

History of Medicine

The Bhopal gas tragedy from a medical point of view : Taking a look back

On the fateful night of 2nd December, 1984, methyl IsoCyanate (MIC), a deadly toxic gas with the smell of boiled cabbage, escaped from tank no. 610 of the Union Carbide plant in Bhopal. Inadvertent entry of water in MIC tank caused the chemical to swiftly convert to gas and it spread like a yellowish-brown cloud in the direction of wind. The gas spread quickly to the nearby shanty town and railway station, killing thousands in its way. The exact number of dead will never be known because in many cases entire families were wiped out with no one to claim the deadbodies or claim compensation. But according to various observers, the number of dead varied between 16000 and 30000 with a further half a million suffering devastating health consequences. The health effects of this tragedy are very much present even today. This article will be a small attempt to analyse the Bhopal tragedy from a medical point of view. Since this was a socio-economic disaster of gigantic proportions, both the scientific as well as the popular account of the health effects will be described here. Thus, journalistic accounts will go side by side with discussion of scientific studies.

Immediate Effects :

Popular account :

According to eye witness accounts, both humans and animals suffered acutely as a result of the toxic fumes. MIC was the main gas released from the tanks but other deadly toxins in the mixture included phosgene, mono-methyl-amine and hydrocyanic acid. In most cases, the immediate effect of inhalation of this toxic mixture was respiratory arrest. Since the gaseous mixture was heavier than air, it travelled close to the ground and initially killed those who were sleeping on the ground or who were cripples. But all people did not have the merciful death of instantaneous respiratory and cardiac arrest. Many suffered a slow agonizing death, gasping for air with severe pulmonary haemorrhage and blood running from the corners of their mouths. Paradoxically, as people panicked and started running, they were forced to breathe heavily and this led to more inhalation of the toxic gas.

People started vomiting and as they fell, many drowned in their own vomitus. Later, the next morning, bodies were discovered with yellowish froth in the mouth and greenish or bluish hue of the skin. Many people had severe chemical burns of the cornea and became permanently blind (this last point is disputed).

However, only choking by the gas was not the sole cause of death. The effects of the gas caused people in the street to lose control of their cars, leading to many hapless mortals being run over. Some people jumped from bridges and roofs of houses in fear and

Fun fact — A Naga Sadhu was meditating in a park near the chemical plant. He was the only one who survived in that area. It was later surmised that his yogic habit of breathing once every three to four minutes may be the reason for his miraculous survival.

Bhopal gas disaster at a glance :

- Date : Night of 2nd December, 1984
- Number of deaths : (official) 3787; (public claim) at least 20,000; Number affected : (official) 558, 125
- At sambhavna clinic
 - Over 2500 children with possible birth defects
 - Rates of malignancy 8 times higher compared to gas-unexposed population
 - Permanent disabilities: 4944
- High percentage of various psychiatric ailments : mostly untreated
- Ongoing silent disaster: contamination of groundwater from the plant

confusion.

People with pre-existing lung conditions like tuberculosis were quick to die in suffocation.

Animals like cattle did not fare any better. Thousands of cows, horses and buffaloes were found to have choked. The next day, the BBC reported that “Thousands of dead cats, dogs, cows and birds litter the streets...”

According to the doctors who attended emergency that night at Hamidia Hospital, Bhopal, people were gasping for breath like “fish out of water”. Most of the doctors there had never even heard of MIC and there was no manual to guide initial treatment plans. The doctors also found many of the victims with amnesia and mania, apparently due to CNS effects of the gas. Many also suffered convulsions and myoclonus.

The toxic gas was absorbed in the garments and hair of the victims and the health professionals who were attending these victims also suffered from toxicity to a varying degree. There is an eye witness account of a junior doctor attempting mouth-to-mouth resuscitation of a child and dying in the process.

During post-mortem examination, the doctors found the lungs full of fluid and blood with the trachea full of blood clots. There was massive congestion of liver and spleen. The brains were reduced to gelatinous paste. Most of the bodies gave off smell of bitter almonds, due to the MIC breaking down into hydrocyanic acid inside the body.

Scientific analysis :

The toxicological analysis of MIC was in rudimentary stage at that time. Some animal studies had been done and the medical literature contained only a handful of reported cases. There was no manual or guideline for treatment. In fact, the Bhopal disaster caused the first real life experience with MIC toxicity.

MIC vapour was found to be intensely irritating to the cornea, leading to corneal ulcer, lid swelling and photophobia. In fact, at the Hamidia hospital, the first victim came with eye irritation. Many people also suffered from skin irritation. Autopsy on the lungs showed severe necrotising lesions all through the respiratory tract upto the alveoli. Patches of acute bronchiolitis were also seen. MIC

exposure in lethal doses caused complete destruction of respiratory epithelium in minutes, leading to massive alveolar edema. Chest X ray of the victims showed alveolar and interstitial edema. One term used to describe the effect of MIC on airways is "reactive airways dysfunction syndrome".

Dr DK Satpathy performed an incredible number of autopsies over the 24 hours following the disaster. He also found that the kidneys showed haemorrhage and tubular necrosis; GI tract showed submucosal haemorrhage and myocardium showed severe edema. He preserved the samples for further toxicological analysis. But no further analysis was performed and in 2006, the viscera in refrigerators were destroyed by a power cut.

Intermediate Effects :

Popular accounts :

In July, 1985, the New York Times reported that deformed babies were being born in Bhopal as a result of the gas tragedy. Various citizens' right groups said that there were hundreds of abortions and still births in the immediate aftermath of the tragedy. Numerous babies with severe conditions like cerebral palsy and limb deformities were born. Also, a lot of adults reported persistent debilitating weakness and tingling of the limbs. The trail of the dead did not stop on 3rd December 1984; for the next 8-12 weeks, a number of the gas victims suffered slow painful death.

Scientific outlook :

A study among women who lived within 1 km of the plant and who were pregnant at the time of gas leak showed a 43% rate of abortion. There was 14% neonatal mortality. There was a significant rise in congenital deformities. Such deformities included spina bifida, congenital heart diseases and limb deformities.

Delayed Effects :

Popular account :

By popular account, the aftermath of the Bhopal tragedy is still very much alive. According to activists and other ground level NGOs, delayed effects include persistent breathlessness, cough, dimness of vision, recurrent body ache, fatigue, depression and other psychiatric symptoms of post-traumatic stress disorder. Women suffer from menstrual irregularities, infertility and anemia. Children born to exposed parents suffer from growth retardation. Also, many activists claim that number of children born with deformity is rising in the gas-affected areas. There is an alarming rise in cancers among the survivors.

Recently there have also been claims of 3rd generation victims of the gas.

Scientific account :

The genotoxic effect of MIC has been proven in in vitro studies. However, inside the human cell, the MIC tends to react with the proteins first and its effect on the DNA is variable. The carcinogenic effect of MIC is even more debatable. An early study in 1999 did not find much increased risk of cancer among the survivors. However, a recent observation from the Sambhavna clinic of Bhopal, the main centre for treatment of gas victims, found very high risks of certain types of malignancy among the survivors.

However, one area where the long term effect of MIC has been documented unequivocally by follow up studies is neuro-behavioural and cognitive functions. Moderate and severely affected gas victims were found to have significant impairment in memory, learning,

motor speed and precision, which persisted over the years.

There are also reports of continued respiratory effects of this gas exposure. Early on, restrictive lung involvement was documented. But later studies also documented significant irreversible obstructive pathology. Fibrotic changes of the lung were observed, especially among those who were infants at the time of the tragedy. Thus, MIC was able to cause severe lung fibrosis after a single exposure. These respiratory effects caused significantly high delayed mortality among the survivors at least for the next 5 years. Later studies showed that with time, type I pneumocytes in the lung decreased and infiltration with eosinophils increased.

Some recent reports claim that people who were exposed to the gas as children are more likely to give birth to babies with congenital malformations even today. However, there is no official data on this topic.

The Bhopal Gas disaster is perhaps the largest industrial disaster in history. We should never forget the lessons learnt from this tragedy so that future recurrences can be avoided. In a developing country like India, every doctor should have basic knowledge of the various industrial chemicals and their health effects.

— RP

REFERENCES

- Lapierre D, Moro J — It was five past midnight in Bhopal. Full Circle Publishing. Delhi: 2001.
- Shrivastava R — Bhopal Gas Disaster: Review on Health Effects of Methyl Isocyanate. *Research Journal of Environmental Sciences* 2011; **5**: 150-6.
- AP. 6 Deformed Babies In India Linked To Bhopal Gas Leak. The New York Times, July 16, 1985. [Cited 2020 Mar 3]. Available online from <https://www.nytimes.com/1985/07/16/world/6-deformed-babies-in-india-linked-to-bhopal-gas-leak.html>
- Verma DR — Epidemiological and experimental studies on the effects of methyl isocyanate on the course of pregnancy. *Environ Health Perspect* 1987; **72**: 153-7.
- Shilotri NP, Raval MY, Hinduja IN — Gynaecological and obstetrical survey of Bhopal women following exposure to methyl isocyanate. *J Postgrad Med* 1986; **32**: 203.
- www.bhopal.org
- Dikshit RP, Kanhere S — Cancer patterns of lung, oropharynx and oral cavity cancer in relation to gas exposure at Bhopal. *Cancer Causes & Control* 1999; **10**: 627-36
- De S — Retrospective analysis of lung function abnormalities of Bhopal gas tragedy affected population. *Indian J Med Res* 2012; **135**: 193-200.
- India Today Web Desk. Bhopal gas tragedy: A doctor preserved victims' samples for 20 years but govt never studied them. India Today [Internet]. [Published 2019 Dec 3; Cited 2020 Mar 3]. Available online from <https://www.indiatoday.in/india/story/bhopal-gas-tragedy-35-anniversary-dr-dk-satpathy-victims-autopsy-samples-1624811-2019-12-03>.
- Dixit R — Proof that Bhopal Gas is Now Claiming its Third Generation of Victims. The Wire [Internet]. [Published 2015 Dec 8; Cited 2020 Mar 2]. Available online from <https://thewire.in/environment/proof-that-bhopal-gas-is-now-claiming-its-third-generation-of-victims>
- Nemery B, Dinsdale D, Sparrow S, Ray D — Effects of methyl isocyanate on the respiratory tract of rats. *British Journal of Industrial Medicine* 1985; **42**: 799-805.
- Dhara VR, Dhara R — The Union Carbide Disaster in Bhopal: A Review of Health Effects. *Archives of environmental health* 2002; **57**: 391-404.