Not every low-dose is low-dose: Impact of revising low-dose CT protocol on mean effective radiation exposure

Student: Claudia Deyirmendjian
Mentor: Sero Andonian, MD, MSc, FRCSC, FACS
Institution: Royal Victoria Hospital – McGill University Health Centre

Personal Statement: I would like to thank the Endourological Society for awarding me the Summer Student Scholarship. This scholarship granted me the opportunity to develop a wide variety of skills under the mentorship of Dr. Andonian. By playing a central role in the study, I developed leadership skills as a researcher and had a global appreciation of the project's progression; I learned about obtaining ethics approval, data collection and statistical analysis as well as manuscript writing. I also familiarized myself with literature in endourology. The results of the study – which were not entirely as expected – not only highlighted the importance of continuous quality management to optimize patient care, but fueled my interest to pursue research and further explore innovation in urology. I am grateful for the invaluable guidance of Dr. Andonian and the support of the Endourological Society for enriching my medical education and enabling me to discover endourological research.

Project Objectives: According to the American Urological Association (AUA) imaging guidelines, patients presenting with renal colic should undergo low-dose rather than standard-dose non-contrast CT. The aim of the study was to assess the compliance of urologists and non-urologists in the usage low-dose CT in the diagnosis and follow-up of urolithiasis patients. Specific objectives were: 1) to determine the frequency with which physicians ordered low-dose versus standard-dose CT, 2) to calculate the actual radiation dose delivered in CT protocoled as low-dose and as standard-dose before and after the revision of the low-dose protocol, 3) to calculate the mean effective radiation dose of patients within one-year of renal colic presentation, and 4) to ascertain the percentage of patients that exceeded the one-year 50mSv limit.

Project Methods: The low-dose CT protocol was revised on April 1, 2019. After obtaining ethics approval, a retrospective chart review was conducted for patients presenting with renal colic to the emergency department between April 1, 2019 and October 1, 2019. Patients were followed at a tertiary stone clinic over a one-year period wherein all imaging studies performed were catalogued

according to the ordering physician's department and hospital. Radiation doses associated with CT scans were calculated using dose-length products, and the mean cumulative effective radiation exposure was determined using all ionizing radiation studies undergone during the one-year follow-up period.

Preliminary Results: During a one-year follow-up period, 225 patients with a mean age of 55 years and an average BMI of 26.6 kg/m^2, underwent 272 abdominopelvic CT scans. When examining the percentage of low-dose CT scans being ordered for evaluation of urolithiasis, urologists ordered significantly more low-dose CT scans than non-urologists (72.0% versus 0%, $p<0.01$). Low-dose CT accounted for only one quarter of all the CT scans protocoled for the diagnosis and follow-up of patients with urolithiasis. The mean effective radiation dose of standard-dose CT was calculated to be 8.5mSv. Prior to the revised protocol, the mean effective radiation exposure of low-dose CT was 6.5mSv, which significantly decreased to 1.6mSv after protocol implementation ($p<0.01$). The mean cumulative effective radiation exposure over the one-year period was calculated to be 19.4mSv, with 7% of patients exceeding 50mSv.

Preliminary Conclusions: After the implementation of a revised low-dose CT protocol on April 1, 2019, the mean effective radiation exposure of low-dose CT significantly decreased. Overall, low-dose CT scans consisted of a minority (25%) of CT performed, with particularly low rates of low-dose CT ordered by non-urologists. In addition, a small percentage of patients continue to exceed the 50mSv threshold despite the reduced effective radiation exposure in low-dose CT. The small percentage of patients exceeding 50mSv necessitates not only further technological refinement in the low-dose CT scan protocol but also improved compliance with AUA imaging guidelines. Furthermore, not every low-dose is low-dose and there was a significant decrease in low-dose effective radiation exposure after revision of the low-dose CT protocol. We advocate for continuous quality improvement of the low-dose CT protocol.