

**The Prehospital Level:** The doctrine, Standing Operating Procedures (SOP), training and equipment at the prehospital level, has been finalized and joint exercises are being conducted regularly with MDA ambulance teams, police forces, and fire services.

**MDA HAZMAT Response Teams:** These teams are based on MDA's regular ambulance teams (MICU and regular ambulances) in 10 out of 40 MDA stations throughout the country. These HAZMAT response stations were chosen in locations in which the main chemical industry or storage and shipment facilities are located. The stations have been equipped with two sets of personal protective suits each, of the "RESPONDER 0011" type. We are now in the process of replacing these suits with the more heavy "BUTYLIC" suit, produced by the TRALLEBORG Company. Each suit includes a SCUBA respirator, BD-88. In addition, five light, disposable suits are available in each station for decontamination teams, with gas masks and filters. The medical equipment contained in a first-aid kit includes an "Ambu" manual respirator with filter, an aspirator (foot-pump type), dressing material, a rubber tourniquet, and a cervical collar. All MDA personnel in the HAZMAT stations, including paramedics, ambulance drivers, and adult volunteers, undergo an annual refresher course and an exercise with police and fire services.

**Hospitalization:** All HAZMAT victims will be hospitalized for observation and medical treatment. Depending on the distance from the incident site to the hospital, the number of casualties and available means for evacuations, an undefined number of victims may bypass the decontamination station and MDA's first-aid points on the scene, and reach the hospitals without decontamination or receiving first aid on-site. Hospitals have to be prepared (as they were during the Gulf War) to receive HAZMAT casualties on very short notice, or without any advance warning. This is a very demanding situation for any hospital and emergency department, even in conventional mass-casualty situations. It requires planning, preparation of a decontamination facility at the entrance to the emergency department, specific medical equipment, drugs, and trained medical teams.

### III.4

#### Decontamination of Victims

*Sven-Åke Persson*

Research Director, National Defense Research Establishment  
Department of NBC Defense, Sweden

Individuals exposed to liquid toxic chemicals must be decontaminated as soon as possible to: 1) save the life of the exposed victim; 2) make transportation and treatment possible; 3) avoid secondary contamination of rescue services and medical personnel; and 4) avoid secondary contamination of transportation vehicles and hospital.

It is extremely important to stop the exposure of the victims to the toxic chemicals and to undress the victim. Decontamination then can be performed by means of: a) dry methods, or b) wet methods.

In peacetime chemical disasters, where resources and supplies are plentiful enough to meet the requirements, the situa-

tion is more favorable than in wartime chemical disasters. Mass casualties, lack of resources, use of chemical warfare agents, combined chemical lesions and trauma, and the need for specific decontaminating agents are some of the problems in war. Rapid and accurate detection of chemical exposure has yet to be developed.

Therefore, safe and effective routines for decontamination and treatment have to be developed to save the patient without contaminating medical personnel or the hospital.

### III.5

#### Chemical Disasters: Lung Injuries

*Goran Hedenstierna, MD*

Department of Clinical Physiology,  
University Hospital, Sweden

Inhalation or aspiration of various chemical compounds can cause severe lung damage—either acute and fullminant or more protracted—sometimes characterized by a biphasic progress with a period of apparent recovery. The distribution of the damage within the lung is dependent on the solubility in water of the compound; the more water soluble it is (e.g., formaldehyde, ammonia), the higher up in the airway tree (larynx, trachea) the damage will be located. If the compound is less soluble in water (e.g., chlorine, isocyanates), small airways and alveoli may be damaged.

In upper-airway involvement, the major findings are burns, edema, coughs, bronchospasms, and breathlessness. With severe exposure, laryngeal and epiglottic edema may develop, and, in the worse cases, laryngospasm. Respiratory and circulatory collapse may occur by reflex mechanisms.

Damage to the peripheral airways and the alveoli causes capillary leakage and pulmonary edema. The chemical irritation also may cause a pneumonitis with leaking airways and activation of inflammatory cells. Finally, many inhaled gases and other compounds can cause systemic effects with little direct damage to the lung tissue (e.g., carbon monoxide, alcohol).

### III.6

#### Ventilatory Support in Acute Severe Lung Injury

*Ulf Ludwigs, MD*

Medical Intensive Care Unit, Department of Medicine-  
Södersjukhuset, Stockholm, Sweden

The acute pathological response of the respiratory tract to chemical irritants is characterized by inflammatory changes in the airway and by alveolar edema. The pathophysiologic correlate is an imbalance of ventilation to perfusion ( $V_A/Q$  mismatch). Clinically, cough, stridor, hypoxemia, and respiratory distress are common symptoms.

Treatment should be directed against the airway inflammatory response with endothelial injury and airway obstruction through the administration of appropriate pharmacological agents. Mild to moderate hypoxemia may be counteracted with supplemental oxygen administered via nasal prongs or by face mask. More pronounced hypoxemia usually requires measures that counteract