Implementing Optimal Kidney Stone CT Protocols Using Outreach from a National Database

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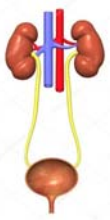
Purpose

- Kidney stones (KS), are common, recurrent, and occur in young patients.
- Optimizing radiation dose for KS CT is highly desirable.
- Guidelines and evidence support use of reduced-dose protocols (DLP < 200mGy*cm)
- Despite this, reduced-dose protocols are underutilized.
- We sought to characterize scan level parameters that influence radiation dose as part of an ongoing effort to optimize CT radiation dose for suspected KS.



Reduced-Radiation Dose Kidney Stone CT Trends

- Reduced-Dose CT (RDCT) Prevalence from national samples
  - ❖ 2011-12
    - 2% KS CT exam met RDCT criteria
    - Mean institutional DLP of 746 mGy*cm (range 307-1497)
  - ❖ 2015-2016
    - 7% KS CT exam met RDCT criteria
    - Mean exam DLP of 689 mGy*cm (95% CI:667, 712)
- Institutions often lack a dedicated RDCT stone protocol
- Protocols are often the same as those for undifferentiated abdominal pain (without contrast)
- Dose Optimization for Stone Evaluation (DOSE) seeks to provide education and consultation to optimize CT protocols.

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Methods

- ACR's Dose Index Registry (DIR) identified 380 institution contributing KS CT exams.
- Institutions were stratified by DLP and randomized
  - 189 institutions to intervention
  - 191 institutions to control
- DOSE Intervention
  - Free access to online CME modules (www.radiq.org)
  - DOSE individualized consultation
- Data was abstracted from provided KS CT protocols (N=50)

  *Tube potential *Pitch *Rotation time

  *Tube current (TC) *Automatic Exposure Control (AEC) use

  *Iterative Reconstruction (IR) use *Institution's DLP (ACR DIR data)
- Scan parameters and DLP for KS CT protocols were analyzed by vendor.
- Student's t-test was used to determine if the use of iterative reconstruction allowed for a significant reduction in TC.

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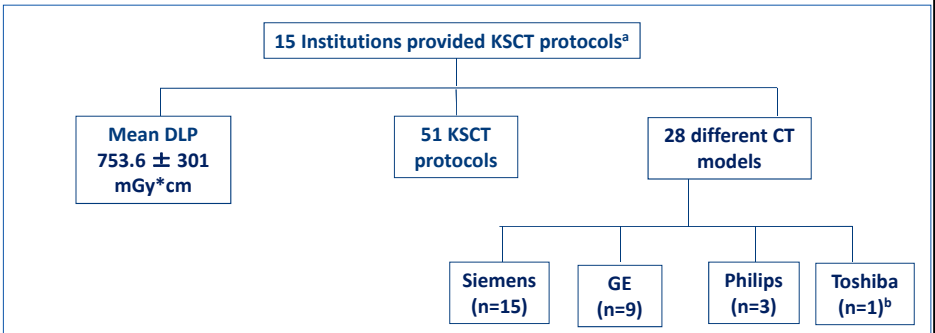
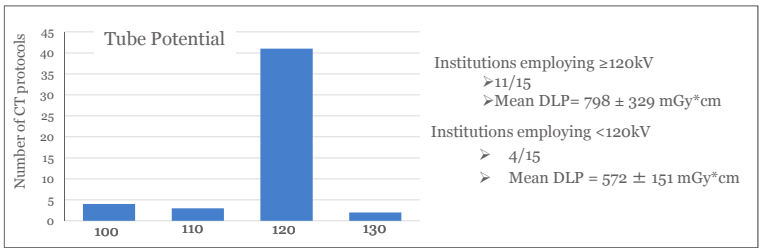
Results



[a]Institutions' response at time of abstract submission. To date 39 institutions have received DOSE consultation
[b]Toshiba protocol was excluded because of incomplete data

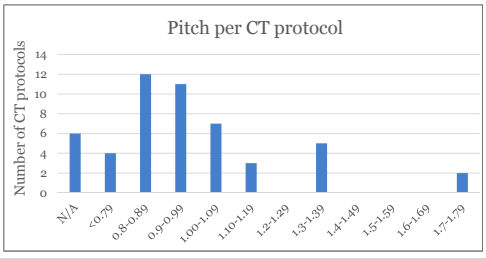
Results

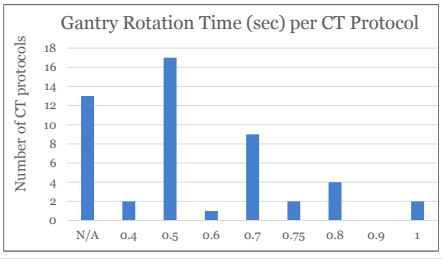
Wide variations in KS CT protocol parameters regardless of CT vendor



Institutions employing ≥120kV
- 11/15
- Mean DLP= 798 ± 329 mGy*cm

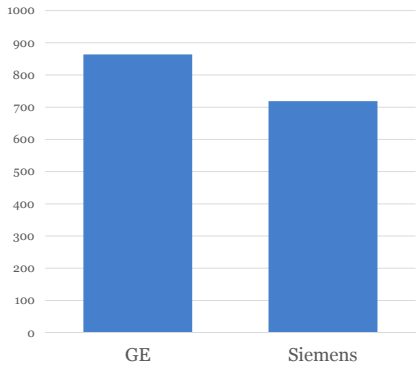
Institutions employing <120kV
- 4/15
- Mean DLP = 572 ± 151 mGy*cm





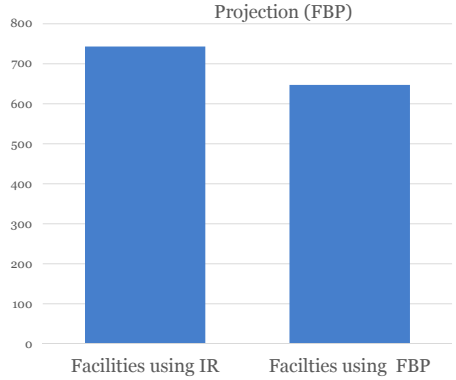
Results

Automatic Exposure Controls (AEC) by Scanner Manufacturer



Although all institutions applied AEC, image quality requirement was set too high for KSCT protocol resulting in higher radiation dose for KSCT in terms of mean DLP.

Institution DLP Associated with Iterative Reconstructions (IR) vs Filtered Back Projection (FBP)



Institutions with IR (mean DLP 743 ± 256 mGy*cm) had a statistically insignificant, higher radiation dose compared to those with FBP (mean DLP 647 ± 132 mGy.cm) (p=0.47) emphasizing insufficient modification to reduce radiation dose.

Results

Overview of KSCT Protocol Settings as Provided by Institutions Compared to Recommendations Reduced-Dose KSCT

Scan Parameters		Provided KSCT	Recommended Reduced Dose KSCT
kV	Mean	118.2 kV	**102 kV[a]**
	Median (IQR)	120 kV (120-120)	**100 kV (100-100)**
Siemens CareDose[b] (effective mAs)	Mean	172 mAs	**102 mAs**
	Median (IQR)	175 mAs (150-200)	**100 (100-100)**
GE AutomA max (mA)[b]	Mean	477 mA	**289 mA**
	Median (IQR)	300 mA (400-580)	**300 mA (250-300)**
Philips Z-Dom (mAs/slice)[b]	Mean	134 mAs	**107 mAs**
	Median (IQR)	146 mAs (101-147)	**100 mAs (100-110)**

[a] Tube current across vendors is not comparable due to different ways of representing and estimating the values.

[b] Four scanners lacked 100 kV capability.

Conclusion

- Available CT technologies (both AEC and IR techniques) are underutilized
- Factors responsible for higher radiation dose in KSCT include higher kV and higher tube current despite AEC
  - This was irrespective of the CT reconstruction technique
- Current KSCT and general abdominal-pelvic CT protocols often have minimal variation
- A true KSCT can and should be performed at significantly reduced-radiation dose compared to a general CT of the abdomen/pelvis

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