**Electromagnetic radiation** is ***indirectly ionizing*** (through short-lived hydroxyl radicals).

* hypoxic tumor cells are significantly less radiosensitive than aerated cells; H: **hypoxic cell sensitizers** (metronidazole, misonidazole - mimic oxygen and increase cell kill), **thymidine analogues** (iododeoxyuridine, bromodeoxyuridine - incorporated into DNA and render cells more susceptible to radiation damage; however, they are associated with considerable acute toxicity.)
* DNA damage is also dependent on phase of cell cycle; most radiation-sensitive phases are G2 and M; H: delivery of radiation in divided doses (*fractionation*) - allows surviving G1 and S phase cells to progress to more sensitive phases (*reassortment*).

**Particles** are ***directly ionizing*** (directly damage DNA) - independent of cellular oxygen levels!

* less dependent on the cell-cycle phase

Palliative radiotherapy

- in certain patients with metastatic disease:

1. symptomatic bony metastases.
2. spinal cord compression due to vertebral metastases.

Adjuvant radiotherapy

- to decrease local-regional recurrence rates.

Preoperative radiation

Advantages:

1. minimize tumor seeding during surgery
2. allows for smaller treatment fields (vs. operative bed contaminated with tumor cells).
3. may achieve adequate reduction to make tumor operable.

Disadvantages:

1. postoperative wound healing problems
2. difficulty in planning subsequent radiation therapy in patients who have positive surgical margins.

Postoperative radiation

* given 3-4 weeks after surgery to allow for wound healing.
* postlaparotomy adhesions *decrease mobility of small bowel loops* - risk for radiation injury in abdominal or pelvic irradiation.

Complications



| **Organ** | **Acute Changes** | **Chronic Changes** |
| --- | --- | --- |
| Nervous system | Cerebral edema | Necrosis, myelitis |
| Eye | Conjunctivitis | Cataract, keratitis, optic nerve atrophy |
| Lung | Pneumonitis | Pulmonary fibrosis |
| Heart | — | Pericarditis, vascular damage |
| Upper aerodigestive tract | Mucositis, xerostomia, anosmia | Xerostomia, dental caries |
| GI tract | Nausea, diarrhea, edema, ulceration, hepatitis | Stricture, ulceration, perforation, hematochezia |
| Kidney | — | Nephropathy, renal insufficiency |
| Bladder | Dysuria | Hematuria, ulceration, perforation |
| Gonads | Sterility | Atrophy, ovarian failure |
| Hematopoietic tissue | Lymphopenia, neutropenia, thrombocytopenia | Pancytopenia |
| Bone | Epiphyseal growth arrest | Necrosis |
| Skin | Erythema, wet or dry desquamation, epilation | Telangiectasia, subcutaneous fibrosis, ulceration |

**Effect of radiation on cervical carcinoma:**

|  |  |
| --- | --- |
| Before irradiation: | One week after high-dose irradiation - injury to tumour cells (note bloating of arrowed nuclei) and induced inflammatory reaction: |

**Skin erythema** (immediate reaction) due to therapeutic radiation:



**Lung fibrosis** due to therapeutic radiation - abrupt demarcation between solid scarred lung (*left*) and adjacent normally aerated lung (*right*) - due to sharp cut-off at edge of irradiated field:

