Medical Aspects of Nuclear Radiation Emergencies

By Clarence C. Lushbaugh, BS, PhD, MD, Karl F. Hübner, MD, Robert C. Ricks, PhD

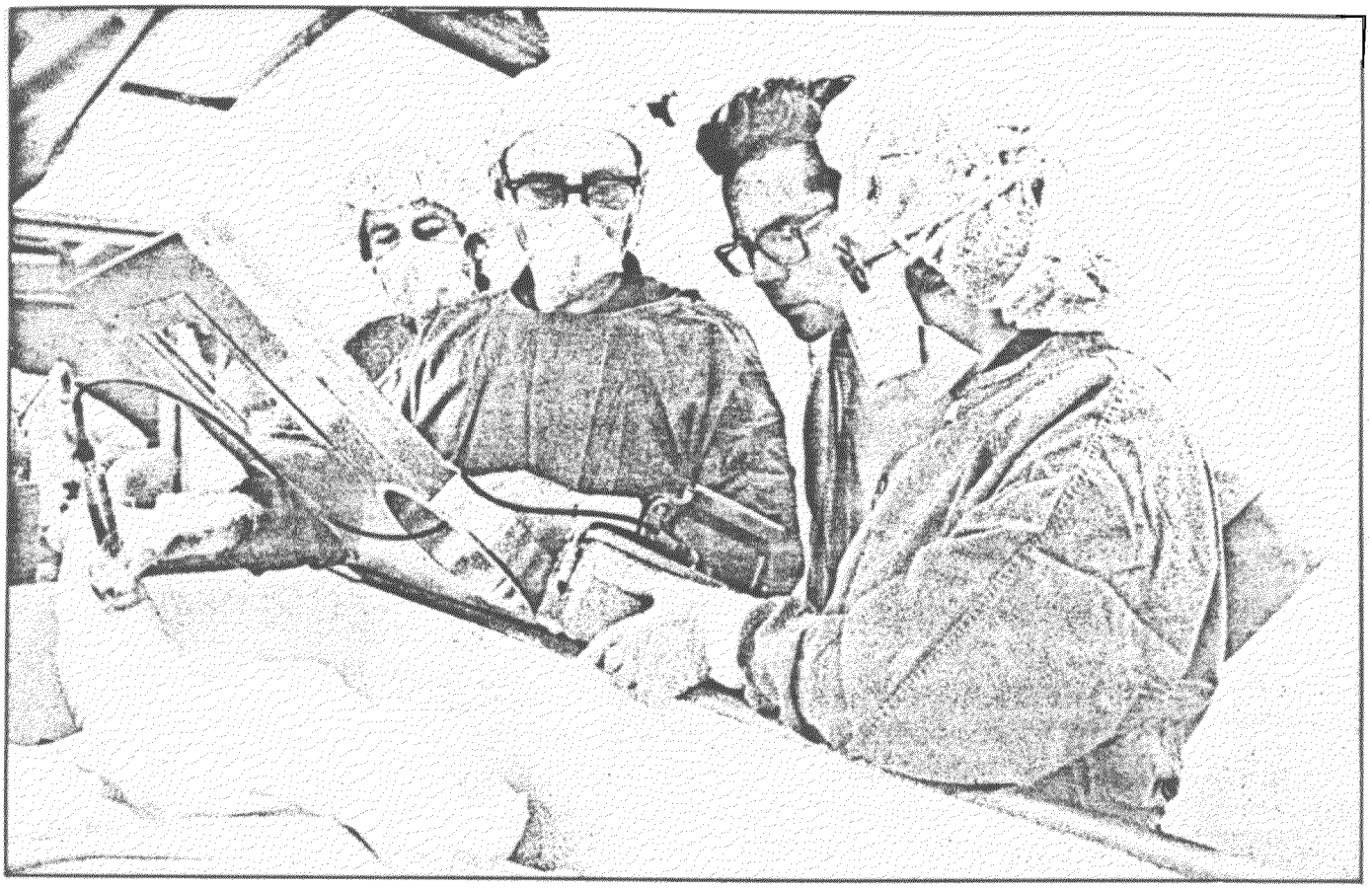
THE GREATEST PROBLEM in developing nationwide emergency preparedness for radiation accidents is caused by their infrequent occurrence. The probability that any particular EMT team will ever be involved in a serious radiation accident is so low that any need for preparation and training for this rare event seems exaggerated. Only a few medical centers (possibly four) in this country have ever faced the problem of caring for radiation-accident cases more than once. Once a hospital or ambulance emergency team has taken care of a radiation-accident case, that team can be considered as trained, particularly if they learn what mistakes they made and correct them. Yet they may not have another chance in their lifetime to care for another radiation-accident case unless our experience of the last 30 years is wrong and radiation accidents become more commonplace. Since, however, radiation accidents, like lightning, do occur even though they do not happen often nor in the same place, preparedness is essential — but largely to allay the common fear of radiation and the unknown mysteries that surround it.

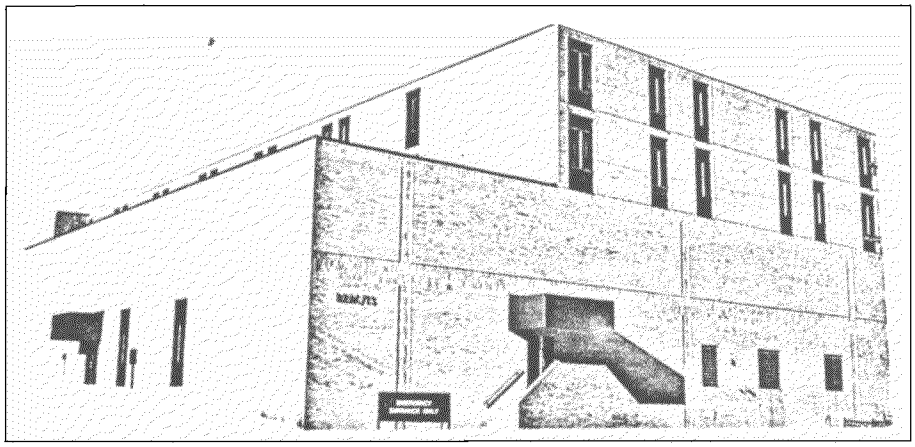
Most people do not believe how rarely the radioactive aspects of a radiation accident require immediate emergency action. However, the important rule is that even the heavily irradiated or contaminated patient must have first aid to ensure his breathing and blood pressure. Flail chests, fractures, hemorrhaging arteries, shock and the like have first priority. No one gets any points at all for a well-decontaminated radiation victim who died from shock during the cleanup. The second most important historically accurate fact is that no radiation accident case has ever been so contaminated that he was a threat to his rescuers.

Generally speaking, when called to the scene of a radiation emergency EMS personnel may assume that police or plant security has arrived and initiated crowd control as well as area isolation. This is particularly true when radiation accidents occur within the confines of nuclear power generating stations or other industrial sites which routinely handle radionuclides. Such is not the case when accidents involving the transport of radioactive materials occur. Thus, EMS personnel should primarily be involved only with the initiation of first aid and rescue techniques. When, however, EMS personnel are called upon to play a role in crowd control as well as administration of first aid or rescue techniques, a few basic principles for personnel protection should be followed. These basic rules serve to protect the accident victims, emergency response personnel, and bystanders as well. Remember that fear, or avoidance of radiation hazards, should never interfere with the administration or extemporization of first aid or rescue techniques.

Upon arriving at the accident scene, visually survey the surrounding area. If possible, park the ambulance upwind of the accident scene avoiding any areas of liquid spills or leaks from transport vehicles or containers that may have been broken in the accident. Look for key elements identifying a potential radiation accident. Such elements include radioactive transport tags attached to vehicles, radioactive shipping labels attached to containers, or information which may be elicited from the victim or victims themselves. Be particularly aware of fire or fire hazards at the scene of a radiation accident and make all attempts to stay upwind of them. Have someone responsible search for a transport manifest which will identify the isotope or isotopes being transported. This manifest should be located in the cab of the transport vehicle. If possible radioactive contamination prevents this search (do not unnecessarily contaminate personnel), it is possible for police personnel to contact the shipping dispatcher directly.

Remember that three basic principles will allow you to limit the radiation exposure to attending personnel and the victim as well. These principles are time, distance and shielding. Well-planned and practiced rescue techniques will limit the time spent in removing a victim from an area of potential radiation exposure. The distance from a source of radiation is important since exposure is determined by the inverse square relationship. Doubling the distance away from a source of radiation reduces the exposure by a factor of four, etc. Conversely, as one halves the distance to a source, the radiation exposure increases by a factor of four.





Formalized education can be obtained at the Radiation Emergency Assistance Center/Training Site (REAC/TS). In the top photo, REAC/TS Director Karl Hübner instructs students in radiation monitoring and decontamination.

Shielding techniques for EMS personnel are usually limited to the use of protective clothing, although in some rare instances, large physical shields such as lead plates may be employed to cut down on radiation exposures. The use of such lead shields, however, would not be the case in the day-to-day activities of EMS personnel With regard to protective clothing, EMS personnel may rely on several items to prevent or reduce radioactive contamination. Such protective clothing includes gloves, shoe covers, and coveralls if available Plastic bags should also be available to contain contaminated clothing and personal items. All personal items belonging to the accident victim should be bagged for possible anaylsis Label all bags to indicate source of the material.

Ambulances should be equipped with basic radiation monitoring instruments (available from Civil Defense), and EMS personnel adequately trained in their use. We feel that such training should extend beyond a simple recognition of the presence of contamination. This training will supplement that of Civil Defense (CD), health physics personnel, and special fire department crews. An instrument survey of the immediate area and the victim can normally identify whether or not radioactive contamination has occurred. If time permits after emergency medical assistance has been administered, monitor the accident victim to determine levels of contamination. Again, remember that the medical needs of the victim always take precedence over radioactive contamination. Action can then be taken to diminish radiation dose to the victim and attending personnel by following a few simple guidelines.

First, remove the victim's clothing, if possible, and cover any wounds with clean dressing using elastic or Velcro bandage to hold the wound cover in place. This normally will reduce the radioactive contamination by as much as 70 percent. If not contraindicated, move the victim away from the area of contamination as quickly as possible and prepare to transport. Care should be taken to prevent the spread of contamination by transporting in the following manner: 1) spread a clean blanket on the ground away from the area of contamination; 2) place the stretcher on top of this blanket; 3) place the victim on the the stretcher, folding the lower blanket over victim and stretcher, and 4) place another blanket

Careful, complete reporting of the radiation injury by field personnel is an important aspect of their responsibility.

on top of the stretcher and victim, securing all areas so that contamination will not likely escape. (This procedure can be modified so that only the victim is between the blankets, thus leaving the stretcher free-rolling.) Plastic bags may be employed to prevent the spread of contamination, provided such contamination is confined to small volume areas such as arms, legs, hands or feet. After removal of contaminated clothing, place a plastic bag over the body area and secure loosely, then wrap victim in the blankets as outlined above. The transport of the victim from the accident scene to the medical facility should provide ample time to continue monitoring the victim for radioactive contamination.

It is important that a disaster tag be attached to the victim, and areas of body contamination be identified on the disaster tag. Identify the specific contaminated area and state the actual meter reading that you obtained during monitoring. The information on the disaster tag will serve as an important information source when the victim arrives at the medical facility.

After transfer of victims to the medical unit, EMS personnel should be thoroughly surveyed for contamination, discarding all contaminated clothing in plastic bags and showering as appropriate. Do not leave the area until released by a responsible health physicist or his designate. Be sure that the ambulance and its contents are thoroughly surveyed and decontaminated if required. If the ambulance is to be left for any period of time, it should be locked to prevent the spread of any potential contamination. By following the simple rules and guidelines above, EMS personnel can diminish the radiation dose to the accident victim and possibly prevent any contamination to attending personnel.

In this review we assume that the hospital designated for the medical care of persons exposed to ionizing radiation has a working response plan for radiation emergencies. A previously selected radiation emergency area (REA), located outside the main flow of daily medical emergencies, should be put in a state of readiness as soon as the phone call announcing the radiation emergency comes in. The hospital disaster supervisor activates the appropriate response plan and calls the team into action. The REA is roped off and adequate floor covering (plastic, paper) is laid on the floor; a control point is established and equipped with essential supplies and staff.

What is needed at the control point? Personal dosimeters sould be available for issue to anyone who has to enter the REA, radiation survey meters in functioning condition have to be available, and preprinted forms for adequate record keeping, in addition to ordinary note pads, are essential. Another important area that needs to be established is a buffer zone. This is an area between the REA and the "clean" part of the hospital, a pass-through area that may become slightly contaminated in action. A floating nurse and an aide should be assigned to the buffer zone and remain there during the entire response. Appropriate instruments and equipment for proper medical-surgical and decontamination procedures should be placed in the REA for back-up in the buffer zone. Prearranged sampling containers for hematologic, cytogenetic, and radioassay tests should be available for each patient with adequate labeling material. To adequately protect personnel, protective clothing (gowns, caps, gloves, boots, and masks) should be available in ample supply. For handling highly radioactive foreign bodies, lead containers (pigs) should be at hand as well as longer tongs or forceps to move "hot" objects. Some hospitals may be equipped with a decontamination table and/or shower and possibly with movable lead shields to expedite decontamination and provide maximum protection of personnel.

When these preparations have been made, guards should be posted at the crucial points of the REA in order to control access by the usually excited and concerned relatives of radiation-accident cases.

It should be emphasized that any surgical or medical needs have absolute priority over those of contamination by radioactive material or external radiation exposure. When the patient is brought into the REA, three types of information are needed in a brief report: 1) the medical status of the victim, 2) the radiation status, and 3) whether the victim presents any contamination hazard to the medical personnel who care for him.

Surgical and medical problems should be dealt with first. When the patient's condition is stabilized, all clothing should be removed from the patient and swipe samples for radioassay should be taken from the nose and any contaminated areas of the skin. At the same time, blood samples for CBC and differential, chromosome analysis, and electrolytes should be taken. After these samples are taken, the entire patient is surveyed for radioactive contamination and the meter readings are recorded on an anatomical diagram. Then decontamination, if required, is started at areas of the highest readings. For decontamination agents, we refer to dilute solutions of laundry bleach, soap and water. Monitoring the progress of decontamination is done by checking either the area involved or the collected washing fluids.

If hospital admission is required, transfer of the now decontaminated patient is done under controlled conditions. New floor coverings are laid down, a clean stretcher is brought in, the patient is transferred through the buffer zone and a thorough radiological survey is made to assure acceptably low levels of radioactivity before moving the patient to "clean" areas of the hospital. Likewise, all personnel that participated in the care and decontamination of the patient must be monitored before being allowed to leave the REA. Showers for the personnel are desirable in the decontamination area. When everyone finally comes out clean, the area itself is then decontaminated.

If the patient is admitted to the hospital proper, a thorough medical evaluation is done to establish the seriousness of any radiation exposure. Although it is beyond the scope of emergency practice, a few essential parameters of this evaluation need to be mentioned. Valuable objective information on possible external total-body irradiation can be obtained from the white blood cell count, the absolute lymphocyte count, and chromosome analysis. Whole-body counting and radioassay of serum and urine will help to recognize internal contamination and exposure to neutron radiation.

Good clinical observations for such

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general symptoms as nausea, vomiting, fatigue, erythema and hair loss provide important biological information for the estimation of the level of total-body or partial-body irradiation.

The definitive care of radiation injury, whole body or local, remains a challenge to the radiobiologist, the internist, and the surgeon. While it is not a responsibility of the emergency on-site crew or the hospital emergency room staff, how intense it must be is often forecast by information about the accident gleaned by the emergency team. Careful complete reporting by field personnel is therefore an important aspect of their responsibility. All level responders need to understand and accept the fact that radiation emergencies can be handled, provided adequate planning and training are there

Formalized training in the techniques of handling and caring for radiation-accident victims can be obtained at the Radiation Emergency Assistance Center/Training Site (REAC/TS). REAC/TS, funded by the U.S Department of Energy, is housed in the Oak Ridge Hospital of the Methodist Church in Oak Ridge, Tennessee. The facility is equipped to treat radiation-accident victims, as a center for continuing studies on human radiation exposure, and as a training/demonstration unit for courses in the handling of radiation-accident cases. Training courses include, "Medical Planning and Care in Radiation Accidents," "Health Physics in Radiation Accidents," and "Handling of Radiation Accidents by Emergency Personnel."

The medical planning and health physics courses are of one-week duration each. The emergency personnel course is two-and-one-half days in duration and emphasizes the practical aspects of handling a contaminated victim by discussing the fundamentals of radiation, how to detect and measure it, how to prevent the spread of contamination, and how to reduce the radiation dose to the victim and attending personnel. Formal lectures are complemented by demonstrations, laboratory exercises, and a simulated accident drill. Courses are acceptable for credit as Category 1 of the Physician's Recognition Award by the American Medical Association and by the Tennessee Nurses Association. During each training course, the REAC/TS staff is complemented by nationally recognized experts in the field of radiation-accident response. Dates for specific courses to be offered in fiscal year, 1979, are as follows: "Medical Planning and Care in Radiation Accidents" — November 13-17, 1978, and March 5-9, 1979; "Health Physics in Radiation Accidents" — January 22-26, 1979, and September 10-14, 1979; "Handling of Radiation Accidents by Emergency Personnel" — December 4-6, 1978, April 23-25, 1979, and September 24-26, 1979. □

Clarence C. Lushbaugh received his BS degree (Anatomy) and his PhD and MD (Pathology) from the University of Chicago. He held faculty positions as pathologist at the University of Chicago and The University of Tennessee — Oak Ridge Graduate School of Biomedical Sciences Dr. Lushbaugh directed experimental work for numerous projects such as Applied Radiobiology and NASA Total Body Irradiation, and has been a member or chairman of more than 18 committees such as Radiation Advisory Panel, Space Science Board, National Academy of Sciences, USAF/NASA Ad Hoc Committee on Electron Skin Effects and Radiotherapy. Currently he is Associate Director of Radiation Emergency Assistance Center/Training Site (REAC/TS).

K F Hübner, MD, was graduated from Basic Sciences and Medical School, University of Heidelberg, Germany. He is Senior Research Scientist for the Medical and Health Sciences Division, Oak Ridge Associated Universities, and is currently director of REAC/TS.

Robert C. Ricks, PhD, was graduated from Texas A&M University. He has held positions teaching Zoology, Advanced Physiology and Endocrinology, has participated in radiation research projects, and is now assistant director of REAC/TS.

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