Workshop #3b: Brachytherapy source commissioning, assay, and related instrumentation

Scope		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**N**
high-E (HDR ^{192}Ir), low-E (^{103}Pd, ^{125}I, ^{131}Cs), infrequently eBT											
rarely LDR ^{192}Ir ribbon	(1%)	0	0	0	1	0	0	0	1	0	2
rarely LDR ^{137}Cs tubes	(3%)	1	0	1	1	2	0	1	0	0	6
	(poll of ~200 participants)										

Commissioning

Brachytherapy Source Registry, managed jointly by the AAPM and the IROC Houston QA Center
source properties (OD, outer length, active L, autoradiographs), half-life, spectrum (NNDC), shielding data (source manufacturer), compare data to manufacturer IFU and any pertinent AAPM guidelines
how to interpret an autoradiograph (semi quantitatively), what to look for (close and far)
describe x100 challenge of measuring BT source dosimetry c.f. linac reference data

Assay - theory

traceable calibrations. AAPM recommends NIST in U.S., Canada has NRCC, others => PSDL/NMI
do not use apparent activity (not a traceable quantity), set plan to become correct: not January 1, 2018
how to read a manufacturer calibration certificate (concern for range and *k*=2 coverage value)
AAPM Butler et al. 2008 requirements (describe all cases), AAPM TG-128 (DeWerd et al. 2011)

Assay - practice

have the appropriate source holder, note that the chamber and source holder are calibrated together
take good photo of insert after calibration: determine if gross damage occurs if readings later seem off
system equilibrates electrically (ideally $\geq$1 h with voltage on) and thermally (maybe $\geq$24 h),
especially important for low-signal measurements
concern for chamber insert orientation: rotate black-dot position to indent (not the air hole)
assay source(s) with frequency (Butler et al. Table 1) and tolerance (Butler et al. Table 2)
compare user assay to manufacturer calibration certificate

HDR

measure with electrometer outside vault
assay: current mode (using leakage current offset and clear the internal capacitor)
assay: integrated-charge mode (variable irradiation times), learn the transit dose for ${}_{dwell}T_{min}$~0.5 s
move source inside well-chamber to determine sweet spot (for HDR source)
locate source at position associated with calibration performed by ADCL (50 mm from distal position)
concern for chamber scatter conditions (>2% effect)
use physicist measurement (with comparison to vendor cal cert) since there are multiple related tasks

LDR

assay: integrated-charge mode ($5 \leq T \leq 30$ s)
assay: current mode only with special capacitor and system with low (<10^{-14} A) leakage
determine long-term leakage (before and after source measurements)
LDR seeds drop reproducibly into chamber insert near well chamber sweet spot
LDR does not use/need triax
track seed number (not orientation), concern for irradiating chamber
establish plan in case seeds get dropped: survey meter collimation, who/how to call for help, etc
use manufacturer cal cert (with comparison to physicist measurement) due to timing for plan reprinting

Related Instrumentation

confirm temperature and pressure gauges are calibrated and in good working order
traceable calibration www.a2la.org of thermometer & barometer: otherwise systematic S_K offset
have redundant measurement system to validate assays done with your primary measurement system
triax cable should be in good shape (visually and electrically), tell management of its limited lifetime
clean electrical connectors with compressed air, do not blow air on them from your mouth (it is moist and has contaminants, blow on glass to prove), isolate each component (chamber, cable, electrometer) in a noisy system (>10^{-14} A and without < 10^{-14} C sensitivity)
convey to management the need for assigning finite lifetime to physics instrumentation