RESEARCH PAPER

Efficacy of Respiratory Muscle training on Arterial Blood Gases, Maximal Inspiratory Pressure and PEFR in patients with Intermediate Syndrome Following OPC poisoning

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ABSTRACT

The OPC poisoning reduces Acetylcholinesterase which results in Ach accumulation in acute phase. In the Intermediate Syndrome following OPC poisoning develops respiratory failure that results in abnormal arterial blood gas results and reduced respiratory function. In this quasi experimental study 51 patients with IMS following OPC poisoning were selected by purposive sampling method underwent respiratory muscle training with Diaphragmatic breathing exercise, Incentive Spirometer and Accapella for three days. Participants were assessed for PaO2, PaCO2, maximal Inspiratory pressure and PEFR. The collected data were taken for inferential statistics with paired 't' test. The results concluded that, the Respiratory Muscle Training improves the ABGs, Maximal Inspiratory Pressure and PEFR in patients with IMS following OPC poisoning.

Keywords: OPC poisoning, Acetylcholinesterase, Intermediate Syndrome, Respiratory Muscle Training, Incentive Spirometer, Accapella, PaO2, PaCO2, maximal Inspiratory pressure and PEFR.

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INTRODUCTION

As per WHO, approximately 30, 00,000 pesticide related poisoning incidence reported worldwide and more than 40,000 mortalities registered annually.[1&11] The developing countries register that, OPC poisoning is the most common among them.[2] Gunnell et al. have submitted their report as 258,234 mortalities occur each year due to OPC poisoning, which is responsible for 30% of the suicides worldwide. [9] In rural south India The occurrence of death due to OPC poisoning is 9.7/100 persons/year.[12]

Intermediate syndrome (IMS) usually starts following 48 hours to 72 hours of oral OP ingestion. It was initially described in mid-1980s. It occurs in around 20% of OP poisoning cases. The paralysis of respiratory muscles and functional loss of limbs are two primary symptoms that denote IMS. Treating this sequence requires mechanical ventilation dependency for 1–2 weeks.[3]

IMS presents with weak respiratory muscles and of proximal limb muscles accompanied by weakness of cranial nerves innervated muscles. Continuous and close monitoring of respiratory function and acid-base status are an absolute necessity.[4–5]Wadia described the influence of OPC poisoning on neurological functions and the respiratory failure.[6] Three constitutes involve in early respiratory failure are: depression of central respiratory drive from the medullary centre, respiratory muscles weakness, and direct pulmonary effects (bronchospasm, bronchorrhoea).[7]

Fenthion poisoning exhibits intermediate syndrome was very often. Fenthion is a highly fat soluble, causing continuous inhibition of AChE over days and delayed respiratory failure.[8] OP agents cause elevated breathing requirement by reducing pulmonary compliance and obstructing the airways.[10]

Acid-base imbalance is the main cause of complications following OPC poisoning. Early reorganization and correcting the acid-base disturbance are the primary goals of the .[13], [14], [15]Liu

et.al. in their retrospective analysis established the relationship between the poisoning severity and respiratory acidosis.[16]

Respiratory acidosis may occur due to sudden elevation of PCO2 as a result of failure of ventilation. This may be caused by any neurological disorders, any CNS depressing opioids or exposure to toxic compounds.[17]Inspiratory muscles weakness leads to acute respiratory acidosis.[18]

Inspiratory muscle training (IMT) is the opted treatment to increase inspiratory muscles strength and endurance to alleviate the respiratory depression by utilizing external device with flow threshold load.[19]

Results of study by Gregoretti et al. revealedthat, ventilator muscle training significantly reduces PaCO2 and increases PaO2in patients with acute quadriplegic injury.[20]Incervical spine injury patients, Golder et al. identified notable decrease in mean PaCO2, significant increase in mean value of PaO2 after respiratory muscle training.[21]

Wanke et al. found inspiratory muscle training is effective in increasing PaO2 and decreasing PaCO2 in Duchenne Muscular Dystrophy patients.[22]Meta analysis report by Raul Febero-Garrido et.al says that, respiratory muscle training improves exercise tolerance, diaphragm thickness and peak expiratory flow rate in stroke survivors.[23]Chaudhary et.al determined that, the respiratory training withIncentive Spirometer and Acapella effectively prevent the early Postoperative Pulmonary Complications in CABG patients.[24]

METHODOLOGY

This quasi experimental study used purposive sampling method and included 51 OPC poisoning patients (32 were male and 19 were female)who exhibited Intermediate syndrome inn their ICU admission period between December 2022 to June 2024 in from urban based specialty hospital ICU in Erode district of Tamilnadu, India.Institutional Ethical Clearance obtained for the study. Due to medico legal aspect of the study population, the study was carried out as single blind study with the physician cooperation. The participants recruited based on the defined sampling criteria. INCLUSION CRITERIA: Intermediate syndrome Patients following OPC poisoning, above the age of 18 years, moderate level of poisoning on Peradenia organophosphorus poisoning scale, mechanically non ventilated patients, patients with abnormal increased PaCO2and reduced PaO2, Patients with reduced PEFR and reduced Maximal Inspiratory pressure. EXCLUSION CRITERIA: Patients with toxic encephalopathy, patients who delayed or failed to decontamination within 4 hours, those require high flow oxygenation (FiO2>45%), patients with poor interpersonal communication, patients on treatment on any organ failure treatment

The participants underwent respiratory muscle training with diaphragmatic breathing training, Incentive Spirometer and Accapella devices. The training was framed to do the exercises for every second hour in the day times for 3 days. The Hemodynamic parameters were assessed periodically and also before and after the respiratory muscle training sessions.

The Arterial blood samples were collected and tested with ABG analyzer (Abbott Pima CD4) in the mornings. The ABG values were recorded every day (3days). The PaO2 and PaCO2 Values were recorded. The Maximal Inspiratory Pressure and PEFR were checked by the physiotherapist with Respiratory Pressure Meter and Peak Flow meter. The collected before intervention data and 4th day morning data were analyzed with Paired‘t’ test. Also the daily variations were described by Mean and Standard Deviations.

DATA ANALYSIS AND INTERPRETATION

The study carried out with null hypothesis that, there is no effect of respiratory muscle exercises on ABGs, MIP and PEFR. The data collected before intervention and after 3 days (4th day morning) intervention were taken for the data analysis.

PAIRED ‘t’ TEST TABLE

Variables	SD	‘t’ value	‘t’ value	P- value
Variables	SD	Table	Calculated	P- value
PaO2	6.78	34.84	1.671	P <0.05
PaCO2	2.97	30.81	1.671	P <0.05
MIP	5.00	47.2	1.671	P <0.05
PEFR	18.47	86.99	1.671	P <0.05

The collected data were undertaken for analysis with paired‘t’ test. The calculated t values for PaO2, PCO2, MIP and PEFR are greater than the table values. Wise PaO2 calculated‘t’ value is 34.84 where the table value is 1.671. PaCO2 calculated‘t’ values are 30.81 where the table‘t’ value is 1.671. MIP calculated‘t’ value is 47.2 and the table‘t’ value is 1.671. PEFR calculated‘t’ value is 86.99 where the table‘t’ value is 1.671. As results shows greater differences between the calculated‘t’ values and the table‘t’ values, the null hypotheses were rejected and the alternative hypotheses were accepted.

DISCUSSION

In OP poisoning, inhibition of acetylcholinesterase activity provokescollection of acetylcholine in the synaptic gap thatresults in extreme cholinergic symptoms and disturbed neurotransmitter activitiesin the nervous system. Theaccumulated synaptic acetylcholine has two types of actions wise, stimulation of muscarinic receptors and depressionof the nicotinic receptors. Altered neurotransmitter activities results in CO2 retention and acid-base imbalance.[25]

In another way, the respiratory muscle weakness reduces the lung volumes and capacities. And thus the patients present with more oxygen requirement and poor effort to eliminate the CO2 results in accumulation in the lung as well as in the venous blood. This in turn develops respiratory acidosis. In the very acute phase of OPC poisoning, serum AChE is lowered. Where 71% ABG reports with acid-base disturbances and 29% with normal ABG.[26]

The patients with OPC poisoning develop Intermediate Syndrome after 24 hours of ingestion and the severity depends on the level of poisoning. Peradeniaorganophosphorus poisoning scale explains well about the severity. The intermediate syndrome exhibits secondary respiratory failure and marked respiratory acidosis.

This study included the patients with intermediate syndrome following OPC poisoning based on the inclusion/exclusion criteria. Patients underwent the respiratory muscle training program for three days. There were 54 participants included but 3 of them removed from the study as one developed cardiac arrest on the 2nd day of intervention, one developed seizure and another one developed delirium in the ICU. The primary data collected before starting the respiratory muscle training and every morning in the following days.The data taken for analysis and result interpreted shows there is greater differences in pre and post intervention data. It says that the respiratory muscle training has greater effect on ABG and respiratory functions (MIP & PEFR).

CONCLUSION:

Intermediate Syndrome following OPC poisoning is a fatal situation that develops respiratory failure requires greater ventilatory support. Respiratory failure results in abnormal ABG reports (Respiratory acidosis) and poor respiratory functions. The data from this study expresses that, therespiratory muscle training has greater effect in improving ABGs (PaO2 & PaCO2), respiratory functions wise maximal Inspiratory pressure (MIP)

and Peek Expiratory Flow Rate (PEFR). So this study concludes that, Respiratory Muscle training improves ABGs and Respiratory functions in patients with intermediate syndrome following OPC poisoning. Also future studies may use respiratory muscle training for OPC poisoning to support this study results.

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