

# A Study to Assess the Utility of Peradeniya Organophosphorous Poisoning (POP) Scale, Poisoning Severity Score (PSS) and Glasgow Coma Scale (GCS) in Predicting Severity and Treatment Outcome in Acute Organophosphorous Poisoning

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## ABSTRACT

**Introduction:** Organophosphate compounds are often used for homicidal and suicidal purposes. It accounts for about 80% of pesticide related hospital admissions. Study aimed to assess the severity of OP poisoning by POP scale, PSS and GCS and to compare POP scale, PSS and GCS in predicting the treatment outcome in OP poisoning.

**Material and Methods:** 100 patients of OP compound poisoning were included in the study. POP score, PSS and GCS were assessed at the time of presentation and were grouped based on the severity. These scores were individually evaluated in predicting the ventilator requirement and mortality in OP compound poisoning and the scores were compared with each other, as to assess which score was better in predicting the severity of OP poisoning.

**Results:** Ventilator requirement and mortality was found to be in 43% and 16% of patients respectively. Intubation rates and mortality rates were higher in patients with severe grades of POP score, PSS and GCS with a significant p value (0.00), than in patients with mild to moderate grades. All three scores correlated well in predicting the requirement of ventilatory support and mortality in OP compound poisoning cases.

**Conclusion-** The three scoring systems are simple and effective tool that can be assessed based on the clinical examination. For a resource limited country, like India, any of the three scoring systems can be applied at the primary care setting level which helps in making timely decision regarding need for ventilatory support and timely shifting of patient to the ICU care setting.

**Keywords:** Organophosphorus poisoning, POP score, PSS, GCS

high as 70%. High mortality could be probably due to lack of hospital services in the vicinity, inadequate transport facility, delay in initiation of appropriate treatment, increased patient to care givers ratio, and finally non-availability of definite antidote<sup>2</sup>. Insecticide consumption is one of most common modes of committing suicide followed by hanging in India, more common among males(70.54%) followed by females(29.47%)<sup>3</sup>. Organophosphorus (OP) insecticides are possibly one of the commonest causes of morbidity and mortality due to poisoning worldwide. It is widely seen in developing countries like India as these compounds are easily available. OP insecticide self-poisoning is an important clinical problem in rural part of India. Unintentional poisoning kills far fewer people but is a problem in places where highly toxic OP pesticides are available. Hospitals in rural areas bear the brunt of this problem, and they see hundreds of patients poisoned by pesticides each year. These hospitals are frequently not adequately staffed or equipped to deal with these very sick patients. ICU and ventilators are in short supply to meet the burden. In such cases early assessment by clinical markers is very important to categorise the severity and early referral to higher centre where aggressive treatment can be initiated immediately. Many studies have been undertaken to study the diagnostic and prognostic value of serum cholinesterase levels in OP poisoning and their relationship with neurological syndromes<sup>4,5</sup>. Most of the studies have shown that, though serum cholinesterase can be used as a diagnostic marker, its role is minimal as a prognostic marker<sup>6,7</sup>. Therefore, it is important to compare the easily available scoring systems in predicting the severity with clinical outcome.

## INTRODUCTION

WHO documents pesticide toxicity as a prevalent global problem, associated with over a two lakh deaths in a year, most poisonings occur in Southeast Asia<sup>1</sup>. India being an agriculture based country, Organophosphorus (OP) pesticide are widely used for crop protection and pest control. It is therefore likely to have detrimental effects on farmers who are accidentally over exposed while handling these pesticides. It has also become an agent of choice for self-poisoning as it is widely available and cheap. Pesticide self-poisoning is responsible in killing approximately three lakh people worldwide every year and most of these deaths are from rural areas. In developing countries the mortality can be as

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**How to cite this article:** Raveendra K R, Mohan C N, Nandan Kodur. A study to assess the utility of peradeniya organophosphorous poisoning (POP) scale, poisoning severity score (PSS) and glasgow coma scale (GCS) in predicting severity and treatment outcome in acute organophosphorous poisoning. International Journal of Contemporary Medical Research 2020;7(2):B20-B24.

**DOI:** <http://dx.doi.org/10.21276/ijcmr.2020.7.2.22>



Peradeniya OP poisoning scale is a severity score that assess the severity of poisoning based on symptoms at admission and is simple to use. Patients with a high score on the POP scale had a high rate of morbidity and mortality<sup>8</sup>. Poisoning Severity Score is a severity grading scale adopted by the IPCS for grading the severity of poisoning. PSS recorded at admission can be used to predict outcome of poisoning patients. The Poisoning Severity Score, grades severity as (0) none, (1) minor, (2) moderate, (3) severe, and (4) fatal poisoning. Poisoning Severity Score normally done at admission and at frequent intervals during hospitalisation. Usually the severity grading takes into account only the observed clinical symptoms and signs, rather than those that might be anticipated (laboratory and other parameters)<sup>9</sup>. The Glasgow Coma Scale (GCS) is a neurological scale that aims to give a reliable objective way of recording the conscious state of a person for initial as well as subsequent assessment. It is considered as the best indicator for the assessment of severity, including mortality of OP poisoning patients in an emergency situation<sup>10</sup>. Many studies are available like pseudocholinesterase, Glasgow Coma Scale score, APACHE II score, LDH, serum immunoglobulins, circulating complements, CPK and various other scoring systems, to assess the severity of OP compound poisoning. However there is no consensus regarding these factors to determine severity and also to predict morbidity and mortality<sup>11</sup>. This study was done to compare the three scoring systems in patients with acute OP poisoning to assess severity status. Thus it helps in predicting the outcome and help in making timely decision regarding the need for ventilatory support. Objectives of the study were to assess the severity of OP poisoning by POP scale, PSS and GCS and to compare POP scale, PSS and GCS in predicting the outcome in OP poisoning.

## MATERIAL AND METHODS

The prospective cross sectional study of OP poisoning patients admitted to Victoria and Bowring and Lady Curzon hospitals attached to Bangalore medical college Bangalore India, conducted over a period of 1 year from August 2018 to July 2019. 100 admitted patients with definite history of OP compound poisoning, satisfying the inclusion and exclusion criteria were included in the study. Only direct patients were included into this study. A written informed consent were obtained from each patient. Prior to this ethical approval was obtained from the Institution ethics committee.

All patients were clinically evaluated with detailed history and thorough clinical examination. Routine and specific lab investigations were done at the earliest. Patients were grouped into mild, moderate and severe based on plasma cholinesterase levels. Also, severity status of all the patients were assessed with different international scales namely Peradeniya Organophosphorus Poisoning Scale, Poisoning Severity Score (IPSS PSS) and Glasgow Coma Scale as per table 1 and 2. All patients were treated in the emergency room initially with the protocol line of treatment. Stomach and other body fluid samples were preserved and

later sent to forensic lab for analysis (medicolegal cases). Patients requiring ICU support were assessed and treated accordingly. Patients were monitored till either discharge or death. All patients who recovered underwent psychiatric evaluation and were followed up post discharge for a period of one month both in medicine and psychiatry outpatient department.

## STATISTICAL ANALYSIS

Descriptive analysis like frequency and percentage were calculated. Inferential statistics like chi square test was applied for categorical data. P value was set significant at 0.05.

## RESULTS

A total 100 patients with definite history of OP compound poisoning were enrolled into the study. The mean age group of our patients was 36.04 years. Most of them were males (72%) when compared to females (28%). The common presenting features were vomiting (96%), diarrhoea (50%), salivation and lacrimation (50%) and altered sensorium (42%). The common clinical signs on examination were bradycardia (42%), pinpoint pupils (30%) and tachypnea (26%). Mean duration of the distance travelled by the patient to a tertiary hospital for medical attention was around 9.44 hours. 36 patients came to the emergency room within 6 hours of OP consumption and 38 took 6 to 12 hours, while

| Severity Grades | Pseudocholinesterase levels (U/L) |
|-----------------|-----------------------------------|
| Mild            | 4500-5000                         |
| Moderate        | 2500-4499                         |
| Severe          | <2500                             |

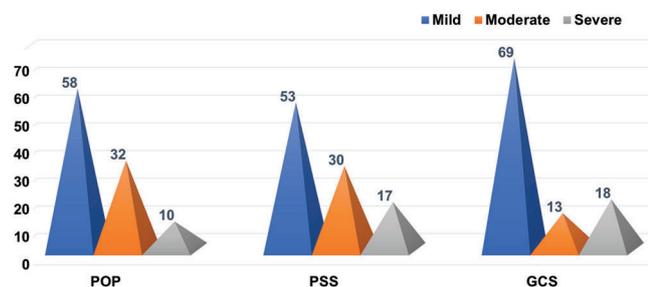
**Table-1:** Proudfoot classification severity of Organophosphorus poisoning based on Pseudocholinesterase levels.<sup>12</sup>

|                        |                                      |   |
|------------------------|--------------------------------------|---|
| Pupil Size             | >2mm                                 | 0 |
|                        | <2mm                                 | 1 |
|                        | Pinpoint                             | 2 |
| Respiratory rate       | <20                                  | 0 |
|                        | >20                                  | 1 |
| Heart rate             | 20 with central cyanosis             | 2 |
|                        | >60                                  | 0 |
|                        | 41-60                                | 1 |
| Fasciculation          | <40                                  | 2 |
|                        | None                                 | 0 |
|                        | Present generalized or continuous    | 1 |
| Level of consciousness | Present Generalized and continuous   | 2 |
|                        | Conscious and rationale              | 0 |
|                        | Impaired response to verbal commands | 1 |
| Seizure                | No response to verbal commands       | 2 |
|                        | Absent                               | 0 |
|                        | present                              | 1 |

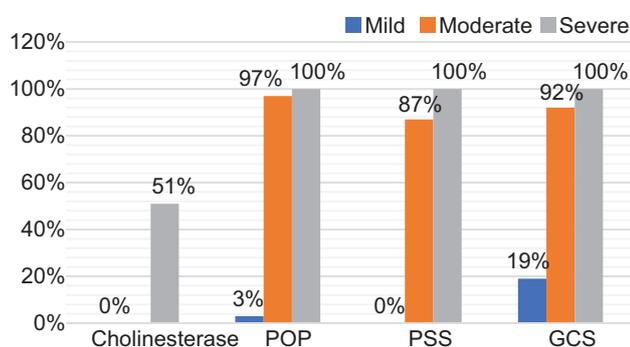
**Table-2:** Peradeniya organophosphorus poisoning scale.<sup>13</sup>

| Severity | POP  | IPCS PSS                                             | GCS   |
|----------|------|------------------------------------------------------|-------|
| Mild     | 0-3  | Mild, transient and spontaneously resolving symptoms | 13-15 |
| Moderate | 4-7  | Pronounced or prolonged symptoms                     | 9-12  |
| Severe   | 8-11 | Severe or life threatening symptoms                  | ≤8    |

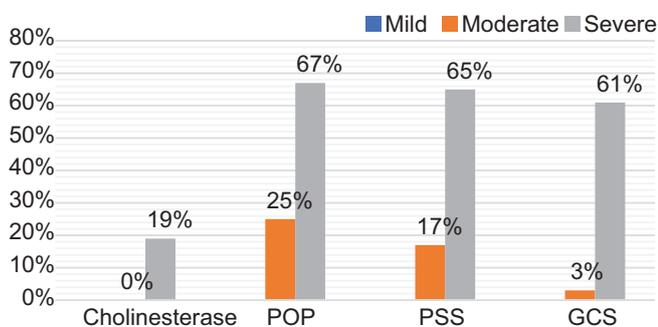
**Table-3:** severity based on POP<sup>13</sup> score, IPCS PSS<sup>14</sup> and GCS<sup>14</sup>



**Figure-1:** Showing the distribution of subjects in percentage based on the three scoring systems.



**Figure-2:** Chart showing severity grading and its correlation with intubation.



**Figure-3:** Chart showing severity of grading and deaths.

26 of them presented after 12 hours of intake of the OP compound. 76 patients were from rural background and 72 among them were involved in agriculture. All 100 patients consumed the poison with suicidal intention. 84 did so for the first time and rest were repeaters (10 for the second time and 6 for the third time). Dimethoate was the most common OP compound consumed and 54 patients had consumed this compound in the present study, followed by parathion 15, chlorpyrifos 14, fenthion 12 and 5 had taken mixture of 2 or more OP compounds. 15 patients had consumed in empty stomach and the rest had taken the compound along with food. Out of 100 patients 30 patients had comorbid conditions like diabetes (10), hypertension (6), both diabetes and hypertension (10), obesity (5), ischemic heart disease (3),

COPD (3), chronic kidney disease (2) and hypothyroidism (1). Out of 43 patients who required ventilatory support, 23 patients were intubated on the day of admission, 10 patients on day 2, 8 patients on day 3 and 2 patients got intubated on day 4 of admission. The mean duration of hospital stay was 4.76 days, among patients who were not intubated and 12.96 days among patients who were intubated.

Patients were grouped based on cholinesterase levels as per Proudfoot classification severity of Organophosphorus poisoning based on Pseudocholinesterase levels<sup>12</sup> (table 1). 12% belonged to mild category, 4% to moderate category and 84% to severe category. 12 patients had pseudocholinesterase levels between 4500 to 5000 U/L, 4 patients 2500 to 4499 U/L and 84 patients below 2500 U/L.

Out of 100 patients 58%, 53% and 69% of them were categorized under mild category, 32%, 30% and 13% under moderate category and 10%, 17% and 18% under severe category, according to the POP score, PSS, and GCS respectively (table 2 and 3) (fig-1).

43 patients required ventilator support and were shifted to ICU for the same. None of the patients in mild and moderate grade based on pseudocholinesterase levels required ventilator support, while 51% with severe grade with pseudocholinesterase levels less than 2500U/L required ventilatory support. 3%, 97% and 100% of patients belonging to mild, moderate and severe grade respectively based on POP score required ventilator support, while no patient, 87% and 100% in the mild, moderate and severe grade respectively based on PSS score and 19%, 92% and 100% in mild, moderate and severe grade respectively as graded by GCS required ventilatory support. All these patients were shifted to the ICU for the same. 24 out of 43 patients who were intubated, belonged to the age groups between 40 to 50 years, 8 were in age group of 20 to 30 years, 9 in 30-40 years and 2 in 50-60 years age group. Most of them were males (35 males and 8 females). Among the patients who were intubated 19 patients took more than 12 hours to reach the hospital after consuming the poison, 14 reached the hospital between 6 to 12 hours and the rest 10 reached within 6 hours. 40 patients were from rural parts of India and the rest of them were from the urban areas and majority of them (36) were farmers. All the patients had consumed the poison with suicidal intention. 27 patients had consumed the poison for the first time, 10 for the second time, and 6 of them for the third time. 20 patients among the 54 who had consumed dimethoate, 7 among the 15 who had consumed parathion, 7 among the 14 who had consumed chlorpyrifos, 4 among 12 who had consumed fenthion and all 5 who had consumed a mixture of two or more OP compounds respectively required ventilatory support. 27 patients among the 30 with associated comorbidities like diabetes, hypertension, obesity,

COPD, ischemic heart disease, chronic kidney disease and hypothyroidism required ventilator assistance.

The overall mortality rate was 16%. All 16 patients were intubated during the course of their stay in the hospital. 14 of them belonged to the age groups between 40 to 50 years and the rest 2 belonged to the age group of 50-60 years. All of them were males. 19% of patients classified under severe grade based on pseudocholinesterase levels with 25% of moderate and 67% of severe grade classified based on POP score, 17% of moderate grade and 65% of severe grade classified based on PSS and 38% of moderate grade and 61% of severe grade classified according to GCS respectively, succumbed to death. Mortality was higher among patients who reached the hospital beyond 12 hours of consumption of the OP compound as 12 among the 19 patients who took more than 12 hours to reach the hospital have died. 14 of them were from rural parts of India and 13 among them belonged to the agricultural sector. There was a significant increase in mortality in individuals who had consumed a mixture of more than one OP compound as all 5 patients who had consumed more than one OP compound mixture have died, followed by dimethoate group 10 patients among the 54. Mortality was significantly high among the ones who had consumed the OP compound in an empty stomach, that is 12 out of the 15 patients who had consumed in an empty stomach have died. Out of 16 patients who died, 11 had associated comorbidities like diabetes, hypertension, obesity, COPD and chronic kidney disease. Among the patients who were put on ventilator, there was a significant increase in mortality among patients who got intubated late, beyond day 3, 5 out of 8 who got intubated on day 3 and 2 who got intubated on day 4 succumbed to death. It was noted that among patients who were intubated for more than a week had significantly higher mortality compared to the ones who were intubated for less than a week, that is 6 out of 12 patients who were intubated for more than a week have died. The most common cause of death was MODS (9 patients) followed by VAP (4 patients).

None of the patients in mild and moderate grade based on pseudocholinesterase levels required ventilator support, while 51% of patients with severe grade with pseudocholinesterase levels less than 2500U/L required ventilatory support. 3%, 97% and 100% of patients belonging to mild, moderate and severe grade respectively based on POP score required ventilatory support. None, 87% and 100% patients belonging to mild, moderate and severe based on PSS grade respectively required ventilator support. 19%, 92% and 100% of patients belonging to mild, moderate and severe grade based on GCS respectively required ventilator support (fig-2).

None of the patients in mild and moderate grade based on pseudocholinesterase levels required ventilator support, while 51% of patients with severe grade with pseudocholinesterase levels less than 2500U/L required ventilatory support. 3%, 97% and 100% of patients belonging to mild, moderate and severe grade respectively based on POP score required ventilatory support. None, 87% and 100% patients belonging to mild, moderate and severe based on PSS grade respectively

required ventilator support. 19%, 92% and 100% of patients belonging to mild, moderate and severe grade based on GCS respectively required ventilator support (fig-2).

19% of patients classified under severe grade based on pseudocholinesterase levels died. 25% of moderate and 67% of severe grade classified based on POP score have died. 17% of moderate grade and 65% of severe grade classified according to PSS have died. 38% of moderate grade and 61% of severe grade classified according to GCS respectively have died (fig-3).

## DISCUSSION

OP compound poisoning is highly preventable and completely treatable if reported early and treated properly. The most important step in the management is the assessment of the patient for the need for ventilatory support. Hence early recognition and transfer of the patient to the ICU holds the key for the better prognosis. Since most of these poisonings occurs in the rural areas, where the basic infrastructure is very poor, clinical scales play an important role in predicting the severity of the situation.

In this study, 100 patients with definite history of OP poisoning presenting to a tertiary care hospital, were assessed using the internationally validated scoring systems like the POP scale, PSS, and GCS to predict the severity of OP poisoning and treatment outcome. In the present study the ventilator requirement and mortality was found to be in 43% and 16% of patients respectively. This correlated with a study conducted by J V Peter et al<sup>14</sup>, where 65.7% of patients required mechanical ventilation and had a mortality of 13.1%. Mortality was significantly higher among the age groups of 40-50 years. But in a study conducted by S Chandrashekar et al<sup>10</sup>, the mortality was more common in the age group of 21-30 years. Also Shashank Tripathi et al<sup>8</sup>, has opined the same in his study. Intubation rates were significantly higher in patients with moderate and severe grades whereas mortality rates were higher in patients with severe grades of POP score, PSS and GCS with a significant p value of 0.00. All the three scoring system correlated well in predicting the need for intubation and mortality in OP compound poisoning cases. These scoring systems are simple and effective tools that can be assessed based on the clinical examination.

In our study it was observed that, patients who had taken poison in an empty stomach, who had consumed a mixture of one or more OP compounds, who had history of previous such attempts of consuming OP compound, who arrived to the hospital beyond 12 hours, who were intubated on day3 or beyond of admission and patients who were intubated for more than a week were among the important factors that contributed to increased mortality.

J O J Davies et al, conducted a multicenter cohort study in Srilanka that evaluated the usefulness of the International Program on Chemical Safety Poison Severity Scale (IPCS PSS) and the Glasgow Coma Scale (GCS) prospectively for predicting death in patients poisoned by OP pesticides and concluded that GCS and IPCS PSS were similarly effective at predicting outcome<sup>15</sup>.

S Chandrashekar et al, conducted an observational clinical study at department of Medicine Kurnool Medical College, Andhra Pradesh, India, on 100 patients to assess the utility of PSS and GCS scoring systems in predicting severity and clinical outcomes in OP poisoning. Both GCS and PSS are effective in predicting severity and outcome of OP compound poisoning<sup>10</sup>.

Shashank Tripathi conducted a prospective cross-sectional study at tertiary health centre Nagpur from October 2011 to September 2013. The study was done to correlate the prognostic value of GCS, POP and serum acetylcholinesterase levels in acute OP poisoning. Mortality was seen in 17.5% of patients and mortality was found to be higher in patients with severe grade of POP score and severe grade of GCS<sup>8</sup>.

## CONCLUSION

OP compound poisoning is one of the common poisonings in this part of the world. Most of these occur from the rural background, either suicidal or accidental. Most of the deaths occur due to delay in reporting to medical facilities or due to lack of infrastructure at the local hospitals (primary health care centres). Hence, most of these patients are referred to so called higher centres for ICU support. Much time is wasted and the same was noticed in our study. Applying different scoring systems at first medical attention often help to recognise the severity and later help for early referral to a tertiary care hospital for ICU support. Further non availability of biochemical testing at all the centres compel for the use of these clinical scoring systems to assess the severity of OP poisoning. All the more, these scoring systems are simple effective tools to be applied in a primary health centre by a primary care physician for early assessment and timely referral for the better treatment outcome.

## LIST OF ABBREVIATIONS

APACHE- Acute Physiology And Chronic Health Evaluation.

COPD- Chronic Obstructive Pulmonary Disease.

CPK- Creatinine phosphokinase

GCS- Glasgow Coma Scale

IPSS PSS- International Program on Chemical Safety Poison Severity Scale.

LDH- Lactate dehydrogenase.

OP- Organophosphorus.

POP- Peradeniya Organophosphorus Poisoning.

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**Source of Support:** Nil; **Conflict of Interest:** None

**Submitted:** 03-01-2020; **Accepted:** 02-02-2020; **Published:** 25-02-2020