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Each practice guideline and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Commission on Quality and Safety as well as the ACR Board of Chancellors, the ACR Council Steering Committee, and the ACR Council. The practice guidelines and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice guideline and technical standard by those entities not providing these services is not authorized.

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ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF HIGH-DOSE-RATE BRACHYTHERAPY

PREAMBLE

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the American College of Radiology cautions against the use of these guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations on available resources, or advances in knowledge or technology subsequent to publication of the guidelines. However, a practitioner who employs an approach substantially different from these guidelines is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and

complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to these guidelines will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

I. INTRODUCTION

Brachytherapy is the use of radioactive isotopes to treat malignancies or benign conditions by means of a radioactive source placed close to or into the tumor or treatment site. Brachytherapy alone or combined with external beam therapy plays an important role in the management and treatment of patients with cancer. Such treatment can be given as interstitial, intracavitary, or intraluminal therapy. High-dose-rate (HDR) brachytherapy uses highly active isotopes, including iridium-192 and cobalt-60, at dose rates of 20 or more cGy per minute at a designated point. HDR brachytherapy is indicated for treatment of malignancies where the treatment site can be well defined and is accessible to applicators to hold the sources. This guideline does not apply to intravascular brachytherapy.

The use of brachytherapy requires detailed attention to personnel, equipment, patient and personnel safety, and continuing staff education.

This guideline has been developed by the American College of Radiology to describe principles of practice for HDR brachytherapy in radiation oncology.

The licensing of radioactive sources and the safety of the general public and healthcare workers are regulated by the Nuclear Regulatory Commission (NRC) or by agreement states.¹ Medical use of isotopes for therapeutic procedures must adhere to the constraints set forth by these regulatory agencies. Detailed descriptions of NRC licensing and safety issues can be found in the Code of Federal Regulations, Part 20 and Part 35. State requirements for the agreement states are found in the respective state statutes and regulations.

II. PROCESS OF BRACHYTHERAPY

The use of HDR brachytherapy is a complex process involving trained personnel who must work in concert to carry out a variety of interrelated activities. Communication among brachytherapy team members and well-defined procedures are essential for accurate and safe treatment.

A. Clinical Evaluation

The initial evaluation of the patient includes history, physical examination, review of pertinent diagnostic studies and reports, and communication with the referring physician and other physicians involved in the patient's care. The extent of the tumor must be determined and recorded for staging; this will facilitate treatment decisions, determine the prognosis of the patient, and enable a comparison of treatment results.

B. Establishing Treatment Goals

The goal of treatment (curative, palliative, or to establish local tumor control) should be documented as clearly as possible. Treatment options and their relative merits and risks should be discussed with the patient. Integration of brachytherapy with external beam therapy should be defined. A summary of the evaluation should be communicated to the referring physician.

C. Informed Consent

Informed consent must be obtained and documented.

¹An agreement state is any state with which the U.S. Nuclear Regulatory Commission or the U.S. Atomic Energy Commission has entered into an effective agreement under Subsection 274.b of the Atomic Energy Act of 1954, as amended (73 Stat. 689).

D. Applicator Insertion

Oncologic practice, including brachytherapy, commonly requires the interaction of multiple specialists. The choice and placement of after-loading applicators and loading and unloading of radioactive sources are the responsibility of the radiation oncologist.

Each type of brachytherapy procedure has its own set of unique characteristics. The brachytherapy team should operate according to an established system of procedural steps that have been developed by the radiation oncologist and brachytherapy team members. This systematic approach to applicator or source insertion should include a description of preimplantation steps, sedation or anesthesia procedures, the specific applicators used, and the insertion techniques. Standard orders or care guidelines may enhance the systematic approach to the insertion process.

E. Treatment Planning

HDR brachytherapy is administered according to the written, signed, and dated prescription of the radiation oncologist. Before treatment, the final prescription must designate the treatment site, the isotope, the number of source positions, the planned dose, the dose per fraction, the number of fractions, and the time interval between HDR fractions. Applicator geometry and isotope dwell positions are defined with localization images or CT scans, as is the location of the normal dose-limiting structures, as delineated by urinary bladder catheter bulb, rectal marker/contrast, or retractor or vaginal packing. Computerized dosimetry is performed by the medical physicist or his/her designee and approved by the radiation oncologist before the treatment proceeds. Independent verification of brachytherapy parameters (by another person or another method) is done pretreatment (see Section V). Optimization techniques to shape the dose distribution are widely available but should be used carefully to avoid undetected hot and cold spots.

F. Treatment Delivery

Prior to each delivery session, the medical physicist or radiation oncologist should verify the proper connection of each applicator to the planned delivery channel. The medical physicist should verify all treatment parameters at the HDR console prior to treatment, including the correspondence between planned source strength and after-loader source strength with appropriate corrections for decay and source changes.

HDR treatment is delivered by remote after-loading of high-activity sources. Radiation safety considerations are essential for HDR procedures. The radiation oncologist and the medical physicist must be in the immediate vicinity at all times while HDR brachytherapy is being

administered, and the patient and functioning of equipment must be continuously monitored by video or audio means and/or direct observation. Treatment delivery must be subject to detailed scrutiny as described in the patient and personnel safety section (see Section V). At the end of each treatment, the patient and the room must be surveyed to ensure that the source has been retracted into the after-loading device.

G. Treatment Summary

At the conclusion of the course of treatment, a written summary of the treatment delivery parameters should be generated, including the total dose of brachytherapy and the total dose of external beam therapy if given, treatment technique, treatment volume, acute side effects, clinical course, and patient disposition.

H. Follow-up Evaluation

Patients treated with HDR brachytherapy should be evaluated at regular intervals by the radiation oncologist for response and early and late effects on normal tissues.

III. QUALIFICATIONS OF PERSONNEL

The HDR brachytherapy team includes the physician(s), medical physicist, dosimetrist, radiation therapist, nurse, and radiation safety officer. HDR brachytherapy requires extensive interaction between all members of the team. Because treatment is given with such a highly active source over a short duration, the consequences of error and possible misadministration are potentially increased with HDR brachytherapy. Communication among team members and well-defined procedures for performing HDR brachytherapy are essential for accurate and safe treatment. Qualifications of the brachytherapy team include the credentials listed below:

A. Radiation Oncologist

Satisfactory completion of an Accreditation Council for Graduate Medical Education (ACGME) approved residency program or an American Osteopathic Association (AOA) approved residency program in radiation oncology.

or

Certification in Radiology by the American Board of Radiology of a physician who confines his/her professional practice to radiation oncology. Alternatively, certification in Radiation Oncology or Therapeutic Radiology by the American Board of Radiology, the American Osteopathic Board of Radiology, the Royal College of Physicians and Surgeons of Canada, or Le College des Medecins du Quebec, may be considered proof of adequate physician qualifications.

B. Qualified Medical Physicist

A Qualified Medical Physicist is an individual who is competent to practice independently in one or more of the subfields in medical physics. The American College of Radiology considers that certification and continuing education in the appropriate subfield(s) demonstrate that an individual is competent to practice one or more of the subfields in medical physics, and to be a Qualified Medical Physicist. The ACR recommends that the individual be certified in the appropriate subfield(s) by the American Board of Radiology (ABR) or for MRI, by the American Board of Medical Physics (ABMP) in magnetic resonance imaging physics.

The appropriate subfields of medical physics for this guideline are Therapeutic Radiological Physics and Radiological Physics.

The continuing education of a Qualified Medical Physicist should be in accordance with the [ACR Practice Guideline for Continuing Medical Education \(CME\)](#). (2006 - ACR Resolution 16g)

C. Radiation Therapist

Must fulfill state licensing requirements and should have American Registry of Radiologic Technologists (ARRT) certification in radiation therapy.

D. Medical Dosimetrist

Certification by the Medical Dosimetrist Certification Board is recommended.

E. Nurse

State licensure as a registered nurse or practical nurse is recommended.

IV. EQUIPMENT

HDR brachytherapy treatment is delivered with computerized, remotely after-loaded devices that contain a specific radioactive source. Equipment manufacturers offer applicators for interstitial, intracavitary, and intraluminal treatment that are used with the treatment units. An applicator replacement schedule should be implemented to avoid damage caused by excessive use. Computerized treatment planning is accomplished with specialized hardware and software compatible with the respective HDR brachytherapy system being used.

Periodic scheduled preventive maintenance is essential. The medical physicist supervising the quality improvement program is responsible for documenting the maintenance and repair of manual equipment, remote

after-loading units, and applicators. (See the [ACR Technical Standard for the Performance of Brachytherapy Physics: Remotely Loaded HDR Sources](#).)

V. PATIENT AND PERSONNEL SAFETY

Patient protection measures include those related to medical safety and radiation protection.

A. Patient protection measures should include:

1. A radiation exposure-monitoring program, as required by the NRC or appropriate state agencies.
2. Annual training of staff in emergency procedures in case of equipment malfunction.
3. Charting systems for prescription, definition and delivery of treatment parameters, and recording and summation of HDR brachytherapy and external beam therapy treatment.
4. A physics program for ensuring accurate dose delivery to the patient.
5. A system for the radiation oncologist and medical physicist to verify independently (by another person or another method) all brachytherapy parameters to be used in each procedure (source, isotope and activity, dose rate, total dose, treatment duration, etc.) prior to institution of HDR brachytherapy.

B. Personnel safety measures should include:

1. A radiation exposure-monitoring program, as required by the NRC or appropriate state agencies.
2. Routine leak testing of all sealed sources, as required by regulatory agencies.
3. Appropriate safety equipment for use of sealed sources.

VI. EDUCATIONAL PROGRAM

Continuing medical education programs should include radiation oncologists, medical physicists, dosimetrists, nurses, and radiation therapy staff. Radiation safety programs should also include hospital-based personnel who will be involved with brachytherapy patients. Educational programs initially and for retraining must cover the following:

A. The safe operation, including emergency procedures, of HDR applicators and HDR remote after-loading equipment and sources as appropriate to the individual's responsibilities.

B. Treatment techniques and new developments in radiation oncology and brachytherapy.

The program should be in accordance with the [ACR Practice Guideline for Continuing Medical Education \(CME\)](#).

VII. DOCUMENTATION

Reporting should be in accordance with the [ACR Practice Guideline for Communication: Radiation Oncology](#).

VIII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION CONCERNS

The Medical Director of Radiation Oncology is responsible for the institution and ongoing supervision of continuing quality improvement (CQI) as described in the [ACR Practice Guideline for Radiation Oncology](#). It is the responsibility of the director to identify problems, see that actions are taken, and evaluate the effectiveness of the actions. The director will designate appropriate personnel to constitute the CQI Committee that will review HDR brachytherapy as part of the CQI meeting agenda. Refer to the [ACR Practice Guideline for Radiation Oncology](#) for a detailed description of CQI Committee functions.

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control Improvement, Safety, Infection Control, and Patient Education Concerns appearing elsewhere in the ACR Practice Guidelines and Technical Standards book.

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REFERENCES/LITERATURE REVIEW

1. Astrahan MA, Jozsef G, Streeter OE Jr. Optimization of mammosite therapy. *Int J Radiation Oncology Biol Phys* 2004;58:220-232.
2. Chadha M. Gynecologic brachytherapy-II: intravaginal brachytherapy for carcinoma of the endometrium. *Seminars in Radiation Oncology* 2002;12:53-61.
3. Crownover RL, Wilkinson DA, Weinhaus MS. The radiobiology and physics of brachytherapy. *Hematol Oncol Clin North Am* 1999;13:477-487.
4. Erickson B, Nag S. Extrahepatic bile duct and liver cancer. In: *Principles and Practice of Brachytherapy*. Nag S, ed., Armonk, NY: Futura Publishing Co; 1997.
5. Gaspar LE, Nag S, Herskovic A, et al. American Brachytherapy Society (ABS) consensus guidelines for brachytherapy of esophageal cancer. *Int J Radiation Oncology Biol Phys* 1997;38:127-132.
6. Hu KS, Enker WE, Harrison LB. High-dose-rate intraoperative irradiation: current status and future directions. *Seminars in Radiation Oncology* 2002;12:62-80.
7. Keisch M, Vicini F, Kuske RR, et al. Initial clinical experience with the mammosite breast brachytherapy applicator in women with early-stage breast cancer treated with breast-conserving therapy. *Int J Radiation Oncology Biol Phys* 2003;55:289-293.
8. Kelly JF, Delclos ME, Morice RC, et al. High-dose-rate endobronchial brachytherapy effectively palliates symptoms due to airway tumors: the 10-year MD Anderson Cancer Center experience. *Int J Radiation Oncology Biol Phys* 2000;48:697-702.
9. Kubo HD, Glasgow GP, Pethel TD, et al. High-dose-rate brachytherapy treatment delivery: report of the AAPM Radiation Therapy Committee Task Group No. 59. *Med Phys* 1998;25:375-403.
10. Kuehne J, Kleisli T, Biernacki P, et al. Use of high-dose-rate brachytherapy in the management of locally recurrent rectal cancer. *Dis Colon and Rectum* 2003;46:895-899.
11. Lorvidhaya V, Tonusin A, Changwiwit W, et al. High-dose-rate afterloading brachytherapy in carcinoma of the cervix: an experience of 1992 patients. *Int J Radiation Oncology Biol Phys* 2000;46:1185-1191.
12. Mazon JJ, Noel G, Simon JM. Head and neck brachytherapy. *Seminars in Radiation Oncology* 2002;12:95-108.
13. Nag S, Erickson B, Thomadsen B, et al. The American Brachytherapy Society recommendations for high-dose-rate brachytherapy for carcinoma of the cervix. *Int J Radiation Oncology Biol Phys* 2000;48:201-211.
14. Nag S, Kuske RR, Vicini FA, et al. Brachytherapy in the treatment of breast cancer. *Oncology (Huntingt)* 2001;15:195-202.
15. Nath R, Anderson LL, Meli JA, et al. Code of practice for brachytherapy physics: report of the AAPM Radiation Therapy Committee Task Group No. 56. American Association of Physicists in Medicine. *Med Phys* 1997;24:1557-1598.
16. Petereit DG, Pearcey R. Literature analysis of high-dose-rate brachytherapy fractionation schedules in the treatment of cervical cancer: is there an optimal fractionation schedule? *Int J Radiation Oncology Biol Phys* 1999;43:359-366.
17. Quon H, Harrison LB. Brachytherapy in the treatment of head and neck cancer. *Oncology* 2002;16:1379-1393.
18. Vicini FA, Kini VR, Edmundson G, et al. A comprehensive review of prostate cancer brachytherapy: defining an optimal technique. *Int J Radiation Oncology Biol Phys* 1999;44:483-491.
19. Vicini F, Vargas C, Gustafson G, et al. High-dose-rate brachytherapy in the treatment of prostate cancer. *World J Urology* 2003;21:220-228.