CONDITION

Radiation injuries

Radiation injuries are tissue and organ damage caused by a large or concentrated dose of ionizing radiation.

WHAT IT IS
Tissue damage from high or concentrated ionizing radiation

BODY SYSTEM
Skin, blood, digestive system, and many organs

MAIN SYMPTOMS
Nausea, skin redness, fatigue, low blood counts

WHAT CAUSES IT
High-dose ionizing radiation exposure or radioactive contamination

HOW IT IS DIAGNOSED
Exposure history, serial blood counts, radiation dose assessment

MAIN TREATMENT
Decontamination, supportive care, and radiation-specific medicines

CAN IT BE CURED?
Sometimes - recovery depends on dose and organs injured

IS IT AN EMERGENCY?
Sometimes - sudden exposure or severe symptoms needs emergency care

LONG-TERM OUTLOOK
Mild injuries may heal; severe injuries can be fatal

Overview

Radiation injuries happen when ionizing radiation damages the body's cells and tissues. Ionizing radiation has enough energy to affect DNA, the material that controls how cells work. Sources include X-rays, gamma rays, radioactive particles, and some equipment used in industry or medicine.

The type of injury depends on the radiation dose, how quickly it was received, and how much of the body was exposed. A focused exposure may injure one area, often the skin. A large dose reaching most of the body over a short time can cause acute radiation syndrome, sometimes called radiation sickness.

Exposure and contamination are different. External exposure means radiation passed through the body from a source outside it. This does not usually make you radioactive. Contamination

means radioactive material is on the skin, clothes, or inside the body. Contamination may continue to expose tissues until the material is removed or loses its radioactivity.

Most everyday medical imaging does not cause radiation sickness. Radiation treatment for cancer deliberately exposes a limited area and may cause expected local side effects. Unexpected injuries are more likely after an industrial accident, mishandled radioactive source, major nuclear event, or unusually prolonged medical procedure involving radiation.

Symptoms

Symptoms may begin within minutes, hours, days, or longer. Their timing does not reliably show the dose without specialist assessment. Some early symptoms also resemble common illnesses, so symptoms alone cannot confirm a radiation injury.

Possible early effects of a significant whole-body exposure include:

A person may initially feel ill, then improve for a time before becoming unwell again. This symptom-free period is called a latent phase. Later effects can include infection, bruising, bleeding, dehydration, hair loss, and worsening weakness.

Skin injury may appear hours to weeks after exposure. The affected area can become red, swollen, painful, itchy, or blistered. Hair may fall out in one patch. More serious injury can cause an open sore or tissue death. Skin damage may improve and then flare again because deeper tissues continue to change.

Radioactive material inside the body may cause no immediate symptoms. Its effects depend on which radioactive substance entered the body and where it collects. For example, some materials concentrate in the thyroid, bones, or other organs.

- Nausea, vomiting, loss of appetite, or diarrhea
- Headache, weakness, fever, or unusual tiredness
- Skin redness, swelling, itching, or burning
- Temporary confusion after a very severe exposure

Causes and risk factors

Radiation injury requires enough ionizing radiation to overwhelm the body's ability to repair damage. The source may be outside the body, on the body, or inside it.

Possible situations include an accident involving industrial or research equipment, an

unshielded radioactive source, a nuclear emergency, or a problem during a radiation-based medical procedure. Radiation therapy can also cause local tissue injury, although treatment teams plan doses carefully to limit damage to healthy tissue.

Risk is shaped by several factors:

Cells that divide rapidly are especially sensitive. These include cells in bone marrow, which makes blood cells, and cells lining the digestive tract. The skin, reproductive organs, and developing fetus can also be sensitive.

Radiation injury is not caused by ordinary contact with someone who has only been externally exposed. Radioactive dust or liquid on clothing or skin can sometimes be transferred until decontamination is completed.

- The total radiation dose
- How quickly the dose was received
- Whether the whole body or one area was exposed
- The type and energy of the radiation
- Distance from the source and the shielding present
- Whether radioactive material entered the body
- Age, health, and existing injuries

Diagnosis

Diagnosis begins with details of the event. Medical teams may ask when and where the exposure happened, how long it lasted, whether shielding was present, and whether other people were affected. Workplace radiation badges, environmental measurements, and information about the source can help estimate the dose.

Blood counts are often repeated over hours or days. A falling number of lymphocytes, a type of white blood cell, can help estimate the effect on bone marrow. Other blood tests check organ function, infection risk, bleeding risk, and fluid balance.

Specialist laboratories may examine chromosomes in blood cells for changes caused by radiation. This is called biological dosimetry. It can help estimate a dose when physical measurements are unavailable.

If internal contamination is possible, urine, blood, nasal swabs, external detectors, or whole-body counting equipment may be used to identify radioactive material. The exact test depends on the suspected substance.

Skin injuries may need photographs, repeated examinations, or scans to assess deeper tissue damage. Because radiation effects can develop slowly, an early normal examination does not always rule out injury.

Treatment and management

Treatment is based on the type of radiation, the estimated dose, the tissues affected, and whether contamination remains. Significant injuries are usually managed with help from radiation medicine, toxicology, blood, burn, or public health specialists.

If radioactive material is on the body, removing outer clothing and placing it in a sealed container can remove much of the contamination. Skin and hair are washed gently with soap and lukewarm water. Scrubbing hard may damage the skin and allow material to enter the body.

Life-saving treatment should not be delayed for decontamination. Emergency teams use protective measures while caring for contaminated patients.

Supportive treatment for acute radiation syndrome may include fluids, medicines for nausea, pain control, and careful monitoring. Low blood counts may require medicines that help bone marrow produce blood cells, treatment for infection, or blood product transfusions. Stem cell transplantation is considered only in selected circumstances.

Internal contamination sometimes requires a medicine that binds to, blocks, or speeds removal of a particular radioactive substance. These medicines are specific to the contaminant. Potassium iodide protects the thyroid from radioactive iodine only; it does not treat external radiation exposure or protect other organs. It should be taken during an emergency only when public health authorities advise it.

Skin injuries need ongoing wound care. Treatment may include dressings, pain relief, infection management, and surgery for badly damaged tissue. Symptoms can recur, so follow-up may continue after the skin appears to improve.

Complications

Radiation can reduce production of white blood cells, red blood cells, and platelets. This can lead to infection, anemia, bruising, or bleeding. Severe injury to the digestive tract may cause ongoing diarrhea, dehydration, bleeding, and difficulty absorbing nutrients.

Deep skin injury can result in chronic pain, poor wound healing, scarring, ulcers, or tissue death. Damage to small blood vessels may continue for months or years.

Other possible long-term effects include cataracts, infertility, reduced thyroid function, lung or kidney damage, and scarring inside affected organs. The risks depend on which tissues received radiation and the dose they received.

Radiation exposure can increase the chance of developing certain cancers later in life. An increased risk does not mean cancer will definitely occur. The size of the risk is assessed from the dose, age at exposure, organs affected, and type of radiation.

A radiation emergency may also cause anxiety, sleep problems, or distress about future health. These effects are real and may need support even when physical testing shows a low exposure.

Prevention

Some radiation injuries can be prevented, but not every accidental exposure can be predicted. Workplaces and medical facilities reduce risk through training, shielding, controlled access, equipment checks, and personal dose monitoring.

The main principles are to spend less time near a source, increase distance from it, and place suitable shielding between the source and the body. Only trained workers should handle radioactive materials or unknown industrial equipment.

During a public radiation emergency, follow official instructions. You may be told to go indoors, stay indoors, close windows, or move to another area. Do not approach fallen equipment, unusual metal containers, or suspected radioactive material.

If contamination is possible, remove outer clothing without shaking it, keep it away from other people, and wash exposed skin gently. Do not take potassium iodide or other radiation medicines unless authorities recommend them for the specific event.

Necessary medical imaging and cancer treatment use radiation for a clinical purpose. Ask the medical team about concerns, but do not avoid needed care solely because radiation is involved.

Living with it and what to expect

Recovery can take days, months, or longer. A mild, localized skin injury may heal, although the area can remain sensitive or change color. Deeper injury may repeatedly break down and require long-term wound care or surgery.

After a substantial whole-body exposure, blood counts may remain low for weeks. During this

period, medical teams may monitor for infection and bleeding. Recovery becomes more likely as the bone marrow begins producing healthy blood cells again, but severe exposure can cause permanent organ damage or death.

Follow-up is tailored to the estimated dose and affected organs. It may include blood tests, skin checks, eye examinations, thyroid testing, fertility discussions, or monitoring for organ problems. Cancer screening usually follows established recommendations, with additional surveillance when a radiation specialist considers it appropriate.

Keep records about the exposure, dose estimates, test results, and treatments. These may be useful years later if a new health concern develops.

Many people with limited exposure return to their usual activities after monitoring or treatment. Others live with scarring, fatigue, pain, fertility problems, or concern about future illness. Counseling, rehabilitation, pain care, and practical workplace support may form part of recovery.

When to get medical help

Seek emergency help after a known or suspected major radiation incident, especially if you develop repeated vomiting, confusion, collapse, severe weakness, extensive skin redness, unexplained burns, or blistering. Tell the emergency dispatcher that radiation or radioactive material may be involved.

Do not handle or transport a suspected radioactive object. Move away from it and contact emergency services. During a large public incident, use official emergency channels rather than going outside to investigate.

If radioactive material may be on your clothing or skin, keep away from other people when practical and follow official decontamination instructions. Do not delay urgent care for serious injuries.

Arrange routine medical follow-up if you have persistent skin changes, patchy hair loss, an area that repeatedly blisters or opens, unusual bruising, or ongoing symptoms after a documented exposure. People previously treated with radiation should also report unexpected changes in the treated area to their treatment team.

Common questions

Can a radiation injury spread from person to person?

Radiation injury itself is not contagious. Someone exposed to radiation from an outside source does not normally expose other people afterward. Radioactive material on clothing, skin, or body fluids may be transferable until it is removed or contained.

Am I radioactive after an X-ray or CT scan?

No. Standard X-rays and CT scans pass radiation through the body but do not leave radioactive material behind. Some nuclear medicine tests use a radioactive tracer, which remains temporarily, but the amount and safety advice are managed by the medical team.

How much radiation causes radiation sickness?

There is no single simple answer. The effect depends on the total dose, how quickly it was received, the type of radiation, and how much of the body was exposed. Specialists use event information, dose measurements, symptoms, and blood tests to assess risk.

Does potassium iodide protect against all radiation?

No. Potassium iodide helps protect the thyroid from radioactive iodine. It does not protect the rest of the body, remove other radioactive materials, or treat damage from external radiation.

Will radiation exposure give me cancer?

Not necessarily. Some exposures increase the future chance of cancer, but many exposed people do not develop it. The size of the risk depends on the dose, the organs exposed, age at exposure, and other cancer risk factors.

Can radiation burns appear later?

Yes. Skin changes may be delayed and can worsen after seeming to improve. A suspected radiation skin injury needs continued assessment because damage beneath the surface may develop over days or weeks.

Sources

- Centers for Disease Control and Prevention: Acute Radiation Syndrome
- Centers for Disease Control and Prevention: Cutaneous Radiation Injury
- Centers for Disease Control and Prevention: About Health Effects of Radiation
- Radiation Emergency Medical Management: Diagnosis and Treatment Guidance
- US Food and Drug Administration: Radiation Emergency Medical Countermeasures
- World Health Organization: Ionizing Radiation and Health Effects