Image-Guided Tumor Ablation: Standardization of Terminology and Reporting Criteria—A 10-Year Update: Supplement to the Consensus Document

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This table was developed by the Technology Assessment Committee of the Society of Interventional Radiology as a supplement to "Image-Guided Tumor Ablation: Standardization of Terminology and Reporting Criteria," a standards of practice document published in this issue (1).

Common topics for reporting and details and descriptions requested are summarized in the following table. Specific definitions of terminology can be found within the document text.

Topic	Requested Descriptions
Ablation parameters	
Chemical ablation	Route (intravenous, intraarterial, or direct) Commercial source or methods of preparation Amount injected Delivery vehicle (size and type of needle/catheter) Rate of delivery (rapid injection or defined infusion rate) Intended effect (if different from complete tissue destruction; eg, enhance other ablative modalities)
Energy-based ablation	**Energy source (device name/model, manufacturer)** Radiofrequency (monopolar, bipolar, or multipolar) Microwave (frequency used: 915 MHz or 2.45 GHz) Laser Ultrasound (interstitial or high-intensity focused ultrasound/extracorporeal) Irreversible electroporation Cryoablation (gases used)
Applicator	Manufacturer name/model Length, gauge size Description of active component **Modality-specific descriptions** Radiofrequency: geometry of active component (length of active tip, configuration) Microwave: energy frequency, antenna design (dipole, slot) Laser: precise wavelength, type of laser fiber (flexible, glass dome), tip modifications (ie, flexible diffusor tip or scattering dome) with dimensions and materials, fiber diameter Irreversible electroporation: active tip length, electrode number, interelectrode spacing Cryoablation: number **Multitined, expandable applicators, cluster electrodes, multielement antennas** Diameter and configuration Variable stepwise applicator deployment **Internally cooled applicators and perfusion electrodes** Closed or open applicator system Cooling agent (ie, saline, gas), approximate temperature of agent, perfusate volume, rate of infusion **Multipolar ablations** Number of applicators, spacing between applicators, length of active tips, application algorithms

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The author has not identified a conflict of interest.

J Vasc Interv Radiol 2014; 25:1706–1708

http://dx.doi.org/10.1016/j.jvir.2014.09.005

Application parameters	**Energy application parameters and algorithm of energy deposition** Estimated power (in source-specific terminology), duration of application, specific application algorithms (eg, pulsing techniques, ramped energy deposition) **Multiple applicator insertions of a single applicator** With multiple overlapping ablations: number of ablations, mean duration, ablation endpoint, spacing, degree of overlap **Multiple separate applicators inserted simultaneously** Multipolar or "switching" technology Specific application algorithm description (eg, pulsing), duration, spacing, approximate phase between antennas (for microwave)
Tissue properties	When tissue properties are likely to have a disproportionate effect on the outcome of ablation, are being modulated, or are being specifically studied, additional description of methods of assessment or discussion, or both, should be provided Examples of tissue properties include blood/air flow–related cooling/heating, thermal or electrical conductivity (radiofrequency and irreversible electroporation), tissue elasticity/fibrosis, water content, and permittivity (microwave)
Ablation procedure	Procedure refers to a single intervention event. When a predetermined course of treatment is performed, the number of planned procedures and any deviations should be described
Indications	Treatment intent: curative, palliative, debulking Clinical indications for symptomatic tumors
Patient information	Demographic information, comorbidities Patient inclusion/exclusion criteria Performance status (eg, Eastern Cooperative Oncology Group, Karnofsky scale) Primary organ function status (eg, Child-Pugh score or Model for End-Stage Liver Disease score in cirrhosis, pulmonary function tests for chronic lung disease) Additional previous or ongoing treatments/trials (with specific protocols, duration of therapy, and timing with respect to ablation)
Tumor features	Type of tumor Description of treated tumors (size, number, location) Tumor size stratification: mean maximum diameter < 3 cm (small), 3–5 cm (intermediate), and > 5 cm (large) Degree of diagnostic proof required (eg, imaging criteria alone, tissue biopsy) Tumor stage at the time of treatment
Procedure details	Devices used, approach (eg, percutaneous, laparoscopic), use of ancillary procedures, number of treatment sessions per tumor and patient, number of times applicator was repositioned, any procedure for applicator removal (eg, tract ablation) When different devices are used in a single study, a table outlining device types and techniques should be included Non–ablation-related procedural information, including anesthesia or moderate sedation (with medications used), hospitalization if used
Concomitant, combination, and concurrent therapies	Rationale for use Agent used (substance, concentration, manufacturer), route, rate of administration, timing relative to ablation
Image guidance	Imaging techniques (including modality, imaging protocols, use of contrast material) for each procedure step, including initial tumor characterization, procedure planning, image guidance, monitoring and intraprocedural modification, and immediate assessment of treatment response
Image fusion/navigation	Type of source/reference images, whether real-time imaging incorporated into the fusion, projections displayed Methods of registration (ie, rigid or elastic, fiducial marker or landmark selection, software source, and level of automation) Errors should be described in terms of overall accuracy (system error), registration error (root-mean-square where applicable), and target to registration error
Monitoring	Noninvasive thermal monitoring: technique descriptions including magnetic resonance imaging protocols and imaging sequences, if used Other types of monitoring, such as evoked potentials for nerve monitoring: detailed descriptions of technique
Ancillary procedures	If used, include agent/device (ie, air, water, contrast material, or devices such as balloons) and endpoint (eg, specified distance between target and nontarget structures)
Pathologic evaluation	When reporting pathologic findings, both histopathologic and immunohistochemical evaluation of the ablation zone are recommended
Gross	Central zone of ablation and width of peripheral inflammatory rim Short axis and long axis with or without volume

Histopathologic	When performed, tumor cells in morphologic stains (hematoxylin-eosin) should undergo viability staining (with details of technique and types of stains used)
Imaging evaluation	Imaging techniques (including modality, imaging protocols, use of contrast material) Timing of imaging with respect to ablation Criteria used to define ablation zone on imaging (eg, lack of contrast enhancement) **Ablation zone measurements** Short-axis and long-axis measurements required Volumetric measurements if possible, although only in addition to diameter measurements Degree of uniformity or irregularity should be described Approximate size of ablative margin
Treatment success	Rates of technical success (whether tumor treated according to predetermined protocol); descriptions of partial ablation (eg, 70% of tumor was ablated) should be avoided Number of sessions required to reach predetermined endpoint Primary and secondary technical efficacy rates, including prospectively defined time of evaluation at which time determination of "complete ablation" by imaging (commonly, 1 wk to 1 mo) Retreatment rates: number of tumors that are completely treated (primary or secondary efficacy rates) that required additional treatment for residual tumor at a later time point **Disease progression** Residual, unablated tumor—rates of tumor at edge of previous ablation zone on contrast-enhanced imaging after one or more negative imaging studies Should be distinguished from new tumor foci separate from the ablation zone but within the same organ or distant malignancy
Complications	Rates on a per-session and per-patient basis If deaths, provide causes/reasons Severity/grading of complications required Differentiate between immediate (0–24 h), periprocedural (1–30 d), and delayed (> 30 d) **Classification systems** Society of Interventional Radiology grading system preferred, others can be used if rationale specified (eg, National Cancer Institute Common Terminology Criteria for Adverse Events [v.4.0 or latest] and Clavien-Dindo classification)
Follow-up and outcomes	
Imaging follow-up	Techniques/modalities used Protocol for when imaging performed Criteria for response assessment (eg, modified Response Evaluation Criteria in Solid Tumors) and imaging features used (size, lack of contrast enhancement)
Longitudinal follow-up guidelines	Technical success and early safety data—minimum 6-month follow-up Preliminary clinical outcomes—minimum 1-year follow-up Intermediate-term data—minimum 3-year follow-up Long-term data—at least 5-year follow-up Longer follow-up may be required for slow-growing tumors
Clinical outcome metrics	**Overall survival** Required for all intermediate-term and long-term studies Survival calculated from start of ablation rather than start of treatment Also should be reported from the time of diagnosis Provide percentage survival at specified time points and mean/median survival times **Time-to-progression and progression-free survival** Local time-to-progression/progression-free survival should be differentiated from organ-specific time-to-progression/progression-free survival Calculated from the time of initiation of ablation treatment Definitions of "progression" required (eg, percentage increase in treated tumor size) When performed for symptom relief, report **symptom-free survival** For patient populations with substantial non–cancer-related mortality (eg, early-stage renal cancers in older patients), **cancer-specific survival** can be reported For **palliative treatment**, quantification of outcomes using quality-of-life indices, medication usage assessment (eg, morphine-equivalent dose) tools should be performed

REFERENCE

1. Ahmed M, Solbiati L, Brace CL, et al. Image-guided tumor ablation: standardization of terminology and reporting criteria—a 10-year update. J Vasc Interv Radiol 2014; 25:1691–1705.