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# Effect of Vertebral Pressure Technique and Intercostal Stretch Technique on Respiratory Rate, Tidal Volume, $SpO_2$ and Heart Rate among Organophosphorus Poisoning Patients: An Experimental Study

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## ABSTRACT

**Background**: Respiratory PNF technique is a proprioceptive and tactile stimulus that alters the depth and rate of breathing. Intercostal stretch enhances the chest wall elevation and increase chest expansion and diaphragm excursion to improve intra-thoracic lung volume which contributes to improvement in flow rate percentage. Vertebral pressure is another respiratory PNF where there is increased epigastric abdominal excursion over T2-T4.
**Objective**: To find out the effect of Vertebral pressure and Intercostal stretch technique on respiratory rate, tidal volume, $SpO_2$ & heart rate among organophosphorus poisoning patients
**Method**: Data was collected from 24 ICU patients who were on mechanical ventilator. Subjects were divided in two groups. Intercostal stretch technique was given to group A and vertebral pressure technique was given to group B, changes HR, RR, $SpO_2$, tidal volume was noted and data analysis was done.
**Result**: There was significant difference between pre intervention and post intervention readings for both the groups A and B at heart rate, respiratory rate, $SpO_2$ and tidal volume related ($p<0.001$). It thus proved that respiratory stimulation improves TV, Decrease in RR and HR and increase in $SpO_2$ for both groups.
**Conclusion**: Proprioceptive Neuromuscular Facilitation techniques are effective in improving HR, RR, lung capacity and Oxygen saturation in patients with OP poisoning. There was significant difference between pre intervention and post intervention readings for both the groups A and B at heart rate, respiratory rate, SpO2 and tidal volume.

***Keywords***: Organophosphorus poisoning, Mechanical ventilator, intercostal stretch, Vertebral pressure, Respiratory PNF.

## INTRODUCTION

Poison is a substance that causes damage or injury to the body and endangers one's life by severely affecting one or more vital functions due to its exposure by means of ingestion, inhalation, or contact [1].

In some cases, Death occurs within few hours, death occurs even after stabilizing the patient; this can result due to cardiovascular failure, muscle weakness and paralysis of respiratory muscles, in severe exposure untreated patient die as a result of respiratory arrest. Routes of poisoning can be through Oral, Inhalation or dermal. Most commonly used route for poisoning

exposure was oral followed by inhalation and dermal exposure [2].

In India as agriculture is the major occupation, they stock pesticides to eradicate the weeds and pest therefore due to easy availability of pesticides they are commonly used by farmers or farm workers to end their lives in stressful situation [3]. Pesticide poisoning from occupational, accidental and intentional exposure is a leading public health problem of the developing world [4].

Various Types of drugs used in poisoning are organophosphates is 71% (most common) followed by, rat poisoning (zinc phosphide and aluminum phosphide) which is 13%, Pyrethroids are 7%), carbamates (6.5%), and organochlorine (2.5%) were the chemical used for intentional poisoning. OP compounds have many toxic effects on pulmonary and cardiovascular system, due to this overstimulation of muscarinic acetylcholine receptors in the parasympathetic system causes pulmonary disorders such as ARDS. In the sympathetic system due to overstimulation of nicotinic acetylcholine receptors myocardial necrosis occurs [5].

There is literature which says that, 1045 poisoning cases were reviewed out of which, intentional poisoning cases were 68.42% and 31.58% cases were due to accidental poisoning [2]. Agents which are commonly used for poisoning were pesticides (39.5%) followed by medicines (26.1%) young populations were commonly observed from which 469 of 1045 [2]. In developed countries, the rate of mortality from poisoning is 1% to 2% but in India it varies between 15 to 30% [6]. Poisoning is the fourth most common cause of mortality in rural India [7].

A mechanical ventilator is a device, designed to move breathable air in and out of the lungs to help mechanism of breathing for a patient who is undergoing from breathing insufficiency [8,9]. In Intensive Care Unit (ICU), ventilator is a resuscitative procedure for the patients who are immune-compromised. The chest care of unconscious and recombinant patients is difficult and challenging because they voluntary breathing effort. In such cases mechanical ventilation helps in decreasing work of breathing by preventing hypoxia. Assist control ventilator delivers a set tidal volume when triggered by the patient's inspiratory effort and helps in weaning process [10,11].

Neuro physiological facilitation of respiration is a proprioceptive and tactile stimulus that changes the depth and rate of breathing. Intercostal stretching is an effective PNF technique helps in upgrading breathing pattern and respiratory muscle activity. The Intercostal stretch enhances the chest wall elevation and increase chest expansion and diaphragm excursion to improve intra-thoracic lung volume which contributes to increase in flow rate percentage [12]. Vertebral pressure is another respiratory PNF where there is increased epigastric abdominal excursion over T2-T4.

A study was conducted to find the significance of PNF technique with conventional chest physiotherapy in mechanically ventilated OP poisoning patient and they found that PNF is not an additive to improve hemodynamic as well as pulmonary parameter values, in OP poisoning acute management period [13]. Another study compared the PNF vs. resistance training of respiratory muscles on RR on 30 ICU patients. Result shows that PNF was successful in reducing respiratory rate in ICU patients when compared with patients treated with abdominal weights placed on their upper abdomen [14].

Aim and objectives of this study was to study and find out the effect of vertebral pressure and Intercostal stretch technique on respiratory rate, tidal volume, $SpO_2$ & heart rate among organophosphorus poisoning patients

## MATERIALS AND METHODS

This experimental study was conducted on 24 organophosphorus patients aged 20-85 years who was on mechanical ventilator from tertiary care hospitals in

Sangli district, Maharashtra. Ethical clearance was obtained from the institutional ethical committee of MMC. College of Physiotherapy, Wanless Hospital, Miraj, Maharashtra. Purposive sampling technique was used. The inclusion criteria for the study were, both males and females, HR <140/min, BP < systolic 180mmHg, ventilator modes should be SIMV or Bi-PAP. Patients with rib & thoracic vertebrae fracture, cardiac condition, respiratory condition, cardiac and abdominal surgery, malignancies were excluded. Written informed accent was signed from patients relative.

Pre intervention assessment was taken for both the groups. Group A subjects was given Intercostal stretch technique with therapist standing behind the patient. Intercostal stretch is provided by applying pressure to the upper border of a rib in the downward direction. The application of stretch is timed with an exhalation and stretch position is then maintained as the patient continues to breathe in his usual manner. 3 sets were given, 3 reps each with rest time of 1 min. Group B was given vertebral pressure technique, therapist standing behind the patient. Firm pressure applied directly over the vertebrae of the upper and lower thoracic cage, the pressure should be applied with an open hand for comport and must be firm enough to provide some stretch 3 sets were given, 3 reps each with rest time of 1 min. The post intervention results were noted for both the groups.

**Statistical analysis**

Data was collected from 24 patients. Statistical analysis was done by SPSS software version 20.0. Pre and post outcomes of HR, RR, $SPO_2$, tidal volume was done using paired T test and between the group analysis was doing using unpaired T test.

## RESULT

The study included 24 subjects from which 11 were females and 13 were males.

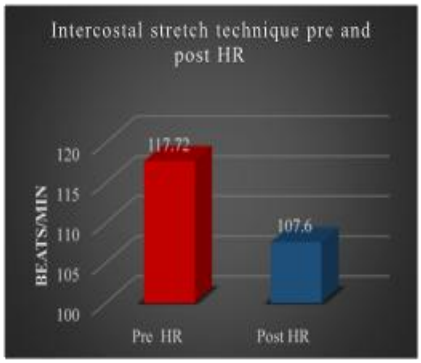
Graph 1-8 depicts comparison between pre and post outcome parameters like heart rate, respiratory rate, $SpO_2$ and tidal volume of group A and group B respectively. Paired t test was done to compare between pre intervention and post intervention in both the groups. Group A- Intercostal stretch technique and Group B- Vertebral pressure technique. There was significant difference between pre intervention and post intervention readings for both the groups A and B at heart rate, respiratory rate, $SPO_2$ and tidal volume related ($p<0.001$). Graph 9 shows statistics of pre and post interventions groups.

Table 1 depicts statistics of Group A- intercostal stretch technique and Group B- vertebral pressure technique post intervention. Unpaired t test was done to compare between the group A and group B after post intervention. Mean HR after intervention, for group B (109.92) was significantly decreased in mean HR for group A (107.67) ($p=0.19$). Mean RR after intervention, for group B (20.08) was significantly decreased in mean RR for group A (17.97) ($p=0.03$). Mean $SPO_2$ after intervention, for group B (98.25) was significantly increased in mean $SPO_2$ for group A (98.67) ($p=0.6$). Mean Tidal volume after intervention, for group B (418.17) was significantly increased in mean tidal volume for group A (405.42) ($p=0.14$).

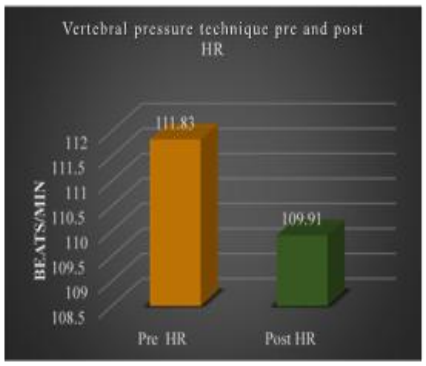
Both the techniques show significant effect on HR, RR, $SpO_2$ and tidal volume. But, the mean difference between pre and post intervention heart rate, respiratory rate and tidal volume was effective in Group A than Group B (graph 10). It also suggests that there was no significant difference in the values of $SpO_2$ between pre and post intervention in both groups. Therefore, this study shows that Group A (intercostal stretch) is effective than Group B (vertebral pressure technique) in terms of HR, RR and TV parameters. This study proves alternate hypothesis which shows significant effect of intercostal stretch technique and vertebral

pressure technique on Heart rate, respiratory rate, $SpO_2$ and tidal volume.

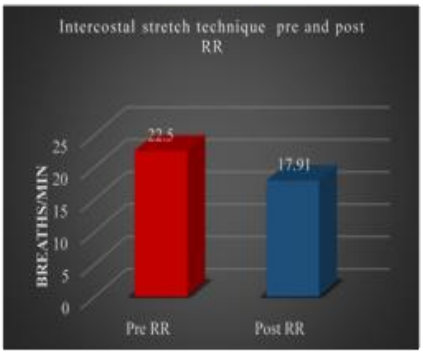
Graph 1: Bar diagram showing Comparison of pre and post Heart rate of Intercostal stretch



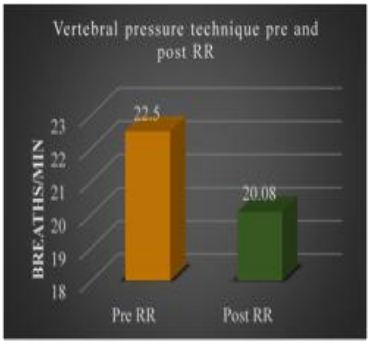

Graph 2: Bar diagram showing Comparison of pre and post Heart rate of Vertebral Pressure technique.




Graph 3: Bar diagram showing Comparison of pre and post Respiratory rate of Intercostal stretch technique

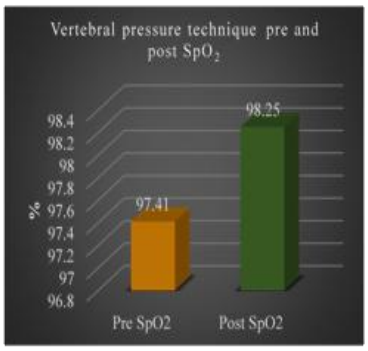



Graph 4: Bar diagram showing Comparison of pre and post Respiratory rate of Vertebral Pressure technique

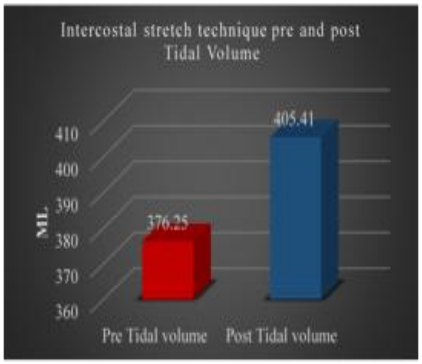



Graph 5: Bar diagram showing Comparison of pre and post $SPO_2$ of Intercostal stretch technique

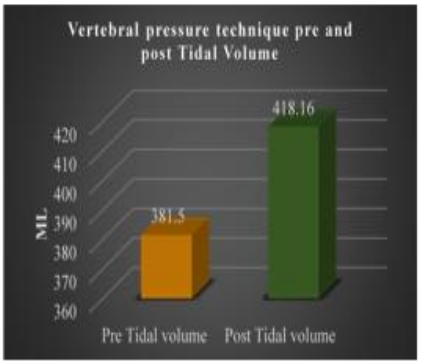

Graph 6: Bar diagram showing Comparison of pre and post $SPO_2$ of Vertebral Pressure technique




Graph 7: Bar diagram showing Comparison of pre and post Tidal Volume Intercostal stretch technique.




Graph 8: Bar diagram showing Comparison of pre and post Tidal Volume of Vertebral Pressure technique



**Graph 9: Mean distribution of intercostal stretch and vertebral pressure post intervention**

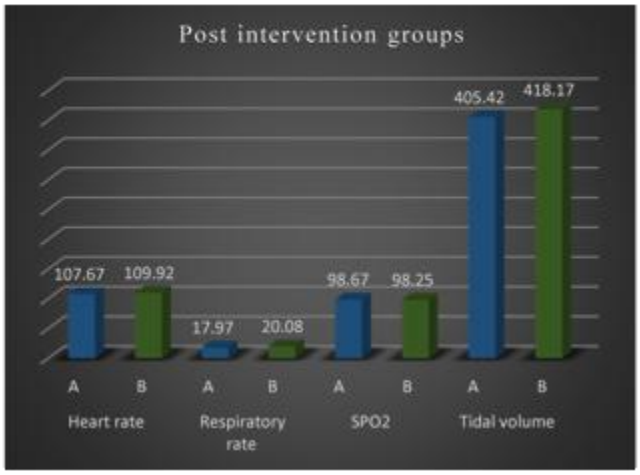



**Table 1: Descriptive statistics of Group A- intercostal stretch technique and Group B- vertebral pressure technique post intervention**

| Outcome | Group | Mean | Std. Deviation | Unpaired t statistic | p value |
|---|---|---|---|---|---|
| Heart rate post intervention | A | 107.67 | 9.77 | 0.639 | 0.188 |
| | B | 109.92 | 13.14 | | |
| Respiratory rate post intervention | A | 17.97 | 2.23 | 0.012 | 0.027 |
| | B | 20.08 | 3.97 | | |
| $SPO_2$ post intervention | A | 98.67 | 0.49 | 0.082 | 0.613 |
| | B | 98.25 | 0.62 | | |
| Tidal volume post intervention | A | 405.42 | 10.18 | 0.013 | 0.140 |
| | B | 418.17 | 12.67 | | |

## DISCUSSION

The study is an experimental comparative study to find out the effectiveness or Proprioceptive Neuromuscular Facilitation of IC stretch and PNF technique of vertebral pressure in patients with OP poisoning. Study has focused on comparison of effect of intercostal stretch and vertebral pressure technique on $SpO_2$ RR HR and has found that application of both IC stretch and vertebral pressure shows improvement.

Data was collected from total 24 patients consisting of 6 females and 6 males in group A and 5 females and 7 males in group B. Paired t test was done to compare between pre intervention and post intervention in both the groups. There was significant difference between pre intervention and post intervention readings for both the groups A and B at heart rate, respiratory rate, $SpO_2$ and tidal volume related ($p<0.001$). Mean post intervention parameter values of heart rate (107.666) and (109.916) was significantly less than mean heart rate value in pre intervention (117.7) and (111.833) respectively ($p<0.001$). Mean post intervention parameter values of Respiratory rate (17.916) and (23.54) was significantly decreased than mean respiratory rate value at pre intervention (22.5) and (20.0833) respectively ($p<0.01$). Mean post intervention parameter values of $SPO_2$ (98.666) and (98.25) was significantly increased than mean $SPO_2$ value at pre intervention (97.833) and (97.416) respectively ($p<0.001$). Mean post intervention parameter values of tidal volume value (405.416) and (418.166) was significantly increased than mean tidal volume value at pre intervention (376.25) and (381.5) respectively ($p<0.001$). It thus proved that respiratory stimulation improves TV, Decrease in RR and HR and increase in $SpO_2$ for both groups.

Similar study was done by Gupta P, et. al. in 2014 comparing IC stretch technique and anterior basal lift technique on respiratory rate, saturation of peripheral oxygen and heart rate. 30 subjects were

included in the study [15]. Result shows difference in group A in terms of RR, HR and $SpO_2$ ($p < 0.05$) compare to Group B results. It has been found that IC stretch is more effective in reduction of respiratory rate and heart rate and improving oxygen saturation than anterior basal lift technique.

Over T9-T11- increased Respiratory movement was owed, due to movement of apical thorax. It follows the dorsal root mediated intersegmental reflex. Observations of augmented diaphragmatic activity in response to high thoracic vertebral stimulation and facilitate apical respiratory activity following pressure over lower thoracic vertebrae. Proprioceptive and tactile stimuli selected produce remarkably consistent reflexive responses in ventilatory muscles which produce inspiratory expansion of ribs, increased epigastric excursion, visibly often palpably increased tone in the abdominal muscles and lowers the respiratory rate [12].

While Majority of the responses to proprioceptive neuromuscular stimuli are mediated by muscle stretch receptors via dorsal root and inter segmental reflexes therefore there was mild significant differences noted while comparing the two groups [12].

Intercostal stretch techniques and vertebral pressure technique show significant effect on HR, RR, $SPO_2$ and tidal volume. But, the mean difference between pre and post intervention heart rate, respiratory rate and tidal volume was effective in Group A than Group B. It also suggests that there was no significant difference in the values of $SPO_2$ between pre and post intervention in both groups.

Therefore, this study shows that Group A (intercostal stretch technique) is effective than Group B (vertebral pressure technique) in terms of HR, RR and TV parameters. This study proves alternate hypothesis which shows significant effect of intercostal stretch technique and vertebral pressure technique on Heart rate, respiratory rate, $SPO_2$ and tidal volume

This study has certain limitation, one of it was small sample size. There was limited information available regarding vertebral pressure technique attributing to study limitation. Further study with other PNF techniques should be done.

## CONCLUSION

On the basis of above discussion and analysis of outcome, it is suggested that though Proprioceptive Neuromuscular Facilitation of IC stretch and vertebral pressure produces benefits in treating OP poisoning, it does not produce any significant added benefits by itself when it is compared with each other.

The conclusion of study reveals that both Proprioceptive Neuromuscular Facilitation techniques are effective in improving HR, RR, lung capacity and Oxygen saturation in patients with OP poisoning. There was significant difference between pre intervention and post intervention readings for both the groups A and B at heart rate, respiratory rate, $SpO_2$ and tidal volume related ($p<0.001$)

Both Proprioceptive Neuromuscular Facilitation IC stretch Technique and Vertebral pressure Technique used in the study ensure improvement in breathing control by reduction in RR and HR and improving oxygen saturation.

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**Conflict of Interest:** None

**Source of Funding:** None

**Ethical Approval:** Approved

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