but increase the risk of thromboembolism and hepatic adenomas.

- Overdose of acetaminophen may cause centrilobular liver necrosis, leading to liver failure. Early treatment with agents that restore GSH levels may limit toxicity. Aspirin blocks the production of thromboxane A_2, which may produce gastric ulceration and bleeding.
- The common drugs of abuse include sedative-hypnotics (barbiturates, ethanol), psychomotor stimulants (cocaine, methamphetamine, ecstasy), opioid narcotics (heroin, oxycodone), hallucinogens, and cannabinoids (marijuana)

Injury by Physical Agents

Injury induced by physical agents is divided into the following categories: mechanical trauma, thermal injury, electrical injury, and injury produced by ionizing radiation. Each type is considered separately.

Mechanical Trauma

Mechanical forces may inflict a variety of forms of damage. The type of injury depends on the shape of the colliding object, the amount of energy discharged at impact, and the tissues or organs that bear the impact. Bone and head injuries result in unique damage and are discussed elsewhere (Chapters 26 and 28). All soft tissues react similarly to mechanical forces, and the patterns of injury can be divided into abrasions, contusions, lacerations, incised wounds, and puncture wounds. This is just a small sampling of the various forms of trauma encountered by forensic pathologists, who deal with wounds produced by shooting, stabbing, blunt force, traffic accidents, and other causes. In addition to morphologic analyses, forensic pathology now includes molecular methods for identity testing and sophisticated methods to detect the presence of foreign substances. Details about the practice of forensic pathology can be found in specialized textbooks.

Thermal Injury

Both excessive heat and excessive cold are important causes of injury. Burns are the most common cause of thermal injury and are discussed first; a brief discussion of hyperthermia and hypothermia follows.

Thermal Burns

In the United States, approximately 450,000 persons per year receive medical treatment for burn injuries. Eighty percent of burns are caused by fire or by scalding, the latter being a major cause of injury in children. It is estimated that approximately 3500 persons die each year as a consequence of injuries caused by fire and smoke inhalation, mostly originating in homes. Since the 1970s, marked decreases have been seen in both mortality rates and the length of hospitalizations of burn patients. In recent years there were approximately 45,000 hospitalizations per year for burns; among those treated in specialized burn centers (about 55% of those hospitalized), the survival rate was more than 95%, a remarkable testimony to improvements in the care of patients with severe burns. These improvements have been achieved by a better understanding of the systemic effects of massive burns, the prevention of wound infection, and the use of treatments that promote the healing of skin surfaces.

The clinical significance of a burn injury depends on the following factors:

- Depth of the burns
- Percentage of body surface involved
- Internal injuries caused by the inhalation of hot and toxic fumes
- Promptness and efficacy of therapy, especially fluid and electrolyte management and prevention or control of wound infections

Burns used to be classified as first degree to fourth degree, according to the depth of the injury (first-degree burns being the most superficial), but are now classified as superficial, partial thickness, and full-thickness burns.

- *Superficial burns* (formerly known as *first-degree burns*) are confined to the epidermis.
- *Partial thickness burns* (formerly known as *second-degree burns*) involve injury to the dermis.
- *Full-thickness burns* (formerly known as *third-degree burns*) extend to the subcutaneous tissue. Full-thickness burns may also involve damage to muscle tissue underneath the subcutaneous tissue (these were known formerly as fourth-degree burns).

Shock, sepsis, and *respiratory insufficiency* are the greatest threats to life in burn patients. Particularly in burns of more than 20% of the body surface, there is a rapid (within hours) shift of body fluids into the interstitial compartments, both at the burn site and systemically, due to the *systemic inflammatory response syndrome*, leading to shock (Chapter 4). Because of widespread vascular leakiness, generalized edema, including pulmonary edema, can be severe. An important pathophysiologic effect of burns is the development of a *hypermetabolic state* associated with excess heat loss and an increased need for nutritional support. It is estimated that when more than 40% of the body surface is burned, the resting metabolic rate may double.

The burn site is ideal for the growth of microorganisms; the serum and debris provide nutrients, and the burn injury compromises blood flow, blocking effective inflammatory responses. As a result, virtually all burns become colonized with bacteria. Infections are defined by the presence of greater than 10^5 bacteria per gram of tissue, and invasive local infection is defined by the presence of greater than 10^5 bacteria per gram in unburned tissue adjacent to the burn. The most common offender is the opportunist *Pseudomonas aeruginosa*, but antibiotic-resistant strains of other common hospital-acquired bacteria, such as methicillin-resistant *S. aureus*, and fungi, particularly *Candida* species, may also be involved. Furthermore, cellular and humoral defenses against infections are compromised, and both lymphocyte and phagocyte functions are impaired. Direct bacteremic spread and release of toxic substances such as endotoxin from the local site have dire consequences. Pneumonia or septic shock with renal failure and/or the acute respiratory distress syndrome (Chapter 15) are the most common serious sequelae.