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EPIDEMIC OF INHALATIONAL ORGANOPHOSPHORUS POISONING IN YAVATMAL, MAHARASHTRA

Pharmacology

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ABSTRACT

Background: Inhalational organo-phosphorus (OP) compound poisoning is rare and less likely to be sever. But sudden increase in inhalational OP poisoning upto 570 cases and 13 deaths attracted the attention of whole nation. Randomized, retrospective, observational study was carried out to find the cause of this epidemic.

Methods: Thorough study of the case papers of inhalational OP poisoning patients from record section of S.V.N.GMC. Yavatmal was done. Complete data was collected and interpreted. Analysis of data was done on five points, i.e. sprayer's bio-data, insecticide used, spray pump, seed/crop condition and treatment received.

Results: Data collected from July 2017 to December 2017. Maximum number of cases (293) were admitted in September 2017. Total 570 cases were admitted and 13 patients were died even after full intensive care. Mean age of the patients was 36.67 years. Majority of them were professional sprayers but have not taken any pre, intra and post procedural precautions. Endosulfan was most commonly used as insecticide. Almost all sprayers used battery/diesel operated pumps. Cotton crop height was more than the height of sprayer. Treatment received in the form of inj. Atropine and inj. Pralidoxime as per the need of patients.

Conclusion: Spraying precautions, battery/diesel operated pumps, insecticides used were the factors responsible for this epidemic and all factors are preventable. All factors should be modified to prevent the epidemic of the coming crop year 2018.

KEYWORDS

Inhalational poisoning, Insecticide, Farmers, Spraying, Yavatmal.

Introduction

During this crop year 2017, sudden rise of inhalational poisoning of organo-phosphorus (OP) compound is observed in tertiary care hospital, Shri Vasantrao Naik Government Medical College and Hospital, (S.V.N.G.M.C.) Yavatmal. Yavatmal is a tribal city of Maharashtra state, India. The main business of this area is farming. Farmers took seasonal crops mostly in rainy season (June to September) because of scarcity of water. The main crop is cotton, that's why the city is called as Cotton City. S.V.N.G.M.C. Yavatmal have tertiary care hospital with 700 beds and full facility of ICU, ICCU, NICU, Surgical ICU, and separate OT for different surgical departments.

Generally OP poisoning is very common poisoning in this area. Farmer's suicide by ingestion of OP compound is endemic in this area. Sporadic cases are seen throughout the year[1]. Accidental inhalational poisoning by OP compound is rare and occurs during spraying the crop only. Few non-fatal cases were always admitted during July to November of each year. Such inhalational poisoning patient need only symptomatic treatment or at the most only injectable atropine of few doses. Very few patients need the pralidoxime therapy for inhalational poisoning[2].

During this rainy season adequate amount of raining have not occurred. But whatever raining have occurred, it was at appropriate time as per the need of crop development. So the crop flourish rapidly and overgrown. These overgrown and thick crops need spraying of insecticides at regular interval. During spray of the insecticides, this incidence of inhalational OP poisoning have occurred.

Total number of inhalational poisoning cases admitted in S.V.N.G.M.C. Yavatmal were 570 during this crop year 2017. These number of cases were much more as compared to the last year 2016. Not only the number of cases increased, but the severity of poisoning was also increased. Total mortality of inhalational poisoning mount to 13 which was nil last year. This epidemic rise in inhalational poisoning become a frontline news of state and national level.

We carried out a randomised, retrospective, observational study at S.V.N.G.M.C. Yavatmal to find out the main cause of this inhalational poisoning. So that the same can be prevented in the future .

Material and methods

The study was conducted in the department of pharmacology and medical record section of S.V.N.G.M.C. Yavatmal. It is a randomized, retrospective, observational type of study carried out by thoroughly studying the case papers of inhalational poisoning patients[3].

Inclusion criteria: Only inhalational poisoning cases were included in this study. Active professional sprayers were included. Contact poisoning due to leakages in the spray pumps, handling of OP compounds, etc. were included. Ingestion of OP compound orally, unintentionally while taking tobacco, pan or gutkha during the spray period was also included in this study.

Exclusion criteria: Person having past history of hypertension, diabetes mellitus, chronic obstructive pulmonary diseases, pulmonary tuberculosis, heart diseases (ischemic heart diseases, valvular heart diseases and heart failure) were excluded from the study. Orally ingested suicidal or homicidal OP poisoning cases were excluded. Passive inhalers were also excluded.

Detail data about following points were collected. 1. Detail biodata of the sprayer. 2. Insecticides used. 3. Spray pump used. 4. Seed and crop conditions. 5. Treatment received by the patient after inhalational poisoning.

Point no. 1: **Detail bio-data of sprayer** — Name, age, sex, caste, occupation (whether professional sprayer or a new comer), residential address, personal history of tobacco or pan chewing, socio-economic status, past history of similar inhalational poisoning, personal precautions of using mask, protective clothing, etc. taken or not. Whether direction of wind considered before spraying? How many hours/day spraying was done regularly? Before admitted how many days of spraying done? Whether tobacco or pan taken during spray? Taken bath after spraying was over? Date of admission and discharge from the hospital.

Point no. 2: Insecticides used—Proprietary and non-proprietary name of insecticides used for spraying. Whether any new insecticides sprayed this year? Any new mixture of insecticides used this time.

Point no. 3: **Spray pump used**—Type of spray pump used (manual / battery operated / petrol or diesel operated). Whether the same spray pump was used last year ? If new type of spray pump was used, whether proper training of handling such pump was given or not? Spraying capacity of the pump (land sprayed per day). Type of aerosol produced by spray pump. Whether the spraying pump have leakages ?

Point no. 4: **Seed and crop conditions**—Type of crop on which spraying was done (cotton, soyabean, bengalgram, other crops). Height of crop at the time of spraying (below knee, upto the height of the sprayer, more than the height of the sprayer). Whether new type of seed used so that the height of crop was increased (2BT or 3BT). Whether any new processing made by the seed manufacturing

company so that crop height was increased?

Point no. 5: **Treatment part**—After how many hours initial symptoms develop? Whether same symptoms developed last year? Whether PHC treatment taken? Within how many hours patient admitted in S.V.N.G.M.C. Yavatmal after OP compound spraying? How many pralidoxime injections were utilized for treating the patient? Whether patient need help of ventilator? How many days patient remain admitted in the hospital? What was the outcome of the patient (cured and discharged/refer to higher centres/discharged against medical advice/died)?

Results

Inhalational OP poisoning data was collected right from the starting of admission of patients i.e. july 2017 to the last case admitted or till the season of spraying was over. Total 570 cases were admitted during July 2017 to December 2017. There was no inhalational poisoning case admitted during June 2017. There were 16 cases admitted in July, 143 cases admitted in August , 293 cases admitted in September, 75 cases admitted in October, 25 cases admitted in November and 5 cases were admitted in December 2017 (Table no.1). Largest number of cases were admitted during the month of September 2017, on an average almost 10 cases were admitted per day. The age ranges from 12 years to 70 years (mean 36.67 years). Lowest age affected by inhalational poisoning was 12 yrs and two patients of 12 yrs were admitted. Eight patients were above 60 years of age including one patient of 70 years and two patients of 67 years old. Only 12 female patients were admitted and no death was reported for females. Duration of spraying was ranges from one day to one week. Total duration of stay of the patient in the hospital was ranges from one day to more than one month.

Majority of the sprayers were professional sprayers. Nearly all sprayers were of low socio-economic state and farm worker by occupation. No one had taken the pre-procedural (finding direction of wind, discarding leakage pumps, etc.), intra-procedural (wearing protective clothing, mask, cap, handgloves, etc. Thoroughly washing the hands before taking tobacco by poison covered hands), and post-procedural (taking bath after spraying) precautions. Most commonly used insecticide was endosulfan.

Almost everyone had used either battery or petrol/diesel operated spraying pumps. Spraying capacity of these battery /diesel operated spraying pumps were very high as compared to the manual pumps. Manual pump can spray one to one and half acres of agricultural land per day. Battery/diesel operated pumps can spray five to seven acres of land per day. Aerosol in the form of fine fog (droplet of micrometer diameter) was produced by these pumps. Whereas big droplets and no fog have been produced by the manual pumps. Majority of the sprayers sprayed cotton crops, whose height was about six foot, more than or equal to the height of the sprayer. On an average about 10 to 20 Injections of pralidoxime 1 gm were used per patient. Injection atropine was routinely used for each and every case till full atropinsation occurred[4].

Even after full intensive and emergency treatment, 13 (2.28%) patients were died. Table no.2 show details of the patients died. Mean age of the patients died was 37.69 years. Maximum number of patients died in September i.e. 6 deaths and there was no death reported in July, November and December. Total duration of hospital stay was ranges from one day to 24 days. Near about half of the patients died within one or two days, indicating sever OP poisoning.

Table No. 1.Month wise IPD admissions and outcome of inhalational OP poisoning patients.

Sr. No	Month (2017)	Total Cases Admitted	Patients Cured (from total cases)	Patients Died (%)
1	July	16	16	0
2	August	148	143	5
3	September	299	293	6
4	October	77	75	2
5	November	25	25	0
6	December	05	05	0
7	Total	570	557 (97.71 %)	13 (2.28 %)

Table no.2. Detail of patients died due to inhalational OP poisoning.

Sr.No	Initials	Age (yrs)	Date of Admission	Date of Death	Hospital stay (days)
1	D.C.	50	06.08.2017	24.08.2017	18
2	D.M.	52	07.08.2017	31.08.2017	24
3	K.P.	35	17.08.2017	06.09.2017	20
4	A.S.	30	28.08.2017	04.09.2017	07
5	D.M.	30	27.08.2017	31.08.2017	04
6	A.C.	24	11.09.2017	12.09.2017	01
7	R.C.	45	12.09.2017	13.09.2017	01
8	B.S.	40	21.09.2017	23.09.2017	02
9	R.R.	35	24.09.2017	26.09.2017	02
10	G.F.	48	21.09.2017	01.10.2017	11
11	V.T.	28	21.09.2017	03.10.2017	13
12	G.N.	40	12.10.2017	13.10.2017	01
13	M.B.	33	12.10.2017	14.10.2017	02

Discussion

Though the rainy season of 2017 was not good as per the amount of rain is concerned. But the raining occurred at proper time and in adequate amount which was required for the development of crops. This leads to flourishing of the crops so much so that the cotton crop attained height of six feet to seven feet. Increased height of crop adversely affected the spraying. Sprayer has to spray the insecticide pointing nosel of pump upward towards the sky. This lead to heavy exposure of the sprayer to the insecticides by inhalational route as well as by skin contact, because no one had taken the precaution of using mask, cap and protective clothing. These two factors i.e. height of the crop and the precautionary measures might be one of the major cause of this inhalational OP poisoning.

As the raining was not continuous, the chances of crop diseases was increased. Farmers at any cost try to save their crops by spraying large amount of insecticides. Generally cotton crop required three to four rounds of insecticidal spraying. But it increased upto five times. There were some additives added for better effect of insecticides, e.g. some liquid preparation decreases the surface tension between leaf and insecticide and evenly spread the insecticides on leaf. These additives whenever come in contact with skin might lead to rapid absorption of insecticides. So increased use of insecticide and additives may predispose to more chances of OP inhalation. Extensive research is needed for preparation of non-poisonous insecticides like bio-fertilizers, which surely decrease the OP poisoning.

Insecticidal spraying was mostly done by a special farm workers i.e. professional sprayers. These professional sprayers have very low socio-economic status. The median age of these sprayers was quite young i.e. around 25 to 35 years. Almost everyone had a personal history of tobacco chewing. During spraying they may take tobacco or pan with insecticidal soaked hands. That may lead to dangerous consequences. Because during post mortem there was small amount of ingested poison present in the stomach and intestine of some of the patients of inhalational OP poisoning.

As per the information given by the Agricultural Department, around 40,000 professional sprayers are present in Yavatmal district. These are hard working young peoples, try to earn more money during crop season of four to five months. By using manual spray pump they could spray only 1 to 1.5 acres of agricultural land and earn about 500-750 rupees per day. By using battery/diesel driven spray pumps about 5 to 7 acres of land could be sprayed and earn 2500 to 3500 rupees per day. The greed of earning more money might lead to this epidemic.

Spraying pumps were the major culprit behind these cases. The battery/diesel operated pumps are so designed that they spray about five to seven acres land per day. The speed of spray is so much that the sprayer literally run fast by holding the pump in hand. These pumps form very fine droplets in the form of fog at very high speed. The fog droplet are of micrometer diameter. These fog droplet remain suspended in air for long time due to their light weight and get inhaled and entered into the lungs. Particle size of 1 to 5 micrometer largely deposited in small conducting airways and alveoli, while 5 to 10 micrometer deposited in large conducting airways. Particle size more than 16 micrometer largely deposited in oropharynx. So increasing the particle size may decrease the inhalational poisoning[5] . Using manual spray pumps or modified form of battery/diesel pump which do not produce fog may prevent the hazard.

Lungs have high absorbing surface area and rich vasculature as compared to gastro-intestinal tract (GIT). OP compound rapidly get absorbed from lung surface as compared to GIT. Ingested OP compound can remain in GIT for long time and food also delay the absorption. During this period it can be removed by gastric lavage. So the bio-availability of poison can be decreased. This is not possible in lungs, whatever poison is inhaled that completely get absorbed. Poison in GIT may get inactivated by luminal, hepatic and other enzymes. Inhaled poison bypasses the first pass metabolism and directly entered into systemic circulation in its active form. So even small amount of OP compound causes more damage by inhalational route[6,7] . Preventing the inhalation of spray material by proper fitting mask or helmet may play a major role.

Conclusion

Number of factors responsible for this epidemic were preventable. Professional sprayers should instructed to take pre, intra and post procedural precautions seriously. Battery/diesel operated pumps need further modifications to minimize the inhalation. Further research is needed for preparation of non-poisonous insecticide i.e. bio-fertilizers.

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