ACR–ABS–ARS PRACTICE PARAMETER FOR THE PERFORMANCE OF RADIONUCLIDE-BASED HIGH-DOSE-RATE BRACHYTHERAPY

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Each practice parameter 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 and approval. The practice parameters 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 parameter and technical standard by those entities not providing these services is not authorized.

PREAMBLE

Radiologists, medical physicists, non-physician radiology providers**,** radiologic technologists, and all supervising physicians have a responsibility for safety in the workplace by keeping radiation exposure to staff, and to society as a whole, "as low as reasonably achievable" (ALARA) and to assure that radiation doses to individual patients are appropriate, taking into account the possible risk from radiation exposure and the diagnostic image quality necessary to achieve the clinical objective. All personnel who work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection, application of dose constraints and limits) and the principles of proper management of radiation dose to patients (justification, optimization including the use of dose reference levels). https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1775_web.pdf

Facilities and their responsible staff should consult with the radiation safety officer to ensure that there are policies and procedures for the safe handling and administration of radiopharmaceuticals in accordance with ALARA principles. These policies and procedures must comply with all applicable radiation safety regulations and conditions of licensure imposed by the Nuclear Regulatory Commission (NRC) and by applicable state, local, or other relevant regulatory agencies and accrediting bodies, as appropriate. Quantities of radiopharmaceuticals should be tailored to the individual patient by prescription or protocol, using body habitus or other customized method when such guidance is available.

Nationally developed guidelines, such as the ACR's Appropriateness Criteria®, should be used to help choose the most appropriate imaging procedures to prevent unnecessary radiation exposure.

Additional information regarding patient radiation safety in imaging is available from the following websites – Image Gently® for children (www.imagegently.org) and Image Wisely® for adults (www.imagewisely.org). These advocacy and awareness campaigns provide free educational materials for all stakeholders involved in imaging (patients, technologists, referring providers, medical physicists, and radiologists).

Radiation exposures or other dose indices should be periodically measured by a Qualified Medical Physicist in accordance with the applicable ACR Technical Standards. Monitoring or regular review of dose indices from patient imaging should be performed by comparing the facility's dose information with national benchmarks, such as the ACR Dose Index Registry and relevant publications relying on its data, applicable ACR Practice Parameters, NCRP Report No. 172, Reference Levels and Achievable Doses in Medical and Dental Imaging: Recommendations for the United States or the Conference of Radiation Control Program Director's National Evaluation of X-ray Trends; 2006, 2009, amended 2013, revised 2023 (Res. 2d).

I. INTRODUCTION

This practice parameter was revised collaboratively by the American College of Radiology (ACR), the American Brachytherapy Society (ABS), and the American Radium Society (ARS).

Brachytherapy is a radiotherapeutic method in which radionuclide or electronic sources are used to deliver a radiation dose to a treatment site (target) up to a few centimeters from the source by surface, intracavitary, intraluminal, or interstitial application. This practice parameter refers only to the use of radionuclides for brachytherapy. Brachytherapy alone or combined with external-beam radiotherapy plays an important role in the management and treatment of patients with cancer [1]. High-dose-rate (HDR) brachytherapy uses

radionuclides such as iridium-192 at dose rates of 20 cGy/min (12 Gy/hr) or more to a designated target point or volume. HDR brachytherapy is indicated for treating invasive tumors where the treatment volume or targeted points are defined and accessible.

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

The licensing of radioactive sources (radionuclides) and the safety of the general public and health care workers are regulated by the Nuclear Regulatory Commission (NRC) or by agreement states[1]. Medical use of radionuclides 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.

A literature search was performed and reviewed to identify published articles regarding practice parameters and technical standards in HDR brachytherapy.

[1] An agreement state is any state with which the US Nuclear Regulatory Commission or the US 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).

II. PROCESS OF BRACHYTHERAPY

The use of HDR brachytherapy is a complex multistep 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. See the ACR–ARS Practice Parameter for Communication: Radiation Oncology[2].

A. Clinical Evaluation

The initial evaluation of the patient includes history, physical examination, review of ongoing diagnostic studies and reports, and communication with the referring physician and other physicians involved in the patient's care. The extent of the disease must be determined and recorded for staging. Staging facilitates treatment decisions, determines the prognosis of the patient, and enables a comparison of treatment results. When applicable, studies are performed to assess treatment response. The brachytherapy treatment target and organs at risk should be identified and documented as part of the clinical evaluation. See the ACR–ARS Practice Parameter for Radiation Oncology [3]and the ACR–ARS Practice Parameter for Communication: Radiation Oncology [2].

B. Establishing Treatment Goals

The goals of radiotherapy should be clearly documented. Treatment options and their relative benefits and risks should be discussed with the patient. The role of integrating other therapies, such as external-beam therapy, chemotherapy, immunotherapies, or hormonal manipulation, with brachytherapy must be consulted and discussed when defining the course of treatment. A summary of the evaluation should be communicated to the referring physician and other physicians involved in the patients's care.

C. Informed Consent

Informed consent must be obtained and documented. See the ACR-ARS Practice Parameter on Informed Consent – ??Radiation Oncology [4].

D. Applicator Placement

Oncologic practice, including brachytherapy, may require the interaction of multiple specialists. The choice and placement of afterloading applicators, treatment planning, and treatment delivery are the responsibility of the radiation oncologist who is a licensed authorized user of radionuclides for medical purposes[5].

Each type of brachytherapy procedure has unique characteristics. The brachytherapy team should operate according to an established procedural system that has been developed by the radiation oncologist and brachytherapy team members. This systematic approach to applicator insertion and source afterloading should include a description of preimplantation procedures, sedation or anesthesia needs, applicator option, and insertion techniques. Standard orders or care guidelines may enhance the systematic approach to the brachytherapy process. The physician should be responsible for applicator removal, including supervision or oversight of applicator removal if done by a trained member of the brachytherapy team.

E. Image Acquisition

In most applications, images of the implanted regions should be obtained. Imaging should be standardly performed for treatment planning and/ or to verify intended applicator position for intracavitary, interstitial, intraluminal, and complex surface brachytherapy. In certain instances (ie, simple surface brachytherapy), clinical assessments without radiographic images may suffice for verification of applicator position, and clinical photography is encouraged in such situations. Images may be either 2-D (radiography - based) or 3-D (ultrasound, computed tomography, or magnetic resonance imaging based). The authorized user should select the optimal imaging protocols for treatment planning. These protocols acquire optimal images of the implant applicator, the treatment target, and the surrounding normal tissues. It is desirable to have 3-D spatial information so that the relationship of the target and surrounding critical organs can be visualized. The dose applied to the target and to the normal critical structures can then be determined and optimized. For instance, to help mitigate localization uncertainties, CT or MRI slice thicknesses on the order of 1 to 2 mm should be considered. Optimization of the diagnostic and functional imaging protocols in collaboration with diagnostic radiologists, nuclear medicine physicians, and imaging physicists is critical.

F. Treatment Planning

As the authorized user, the radiation oncologist must provide a signed and dated written directive (WD) to the planner (ie, Qualified Medical Physicist, certified medical dosimetrist), as described in the regulations applicable to your state. The WD should include at least the treatment site, the radionuclide used, the dose per fraction, the total number of fractions, the planned total dose, and the dose specification (ie, target volume, point, distance from lumen, or surface of applicator) as per NRC 10 CFR 35.40[6]. Based on anatomical targets/organs at risk (OARs) as well as dose specifications, the treatment planner creates a treatment plan. Computer-planning techniques to shape the dose distribution are widely available and should be used correctly to properly optimize the dosimetry in all visualized planes. Verification of the resultant plan's dosimetric calculations must be performed using a secondary dose calculation prior to treatment delivery (see Section V). Once the radiation oncologist has reviewed and approved the plan and final adjustment to the WD (prescription) parameters has been made, the plan must be saved and locked using a unique user identification and password combination to prevent any unintended changes.

G. Treatment Delivery

Time-out: Verification of patient identity is required prior to treatment delivery. A time-out should be performed and documented in the medical record prior to treatment delivery. At a minimum, the time-out should include patient identity, treatment site, laterality if applicable, dose per fraction, and fraction number of the total course.

Prior to each treatment, the radiation oncologist, Qualified Medical Physicist, or the radiation therapist should verify and document that the HDR afterloader transfer tubes are appropriately connected to each applicator channel. The patient and the room must be surveyed with pre-treatment survey results documented in the patient records. The Qualified Medical Physicist should verify and document all treatment parameters at the HDR treatment console prior to source delivery, including the correspondence between planned source strength and afterloader source strength with appropriate corrections for source decay. In a multi-fraction treatment regimen using indwelling needles or catheters, where interfraction movement is possible, it is important to verify that the applicator is stable with regards to the target and OARs before delivery of subsequent fractions. In any single-fraction treatment it is also important to verify applicator positioning prior to treatment. Verification of applicator position can be performed by visualizing the applicator relative to the patient and/or with 2-D or 3-D imaging.

Radiation safety measures are mandatory for HDR procedures to ensure exposure is confined to the patient and that the source is properly delivered and returned to the radiation safe location within the afterloader. The radiation oncologist and the Qualified Medical Physicist must be in the immediate vicinity at all times while HDR brachytherapy is being administered. The patient must be continuously monitored by video and/or audio means during treatment, and the proper functioning of equipment must be supervised by the qualified personnel. Treatment delivery must be documented for each fraction and subject to detailed examination as described in the patient and personnel safety section (see Section VI). At the end of each treatment, the patient and the room must be surveyed to confirm the source has been safely retracted into the afterloading device. The radiation survey results should be recorded and maintained per regulatory requirements.

H. Treatment Summary
At the conclusion of the course of treatment, a written treatment summary that includes a description of the brachytherapy technique/applicator(s), dose per fraction, number of fractions, total brachytherapy dose, cumulative dose to the target and OAR, and dose specification and total dose of external-beam radiotherapy, if given, should be generated. There should also be a brief outline of the clinical course, acute toxicities or procedure complications, if any, and a plan for patient follow-up care. See the ACR–ARS Practice Parameter for Communication: Radiation Oncology [2].

I. Follow-up Evaluation
Patients treated with HDR brachytherapy should be evaluated at regular intervals for disease status, procedure-related side effects, and radiation complications. Information about the patient's clinical status should be communicated to the primary, referring, and other appropriate physician(s).

J. Emergency Procedures
Emergency procedures that outline the actions taken by the radiation oncologist, Qualified Medical Physicist, radiation safety officer, and any additional members of the treatment team in the event a radioactive source does not retract, as planned, from the patient at the end of HDR delivery must be defined. Emergency procedures should be reviewed and documented with each member of the brachytherapy team at least annually.

III. QUALIFICATIONS OF PERSONNEL

The HDR brachytherapy team includes the radiation oncologist , Qualified Medical Physicist, dosimetrist, radiation therapist, and/or nurse. An individual serving in the role of radiation safety officer should provide an independent regulatory oversight. HDR brachytherapy requires close coordination between all members of the team as radiation is given in relatively large doses per fraction in a short period of time. Errors in treatment leading to radiation misadministration can happen quickly with serious consequences. Communication among team members and well-defined procedures for performing HDR brachytherapy are thus essential for accurate and safe treatment. Qualifications of the brachytherapy team include the credentials listed below.

A. Radiation Oncologist who also meets the requirements of the Authorized User[5]
Certification in Radiology 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 (RCPSC), or the Collège des Médecins du Québec, or certification in Radiology by the American Board of Radiology of a physician who confines his/her professional practice to radiation oncology.
or
Satisfactory completion of a residency program in radiation oncology approved by the Accreditation Council for Graduate Medical Education (ACGME), the RCPSC, the Collège des Médecins du Québec, or the American Osteopathic Association (AOA).

B. Qualified Medical Physicist
For the qualifications of the Qualified Medical Physicist, see the ACR–AAPM Technical Standard for the Performance of High-Dose-Rate Brachytherapy Physics [7].

C. Medical Dosimetrist
Board certification by the Medical Dosimetrist Certification Board is highly recommended.

D. Radiation Therapist
The radiation therapist must fulfill state licensing requirements and should have American Registry of Radiologic Technologists (ARRT) certification in radiation therapy.

E. Nurse
The nurse must fulfill state licensing requirements.

Continuing Education Program

Continuing medical education (CME) programs should include radiation oncologists, Qualified Medical Physicists, dosimetrists, radiation therapists, nurses, and radiotherapy staff. Radiation safety programs should also include hospital-based personnel who will be involved with brachytherapy patients. Educational programs used for both initial training and retraining must cover the following:

- The safe operation, including emergency procedures, of HDR applicators and HDR remote afterloading equipment and sources as appropriate to the individual's responsibilities.
- Treatment techniques and new developments in radiation oncology and brachytherapy
- The program should be in accordance with the ACR Practice Parameter for Continuing Medical Education (CME) [-3197622]

The Medical Director of Radiation Oncology is responsible for the institution and ongoing supervision of continuing quality improvement (CQI) as described in the ACR–ARS Practice Parameter for Radiation Oncology[-3197883]. It is the responsibility of the Director to identify problems, ensure 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–ARS Practice Parameter for Radiation Oncology[-3197883] for a detailed description of CQI Committee functions.

IV. PATIENT SELECTION CRITERIA

A. Cervical Cancer
Brachytherapy is an essential modality in the definitive treatment of cervical cancer as there is improved survival compared with advanced techniques of external-beam radiotherapy [8, 9]. Brachytherapy is given in conjunction with external-beam radiotherapy with or without concurrent for chemotherapy locally advanced cervical cancer. Omission of chemotherapy can be considered for patients with early-stage disease in whom radical hysterectomy is medically contraindicated. International randomized trials and meta analyzes have concluded that HDR brachytherapy is equivalent to low-dose-rate (LDR) brachytherapy for local control, survival, and toxicity. Treatment planning is an integral part of cervical cancer brachytherapy because of the need for high curative doses to the cervix and paracervical tumor and the close proximity of the normal pelvic organs. 3-D image-based brachytherapy should be performed with the applicator in place, preferably with incorporation of MRI given the superior soft-tissue delineation of the clinical target volume [10]. MRI may be performed at a time prior to applicator placement with incorporation of findings into a CT-based treatment plan, or, more ideally, MRI may be performed with the applicator in place. A high-risk clinical target volume (HR-CTV) is commonly generated for dose specification, which consists of residual gross disease, cervix, and regions of regressed disease with intermediate signal on T2-weighted MRI (gray zones) [11]. If MRI cannot be performed proximate to the time of implant, then 3-D imaging with CT or ultrasound should be utilized to delineate the target volume.

Cervical brachytherapy is most commonly delivered with intracavitary applicators with or without interstitial needles. For more advanced disease, brachytherapy may also be delivered with a perineal template or free-hand technique with interstitial needles and an intrauterine tandem. Intracavity or interstitial brachytherapy is used postoperatively in some patients following hysterectomy [11-24].

B. Endometrial Cancer

Vaginal brachytherapy, with or without external-beam radiotherapy, is frequently used following surgical staging in the treatment of patients with early endometrial carcinoma. Vaginal brachytherapy is an effective means of reducing the risk of a vaginal recurrence with a low risk of morbidity. Brachytherapy is also used for patients with recurrent endometrial carcinoma and, in this setting, application may be intracavitary or interstitial based on tumor thickness and depth of invasion. Brachytherapy is routinely used following external-beam radiotherapy in previously unirradiated patients with recurrent disease. Definitive radiotherapy with brachytherapy with or without external-beam radiotherapy may be considered for patients with medically inoperable endometrial carcinoma [13, 15-21].

C. Vaginal Cancer

Brachytherapy is used alone or in combination with external-beam radiotherapy with or without chemotherapy concurrent in the curative treatment of cancers of the vagina. Depending on the extent of initial disease and residual disease following external-beam radiotherapy, brachytherapy may be either intracavitary or interstitial [12, 14].

D. Bile Duct

Postoperative radiotherapy may be helpful in patients with positive margins or positive nodes. Intraluminal or interstitial brachytherapy can be used as a boost following external-beam radiotherapy to areas of close or positive margin. External-beam radiotherapy plus brachytherapy can be effective palliation for patients with unresectable disease. There is evidence that radiotherapy can provide long-term local control and that dose escalation with brachytherapy may be important to yield improved outcomes. Intraluminal brachytherapy alone can be used to palliate biliary obstruction along with percutaneous drainage [25-27].

E. Esophagus

HDR intraluminal brachytherapy has been used in the treatment of esophageal cancer, both for palliation and as a component of a definitive regimen [28]. In the definitive setting, HDR brachytherapy has most commonly been used in combination with external-beam radiotherapy, though brachytherapy alone may be adequate in the subset of cancers confined to the mucosal layer of the esophagus [29-31]. The improvement in local control with the addition of HDR brachytherapy must be balanced against the risk for treatment-related morbidity in each individual case.

F. Lung/Bronchus/Trachea

HDR brachytherapy has been used to treat malignancies involving the central lung, bronchus, and trachea. In definitive cases, it can be used alone or in conjunction with external-beam radiotherapy [32-35]. HDR brachytherapy also has a well-established role in the palliation of primary and recurrent endobronchial lesions [36].

G. Prostate

HDR or LDR brachytherapy may be used as monotherapy or as a boost in combination with external-beam radiotherapy for the treatment of prostate cancer. It may be used as monotherapy for select low-risk and select patients with intermediate-risk disease [37-48] (ie, favorable intermediate-risk and select unfavorable intermediate-risk) and as a boost in combination with external-beam radiotherapy for unfavorable intermediate-risk or high-risk disease. In addition, HDR brachytherapy may be used to salvage local recurrence of disease after prior definitive radiotherapy [49-54]. There is a separate ACR–ABS Practice Parameter for Transperineal Permanent Brachytherapy of Prostate Cancer [55].

H. Breast

HDR brachytherapy can be used as a boost to the tumor bed after conventional external-beam

radiotherapy, and it can also be used for delivering accelerated partial breast irradiation (APBI) as the sole postoperative radiation treatment [56-60]. APBI is used for select patients with early breast cancer or in situ disease or recurrent disease. This approach treats a limited volume of breast tissue around the lumpectomy site over a short duration of time. Applicator insertion techniques include multicatheter interstitial tubes stabilized with buttons and various single-entry intracavitary devices (balloon catheters and other multichannel devices). Additionally, HDR brachytherapy can be noninvasively targeted to the lumpectomy bed by utilizing superficially placed applicators positioned with mammographic image guidance [61-65] . The role of radionuclide-based intraoperative therapy in treating early-stage disease remains an option in select circumstances [66] . In this approach, radiotherapy is administered to the tumor bed at the time of the lumpectomy procedure. Further information related to patient selection and indications is available from ASTRO and ACR documents [67, 68].

I. Head and Neck

LDR brachytherapy has long played an important role in the treatment of head and neck malignancies. The same operative techniques may be used for HDR brachytherapy [69-80]. Tumors in the head and neck affect important anatomical structures; therefore, careful attention to the preservation of normal tissue structure and function is needed. Multi-fraction regimens that avoid large doses per fraction have been recommended[81]. Computer-based dose optimization, advances in radiation safety, and improved nursing care are important reasons why LDR brachytherapy is being supplanted by HDR brachytherapy, especially in head and neck brachytherapy where nursing care is so important to patient comfort and quality outcomes [40, 82-87]. Interstitial, intracavitary, surface applications, and intraoperative techniques are applicable techniques. Head and neck brachytherapy may be applied as a boost treatment in combination with external-beam radiotherapy as definitive therapy or as monotherapy in the postoperative setting in the event of close or positive margins. It may be used in any sites in the head and neck as primary curative treatment, as salvage therapy, or for reirradiation [88].

J. Soft-Tissue Sarcoma

HDR brachytherapy has a role in the treatment of soft-tissue sarcoma, typically as part of a multidisciplinary management plan with surgery as the primary intervention. It can be a part of definitive therapy [89-97], postoperative adjuvant therapy [98-100], intraoperative radiotherapy [90, 101-103], and palliative treatment.

K. Pediatric Tumors

HDR brachytherapy can be useful in managing pediatric tumors. There are potential long-term consequences of irradiation in the pediatric patient, which should be a primary consideration in treatment planning along with local disease control. With its advantageous dose distribution, there are major advantages to HDR brachytherapy for avoiding irradiation to normal tissue and growth centers in the pediatric population .

L. Skin

Although skin cancer can be treated using a variety of radiotherapy techniques, HDR brachytherapy offers unique dosimetric properties that may be useful for treating skin cancer over irregularly shaped and difficult-to-access skin surfaces [104-108]. Both interstitial and plesiotherapy (surface applicators) techniques can be used and allow for safe hypofractionation of the treatment course. HDR brachytherapy can also be used in combination with surgery for keloids [109-111].

M. Intraoperative Brachytherapy

HDR brachytherapy catheters and/or other devices can be inserted at the time of open or laparoscopic surgery. Such devices can be left in place for postoperative simulation dosimetry and fractionated treatment delivery in a brachytherapy suite or shielded room. The advantages of the fractionated approach are time allocation for wound healing, obtaining simulation imaging, achieving good dosimetry, and the dose fractionation for normal tissue tolerance. Alternatively, in a shielded operating room , applicators can be inserted after maximum tumor resection, and a single HDR fraction can be given to the surgical margin while the tumor bed is accessible and normal tissues can be displaced or shielded from the site of

treatment. Special intraoperative applicators have been developed that conform to various tumor bed configurations. These techniques may be used in a variety of tumor types and body sites [112, 113].

N. Anorectal

Interstitial, intraluminal, or intraoperative HDR brachytherapy may be used in the treatment of anal and rectal cancers. This modality can be part of a preoperative approach for resectable or locally advanced rectal cancers[114, 115] or for unresectable, inoperable, and recurrent disease. For anorectal cancers, HDR brachytherapy can be used as a boost after external-beam radiotherapy [116] or as definitive treatment in selected cases. Both interstitial and intracavitary techniques have been used.

O. Other Indications

The list of indications above is not comprehensive or exclusive. Brachytherapy can be applied and radiation accurately delivered to any site where there is localized disease. The indication may be curative or palliative. The individual radiation oncologist may find HDR brachytherapy beneficial in a variety of other tumor types and specific clinical situations (eg, penis, bladder, urethra, vulva, central nervous system, ocular).

V. EQUIPMENT

HDR brachytherapy treatment is delivered with computerized robotic devices (remote afterloading devices) for reasons of radiation safety and precision of treatment delivery. They consist of a small radiation source of high specific activity attached to the end of a fine cable, a radiation-safe container, a motor drive, and sophisticated computer equipment for reliable execution of complex radiation treatment plans (ie, instructions for where and how long the radiation source should be deployed). Equipment manufacturers offer a wide range of applicators for interstitial, intracavitary, intraluminal, and surface brachytherapy. The radiation source must be changed routinely (usually every few months depending on the radionuclide used) to account for radioactive decay, and a maintenance contract is essential to ensure the equipment functions safely and correctly. A schedule of updating and replacing the applicators and transfer tubes should be implemented to address issues of wear and aging equipment. Computerized treatment planning is accomplished with specialized hardware and highly technical software compatible with the respective HDR brachytherapy system being used.

Periodic scheduled preventive maintenance is essential. The Qualified Medical Physicist supervising the quality improvement program is responsible for documenting the maintenance and repair of remote afterloading units, applicators, transfer tubes, and other equipment (see the ACR–AAPM Technical Standard for the Performance of High-Dose-Rate Brachytherapy Physics)[7].

VI. PATIENT AND PERSONNEL SAFETY

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

A. Patient protection measures should include the following:

1. A radiation exposure monitoring program as required by the NRC or appropriate state agencies
2. Annual (re)training of staff in emergency procedures in case of equipment malfunction and in brachytherapy-specific quality management procedures
3. Charting systems for dose specification, definition, and delivery of treatment parameters and recording and summary of HDR brachytherapy and external-beam radiotherapy treatment
4. A physics quality assurance program for ensuring accurate dose delivery to the patient
5. A system for the radiation oncologist and Qualified Medical Physicist to verify independently (by another person or another method) all brachytherapy parameters to be used in each procedure (source model, radionuclide source strength activity , total dose, treatment duration, etc.) prior to HDR brachytherapy treatment delivery
6. Routine leak testing of all sealed sources as required by regulatory agencies
7. Use of a hand-held radiation survey meter when initially entering the room before and after a source run

B. Personnel concern measures should include the following:

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. Use of a hand-held radiation survey meter when initially entering the room before and after a source run
4. Appropriate safety equipment for use of sealed sources

VII. DOCUMENTATION

Reporting should be in accordance with the ACR–ARS Practice Parameter for Communication: Radiation Oncology [2].

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

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 appearing under the heading *ACR Position Statement on Quality Control and Improvement, Safety, Infection Control and Patient Education* on the ACR website (https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Quality-Control-and-Improvement).

IX. SUMMARY

HDR brachytherapy is an important modality in the treatment of a variety of different malignancies. Its use allows for application of high doses of radiation to defined target volumes and allows relative sparing of adjacent critical structures. Coordination between the radiation oncologist and treatment planning staff and effective quality assurance procedures are important components of successful HDR brachytherapy programs.

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*Practice parameters and technical standards that are collaborative with only radiation oncology societies (ACR Resolution 8, 2010) or are collaborative with the American Association of Physics in Medicine (ACR Resolution 54, 2015) are approved by the ACR Council Steering Committee (CSC) and the ACR Board of Chancellors (BOC) and will not go through the ACR Council. The effective date for these CSC/BOC documents is the first day of the month following a 60-day period that begins on the date the document was approved.

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