



## MORPHOLOGICAL FINDINGS IN RAT KILLER POISONING CASES- MEDICOLEGAL AUTOPSY BASED RETROSPECTIVE STUDY

### Pathology

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### ABSTRACT

The World Health Organization (WHO) estimates that nearly 9,00,000 people worldwide die from suicide every year, including about 1,70,000 in India. Suicide is the act of intentionally causing one's own death. With the growing menace of this event the challenges lie ahead not only on the individual but also the society as a whole to tackle this problem. For the fifth successive years, the Union Territory of Puducherry has been found to have the highest rate of suicide in India. We have noticed that, due to easy availability of rat killer poison in grocery shops and supermarkets and due to its low cost, suicide by ingestion of rat killer poison is common method of suicide in Pondicherry. Active ingredients include anticoagulants in massive toxic doses which cause diffuse internal bleeding. Hence, this study is undertaken to study the various morphological (gross and microscopic) findings in patient dying due to rat killer poisoning.

### KEYWORDS

Rat Killer poison, Rodenticide, Morphology, Congestion.

### INTRODUCTION:

The World Health Organization (WHO) estimates that nearly 9,00,000 people worldwide die from suicide every year, including about 1,70,000 in India.<sup>1</sup> The Government of India relies on its National Crime Records Bureau (NCRB) for national estimates, and these report fewer suicide deaths (about 1,35,000 suicides in 2010)<sup>2</sup> than estimated by WHO. The reliability of the NCRB data is questionable since they are based on police reports. The first ever nationally-representative survey of causes of deaths in India finds that suicide is an important cause of avoidable deaths particularly among young adults aged 15–29 years.<sup>3</sup>

Suicide (Latin suicidium, from sui caedere, "to kill oneself") is the act of intentionally causing one's own death.<sup>4</sup> Suicide and attempted suicide, while previously criminally punishable, is no longer in most Western countries.<sup>5</sup> Section 309 of the Indian Penal Code, says that, whoever attempts to commit suicide and does any act towards the commission of such offence, shall be punished with simple imprisonment for a term which may extend to one year.<sup>6</sup> However, upon considering the recommendations of the Law Commission, Government of India introduced Mental Healthcare Bill and the same was passed in the Rajya Sabha on August 8, 2016 and the Lok Sabha on 27 March 2017.<sup>7</sup> The relevant provision of the Mental Healthcare Bill states, "Notwithstanding anything contained in section 309 of the Indian Penal Code, any person who attempts to commit suicide shall be presumed, unless proved otherwise, to have severe stress and shall not be tried and punished under the said Code."<sup>8</sup>

Suicide is an escapist measure taken by a person whose cognitive abilities are completely masked and clouded by confusion and in whom death may appear to be the only immediate certainty upon which he/she can lay hands on. With the growing menace of this event the challenges lie ahead not only on the individual but also the society as a whole to tackle this problem.<sup>9</sup>

We have noticed that, due to easy availability of rat killer poison in grocery shops and supermarkets and due to its low cost (Rs.12 to 15/packet), suicide by ingestion of rat killer poisoning is very common method of suicide in Pondicherry. The study is undertaken to study the various morphological findings in rat killer poisoning cases.

### MATERIALS & METHODS:

A retrospective study was conducted at Department of Pathology on medicolegal autopsies sent from Department of Forensic Medicine, IGMC & RI, Pondicherry, over a period of three years from January 2015 to December 2017. No objection certificate was obtained from Director of the institute and certificate of approval for conduct of study

was obtained by the Institutional Ethics Committee (IEC), for analyzing medicolegal documents. Waiver of consent was also obtained from the IEC as it was retrospective record based study with no interventions.

The study design was comprised of thoroughly scrutinized information gathered from autopsy related documents, proforma, history from relatives of the deceased, hospital records, concerned investigating agencies and laboratory report of viscera and their contents, fluids, diseased tissues and organs and other relevant suspicious samples, available in department. The organs relevant to the case concerned were sent for histopathological examination by the forensic expert after completing the autopsy at mortuary. In most of the cases, specimens received were heart, lungs liver, kidneys, and brain which were sent in 10% formalin. Representative bits from the concerned organs were processed in a routine manner after describing the gross specimen findings. Histopathology sections were stained with routine hematoxylin and eosin (H & E) stain and special stains were used as and when required. Morphological findings of all the organs sent were recorded in the study proforma. Conclusions were drawn by considering various gross and microscopic findings, as most possible cause of death. A brief discussion of the salient features was done with the forensic expert.

#### a) Inclusion criteria:

- All medicolegal autopsies carried out in our institute for a period of three years from January 2015 to December 2017 were considered for the study. Autopsy cases with alleged cause of death due to 'rat killer poisoning' formed the study group.

#### b) Exclusion criteria:

- Completely autolysed tissues where definitive microscopy opinion was not possible were not taken into consideration.
- All other postmortem reports other than alleged rat killer poisoning were excluded.
- Reports with the final opinion from 'chemical examiners' where the poisoning was other than rat killer poison were excluded.

**Sample size:** Sample size was calculated using data from autopsy register kept in the histopathology section of the department of Pathology. A detailed requisition form was consisted of Patient identification, brief history, autopsy findings, and preliminary cause of death along with pieces of organs received from Forensic Medicine department. Data were collected and along with gross and microscopic features which were analysed and tabulated.

**Statistical analysis:** Data regarding age and sex of the patient, autopsy findings, alleged cause of death, gross and microscopy findings were collected from autopsy request forms and autopsy registers. The data was entered and analyzed using SPSS software.

**RESULTS:**

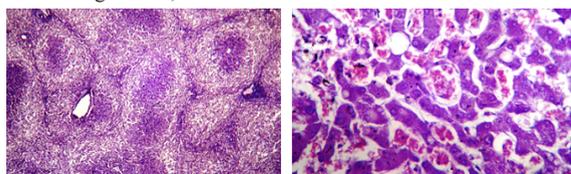
As our study period was limited for 3 years, we received total of 28 cases of rat killer poisoning cases from January 2015 to December 2017 out of the total 880 cases of medicolegal autopsies carried out in our institute. Age group ranged from 21 years to 87 years. There were 14 females and 14 males in the study group, indicating equal sex predominance. Most of the common mode of suicide in males was found out to be hanging as found on discussion with forensic expert. There were cases of poisoning by Organophosphorous compounds, Cypermethrin, Monocrotopha, Oduvanthalai, Kerosene ingestion, Yellow oleander poisoning, etc., all of which were excluded from the study group. Other cases of suicide by unnatural deaths like hanging were also excluded.

The major organs received in all the cases were included heart, lungs, liver, kidneys, spleen and brain. **On Gross examination**, the most common morphological finding noted over almost all major organs received is moderate to severe congestion. Massive intracranial hemorrhages were noted while performing autopsies by the forensic expert in several cases of rat killer poisoning. Petichial hemorrhages were noted over pericardial surface of heart and myocardium showed congestion. Kidneys shows severe congestion and petichial hemorrhages found upon stripping the renal capsule and on cut surface. Cut section of lungs showed hemorrhagic fluid that oozing out from cut surface and showed massive congestion. The lungs were heavy and showed pneumonia changes in five cases (Fig No.1)

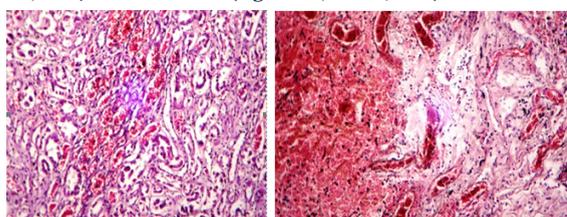


**Fig 1: Showing massive congestion of Heart, Lung and Kidney on cut surface.**

**On microscopic examination (table 1)**, almost all organs showed congestion as common finding with varying degree of hemorrhages in their parenchyma. The kidneys show significant congestion and acute tubular necrosis. Most significant finding in the lungs was congestion in all cases with associated other findings like pneumonia and emphysema. In the liver, the most characteristic finding noted was submassive hepatic necrosis noted in eight cases. Chronic venous congestion of liver was noted in three cases. Sections from heart revealed varying degrees of atherosclerotic changes in the coronaries and aorta. Sections from brain showed congested cerebral blood vessels in eight cases, otherwise were unremarkable.



**Fig No 2: Liver showing submassive hepatic necrosis (left side: H & E, 10X) and CVC Liver (right side, H & E, 40X)**



**Fig No 3: Severe congestion and hemorrhage in Kidney (left side) and Lung with interstitial hemorrhages (H & E sections 10X both)**

Table 1: Organ and Findings	28 cases
<b>Liver</b>	No
Microvesicular steatosis	9 cases
Submassive hepatic necrosis	8 cases
Periportal chronic inflammation	6 cases
Chronic venous congestion (CVC)	3 cases
Cirrhosis of liver	1 case
Acute hepatic necrosis	1 case
<b>Lungs</b>	No
CVC Lung	All Cases
Alveolar edema	14
Bronchopneumonia	6
Lobar Pneumonia	2
Interstitial pneumonia	2
Emphysema	2
Aspergillosis	1
Acute Respiratory Distress Syndrome (ARDS)	1
<b>Kidney</b>	No
Acute Tubular necrosis	13
Chronic Venous Congestion	11
Chronic pyelonephritis (CPN)	1
Normal	3
<b>Heart</b>	No
Atherosclerosis	All cases
Old MI	2
<b>Brain</b>	No
Normal	20
Congestion	08

**DISCUSSION:**

For the fourth successive year (2011 to 2014), the Union Territory of Puducherry has been found to have the highest rate of suicide in India, according to data on the 'Accidental Deaths and Suicides in India 2014' published by the National Crime Records Bureau of the Union Ministry of Home Affairs.<sup>2</sup> In 2010, the suicide rate in Puducherry was 45.5 per 1,00,000 population, which was four times that of the Indian national average suicide rate (11.4 per 100000 population) and two times that of suicide rate in Tamil Nadu (24.5 per 100000 population). From 2000 to 2010, Puducherry has ranked either first or second in its suicide rate in India. The rate refers to the number of suicides per one lakh population, and Puducherry has a rate of 40.4, at four times the national average of 10.6. With a total of 644 cases of suicide in 2014, it is a significant increase from 546 in 2013.<sup>3,5,6</sup> In 2015, more than 1.3 lakh people committed suicide across India. Puducherry accounted for 711 of these deaths even though it accounts for only 0.1% of the population. In 2016 and 2017, Puducherry suicide cases have again crossed 700, which is maximum one can come across the country. Puducherry is followed by Sikkim, Andaman and Nicobar Islands, Tripura and Kerala in suicide rates. 'Family Problems', 'Failure in examination' and 'Illness' are listed as the leading causes for suicides in Puducherry. Youths (15-29 years) and lower middle-aged people (30-44 years) were the prime groups taking recourse to the path of suicides. Around 35.4% suicide victims were youths in the age group of 15-29 years and 33.3% were middle aged persons in the age group 30-44 years. The most common reason for teenage suicides is failed love affairs; in the age group 19-26, it is generally the burden of education loans and poor performance in colleges and universities; for people more than 26 years of age, it is extramarital affairs and alcoholism. Pondicherry's population appears to be four times more suicide prone than any other region in the country.

Rodenticides (rat poisons) are typically non-specific pest control chemicals made and sold for the purpose of killing rodents. Active ingredients include anticoagulants in massive toxic doses which cause diffuse internal bleeding.<sup>7</sup> They may also contain metal phosphide (like zinc phosphide) which reacts with acid in the digestive system and generate the toxic phosphine gas.<sup>8</sup> They may also contain Calciferols, which affect calcium and phosphate homeostasis in the body. The toxic dose leads to arrhythmias, bleeding, and possibly renal failure.<sup>9</sup>

Paracelsus, father of toxicology quoted that "All things are poisons and there is nothing that is harmless, the dose alone decides that something is no poison."<sup>1</sup> Any substance irrespective of its quality or quantity when given with an intention to endanger, injure or kill a person, will be called poison.<sup>2</sup> Poisoning and hanging are the two major modes of

suicides in India. In India, most common poisons consumed are pesticides, sedative drugs, plant toxins, chemicals and household poisons. Pattern of poisoning in a particular region depends on variety of factors like its easy availability and accessibility of poison and socioeconomic status of the population.

"Alcohol dependence and abuse were found in 35% of suicides," says a 2007 paper titled *Suicide and its Prevention: The urgent need in India*, published in the *Indian Journal of Psychiatry*. "Around 30-50% of male suicides were under the influence of alcohol at the time of suicide and many wives have been driven to suicide by their alcoholic husbands," the study says. This is because alcohol abuse lowers the level of serotonin, a chemical produced by the human body that is thought to be responsible for maintaining mood balance. Lower serotonin levels are associated with depression. Puducherry, union territory, is considered heaven for alcoholics and one can see arrack shops on each and every corner of the street. Alcoholic beverages are sold openly even in supermarkets and almost every tourist hotels at competitive prices in Pondicherry and its tax free quota gives boost for the alcoholics. "Alcoholism is a major public health problem in Puducherry. What is cheap and easily available here is hard liquor. For a person who is already vulnerable, this is dangerous," says a study at the Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER) in Puducherry.

Suicidal behaviour is strongly determined by two important factors: aggression and impulsivity. Alcoholism is considered a family disease and not just something that affects an individual.

In 2010, India had an estimated 12 million dependent users (those who are addicted), 24 million harmful users (not addicted but can cause harm, for example, drunken driving or domestic violence after drinking) and 34 million habitual users (those who use alcohol moderately without causing harm), according to a 2011 study conducted by NIMHANS.

The literacy rate of the Union territory is 85.8%, much higher than the national average of 74.04%. But here, too, the evidence is not that clear-cut. "Even though evidence says literacy is high in Puducherry, the situation on the ground, in rural areas, is different. Illiteracy is still a major concern."

"Suicide is sometimes an attention-seeking tactic, mostly for students. Among school girls, parent's scolding is a reason for so many to commit suicide. Small conversations become a big issue."

A study at department of psychiatry, JIPMER, says, "People of south India have a tendency to internalize their feelings. There is very little external aggression. Pondicherry conjures up its fair share of trademark images right from heritage homes and French quarters, to spiritual retreats and pristine beaches. Not exactly the backdrop one might imagine for its second-most prominent (statistical) contribution to India—the highest suicide rate in the country".

A comprehensive report done at Pondicherry attempted to investigate the high suicide rates and found that alcoholism and economic divides could be the biggest explanations for the high prevalence of the same. A 2007 all India study showed that "around 30-50% of male suicides were under the influence of alcohol at the time of suicide and many wives have been driven to suicide by their alcoholic husbands," a perfect illustration for Pondicherry where alcohol is easily procurable. A JIPMER study in 2014 concluded that alcoholism was a medico-social problem in Pondicherry, linked to the high suicide rate.

When a 20-year-old with no medically diagnosed psychiatric problems attempted suicide, it was revealed that her father was an alcoholic who for, as long as she could recollect, would drink and beat her mother. The family had loans to repay and he had started beating her as well, illustrating how alcohol abuse can wreak havoc in family setups. The other frequently offered explanation Pondicherry's duality that allows it to exist as both the prosperous 'White Town,' and the poor and backward 'Black Town'. Pondicherry needs urgently an empathetic approach, which seeks to protect human life while attempting to understand the real causes behind this phenomenon.

**To conclude**, we took up this study to learn characteristic morphological findings in various organs in patient dying due to rat killer poisoning. The results may impart knowledge for the emergency

physician in management of intoxicated patients. The study may also be helpful for the government authorities and planning bodies, to plan and implement strategies towards prevention of suicides and poisoning in future.

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