

# Quantification of Dose Reduction with Exclusion of Surveillance Pelvic CT scans after treatment of Wilms Tumor

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# Disclosures

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# Background: Wilms Tumor

- Most common childhood solid renal tumor in patients under 15 years of age
  - 5-6% of all cases
  - Approximately 500 new cases per year [1-5]
  - Affects approximately 1:10,000 people [1]
- Current guidelines recommend multiple surveillance CT scans for children with Stages I-III Wilms tumors (WT) [6,8].

# Introduction:

- Low to intermediate risk patients may not need surveillance pelvic CT scans due to low rate of pelvic recurrence for patients without pelvic involvement at diagnosis and when CT is performed for off-therapy routine reasons [9-11].
  - Children have more susceptibility to radiation effects [9-11].
- Radiation exposure risks should be considered when determining surveillance imaging guidelines [12-14].
- Frequent CTs and increasing cumulative radiation dose are associated with an increased lifetime attributable cancer risk for malignancy [15-16].
- Image Gently campaign and ALARA
  - Reduce effective radiation doses without compromising of specificity or sensitivity [12-14].

# Purpose:

- To determine the change in total radiation dose when excluding the pelvic portion of surveillance CT scans in patients with Wilms tumor and without prior pelvic involvement

# Methods/Materials:

- Following IRB approval, retrospective review of 55 consecutive patients:
  - Abdomen and Pelvis CT scans between 01/01/05 to 07/12/18
  - Imaging report mentions Wilms tumor diagnosis.
- Patients, 30 total, excluded for multiple reasons:
  - Different tumor or different disease
  - Surveillance scan not available
  - Remote history
  - Older than age range or study outside of date range
  - Presence of initial pelvic involvement of disease
  - Phantom abnormalities preventing accurate evaluation

# Methods/Materials:

- 25 patients with 30 studies included:
  - Less than 20 years old at presentation
  - No pelvic metastatic disease at initial diagnosis
- Whole body effective dose and organ doses determined without and with the pelvic portion of the CT below the iliac crests
  - Statistical analysis of dose reduction performed using the paired t test

# Methods/Materials:

- Z-axis length of original CT scan was recorded utilizing table locations with reference to CT localizer radiograph (from the original cranial and caudal most locations).
- Limited field CT scan was measured beginning at cranial most location with caudal location defined by level of the iliac crest.
- Limited images and corresponding doses were evaluated and recorded by one reviewer.
- Radiology reports were reviewed by one reviewer to determine any subsequent new pelvis metastatic disease.

# Methods/Materials

- Doses estimated utilizing commercial software package
  - Radimetrics, Toronto, ON
  - Anthropomorphic phantom and Monte Carlo methodology
  - Interactive software which allowed for reevaluation of estimated dose based upon new scan ranges.
- Software provides whole body effective doses and individual organ equivalent dose estimates based on the International Commission on Radiological Protection 103 [17].
- CT dose index volume (CTDIvol) and dose length product (DLP) for each scan were recorded.
- Original and new doses recorded for whole body and individual organs:
  - Whole body doses, evaluated in all cases
  - Reproductive organs, gender matched evaluation
  - Bladder, evaluated in all cases
  - Spleen (for comparison purposes), evaluated in all cases

# Results:

- Mean effective dose (without and with exclusion of pelvis)
  - Original scan 7.10 mSv
  - New limited scan 5.41 mSv
  - Dose reduction of 23.8% ( $p < 0.001$ )
- Mean bladder dose (without and with exclusion of pelvis)
  - Original scan 8.54 mSv
  - New limited scan 0.89 mSv
  - Dose reduction of 90% ( $p < 0.001$ )
- Mean reproductive organ dose (ovaries and testicles)
  - Ovaries
    - Original scan 6.11 mSv
    - New limited scan 1.88 mSv
    - Dose reduction of 69% ( $p < 0.001$ ) to the ovaries in females
  - Testicles
    - Original scan 9.48 mSv
    - New limited scan 0.35 mSv
    - Dose reduction of 96% ( $p < 0.05$ ) to the testicles in males
- No subjects demonstrated pelvic metastases on the surveillance scans.

**Mean dose reduction in mSv for whole body effective dose and individual organ equivalent dose estimates**

	Original scan (mSv)	Limited Scan (mSv)	% dose reduction
Whole body effective dose	7.10	5.41	24
Bladder	8.54	0.89	90
Ovaries	6.11	1.88	69
Testicles	9.48	0.35	96

# Discussion:

- Statistically significant dose reduction was estimated with exclusion of the pelvic portion of the CT scan examinations for surveillance.
- In particular, we observed impressive dose reductions to the whole body effective doses and individual organ equivalent dose estimates.
- In particular, significant reduction in radiation dose to the gonads was demonstrated.

# Discussion:

- Limitations of the study include:
  - Small sample size
    - Exclusion of moderate number of available patients
  - Retrospective review
  - Only excluded pelvis in patients for off-therapy scans and routine reasons
  - Potential risk of missed pelvic metastasis with excluding scan of the pelvis
  - Future larger scale prospective studies are warranted to validate these findings and to confirm extremely low long term risk for pelvic metastases in patients without symptoms and after therapy.

# Conclusions:

- Limited-range routine CT abdomen surveillance examination in pediatric patients off-therapy having prior Wilms tumor with exclusion of the pelvis significantly reduces dose to the whole body and major pelvic organs, highly desirable in the radiosensitive pediatric populations.

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