless |
| 11 | 72/F | - | oral | 196 | 112 | 9.34 | 1 | 155 | 153 | - | - | - | - | - | Mortality within 24hours |
| 12 | 62/M | - | oral | 64 | 36 | 13.42 | 0 | 128 | - | - | - | - | - | - | hopeless |
| 13 | 69/M | - | oral | 108 | 89 | 5.88 | 23 | 1,256 | 850 | 913 | 664 | 1,549 | 2,290 | 2,475 | hopeless |
| 14 | 65/M | 10 | oral | 103 | 70 | 3.57 | 6 | 129 | 134 | 119 | 123 | - | - | - | hopeless |
| 15 | 41/M | 150 | oral | 110 | 70 | 1.64 | 2 | 1,290 | 2,933 | - | - | - | - | - | hopeless |
| 16 | 43/M | - | oral | 140 | 90 | 0.37 | 23 | 66 | - | 1,322 | 2,401 | 4,512 | 5,193 | - | hopeless |

# Chapter 4. Considerations

This study was conducted in patients who were hospitalized for organophosphate poisoning and aged 18 years or more among, but excluded the patients with hepatic cirrhosis, tumor, deteriorated nutritional status, or infection which are known to affect the rate of recovery of Cholinesterase(Nelson & Burritt, 1986).

The agricultural organophosphate pesticide is an insecticide which is widely used across the world. It has been mostly used in rural areas, but most recently, used to eradicate harmful insects even in the downtown, mostly from occupational exposure, deliberate poisoning, and mishap. The death rate from this pesticide is known higher than the other poisonings. In this study, suicide was mostly a cause of poisoning. Consistently, Jeon et al.(2002) reported that suicide was 67.3%(Chun et al, 2002).

Han et al.(2005) suggested that the patient group with pneumonia had higher incidence of endotracheal intubation. This study reported that the geriatric group had higher incidence of endotracheal intubation. This is considered that the patients with higher level of severity would have higher incidence of endotracheal intubation (Han et al, 2005)

The causes of death from organophosphate poisoning were known to include aspiration pneumonia, shock, respiratory complications, and abnormal central nervous system. Han et al. (2005) reported that 53% came from pneumonia. Ryu et al.(1993) reported that 31.7% came from pneumonia. Pneumonia was reported as a major cause of death within 24 hours of organophosphate poisoning, which was consistent with this study(han et al, 2005, lu et al, 1993).

Jin et al.(2004) reported that the incidence rate of abnormal central

nervous system was 83% in patients requiring mechanical ventilation and the incidence rate of serious case was 66.6%. They also added that the incidence rate of respiratory complications was 50%. In this study, as the incidence rate of central nervous system and of serious case was higher in geriatric patients, there was a difference in the incidence rate of abnormal central nervous system and of serious case by age(Jin et al, 2004). This is considered that as the rate of recovery of cholinesterase level in geriatric patients is significantly lower than in middle-aged patients, the incidence rate of central nervous system and of serious case becomes higher.

Ha et al.(1998) insisted that the total period of hospitalization for organophosphate poisoned patients was 15.6 days and that the age increased, the period of hospitalization increased, which were consistent with this study. This indicated that the total period of hospitalization increased as they aged (ha et al, 1998).

Gang et al.(2009) reported that the Cholinesterase level in the patients who survived was higher, but the Cholinesterase level in the patients who died was lower, which was similar to this study. However, after repeated measures of the rate of recovery of Cholinesterase level, there was no difference in death. This indicated that death had no impact on Cholinesterase level.

Lin et al.(2006) reported that the dose of poisoning in the patients who died was high and the Cholinesterase level was low, which was similar to this study. It is considered that this is correlated with the Cholinesterase level and the dose of poisoning.

The organophosphate poisoned symptoms include suppressing the activity of Cholinesterase in neuromuscular system, central nervous system, and parasympathetic nerve endings and accumulating acetylcholine in synapses

(Haddad et al, 1998, Ellenhorn, 1997). The excessively accumulated acetylcholine paralyzes cholinergic stimulation in central nervous system, autonomic ganglion, parasympathetic nerve endings, and sympathetic ganglia (Borowitz, 1988). In organophosphate poisoned patients, Cholinesterase diminished, but recovered 25% to 30% within 7 to 10 days after exposure and normalized to the values measured before exposure after 4 to 6 weeks and the erythrocyte Cholinesterase increased 1% every day and normalized at 5 to 7 weeks(Midtling et al, 1985, Coye et al, 1986, Brunton, Chabner & Knollmann, 1994).

Jeon et al.(2002) reported that blood-plasma cholinesterase activity were closely correlated to the toxicity of poisoning components, the elapsed time till gastric lavage, the dose of poisoning, patient's APACHE III score, duration of respirator treatment, and the occurrence of pneumonia would be utilized as clinical severity predictors(Chun et al, 2002), and Oh et al(1998) reported that if Cholinesterase level recovers over time, prognosis would be good. Likewise, this study showed that there was a difference in Cholinesterase level depending on severity.

Also, age had an impact on the Cholinesterase level: the rate of recovery of Cholinesterase level was lower in geriatric patients than in middle-aged patients.

Several limitations of this study should be considered. First, our study was did not measure red blood cell cholinesterase. The cholinesterase is a family of enzymes that catalyze the hydrolysis of the neurotransmitter acetylcholine into choline and acetic acid, a reaction necessary to allow a cholinergic neuron to return to its resting state after activation. Acetylcholinesterase also known as RBC cholinesterase is found at mainly neuromuscular junctions and cholinergic brain synapses, where its activity serves to terminate synaptic transmission. Pseudocholinesterase, also

known as plasma cholinesterase, found primarily in the liver. The term "serum cholinesterase" is generally used in reference to a clinical test that reflects levels of both of these enzymes in the blood.

However, the measure makes it easy to plasma cholinesterase and acute intoxication is known to significant than RBC cholinesterase. The plasma cholinesterase within 7-10 days of exposure had recovery 25-30%, and is normalized after 4-6 weeks. The RBC cholinesterase was increased by 1% on the first 5-7 weeks will be normalized(Wang R & Tang XC, 2005).

Second, RBC cholinesterase is not significant because it was high dose intoxication in this study patents(Midtling JE et al 1985, Coye MJ et al 1986).

# Chapter 5. Conclusion

In organophosphate poisoned patients, the rate of recovery of Pseudocholinesterase was lower, but the incidence rate of intubation, the incidence rate of aspiration pneumonia, the incidence of shock, the incidence of abnormal central nervous system, and the severity were higher in geriatric patients than in middle-aged patients.

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