(26)

The Board of Supervisors

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Martinez, California 94553

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Contra Costa County

Phil Batchelor
Clerk of the Board
and
County Administrator
(415) 646-2371

Cool
pt

August 14, 1990

Kenneth Carr, Chairman
Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Chairman Carr:

The Contra Costa County Board of Supervisors is supporting HR5505 (Miller) and S2979(Mitchell) which would prohibit federal pre-emption of state disposal standards on deregulated radioactive waste and regulated low-level radioactive waste and prohibit implementation of the Nuclear Regulatory Commission's low-level radioactive waste deregulation policy. We believe that the NRC policy does not protect the public interest and urge you to rescind it immediately

The NRC policy is inconsistent with the Resource Conservation and Recovery Act which specifically allows states to set more stringent standards for the disposal of hazardous waste. In addition, the NRC definitions of "low-level" are 250% higher than EPA recommendations for individual dosage limits and more than 1000% greater than International Atomic Energy Agency standards for collective dosages.

The NRC policy does not take into account its impact on closure and postclosure requirements of landfills. In Contra Costa County, the presence of less than 1% hazardous waste in one of our landfills substantially increased closure and post closure costs; from $33 million to $41.5 million. It is financially irresponsible to allow hazardous materials in municipal solid waste landfills.

The siting of landfills is a difficult process needing careful consideration of environmental and community concerns. After five years of investigations and hearings, the Board of Supervisors recently approved land use permits for two municipal solid waste landfills, subject to over 100 conditions of approval. Receipt of radioactive waste is specifically prohibited at these landfills in the conditions of approval.

Radioactive waste can be properly disposed at licensed sites specifically designed for receipt of hazardous waste. It would against the public interest-- health, safety and financial -- to allow the NRC deregulation policy to stand. Please support S2979 (Mitchell).

Sincerely,

Nancy Fahden

Nancy C. Fahden
Chair, Board of Supervisors

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PDR FOIA
BECKER90-415 PDR

cc: Senator George Mitchell
Congressman George Miller
Bill Morris, Director
NRC Div. of Regulatory Applications

B/16

WEAPONS OF WAR

THE ATOMIC BOMB

Scientists Reassess the Long-Term Impact of Radiation

By Larry Thompson
Washington Post Staff Writer

In a blast of light and radiation, four square miles of Hiroshima, a thriving Japanese city of 343,000 people, instantly disappeared on Aug. 6, 1945, after an American B-29, the Enola Gay, detonated a 20-kiloton atomic bomb above the city. The ensuing explosion and fire immediately killed 66,000 people and injured 69,000.

Three days later, a second bomb fell on Nagasaki, a slightly smaller harbor city that was home to 250,000 people. An estimated 39,000 died instantly, 25,000 were injured, and 40 percent of the city was damaged or destroyed.

Nine days after Hiroshima was leveled—on Aug. 15, 1945—Japan surrendered.

The atomic bomb forever altered both war and the postwar world. It also propelled the danger of radiation and the threat of nuclear catastrophe into the forefront of the public consciousness, creating images of mass destruction and human suffering that transcended the horror of weapons in wars past.

Nor[illegible] are later, scientists have learned much about [illegible] radiation does—and does not do—to the human body. They are reassured that the darkest fears about widespread cancer and genetic mutations have not materialized. At the same time, they now recognize that the potential hazards of exposure to low levels of radiation are greater than previously thought.

For more than four decades, the 91,228 survivors of Hiroshima and Nagasaki have been meticulously followed to see if they developed health problems that could be traced to their exposure to the bombs. Results of these studies have in large part led to a reassessment of the dangers of radiation.

As epidemiologist John D. Boice Jr. of the National Cancer Institute put it in a special issue of the Journal of the American Medical Association commemorating the 45th anniversary of the Hiroshima and Nagasaki bombings: "The study of Japanese atomic bomb survivors ... continues to provide the framework by which we understand the effects of radiation and judge the potential risks from low-level exposures."

Genetic Risks

In the 1940s and '50s, scientists feared that radiation would cause profound genetic effects, perhaps even mutating the human race over generations. The concern was fueled by fears about global fallout from atmospheric testing and led in part to the 1963 ban on such tests.

But now a study comparing more than 31,150 children of A-bomb survivors with 41,066 children whose parents were not exposed has failed to find a significant increase in birth defects, childhood cancer, abnormal chromosomes in white blood cells or mutations in blood proteins, according to a report in the June issue of the American Journal of Human Genetics.

"Studies of the children of the atom bomb survivors have failed to detect genetic injury," said Arthur C. Upton, chairman of environmental medicine at the New York University Medical Center in New York City and chairman of the National Research Council's fifth committee on the Biological Effects of Ionizing Radiation. "That is very reassuring."

Yet, he said, scientists cannot assume that there was absolutely no genetic damage in these children. Some injury may have occurred that has not been detected because large numbers of people are required to observe subtle gene mutations.

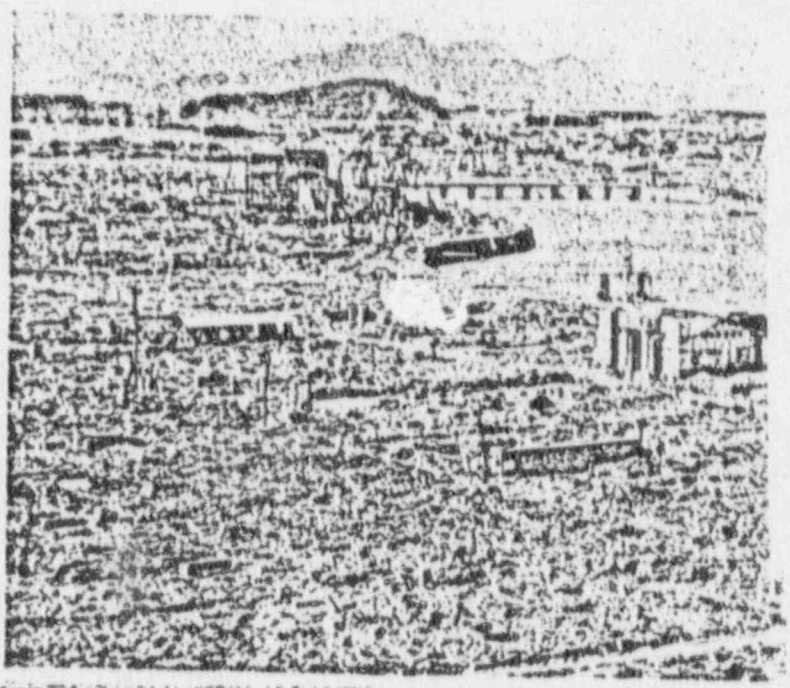
"Only 100,000 people in Japan have been studied," said Eric J. Hall, director of the Center for Radiological Research at Columbia University College of Physicians and Surgeons. "It took 7 million mice to see the [genetic] effect" of radiation in the rodent. And in the mouse, the changes were minor, such as coat color alterations and tiny deformities in the skeleton.

Similar subtle changes might have occurred in the children of bomb survivors. In fact, small changes were seen in blood proteins of some children, but the numbers were not statistically significant. "We are not talking about [illegible] that effects or kids with two heads," Hall said. "These are tiny genetic changes."

Damage in the Womb

For those women who were pregnant at the time of the blasts, the impact on their offspring was potentially devastating. Researchers have tracked 98 pregnant women who were within 2,000 meters—roughly a mile and a quarter—of the center of the detonation site.

James N. Yamasaki, a Japanese-American pediatrician



General view of Hiroshima shows the devastation wrought by the atomic blast over ground zero.

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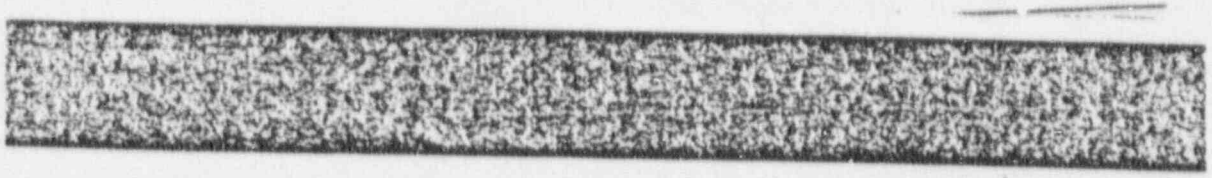
Aug 14, 1990



al physician-in-charge of the bomb studies in Nagasaki, and that a fetus exposed to radiation in the eighth to nth week of development had a significantly higher ance of being born with mental retardation, small head e, seizures and poor performance on conventional ligence tests and in school.

Researchers know that the fetal brain grows very fast ring that time and is very vulnerable to damage when mother is exposed to harmful substances. "If the child is a dose of 100 RADs during th... time, there is a 40 rcent chance of having severe mental retardation," Yasaki said.

The study also showed that women who suffered symptas of radiation sickness after the blasts gave birth to bies who had many more problems than women who d no aftereffects. Among women who endured radiaon sickness, more than 40 percent of infants died. Yet women with no symptoms, the infant mortality rate s less than 9 percent and nearly 90 percent of the surng children appeared unaffected.

Radiation-Caused Cancer

In the past two decades, concern has shifted from fears about genetic harm to future generations to the chances of cancer in survivors that develop decades after exposure. Indeed, health officials have seen what they call excess cancers in the A-bomb survivors as well as in people exposed to medical radiation and in those who live near some of the nation's bomb factories.

But the radiation-cancer link is more complex than previously realized.

In the special JAMA report, scientists showed that only certain cancers—tumors of the breast and thyroid and leukemia, have risen as a result of A-bomb radiation. Other types of cancer, however, appear to resist the effects of the bomb. These include cancers of the liver, gallbladder, uterus, bone and prostate.

"While it is often said that radiation causes all forms of

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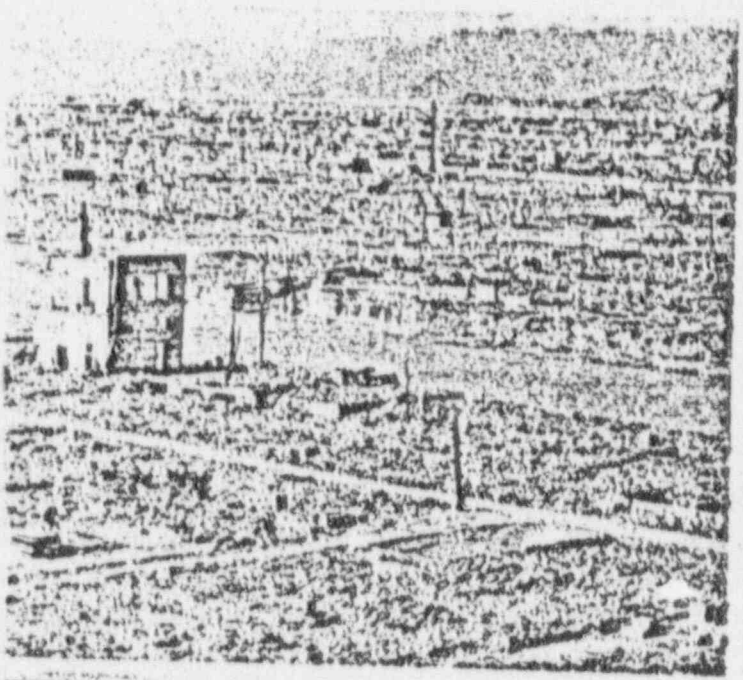

CHEMICAL WARFARE

What Researchers Know About How Poison Gases Affect the Body

By Sally Squires
Washington Post Staff Writer

Ever since 5,000 Allied soldiers died from exposure to poisonous chlorine gas on a spring day in 1915 near Ypres, Belgium, modern medicine has been struggling to combat one of the deadliest and most frightening aspects of warfare.

Now, nearly a century later in an era replete with sophisticated military technology that includes satellite photos and cruise missiles, often invisible and sometimes odorless poison gases remain capable of severely hampering the ability of troops to fight and of battlefield doctors to treat them.

Dubbed "the poor man's atomic bomb," chemical weapons are among the deadliest agents known. They include poison gases such as chlorine, cyanide and phosgene, as well as nerve and mustard gases. Two nerve gases—tabun and sarin, both known to be produced by Iraq—are so toxic that a pinhead-sized droplet can kill within minutes.

These two compounds, along with another nerve gas called soman, were developed by the Germans during World War II. They contain phosphorus, hydrogen and carbon and are chemically related to pesticides. They kill by blocking a key protein or enzyme in the body. That, in turn, leads to a build-up of acetylcholine, a chemical messenger that normally crosses the gap between nerve and muscle cells and causes debilitating disturbances of the central nervous system. Almost immediately, those exposed to a large dose of nerve gas experience excessive sweating convulsions and loss of consciousness. Death occurs within minutes.

Mustard gases, known as blistering agents, also can be lethal. Sulfur mustards produce yellowish clouds that smell like garlic and primarily affect the skin, eyes and lungs. They attack the body's key genetic material, DNA, and kill cells. Sulfur mustard gases inflict severe burns, sear the lining of the lungs and can cause blindness. They kill about 1 to 5 percent of those exposed.

Surviving chemical warfare largely depends on complete isolation from the environment. Soldiers wear life-saving garb that resembles the suits worn by astronauts on space walks. The suits are heavy, cumbersome and hot and limit a soldier's vision. During training exercises, the chief problem with the suits was heat stress, according to Carol Fullerton, a psychologist with the Uniformed Services University of the Health Sciences in Bethesda who has studied combat exercises.

Protective clothing and masks make diagnosing and treating injured soldiers on the battlefield difficult. "You can't take a pulse or blood pressure through the gear," said Robert Ursano, acting chairman of the department of psychiatry at USUHS who also studied soldiers' reactions to the protective suits during simulated combat. "If you're lucky and the person is still conscious, you may get him to talk to you or see his eyes, but that's about it."

The garb also creates psychological problems for

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RADIATION, From Page 13

cancer, many sites show no increase among atomic bomb survivors," wrote Boice of NCI.

Still, the association between radiation and certain cancers is marked. Leukemias appeared in a wave-like pattern, rising in 1950, peaking in 1960 and then falling to nearly the rate of the unexposed population by 1975, according to long-term follow-up of the Japanese survivors.

Cancer of the thyroid was the first solid tumor to appear. Radioactive iodine-131, produced in nuclear explosions tends to concentrate in the thyroid gland.

The number of radiation-caused cancers among bomb survivors is statistically significant. Yet, so far, the total number of excess cancers has turned out to be relatively small. "People think half of Japan is affected," Hall said. So far, about 100 Japanese who survived the blast and its immediate aftermath have developed leukemia, a relatively rare cancer of the white blood cells. An additional 300 have developed so-called solid tumors, such as those of the breast or colon.

"Out of 100,000 people studied, 20,000 are going to die of cancer anyway," Hall said. "We are looking at the difference between 20,000 [who would normally get cancer] and 20,400. It is not a big effect, and it is hard to see."

While cancers do increase, they "only begin to appear after the survivors attain the age at which cancer is normally prone to develop," Yukiko Shimizu and others from the Radiation Effects Research Foundation in Hiroshima wrote in JAMA. "Radiation only induces the first mutational step in the transformation of a normal cell to a malignant one . . ."

As the population ages, the number of radiation-caused cancers is likely to increase. But an explosive rise in cancers among bomb survivors is not expected. "Ionizing radiation is not a terribly powerful carcinogen," said William J. Schull, director of the genetics centers at the University of Texas Health Science Center at Houston. "We know of chemicals that are far worse than ionizing radiation."

Debate About Doses

While a surge in cancer deaths has not occurred in the aftermath of the bomb, researchers remain cautious about the effects of low levels of radiation. After decades of research, the general consensus is that there is no safe level of radiation. "Large radiation doses cause cancer, but we may never know whether small doses . . . do so," noted NCI's Boice. "Nonetheless, it is prudent to assume that there is no threshold below which radiation would fail to cause some deleterious effect."

Furthermore, scientists have reevaluated the dose of radiation received by the bomb survivors. They now calculate that the Japanese who survived the blasts actually were exposed to less radiation than was previously believed. That means the small but significant amount of excess cancers and other biological effects seen in the Japanese population was caused not by high amounts of radiation but by substantially lower levels.

Last December, the National Research Council published new estimates of the dangers of radiation in part based on this reassessment of the Japanese bomb survivors. The council, the research arm of the National Academy of Sciences, reported that the risk of contracting cancer from low levels of radiation was about three to four times greater than previously estimated.

As a result, the medical community has grown more cautious about what was once considered a "low" dose of radiation. The National Research Council's report concluded that "increasing doses of radiation produce proportional increases in solid cancers of the breast, lung, stomach, ovary and other organs."

"The increase in certain cancers are related to dose," Upton said. "The higher the dose, the larger the increase in the chance of getting a cancer."

Repairing DNA

Another factor that affects the impact of radiation is the body itself. Research has now demonstrated that individual molecules of DNA that carry genetic material have the ability to repair the damage and restore the cell—a process scientists call DNA repair.

"Mammalian cells are very well equipped to deal with radiation damage and heal the bulk of it, especially given enough time," said Columbia's Hall.

When radiation strikes the body, it causes chemical changes in the cells. If a large amount of radiation damages enough cellular chemicals, including the DNA molecules, then the cell dies. If enough cells die, so does the victim.

But when the DNA molecules survive the initial exposure, the body has a chance to recover. That means the size of the dose is not the only determinant of how much damage is done to the body. It's also important how fast the radiation is absorbed. If a large dose of radiation is given over a long period of time, the DNA molecules in the cells have time to repair the damage. For that reason, scientists suspect that the impact of accumulated doses of radiation over the years is much less than a single dose of the equivalent amount.

"In lab animals, when we spread the dose of X-rays or gamma rays over a long period of time—weeks or months—the increase in tumor frequency is very much smaller, by a factor of two to 10," than it would be if the dose came all at once, Upton said.

The ability to repair radiation damage may help explain why some groups of people can tolerate fairly high doses of radiation. For example, one group of Chinese lives in a region where natural background radiation is three to five times higher than normal, but "the population does not have a big jump in cancers compared to nearby populations," Upton said.

Fallout at Home

Research on the Japanese survivors has raised concerns about Americans living near nuclear plants in this country, such as the Rocky Flats plutonium plant near Denver and the facility in Hanford, Wash. A government-funded study by a committee of independent scientists made public last month showed that beginning in the late 1940s, residents near Hanford were exposed to radioactive emissions.

In fact, those living around Hanford may actually have received greater doses of radiation, though over a longer

HOW RADIATION IS MEASURED

American scientists measure radiation in terms of RADs and REMs. RAD, or radiation absorbed dose, is a measure of how much radioactive energy is absorbed by one gram of a material. REMs, which means RAD equivalent in man, is a standard unit of measure of biological damage by one RAD striking the human body. Although they are technically different, they tend to be used interchangeably.

Each year, everyone receives about one tenth of a RAD from cosmic rays and other background radiation sources. A chest X-ray with today's equipment produces about one third of a RAD.

The current best guess about the impact of radiation on cancer rates is that exposing 10,000 people to one RAD will produce between one and three extra cases of cancer in a population that would be expected to get 2,000 cases of cancer anyway, according to Eric J. Hall, director of the Center for Radiological Research at Columbia University College of Physicians and Surgeons.

Predicting the risks for individuals is more difficult. "The lowest dose that we can show that increases the risk of cancer is the dose between 20 and 49 RADs," said William J. Schull of the University of Texas Health Science Center at Houston. "Below 20 RADs, we really don't know what is happening."

The Japanese bomb survivors received an average dose of 25 RADs, though many received higher or lower doses.

According to federal regulations, nuclear workers are allowed to absorb one-and-a-quarter RADs every three months. A man-made source of radiation may not expose the public to more than two one-thousandths of a RAD in an hour or one tenth of a RAD in a seven-day period.

While no one knows how low a dose must be to cause no harm, scientists have shown that a dose of 600 RADs in a short time—six to seven days—would kill 90 percent of those exposed. A dose of 450 RADs in a short time would kill about half of those exposed, and 300 RADs might kill about 10 percent.

Doses between 200 and 450 RADs would cause severe radiation sickness from which most victims would probably recover. Doses between 50 and 200 RADs would cause nausea and diminished resistance to infections but medical treatment would not be required. Doses below 50 would not cause short-term problems but would likely have long-term effects such as a higher risk of cancer.

— Larry Thompson

One of five photographs taken by Yoshito Matsushige in Hiroshima on Aug. 6, 1945.

GICAL WARFARE, From Page 10

: soldiers and adus to the intense stress of combat. ve studies of military exercises that simulated battle- response to chemical warfare found that as many as ercent of GIs who wore the protective garb "experi- d moderate to severe psychological symptoms, includ- xiety, claustrophobia and panic," Ursano and Fuller- reported in an article published earlier this year in the nal Military Medicine.

: one training exercise involving 100 troops, 7 percent ey felt severely claustrophobic or had so much difficulty : their equipment that they simply removed it, an ac- that would have been fatal during an actual chemical ck.

With adequate training and experience, people can n to overcome that," said Col. Michael A. Dunn, com- der of the U.S. Army Medical Research Institute of rmical Defense at the Aberdeen Proving Ground, Md. 'let even when well-trained troops are able to don their r rapidly, chemical weapons attacks may occur so fast t they are still exposed to lethal doses.

"Some soldiers on a chemical battlefield may be at risk absorbing up to five times the lethal dose of [soman] ring an intense chemical attack," according to Dunn and ederick Sidell, both physicians at Aberdeen.

As an additional measure, U.S. troops who are bound for ttlefields where they are likely to face chemical weapons e tablets containing pyridostigmine, a drug that acts as preventive treatment against nerve gas. Pyridostigmine ne can't protect against exposure to nerve gas. But the ng greatly boosts the ability of two antidotes—oximes d atropine citrate—which counteract the toxic effects of rve gas exposure and must be injected soon after an tack.

Pyridostigmine prevents the poison chemicals from at- ching to one type of protein that regulates the nervous

THE HIGH TEMPERATURES AND ARID CONDITIONS OF DESERT WARFARE COMPLICATE THE PROBLEMS OF EXPOSURE TO CHEMICAL WEAPONS

ystem signals. Taken at the correct dosage, pyridostig- ine causes no side effects, according to Dunn.

Typically, soldiers take one tablet every eight hours. How- ver, taking too high a dose of the drug or taking it too often an cause visual or intestinal disturbances. The chief drawback f pyridostigmine is that it cannot reach the brain, where nerve gases inflict some of the greatest harm. This is why it must be coupled with the two antidotes.

American soldiers carry with them two types of auto- matic syringes loaded with atropine citrate and oximes. Both antidotes can counteract nerve gas but are power- less against mustard gas. The syringes can pierce protec- tive garb and clothing with a tiny hole, and soldiers are trained to inject them- selves in the thigh at the first sign of exposure.

Oximes are organic compounds that at- tach to the nerve gases and remove them from the key process, thereby al- lowing the nervous system to function normally. The second antidote, atropine ci- trate, counteracts the effects of nerve gases throughout the body. It works by interfer- ing with the build-up of acetylcholine, a key chemical messenger, and blocks dis- turbances in the central nervous system that the gases are designed to create.

U.S. soldier wears protective gear against chemical attack during maneuvers in Egypt last year.

Like pyridostigmine, the antidotes can cause side effects if they are used improperly.

The high temperatures and arid conditions of desert warfare further complicate the problems of exposure to chemical weapons. The chemicals are often invisible and odorless, and, as a result, symptoms of heat stress, such as sweating, may be mistaken for exposure to nerve gas.

The soldier who mistakes heat stroke for gas exposure and injects himself with atropine will suffer the side effects of that drug, which are similar to an overdose of cold medication. "You feel like your heart is speeding up," Ursano said. "With very high doses, you will feel frightened and have psychotic hallu- cinations that mimic the kinds of things you might have from a nerve gas exposure." More atropine may then be adminis- tered, which only worsens the problem.

Emergency medical facilities in gas-tight mobile units or underground shelters can provide care, but first the injured must be decontaminated, a time-consuming process similar to going through a series of air locks on a spacecraft.

Health care workers wearing protective suits cut away the injured soldier's gear and lift him out of it. But regular clothing worn underneath, as well as wounds, are also likely to be con- taminated with poison chemicals after a bullet, shrapnel or a grenade rips through the protective gear.

To prevent the chemicals from spreading into the gas- tight medical unit, the injured must be processed in stages until they are sufficiently decontaminated to enter the main medical facility. "It's a very difficult operational and medical environment," Ursano said.

Those who survive chemical warfare attacks may face long periods of recovery. Mustard gas burns are similar to those from fire and take a long time to repair. Nerve gas exposure results in increased irritability, memory loss and difficulties with more subtle mental functions, such as the ability to solve problems. ■

WHAT TEAR GAS DOES

Despite concerns in the international community about some of the uses of tear gas, it remains a common means of controlling and subduing crowds throughout the world.

It was frequently employed by police during the anti-war demonstrations of the 1960s and early '70s, including at the 1968 Democratic convention in Chicago.

More recently, tear gas was used on the West Bank and Gaza strip.

Considered by medical authorities to be a riot control agent rather than a deadly chemical weap- on, tear gas is a common term for a family of chemi- cal compounds that cause temporary disability. More than a dozen chemicals are used as tear gases worldwide.

All produce intense burning of the eyes, which causes tearing and sometimes temporary blindness. Other effects include irritation of the nose, trachea and lungs, coughing, vomiting, diarrhea and skin sensitivity.

Proponents claim that when tear gas is properly used, its noxious effects are transient and pose no long-term health risk. But with enough exposure, toxicology studies show, tear gas can cause pneu- monitis—a chemical inflammation of the lungs sim- ilar to pneumonia—and can lead to a fatal condition called pulmonary edema or fluid in the lungs. A 1972 report in the American Journal of Diseases in Children described the treatment of an infant who was exposed to tear gas when police fired canisters into a house to subdue a mentally disturbed adult. The baby developed pneumonitis and was hospital- ized for 29 days.

Most people who encounter tear gas recover by rinsing their eyes and skin with water. Persistent eye irritation can be relieved with local anesthetics, according to a 1968 report in the Journal of the American Medical Association, while skin irrita- tions can be treated with topical steroid creams.

But lingering questions about the use of tear gas remain. Some anecdotal reports have linked mis- carriages and stillbirths to exposure, but no studies have been done. A 1965 report by Harvard re- searchers published in the Journal of the American Medical Association called for "an investigation into the full toxicological potential of tear gas chemicals and renewed debate on whether their use can be condoned under any circumstances."

— Sally Squires

period of time, than the Japanese who were bombed. The average dose received by the Japanese is believed to have been about 25 RADs, which was delivered instantly. The recently released study said that those living near Hanford received an average dose of 33 RADs, delivered over a period of a few years.

At the same time, any increase in radiation-caused can- cers is expected to be less than the rates among bomb sur- vivors because the exposure occurred over a much longer period of time.

More is known about the long-term effects of radiation from atmospheric tests conducted in the 1940s and '50s. A new study of Utah residents living downwind from a Ne- vada test site during that time showed a higher than ex- pected rate of cancer deaths.

Researchers at the University of Utah Medical Center compared 1,177 leukemia deaths in that area to 5,330 deaths statewide, in an effort to determine whether the more than 100 atmospheric tests increased the risk of leukemia.

The Utah scientists concluded that radiation raining down on Utah from the above-ground detonations raised the number of leukemia cases statewide by between 3 and 5 percent above the expected rate, according to the study published in JAMA.

Most of those cases may have resulted from a test con- ducted on May 19, 1953, nicknamed Dirty Harry—when the winds picked up right after the detonation and carried a radioactive cloud over Washington County, Utah, sooner than anticipated. That meant there was less time for ra- dioactive material to decay into a more harmless form or for the particles carried on the wind to fall to the ground before reaching a populated area. Consequently, more ra- dioactive material rained down on the populace.

The Utah study also showed that the damaging effects were related to dose. "We observed about 7.7 times higher the [number of new leukemia cases] than we would have expected in the very highest risk group," said Joseph L. Lyon, a chronic disease epidemiologist at the University of Utah and study participant.

Lyon said the Utah study does not shed much light on the risks to those living near the Hanford and Rocky Flats plants because different types of radioactive material were released. In Utah, the fallout included cesium as well as radioactive iodine. At Hanford, mostly radioactive iodine was released, which is linked to thyroid cancer. A study of thyroid cancer is being conducted in Utah; similar studies at Hanford will begin soon.

To most scientists, certain risks of radiation are consid- ered negligible—like that of a chest X-ray. Radiation for diagnosis and treatment has become a standard part of medical practice. "Patients ought to be assured that to- day's safety practices are well advanced," Upton said. "We have learned through painful mistakes how to avoid injury."

But the legacy of the Japanese bomb survivors remains a haunting reminder of the questions that still linger about radiation. "We have been looking at the results from ion- izing radiation for almost a century now," Upton said. "Peo- ple discovered almost immediately that this was not a form of energy that could be used carelessly or forgivingly." ■