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Guideline 21-4

A Quality Initiative of the Program in Evidence-Based Care (PEBC), Cancer Care Ontario (CCO)

Organizational Guideline for the Delivery of Stereotactic Radiosurgery for Brain Metastasis in Ontario

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An assessment conducted in March 2024 indicated that Guideline 21-4 REQUIRES UPDATING. It is still appropriate for this document to be available while this updating process unfolds. The PEBC has a formal and standardized process to ensure the currency of each document (PEBC Assessment & Review Protocol)

Guideline 21-4 is comprised of 5 sections. You can access the summary and full report here:
https://www.cancercareontario.ca/en/guidelines-advice/types-of-cancer/60751

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Organizational Guideline for the Delivery of Stereotactic Radiosurgery for Brain Metastasis in Ontario

Section 1: Recommendations

This section is a quick reference guide and provides the guideline recommendations only. For key evidence associated with each recommendation, the systematic review, and the guideline development process, see the Full Report.

GUIDELINE OBJECTIVES

To provide the optimal organizational guidelines for facilities performing stereotactic radiosurgery (SRS) on patients with brain metastasis in Ontario.

TARGET POPULATION

Adult patients with brain metastasis eligible for SRS at centres in Ontario.

INTENDED USERS

This guideline is targeted for:

1. Clinicians involved in the organization and delivery of care for patients with brain metastases who are eligible to receive SRS in Ontario.
2. Administrators involved in the organization and delivery of care for patients with brain metastases who are eligible to receive SRS in Ontario.

RECOMMENDATIONS, KEY EVIDENCE, AND INTERPRETATION OF EVIDENCE

Recommendation 1: Practice Team
The following members should be part of the multidisciplinary case conference (MCC) evaluating patient eligibility and performing SRS for patients with brain metastasis in Ontario • Radiation oncologist • Neurosurgeon • Medical physicist • Radiation therapist • Medical dosimetrist • Neuroradiologist
Qualifying Statements for Recommendation 1
• It is possible that one individual could fulfill both the responsibilities of the radiation therapist and medical dosimetrist, if the appropriate qualifications are obtained. • The clinical and imaging details of each SRS case must be discussed in an MCC. The MCC should be comprised ideally of a radiation oncologist, neurosurgeon, medical physicist, radiation therapist/medical dosimetrist, and a neuroradiologist. At a minimum, the radiation oncologist, neuroradiologist and, if available, a neurosurgeon and neuro-oncologist should be involved when discussing possible radiation necrosis versus tumour progression. • The members of the MCC listed above are in addition to the nurses and administrative staff who provide general support for all patients in the radiation oncology department

Recommendation 2: Qualifications and Responsibilities of the Multidisciplinary Team Members

The following are recommendations for the qualifications of the practitioners of the MCC and their associated responsibilities.

Radiation Oncologist

- Qualifications:
  - The radiation oncologist is accredited by a nationally or internationally recognized program or licensing board
  - Participation in a dedicated fellowship or course that provides technology-specific training is strongly recommended
  - Mentoring or training in a supervised setting within an SRS program is strongly recommended
- Responsibilities include:
  - Team leader, responsible for the selection of members of the SRS team
  - Oversee treatment of patient and sign off on treatment plan
  - Verification of target volume and normal tissues
  - Selection of patient positioning and immobilization
  - Participate in the monitoring and follow-up of patients post-SRS

Neurosurgeon

- Qualifications:
  - The neurosurgeon is accredited by a nationally or internationally recognized program or licensing board
  - Participation in a dedicated fellowship or course that provides technology-specific training is strongly recommended
  - Mentoring or training in a supervised setting within an SRS program is strongly recommended
- Responsibilities include:
  - It is recognized that a neurosurgeon may not be present at each SRS centre within Ontario; however, participation in the treatment decision-making team through an MCC is strongly recommended
  - In an ideal setting, the neurosurgeon would be involved in determining target volume and normal tissues, in particular for benign indications, functional indications, and complex metastasis including postoperative radiosurgery. It is recognized that this is not achievable at smaller centers without neurosurgery and in this situation at least one radiation oncologist must have sub-speciality training in SRS and lead that team.
  - Participation in the monitoring and follow-up of patients post-SRS

Neuroradiologist

- Qualifications:
  - The neuroradiologist is accredited by a nationally or internationally recognized program or licensing board
  - Mentoring or training in a supervised setting within an SRS program is strongly recommended
- Responsibilities include:

- Participation in the development of imaging protocols required for SRS cases
- Reviewing pre- and post-procedure imaging
- Participation in the MCC

Medical Physicist

- Qualifications:
  - The qualified medical physicist is certified by the Canadian College of Physicists in Medicine or an equivalent national or international certification agency
  - Considered beneficial if trained in an SRS-specific setting (within an SRS program or by a supervised vendor)
- Responsibilities include:
  - Being knowledgeable of all technical aspects of an SRS program, which includes simulation, imaging, planning, equipment, treatment delivery, and verification of output calibration
  - Development of the technical quality assurance (QA) program including continual monitoring and associated documentation
  - Working with the radiation oncologists, radiation therapists, and medical dosimetrists to develop the optimal application of SRS and optimal treatment plan for a given patient
  - Being available for consultation for patient set-up and treatment delivery on the day of the treatment
  - Participating in the peer review process
  - Being knowledgeable of the radiation safety procedures
  - Ensure members of the SRS team have the necessary training to ensure the safe operation of the SRS program
  - Working with the information technology staff to ensure network connectivity and data backup procedures are in place
  - Being aware of all sources of uncertainty in SRS, including mechanical and dosimetric, and be able to provide mitigation strategies
  - Participating in continual education activities to maintain expertise and awareness of best practices and guidelines
  - Note: in some centres the medical physicist may also be responsible for SRS planning

Radiation Therapist

- Qualifications:
  - Medical Radiation Technologist (MRT[T]) graduate of a recognized radiation therapy program with registration with the appropriate provincial college
  - Considered beneficial if trained in an SRS-specific setting (within an SRS program or by a supervised vendor)
- Responsibilities of the radiation therapist must be clearly defined and may include the following:
  - Appropriate fabrication of effective patient immobilization devices
  - Patient treatment preparation for the SRS procedure, which includes patient positioning/immobilization
  - Performing and assessing pre-treatment imaging for treatment verification
  - Monitoring the patient during treatment
  - Delivering accurate SRS treatment after appropriate approvals
  - Patient care and side effect management
  - Organizing daily workflow of patients and staff

- Performing daily QA and ensuring safe operation of the technology unit
- Performing emergency procedures adhering to protocols if necessary

Medical Dosimetrist

- Qualifications:
  - MRT(T) graduate of a recognized radiation therapy program with registration with the appropriate provincial college
  - Considered beneficial if trained in an SRS-specific setting (within an SRS program or by a supervised vendor)
  - Considered beneficial if experienced in treatment planning
- Responsibilities of the medical dosimetrist must be clearly defined and may include the following:
  - Working with the radiation oncologist and medical physicist in developing an effective SRS treatment plan for the patient
  - Ensuring all relevant volumetric patient image data are included in the treatment planning system (TPS)
  - Generate all appropriate technical documentation required to implement the treatment plan
  - Be available for the first treatment and assist with verification for subsequent treatments as necessary
  - Note: It is possible that one individual could fulfil both the responsibilities of the radiation therapist and medical dosimetrist, if the appropriate qualifications are obtained

Recommendation 3: Minimum applicable technologies

Predominant technologies that are employed in Ontario for the delivery of SRS include:

- Gamma Knife (GK),
- CyberKnife (CK) and
- Linear Accelerator (linac)

Qualifying Statements for Recommendation 3

- Other units may be available; however, in Ontario these are the most common units used for SRS delivery within the province.
- In addition, the recommendations and guidelines presented apply to any technology that a centre would use for SRS

Recommendation 4: Simulation

The following are recommendations for imaging needed both pre (i.e., simulation) and post (i.e., follow-up) SRS to ensure safe practice and patient safety.

- Simulation
    - Simulation (magnetic resonance imaging [MRI]) to treatment should be performed as close as possible to the treatment delivery date and optimally no longer than seven and certainly no more than 14 days (including weekend days and statutory holidays)
- MRI
    - Thin-slice volumetric MRI is recommended
    - Slice thickness no greater than 1 mm is recommended with in-plane resolution of no more than 1 mm × 1 mm. If 2 mm slice thickness is used then interpolation to 1 mm, and this is acknowledged to be dependent on the type of MRI scanner and image reconstruction
    - Spatial resolution should be sufficiently high for the brain metastases to be adequately visualized and contoured. This may differ according to the device used and, therefore, documents made available by the treatment unit manufacturer should be consulted
    - Signal-to-noise ratios and contrast-to-noise ratios should be sufficiently high for the brain metastases to be adequately visualized and contoured. This may differ according to the device used and, therefore, documents made available by the treatment unit manufacturer should be consulted
    - Minimal geometric distortion. This may differ according to the device used and, therefore, documents made available by the treatment unit manufacturer should be consulted
    - Head coil to accommodate head frame is recommended
    - Independent QA by the SRS medical physicist to ensure compliance with radiotherapy needs as they are independent of those per medical imaging
    - All aspects of image quality should be thoroughly investigated prior to use for SRS including (but not limited to): partial volume averaging, spatial distortion, motion artifacts, magnetic susceptibility artifacts, image reformatting, etc
- Computed tomography (CT)
    - Slice thickness of no greater than 1 mm is recommended
    - With or without contrast
    - In-plane pixel size of 1 mm × 1 mm or finer is recommended
    - All aspects of image quality should be thoroughly investigated prior to use for SRS including (but not limited to): partial volume averaging, spatial distortion, motion artifacts, image reformatting, etc
- Immobilization
    - Invasive head frame or dedicated frameless system manufactured for radiosurgery for all single fraction delivery. Hypofractionated SRS is a distinct entity regarding immobilization
    - Margins considered based on technology

Qualifying Statements for Recommendation 4

- The Working Group members recognize that the MRI recommendations are dependent on the scanner at the SRS centre; however, the recommendations for MRI imaging in this guideline should be viewed as the minimum achievable requirements for safe practice and patient safety
- Guidelines and recommendations for MRI in radiation oncology should be strictly followed to minimize the risks associated with geometric distortion especially if using a 3T scanner [1,2]
- In some instances, images may come from diagnostic departments that are not a part of the dedicated SRS centre. In these cases, special consideration should be given to those scans as they may not meet the minimum recommendation parameters for simulation
- In certain cases, patients may have MRI without any head frame or localization device and then MRI is co-registered to a stereotactic image set later in the process. In such cases, care should be taken to keep the patient as still as possible (minimize motion artifacts) and have their head as close to treatment orientation as possible
- For CT, sufficiently high spatial resolution and signal must be used in accordance with guidelines and recommendations [3,4]

Recommendation 5: Quality Assurance Systems

The following are recommendations for a QA system required for the safe operation of a SRS treatment unit in Ontario.

- The responsible medical physicist should determine that the appropriate testing procedure is used, and documentation is maintained
- Spatial accuracy: The accuracy and precision of delivery should be well-characterized and routinely tested for sub-millimetre targeting accuracy. For multileaf collimator-based delivery of multiple metastases, in particular when treating off-axis, specialized QA devices may be needed to verify the accuracy of radiation field placement throughout the angular range of gantry, collimator, and couch angles [5,6]. A positional end-to-end test for delivery accuracy is recommended that encompasses as much as the workflow as possible, from MRI, through to target delineation and treatment delivery
- Small field dosimetry: For reference dosimetry in linacs, standard protocols TG-51 and IAEA TRS-398 apply [7,8]. For GK, CK, tomotherapy, and cone-based treatments, recommendations as per TRS-483 using machine-specific reference (MSR) fields apply [9]. The differential detector response at small fields relative to the MSR field must be taken into account using Monte Carlo calculated corrections. Additionally, proper alignment and orientation of the detector with respect to the field are also important to consider in relative small field dosimetry

Qualifying Statements for Recommendation 5

- These recommendations are specific to SRS and are in addition to existing guidance documents made available by the treatment unit manufacturer and international and national guidelines [10-14]
- It is recommended that a medical physicist on the SRS team have dedicated small-field dosimetry training, whether through a certified medical physics training program, or by a combination of continuing education courses and direct training by experienced physicists with small-field dosimetry expertise.

Recommendation 6: Patient Follow-up
The following are strongly recommended for a follow-up program for SRS patients in Ontario: • Follow-up of SRS patients should consist of routine clinical visits for the first year (every 2-3 months); second and third year (every 3-4 months); and, thereafter, as determined by the MCC
Qualifying Statements for Recommendation 6
• A routine clinical visit incorporates a standard imaging examination – MRI and preferably with volumetric axial sequences • Interpretation of follow-up imaging should occur based on input from the radiation oncologist, neurosurgeon, and neuroradiologist when it is unclear that progression has occurred, i.e., presented at MCC prior to any further radiation decision • The follow-up treatment plan may be changed at the discretion of the MCC