EMERGENCY ROOM PREPARATION FOR INJURIES CAUSED BY RADIOACTIVE MATERIALS

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With the increasing number of nuclear power plants and expanding use of radioactive materials in industry and medicine, the potential for inadvertent exposure of the public and the workforce to radiation has increased greatly. The recent experience in Chernobyl underscored the need for the emergency rooms of the nation's largest hospitals to prepare for such disasters. This paper discusses a plan developed at the University of Alabama in Birmingham (UAB) to provide medical care related to such events.

The Alabama Power Company (APC) designated the UAB Hospitals as the major treatment center for casualties resulting from overexposure to radioactive material in their nuclear power plants or during the transport of radioactive material. Because of this designation, the Division of Radiological Health in the Alabama Department of Public Health also gave UAB Hospitals the responsibility for treating persons overexposed to ionizing radiation from any source within the state.

Two power plants supply most of the electricity for Alabama: the Tennessee Valley Authority (TVA) for northern Alabama and the Alabama Power Company (APC) for the remainder of the state. A third nuclear power plant is under construction, and another in Mississippi is being considered. The UAB Medical Center is located in north central Alabama and is fairly central to these sites.

The UAB Hospitals have analyzed their tasks and divided the preparations needed into the following segments:

<u>Victim Source:</u> In order to have some idea of the types of injuries to anticipate, it was important to learn the locations of the potential sources. Incidents in the plants could range from ingestion of radioactive products to exposure to external radiation. All could be associated with various forms of radiation and levels of trauma. The source of radioactivity during transport could include fuel elements or radioactive wastes. Specialized information about the state's highway and rail systems was required to learn the routes along which radioactive materials were likely to be shipped and the frequency and types of incidents along these pathways.

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Sources of Notification: It was important to determine who might notify the hospital and to what extent state highway and rail authorities were aware of shipments of radioactive material through the state--in short, the command matrix. We posted in our emergency room (ER) the names and telephone numbers of the officers involved in this network and contacted each by telephone.

For example, we found that information regarding incidents on highways would follow an entirely different chain of command than those within a community and that the initiator of information might be a police officer in a town or city, a county sheriff, or a state trooper. These entities did not always work in close coordination with each other. By contacting them, we were able to establish a nuclear medicine/emergency room 'presence' and a protocol to telephone these contacts every six months.

Hospital Staff Notification: A list of names and telephone numbers of staffs of the emergency room, nuclear medicine department, radiation safety, and security departments, as well as of other hospital personnel, was developed and posted in the UAB Emergency Room.

Nuclear medicine personnel should play a central role in the management of patients injured by radiation, for personnel in this department are most knowledgeable about the problem as a whole, the physics of radionuclides, decontamination procedures, patient handling, and initial therapy.

Types of Radiation Effects: Injuries involving radiation may include thermal burns, ingestion of radioactive materials, wound contamination, and skin contamination. Some fission products that may be present are listed in Table 1, and some neutron activation and elements of power plant fuels appear in Table 2. However, many other elements may be involved in episodes involving movement of wastes or fuels. We anticipate being able to determine the type and extent of injury as early as possible, even by telephone, in order to sort patients properly. From the time of the first notification, we would expect patients' urine to be saved for radionuclide identification and quantification.

Emergency Room Modification: Personal contamination or contamination of the ER in the course of treating the patient must be avoided. Accordingly, needed architectual modifications of the ER were made based on the following assumptions: (1) that motor vehicles transporting such patients are contaminated; (2) that the stretcher, bedding, clothing, and patient's skin are contaminated; and (3) that the patient is internally contaminated. We intend to eliminate the source of this contamination in a stepwise fashion.

First, a rear entry to the ER where we had a ramp was prepared and a rolldown door to isolate two ER operating bays was installed. This prevented personnel from tracking contaminants into the main portion of the ER. Access to storage cabinets and closets from the bays was

TABLE 1

ANTICIPATED FISSION PRODUCTS

ELEMENT	T/2	RADIATION
Sr^{89}	50.5 d	β, γ
Sr^{90} *	27.7 y	β
→ Y^{90}	64.2 h	β
Y^{91}	57.5 d	β, γ
Zr^{95} *	65 d	β, γ
→ Nb^{95}	35 d	β, γ
Ru^{103}	39.8 d	β, γ
Ru^{106}	1.00 y	β
Rh^{103m}	57 m	β, γ
Rh^{106}	30 s	β, γ
I^{131}	8.08 d	β, γ
Cs^{137}	26.6 y	β, γ
Ba^{137m}	2.60 m	β, γ
Ba^{140}*	12.80d	β
→ La^{140}	40.22h	γ
Ce^{141}	33.1 d	β, γ
Ce^{144}	285 d	β, γ
Pr^{143}	13.76d	β
Pr^{144}	17.27m	β, γ
Pm^{147}	2.64 y	β

* The upper nuclide decays into the lower

TABLE 2

ANTICIPATED

NON-FISSION PRODUCTS

FUEL ELEMENTS:	^{235}U	α, γ+	7.1×10^8y
	^{238}U	α, β, γ+	4.5×10^9y
NEUTRON ACTIVATION:	^{24}Na	β, γ	15 h
	^{51}Cr	γ	28 d
	^{54}Mn	β, γ	303 d
	^{56}Mn	β, γ	2.6 h
	^{58}Co	β^+, γ	72 d
	^{60}Co	β, γ	5.2 y
	^{59}Fe	β, γ	44 d

assured and microphones, loudspeakers, and special telephones were installed to facilitate communication between the bays and the rest of the ER.

Preparation of Emergency Room: After being informed of an injury, the designated ER area must be isolated and emergency protective materials obtained from nearby storage areas. Protective floor covering is placed on the external ramp passage leading to the isolated area and on the floor of the ER bays. Personnel are gowned in protective garments and radiation detection devices are activated. Controls are arranged for traffic outside the area if the magnitude of the disaster warrants. The special containers for protective materials for personnel, dedicated radiation detection devices, special tubs in which to cleanse patients (Figure 1), and special waste containers are made available.

Patient Decontamination: On arrival of the patient(s) at the ER, potentially contaminated outer garments are removed and turned over to radiation safety personnel for identification and handling. The stretcher is removed from the vehicle and the patient is transferred to a clean stretcher. If possible, the rest of the clothing is removed before the patient's transfer into the ER.

The patient is rolled into the isolated ER area and placed onto a tub with its drainage prepared for total collection of the wash water for identification and quantification of radioactive material. After assessment of the extent of injury and any localized areas of radioactivity such as the thyroid, washing is commenced. Monitoring by a portable probe with multichannel readout is desirable at this point. The washing should be gentle and without splashing. Under no circumstances should it be done by shower, as has often been suggested; this will avoid splattering and contamination of the shower and drains.

Throughout the cleansing process, close contact is maintained with radiation safety personnel and the patient is monitored continually. Wash water is sent periodically for analysis. When the wash water has become nonradioactive, it is assumed that the skin is clean and that any positive readings are from sources inside the patient. Ideally, a whole body counter should be used at this point for identification, quantification, and tracing of the radioactive material involved.

Identification of Contaminant: All wash material, wipes, clothing, and urine and blood samples are analyzed to determine type and quantity of the radioactive substance. It is important to have appropriate lists of possible elements and identifying information, such as energy spectra. A multichannel analyzer is a necessity (Figure 2). Identification should be carried out as quickly as possible.

Treatment of Other Lesions: The patient should be examined carefully for external lesions. If external wounds or burns are present, these

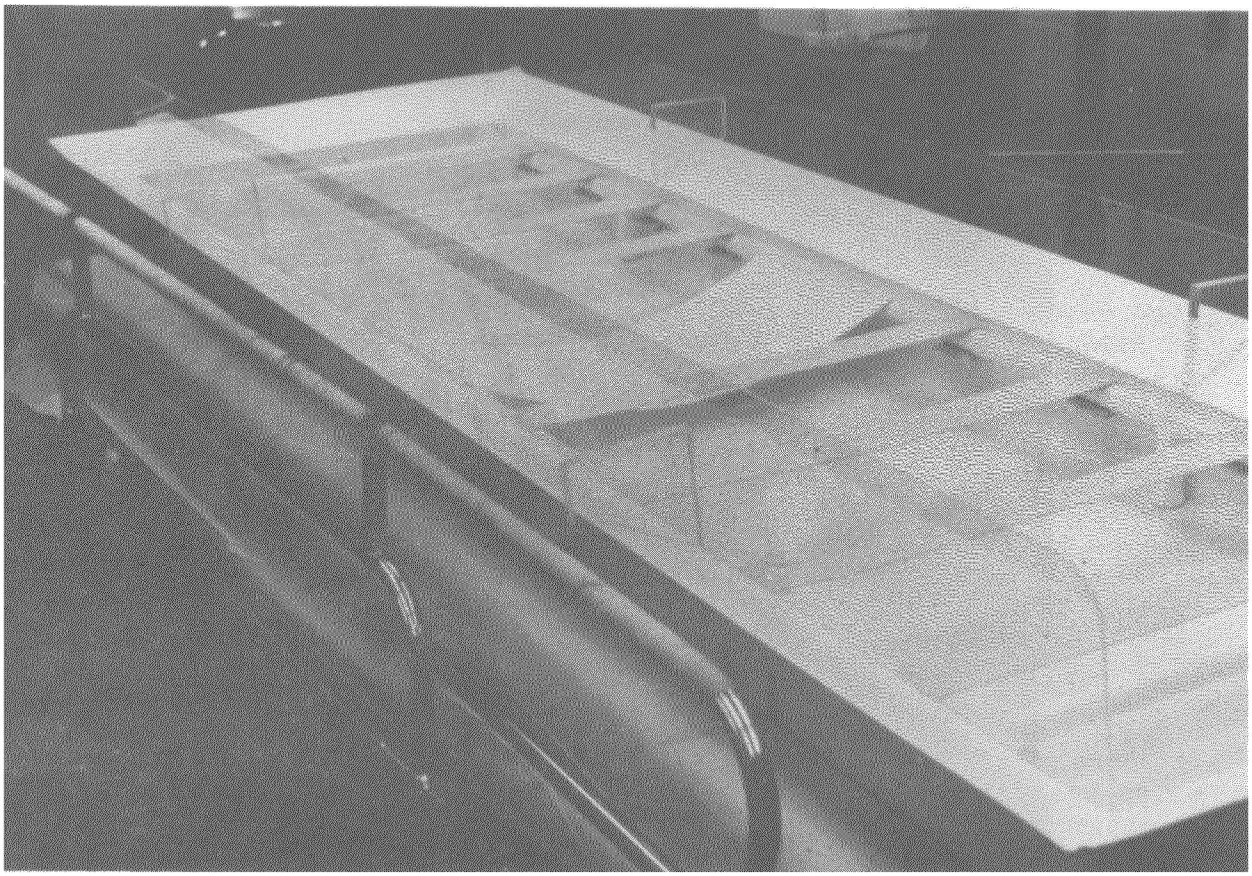

Figure 1. Details of decontamination tubs. Patients are gently washed using overhead water source and all fluids are collected for identification and quantification of radionuclides until wash water is free of radioactivity.