Core medical equipment - Information

Remote-afterloading brachytherapy system

Health problem addressed
These devices are most commonly used in conjunction with external-beam radiotherapy, surgery, or chemotherapy to treat endometrial, cervical, prostate, or pancreatic cancer; they are also the primary treatment for soft-tissue sarcomas, vaginal and rectal cancers, early-stage lip and tongue cancers, and endobronchial carcinomas.

Product description
These systems are typically radioisotope delivery units (i.e., afterload unit) with a source-drive mechanism (usually a computer-controlled stepper motor with drive rollers or belts), applicators, a control console, and a computerized planning unit.

Principles of operation
Remote afterloading brachytherapy systems automatically administer a radioisotope directly to cancerous tissue, thereby minimizing the radiation dose to surrounding tissue and eliminating the radiation exposure to hospital staff. The amount of the radiation dose varies with the brachytherapy method chosen for treatment delivery: low-dose-rate (LDR) brachytherapy uses an implanted source that delivers a dose of 40 to 60 centigrays (cGy) per hour over several days; high-dose-rate (HDR) brachytherapy uses a traveling (stepping) source that delivers a dose greater than 100 cGy per minute for 5 to 30 minutes; pulsed-dose-rate (PDR) brachytherapy uses a cable-driven source delivering a dose of up to about 300 cGy per hour for 10 to 30 minutes, repeated over several days.

Operating steps
After the treatment parameters have been tested, the source drive mechanism, usually a computer-controlled stepper motor with drive rollers or belts, advances the source from the shielded safe through the guide tubes and into the treatment applicators. The source guide tubes, also called transfer tubes, ensure accurate source placement in the applicators. The indexer, which typically provides 18 to 24 channels, facilitates source entry and transfer for complex treatments requiring multiple applicators.

Reported problems
Most of the problems associated with brachytherapy are side effects of radiation. Patients may develop localized irritation, soft-tissue ulcerations, osteonecrosis, small-bowel perforations, radiation mucositis, and abdominal fistulas from implanted radioactive sources. There have also been reports of dose miscalculations and improper handling of source wires and seeds by physicians, nurses, and medical physicists during brachytherapy treatment.

Use and maintenance
User(s): Radiation physicist; licensed dosimetrist (supervised by radiation physicist); radiation oncologist
Maintenance: Medical staff; technician; biomedical or clinical engineer
Training: Initial training by manufacturer and manuals

Environment of use
Settings of use: Hospital radiation oncology department
Requirements: Stable power source; shielding for treatment room and control room

Product specifications
Approx. dimensions (mm): 1330 x 540 x 790
Approx. weight (kg): 92
Consumables: NA
Price range (USD): 255,000 - 485,124
Typical product life time (years): 8 to 10
Shelf life (consumables): NA

Types and variations
High-dose-rate (HDR) brachytherapy; low-dose-rate (LDR) brachytherapy; pulsed-dose-rate (PDR) brachytherapy systems