University of Saskatchewan
Department of Medical Imaging

Resident Research Day 2017
Book of Abstracts

Friday June 16th, 2017

Acknowledgements:

Thank you again to everyone who has worked to make this a successful research day. This includes the quality research produced by residents, medical students and the department radiologists. Our department administrative assistants Kristin Newman and Prachi Bandivadekar for organizing the details. This year GE healthcare is providing us with food and beverages. Finally, three local radiology groups (Associated Radiologists, University Medical Imaging Consultants, and Saskatoon Medical Imaging) have donated funds for motivational prizes to keep the whole thing interesting.

We are fortunate to have Dr. Iain Kirkpatrick joining us from the University of Manitoba as our distinguished guest. He is a fellowship trained abdominal imager from Stanford, with clinical interests in Abdominal and Cardiac imaging. He is a former program director and is currently section head of Abdominal Imaging at the University of Manitoba. Dr. Kirkpatrick is also an active researcher with over 40 publications to his name. We look forward to his insights and comments on the projects this year.

This year we will again be awarding the 'Stuart Houston Award for Medical Imaging Research at the University of Saskatchewan'. Dr. Houston practiced medical imaging at the University of Saskatchewan for 32 years, publishing extensively on medicine and the history of medicine. Dr. Houston is also an Officer of the Order of Canada and a member of the Saskatchewan Order of Merit.

There will also be prizes awarded for the best Quality Assurance project and best medical student project.

On behalf of the University of Saskatchewan residency program and the department of medical imaging I would like to sincerely thank everyone who has contributed to today. We look forward to an excellent day!

Dave Leswick
Research Director

Financial sponsors for today include:

Resident Research day 2017
Friday June 16th, 2017
All Presentations in PET CT conference room

Time	Presenter / Topic	Category
8:00-8:10	D Leswick • Introduction	
8:10-8:20	K Kanga • Transrectal Ultrasound Prostate Biopsy: How Good Are We?	PQI
8:20-8:30	M du Rand • Interventional Radiology Inserted Pleural Pigtail Drains. Are we managing them correctly?	PQI
8:30-8:40	Y Du • An Audit to Ascertain the Number of Failed and Recalled MRI Studies and their Causes	PQI
8:40-8:50	G Watson • Use of Oral Contrast in the Setting of Undifferentiated Abdominal Pain in the Emergency Room	PQI
8:50-9:00	J Wang • Online TI-RADS Calculator	PQI
9:00-9:10	S Melendez • Contrast Reaction Preparedness in the Radiology Department - an Update	PQI
9:10-9:20	N Sahota • Pre-MRI Patient Questionnaire: Clinical Audit	PQI
9:20-9:30	D Horne • Standardized Reporting of Perinatal Urinary Tract Dilation	PQI
9:30-9:45	------------------ COFFEE BREAK ------------------	
9:45-9:55	M Wesolowski • Demonstration of Luxsonic virtual reality radiological viewing software	Demo
9:55-10:05	L Cui • Magnetic Resonance Elastography for Applications in Radiation Therapy	Research
10:05-10:15	X Yi • Low Dose CT Denoising Using Conditional Generative Adversarial Network	Research
10:15-10:25	S Hartimath • Alpha particle labeled ^{225}Ac-DOTA–nimotuzumab for radioimmunotherapy of metastatic colorectal cancer	Research
10:25-10:35	H Fonge • ^{89}Zr-nimotuzumab for potential clinical translation as an anti-EGFR immunoPET agent	Research
10:35-10:45	E Mah • Training and Assessing Undergraduate Medical Education Students in Radiology	Research (med student)

10:45-10:55	J Van Heerden	Research
	• The Utility of Dual Energy CT in Visualizing the Menisci in Patients Unfit for MRI	(med student)
10:55-11:05	M Wright	Research
	• MRI Molecular Imaging of Inflammation in a Mouse Model of Inflammatory Bowel Disease	
11:05-11:15	J Wang	Research
	• Measurement of Gadobutrol Plasma Concentration Using Liquid Chromatography-Mass spectroscopy as a Potential Quantification Method for Glomerular Filtration Rate	

11:15-11:30 ------------------ COFFEE BREAK ------------------

11:30-11:40	N Kalra	Research
	• A Day in MR: Exam Variation and Appropriateness of MRI Exams in Canada	
11:40-11:50	D Dressler	Research
	• Prevalence of Bone-Cartilage Mismatch in the Tibial Plateau on Knee MRI	
11:50-12:00	N Vassos	Research
	• MRI Imaging Features of Soft Tissue Sarcoma with Biopsy Correlation: Imaging Criteria for Malignancy	
12:00-12:10	N Vassos	Research
	• Comparison of Surgeon vs. Patient Questionnaires for Musculoskeletal MRIs	
12:10-12:20	B Alport	Research
	• Knee MRI: How Fast Can We Go? A Comparison of Routine and Fast Knee MRI protocols	
12:20-12:30	J Zheng	Research
	• Changing Utilization of Imaging for Suspected Ureterolithiasis in a Saskatoon Emergency Department	
12:30-12:40	J Huynh & D Horne	Research
	• Medical Imaging Resident after Hours on Call Imaging at the University of Saskatchewan: An Assessment of Busyness Including Inter-Resident Variability (Call Karma)	
12:40-12:50	J Huynh	Research
	• Risk of Thrombosis Following the Use of Two Implantable Venous Devices: A Randomized Study	

-------------------- End of Presentations --------------------

| 12:50-13:00 | Judges meeting |

| 13:00 | Lunch & Award Presentation - PET/CT Conference room |
| | ▪ Best Medical Student Research Project |

18:00	Dinner Awards & Celebration Night- Fireplace Room, Faculty Club
	▪ *RSNA Roentgen Research Award*
	▪ *Stuart Houston Award - Best Resident Research Project*
	▪ *Best Practice Quality Improvement Project*

Transrectal Ultrasound Prostate Biopsy: How Good Are We?

Kavita Kanga & Aatif Parvez

Department of Medical Imaging, University of Saskatchewan

PQI Project

BACKGROUND: Prostate cancer is one of the most common cancers to affect men, with 1 in 8 Canadian men to be diagnosed in their lifetime. TRUS guided prostate biopsies remains one of the main modalities for tissue sampling, with an approximate detection rate of 50%. With the role of PSA in constant debate, and the role of imaging becoming increasingly important in this patient population, it is vital to increase the accuracy of image-guided biopsies.

OBJECTIVE: To determine whether we are meeting an acceptable detection rate for prostate cancer via ultrasound-guided prostate biopsies.

METHODOLOGY: Montage was used to retrospectively identify patients who underwent a prostate biopsy in Saskatoon Health Region from July 2012-July 2017 (in progress). A search of each patient's health records was performed to correlate with pathology results to assess if biopsy results were sufficient and the outcome. Note was also made of imaging indication, hospital location and findings. The initial audit will determine where we stand in regards to sensitivity for ultrasound guided prostate biopsies, and direct any future studies in the area.

RESULTS: Pending.

Interventional Radiology Inserted Pleural Pigtail Drains. Are we managing them correctly?

Mia du Rand*, Brent Burbridge* and Anderson Tyan**

Departments of Medical Imaging* and Respirology**, University of Saskatchewan

PQI project

OBJECTIVES: To assess the outcomes, complications and heterogeneity in management of patients undergoing image-guided pleural small-bore catheter drainage performed at RUH by Interventional Radiology. A specific aim will also be made to standardize care and post-insertion management of these patient to potentially improve clinical outcomes and length of hospital stay.

METHODS: Montage search of Interventional procedures performed at RUH from 1 March 2015 to 1 March 2017. Retrospective chart review of included patients and review of procedural reports. Tube size, drainage systems, time to change of drainage systems to negative pressure systems, post insertion complications, management orders and length of hospital stay will be assessed.

RESULTS: Pending

An Audit to Ascertain the Number of Failed and Recalled MRI Studies and their Causes

Yang Du and Haron Obaid

Department of Medical Imaging, University of Saskatchewan

PQI Project

OBJECTIVES: Premature termination of MRI scans and recalling patients for repeat studies result in loss of valuable scan time and healthcare resources. This is an ongoing study aiming to recognize and quantify the causes of failed MRI to propose methods for prevention.

METHODS: Failed MRI exams from Nov. 2006 to Oct. 7, 2016 were searched via Montage using keywords "Failed exam" OR "Failed Examination" under filters "RUH" "MRI exams". Exam reports were reviewed to determine causes of failure. The reasons were listed and tallied. Subcategory statistical analysis will be conducted using study type and patient demographics and compared with published literature.

The data collection for recalled MRI studies is ongoing. Montage is searched using keyword "Recalled" under the same filters as prior. The exam reports will be reviewed to determined the cause of the recall and whether the recalled studies were successful.

RESULTS: Initial data for causes of failed MRI show 496 failed studies from Nov. 2006 to Oct. 7 2016. The top three causes of failed MRI studies are: claustrophobia (35.3%), movement (18.1%), and body habitus (10.1%). Subcategory analysis and data collection for "recalled" study is currently underway.

CONCLUSION: Ongoing study to examine the causes of failed MRI studies. Initial data collection showed 496 failed examinations in 10 years at our institution. Subcategory analysis and further data collection for "recalled" studies are currently underway.

Use of Oral Contrast in the Setting of Undifferentiated Abdominal Pain in the Emergency Room

Gage Watson and Paul Babyn

Department of Medical Imaging, University of Saskatchewan

PQI Project

BACKGROUND: Recent studies show that the use of oral contrast is generally of little benefit in making the diagnosis in undifferentiated abdominal pain in the emergency room. The average reduction of wait times for patients receiving an abdominal CT ranges from 60-120 minutes when oral contrast is not administered with no overall effect on patient outcome.

AIM: To assess the use of oral contrast with abdominal CT in undifferentiated abdominal pain in Saskatoon Health Region.

METHODS: Montage was used to retrospectively identify patients who underwent abdominal CT imaging for undifferentiated abdominal pain in SHR from January 2016-March 2016. After the initial audit, a PQI presentation and information package was distributed to Radiologists in the SHR. A re-audit will be performed over the time period from March 2017 – May 2017 to assess the overall effectiveness of the original action plane.

RESULTS: The original audit revealed that 32% (87/274) of patients undergoing abdominal CT received oral contrast with only 3 of these 87 patients having a clear indication for oral contrast use. A second audit will be performed prior to research day and will be presented at that time.

Online TI-RADS Calculator

Jimmy Tanche Wang*, Tasha Ellchuk*, Robert Otani*, Gary Groot**, Paul S. Babyn*

Departments of Medical Imaging* and Surgery**, University of Saskatchewan

PQI Project

PURPOSE: Using an online calculator (www.TIRADSCalculator.com) for Thyroid Imaging, Reporting and Data System (TI-RADS) with images and descriptions of each of the ultrasound features as a clinical and educational tool to guide management of incidental thyroid nodules.

DESCRIPTION: Thyroid nodules are common, with a prevalence of up to 68% of adults on ultrasound. Fine needle aspiration (FNA) is the most effective test in determining of a thyroid nodule is malignant and occasionally surgery is required to achieve a definitive diagnosis. Most thyroid nodules are benign and not all nodules require FNA or surgery. Over-diagnosis of thyroid cancer results in detected thyroid cancers without affecting mortality between 45-80% of cases. Recent focus on developing a non-invasive system, Thyroid Imaging, Reporting and Data System (TI-RADS), using ultrasound for risk stratification of thyroid nodules allows identification of clinically significant malignancies while reducing the number of biopsies performed on benign nodules.

In 2017, the American College of Radiology (ACR) released a white paper on the use of the TI-RADS. TI-RADS is based on ACR recommended standardized terms for ultrasound reporting of thyroid nodules. Selected ultrasound features of thyroid nodules are combined into a score to identify nodules that warrant biopsy or sonographic follow-up. Using TI-RADS to risk stratify incidental nodules may result in fewer unnecessary biopsies. An online calculator was developed to facilitate the use of TI-RADS as an educational and clinical tool with images demonstrating each of the ultrasound.

SUMMARY: An online calculator was developed for TI-RADS facilitates the application of TI-RADS in clinical practice. Images and description of each of the ultrasound features of thyroid nodules serve as an educational and clinical tool on the use of TI-RADS. Using TI-RADS in ultrasound based risk stratification of incidental thyroid nodules will guide management and potentially reduce unnecessary thyroid biopsies and interventions.

Contrast Reaction Preparedness in the Radiology Department - an Update

Sarah Melendez & Derek Fladeland

Department of Medical Imaging, University of Saskatchewan

PQI Project

BACKGROUND AND RESULTS: This continuing project was initiated after many research studies have shown that practicing radiologists are quite poor at both recognizing severity of allergic reactions to contrast material and administering appropriate medications to treat the response. I assessed the preparedness of radiology residents, staff radiologists, and CT technologists to do those two tasks. Results show a definite lack of understanding in both recognizing and treating contrast reactions and a fundamental misunderstanding about how to administer IM and IV medications.

INTERVENTION: The PQI project is now at the intervention stage; simulation sessions are being designed for the radiology residents to practice their contrast reaction management skills and learn how to both draw up and administer life-saving medications. Sessions are due to take place in August and January.

Pre-MRI Patient Questionnaire: Clinical Audit

Navdeep Sahota and Haron Obaid

Department of Medical Imaging, University of Saskatchewan

PQI Project

BACKGROUND: MRI requisition forms from physicians provide variable clinical information. At our institution, pre-MRI patient questionnaires are used for routine joint MSK MRI exams as an adjunct. The questionnaire provide clinical information that helps in the interpretation of the MRI. However, they are inconsistently completed and/or scanned into PACS with the patient's images.

OBJECTIVE: Our aim is to assess the compliance of the pre-MRI patient questionnaires.

METHODS: The resident retrospectively reviewed the questionnaires for all routine joint MRI exams over a consecutive three month period (arthograms were included). Exams with non-routine MRI protocols were excluded.

RESULTS: On the first audit cycle, the questionnaire was included in 93% of exams (400/430). When the questionnaire was present, the front page was included in 100% of exams (400/400) and completed in 99% of exams (396/400), but the back page was only included in 90% of exams (359/400) and completed in 73% of exams where it was included (263/359).

INTERVENTIONS: Results were disseminated in the department and discussed at a provincially broadcast PQI presentation. Input was obtained from relevant stakeholders, including MSK radiologists, MRI technicians and MRI front staff. A new questionnaire was implemented.

CONCLUSIONS: A second audit cycle performed shortly after implementation of the interventions showed significant improvement. A third audit cycle performed a full year later showed lasting changes and further incremental improvement.

Standardized Reporting of Perinatal Urinary Tract Dilation

D Horne*, S Wiebe* and R Erickson**

University of Saskatchewan: Department of Medical Imaging* and Pediatrics**

PQI Project

An audit of referrals to Saskatoon Health Region Pediatric Urologists will be performed to identify vague ultrasound reports. These reports using words like "pelviectasis" are the basis of the referrals, and are often unnecessary. Following implementation of the recommendations from the Multidisciplinary Consensus on the Classification of Prenatal and Postnatal Urinary Tract Dilation a follow up audit of referrals will be performed.

Demonstration of Luxsonic virtual reality radiological viewing software

Michal J. Wesolowski

Department of Medical Imaging, University of Saskatchewan,
& Chief Executive Officer, Luxsonic Technologies Incorporated.

Overview of new technology

OBJECTIVE: To develop virtual reality based radiological viewing software and determine if it can be used as both a teaching tool for medical residents and a tool to improve workflow for practicing radiologists.

METHODS: Using a standard software engine and consumer based virtual reality headsets Luxsonic has been developing the software over the past year. With input from several practicing radiologists we have created a beta software version, which will be demonstrated at Medical Imaging Research Day.

RESULTS: The beta version of the software is fully DICOM compliant and can be integrated into PACS. It has an intuitive user interface and can be used to display and manipulate 2D images, DICOM series, and 3D reconstructions. We will be looking for participants to try the system and provide additional input as we continue to refine the software.

CONCLUSIONS: Virtual reality technologies are proving to be of significant interest in medicine. Luxsonic virtual reality radiological viewing software is the first commercial implementation of virtual reality specifically designed with the radiologist in mind.

Magnetic Resonance Elastography for Applications in Radiation Therapy

Lumeng Cui*, Niranjan Venugopal*[&]**, Paul Babyn*, and Francis Bui***

Department of Medical Imaging* and Cancer Clinic**, University of Saskatchewan
College of Engineering***, University of Saskatchewan

Research Project

OBJECTIVES: Magnetic resonance elastography (MRE) is an imaging technique that combines mechanical waves and magnetic resonance imaging (MRI) to determine the elastic properties of tissue. Because MRE is non-invasive, there is great potential and interest for its use in the detection of cancer. The first objective of this study concentrates on parameter optimization and imaging quality of an MRE system. The second objective is to investigate the feasibility of integrating MRE into the radiation therapy (RT) workflow.

METHODS: First, we developed a customized quality assurance phantom, and a series of quality controls tests to characterize the MRE system. Second, with the aid of a tissue-equivalent prostate phantom (embedded with three dominant intraprostatic lesions (DILs)), an MRE-integrated RT framework was developed. This framework contains a comprehensive scan protocol including Computed Tomography (CT) scan, combined MRI/MRE scans and a Volumetric Modulated Arc Therapy (VMAT) technique for treatment delivery.

RESULTS: The first part of the study demonstrated that through optimizing scan parameters, such as frequency and amplitude, MRE could provide a good qualitative elastogram for targets with different elasticity values and dimensions. In the second part, the results showed that using the comprehensive information could boost the MRE defined DILs to 84 Gy while keeping the prostate to 78 Gy. Using a VMAT based technique allowed us to achieve a highly conformal plan (conformity index for the prostate and combined DILs was 0.98 and 0.91).

CONCLUSION: In summary, this study demonstrates that MRE is feasible for applications in radiation oncology.

Low Dose CT Denoising Using Conditional Generative Adversarial Network

Xin Yi, Paul Babyn

Department of Medical Imaging, University of Saskatchewan

Research Project

OBJECTIVE: To access the effect of conditional generative adversarial network (CGAN) on low dose CT (LDCT) denoising.

METHODS: A deceased piglet were scanned under different dose levels by adjusting the tube current.

The effective dose for the CT image series is 14.14, 7.07, 3.54, 1.41, 0.71 mSv. All dose levels were reconstructed with filtered back-projection (FBP) with the four lowest doses also reconstructed with ASIR (40%) and VEO. CGAN was applied to the four lowest dose FBP reconstructed series with the highest standard dose CT (SDCT) as the training reference. Four CGANs were trained in total, each corresponding to a single noise level. BM3D was also employed as a baseline due to its good performance on image restoration under various types of noises. The denoised CT image produced by different methods was compared with the SDCT image using PSNR and SSIM. Meanwhile, mean standard deviation (SD) of 42 hand-selected homogeneous rectangular region of interest (ROI, 172.27 mm2) was also calculated as a direct measure of the noise level.

RESULTS: CGAN produces the best results at lower doses (0.71 and 1.41 mSv) and performs worse at higher doses (3.54, 7.07 mSv), in terms of both PSNR and SSIM, than the competitors. For the mean SD of 42 hand-selected ROIs, only CGAN can achieve lower mean SD than SDCT at all dose levels. The noise reduction factor for CGAN at the lowest dose is 2.45.

CONCLUSION: CGAN has great potential for low dose CT denoising.

Alpha particle labeled ^{225}Ac-DOTA–nimotuzumab for radioimmunotherapy of metastatic colorectal cancer

S. V. Hartimath*, R Chekol*, C R Geyer**, H Fonge*

Departments of Medical Imaging*, Pathology & Lab Medicine**, University of Saskatchewan

INTRODUCTION: Radioimmunotherapy (RIT) is an attractive therapeutic approach for cancer. Nimotuzumab is a humanized mAb which binds to the EGFR receptors and approved for treatment of squamous cell carcinoma of head and neck (SCCHN), glioma and nasopharyngeal cancer. Metastatic colorectal cancer (mCRC) is the second leading cause of death from cancer. EGFR is overexpressed in more than 80% of mCRC. In this study, we are developing new RIT conjugate of ^{225}Ac-DOTA-Nimotuzumab and evaluating its potential application in mCRC.

METHODS: Nimotuzumab chelated with p-NCS-Bz-DOTA. The Invitro binding was evaluated in DLD-1 and HT-29 cells. Radiolabelling was performed with Indium-111 and Ac-225 its invitro characterization like, immunoreactivity, invitro binding, and internalization was carried out.

RESULTS: The DLD-1 cell binding was >95% and only < 13% in HT-29. Radiolabelling yield with In-111 was >65 % with a purity >97 %. The immunoreactivity was 0.837 and receptor internalization showed the maximum membrane bound at 48 hr (85 %, $p<0.05$), followed by cytoplasmic bound (45 %, $p<0.05$). The nuclear bound fraction was also increased, but not significant (18%, $P<0.08$). After optimizing Actinium-225 labelling, the yield was > 45 % with purity >98 %. The In-vivo pilot experiment with DLD-1 xenograft in mice are planned in the coming days (early July).

CONCLUSION: The results showed that the conjugation and labeling of Nimotuzumab did not alter the receptor binding and internalization. Further evaluation in mCRC bearing mice will begin soon.

^{89}Zr-nimotuzumab for potential clinical translation as an anti-EGFR immunoPET agent

R. Chekol*, E. Alizadeh*, W. Bernhard**, R. Viswas*, S. V. Hartimath*, K. Barreto**, R. Geyer** and H. A. Fonge[*]

Departments of Medical Imaging* and Pathology**, University of Saskatchewan

Research Project

BACKGROUND: Epidermal growth factor receptor (EGFR) is upregulated in a number of cancers, including glioblastoma, anal cancers, squamous-cell carcinoma of the lung and epithelial tumors of the head and neck. Nimotuzumab (Nz) a humanized anti-EGFR monoclonal antibody (mAb) with an orphan drug status in the US and EU for treatment of glioma and other cancers The objective of this study was to produce and characterize a GMP-grade ^{89}Zr-desferoxamine-nimotuzumab (^{89}Zr-Df-Nz) and evaluate the pharmacokinetics, biodistribution, microPET imaging, radiation dosimetry and toxicity of ^{89}Zr-Df-Nz in normal and tumor-bearing mice in order to obtain regulatory approval to advance this agent to a first-in-humans phase I/II clinical trial.

In vitro experiments showed that both Nz and Nz-Df have high affinity for the EGFR receptor with K_D value of less than 10 nM. ^{89}Zr-Df-Nz showed saturation and high specific binding in EGFR expressing cell line (DLD-1) with a K_D of 14.1±2.6 nM K_D. ^{89}Zr-Df-Nz exhibited bi-exponential elimination from the blood in non-tumor bearing mice with a distribution half-life (α-phase) of 0.2 h and an elimination phase half-life (β-phase) of 23.5 h. *In vivo* experiments in mice inoculated with two different xenograft models (DLD-1 and MDA-MB-648) showed that, ^{89}Zr-Df-Nz accumulates over time specifically in tumors and showed a high tumor-to-background contrast. The radiation absorbed dose estimates predicted for humans from intravenous administration of ^{89}Zr-Df-Nz to mice showed that the organs that would receive the highest radiation absorbed doses are kidney, liver, spleen and lungs.

The manufacturing and pharmacological properties of ^{89}Zr-Df-Nz met the specifications required for first-in-human clinical trial.

Training and Assessing Undergraduate Medical Education Students in Radiology

Evan Mah*, Brent Burbridge**, Greg Malin*** and Paul Babyn**

College of Medicine*, Department of Medical Imaging,**, and Academic Family Medicine***, University of Saskatchewan

Research Project – *In progress*

BACKGROUND: As there has been a change in clinical practice due to picture archive and communication systems (PACS), this has necessitated that there be associated changes in medical education. Various institutions have attempted to incorporate e-Learning into medical education. Limitations to adapting these e-Learning strategies include: limited functionality; content creation complexity; imaging viewer functionality and usefulness; and overall cost. A novel strategy developed at the University of Saskatchewan is the Online DICOM Image Navigator (ODIN), a server application communicating between the Medical Imaging Resource Center (MIRC) and Blackboard Learning Management software that makes incorporating medical images, and associated content, possible for student learning and evaluation.

OBJECTIVES: (1) To search for, and assess, e-learning platforms available for teaching medical imaging. (2) To evaluate the various e-learning platforms and compare their utility from the perspective of the instructor and student, especially in regards to the ability to create student assignments and exams. (3) To improve radiology assessment in medical education using the available e-learning platforms.

METHODS: We will create radiology content on the various e-learning platform found via our market assessment. A cohort of medical students will be recruited to pilot the e-learning platforms and the assignments created using these systems. After completing the assignments, students will be directed to an online Fluid Survey where they will complete a survey regarding the simplicity/intuitiveness, the efficiency of the systems, of these new strategies and compared to the current non-electronic evaluation methods in use.

We will evaluate the ease of returning the completed assignments for marking, feedback, and performance for the instructor.

RESULTS AND CONCLUSIONS: Project in progress with results pending.

The Utility of Dual Energy CT in Visualizing the Menisci in Patients Unfit for MRI

Jacques Van Heerden*, Michael Shepel** and Haron Obaid**

College of Medicine* & Department of Medical Imaging**, University of Saskatchewan

BACKGROUND: Patients with MRI contraindications remain a big challenge for the orthopedic surgeons in the context of meniscal pathology. Dual Energy CT has shown promising results in ACL imaging.

OBJECTIVE: To assess the utility of Dual Energy CT (DECT) as an effective mean of visualizing the meniscus in patients unfit for MRI. The study will determine the appropriate energy level for visualizing the menisci.

METHODS: A retrospective analysis of 20 DECT scans of the knees. Each knee DECT scan was reprocessed with a different keV values. Ethics and operational approvals were obtained. Two blinded MSK radiologists will use a standardized 5 point Likert scale to assess meniscal visualization for the 3 anatomic parts (anterior horn, posterior horn and body) and two articular surfaces (inferior and superior) using K PACS. Statistics will determine whether there is a certain keV value at which the menisci are better demonstrated.

RESULTS: Datasets were generated and currently being analyzed. All patient identifying information has been anonymized by creating a Master list. Each patient's MRN was converted into a randomly generated project identifying number for study purposes. The Master list links the project ID with the patient's MRN. The data collection forms and data analysis spreadsheets contain project ID number and any patient names or MRN's. All reports generated from the research will use this coded system.

CONCLUSION: This novel study will shed light on the prospect of DECT imaging of the menisci in the context of patients with contraindications to MRI.

MRI Molecular Imaging of Inflammation in a Mouse Model of Inflammatory Bowel Disease

Matthew Wright and Steven Machtaler

Department of Medical Imaging, University of Saskatchewan

Research Project

PURPOSE: MRI and CT enterography currently are used for detection and characterization of active Crohn's disease. CT offers better special resolution than MRI but at a cost of ionizing radiation exposure. MRI therefore is the recommended practice for following disease progression and for assessing response to treatment. Current MRI enterography protocols use intravenous gadolinium contrast, intraluminal contrast agents, fluid sensitive MR sequences and multiplanar reformats to accurately detect disease presence and to assess for complications. MRI technique thus far is able to differentiate acute bowel edema from chronic fibrofatty changes. However detection of early disease (potentially limited to the mucosa or submucosa) is not yet reliably possible.

This study aims to accurately quantify the extent of bowel inflammation in a mouse model. By covalently binding gadolinium to microspheres, which are themselves bound to antibodies targeted to inflammatory markers expressed on endothelial cells (P-selectin) theoretically, it will be possible to detect small early lesions previously undetectable by current means. This would translate into earlier treatment, decreased morbidity, and decreased overall cost to the health system.

METHODS: A mouse model of inflammatory bowel disease will be used. Groups of mice will be administered a medication in their drinking water which induces bowel inflammation. This will be done for a week straight, followed by a week of rest, and completed for a total of three cycles. Mice will be scanned at baseline, and each time following the week long period of drug administration. After each two week cycle of drug administration and rest, a select number of animals will be sacrificed, and their large intestine examined via gross section and via immunohistochemical staining. We plan to also compare current MRI protocol with immunochemical targeted contrast agents as well as new novel sequences shown to be beneficial in detection of chronic fibrosis (MT and CEST sequences). The exact number of animals required is still to be determined, as preparations are currently underway.

Measurement of Gadobutrol Plasma Concentration Using Liquid Chromatography-Mass spectroscopy as a Potential Quantification Method for Glomerular Filtration Rate

Jimmy Wang*, Randy Purves**, Nalantha Wanasundara**, Carl A Wesolowski*, Paul S. Babyn*, Michal J Wesolowski*

Department of Medical Imaging* and Core Mass Spectrometry Facility**, University of Saskatchewan

Research Project

BACKGROUND AND OBJECTIVE: Accurate monitoring of renal function is critical for the management of patients with chronic kidney disease and cancer as well as the assessment of potential live donors for kidney transplantation. The glomerular filtration rate (GFR) is considered the best overall measure of renal function and can be accurately determined from the plasma clearance of a single bolus injection of a glomerular filtration marker, such as; inulin, iohexol, ^{99m}Tc-DTPA, or ^{51}Cr-EDTA.

Contrast enhanced magnetic resonance imaging (MRI) using Gd-DTPA, a gadolinium based contrast agent (GBCA), has also been used to determine GFR, however, this method is less accurate than traditional plasma clearance techniques. Notwithstanding, it could be of great clinical benefit to be able to accurately determine renal function during a contrast enhanced MRI procedure. In this regard we propose using a GBCA as a plasma clearance marker.

METHODS: Gadobutrol was mixed with reconstituted bovine plasma at concentrations of 0.05, 0.01, 0.005, 0.001, 0.0005, 0.0001, 0.00005, 0.00001 mg/ml. The samples were then analyzed using liquid chromatography mass spectrometry (LC-MS) to determine the relationship between spectroscopic signal and concentration. Four samples of unknown concentration were also prepared by a third party and used to blindly test the accuracy of the calibration curve.

RESULTS: Using the LC-MS data a calibration curve that outlines the relationship between gadobutrol concentration and spectroscopic signature was created and was found to be linear with an $R^2 = 0.99$ and shows that concentrations of gadobutrol as low as 10 ng/ml can be measured accurately. Four samples of unknown concentration were then used to test this curve and their measured concentration values were all found to be within 10% of their true concentration values.

CONCLUSION: Successful detection of gadobutrol > 100 ng/ml using the LC-MS technique. Typical concentration of gadobutrol in the blood of a human undergoing contrast enhanced MRI is on the order of mg/ml. Sample concentrations calculated using the calibration curve and the true concentrations of blindly prepared sample differed on average 5.2%. This suggests that the detection of gadobutrol using LC-MS could be used to determine plasma clearance in the future.

A Day in MR:
Exam Variation and Appropriateness of MRI Exams in Canada

Neil Kalra, Juan-Nicolas Pena-Sanchez, Andreea Badea, Sonia Vanderby, Paul Babyn

AFFILIATIONS

Research Study

OBJECTIVES: This study aimed to determine the volumes and types of magnetic resonance imaging exams being performed across Canada, common indications for the exams, and exam appropriateness using multiple evaluation tools.

METHODS: 13 academic medical institutions across Canada participated. Data, including patient demographics, exam priority, type by anatomic region and indication for imaging, were obtained relating to a single common day, October 1, 2015. Each exam was assessed for appropriateness via the Canadian Association of Radiology Referral Guidelines and the American College of Radiology Appropriateness Criteria. The Alberta and Saskatchewan spine screening forms and the Alberta knee screening form were used where applicable. The proportion of exams that were unscorable (due to illegibility or lack of applicable guidelines), appropriate and inappropriate was determined.

RESULTS/DISCUSSION: Data were obtained for 1087 relevant exams. 54% of patients were female; 3% of requisitions did not indicate the patient's sex. Brain exams were the most common, comprising 32.5% of the sample. Cancer was the most common indication. Most exams were given priority levels 2 or 3; 10.2% of the exams were Priority 1. Overall, 87.0% to 87.4% of the scoreable MR exams were appropriate; 6.6% to 12.6% were inappropriate, based on the two main evaluation tools. Results differed by anatomic region; spine exams had the highest proportion with nearly one-third of exams deemed inappropriate. Unscoreable exams differed by evaluation tool, ranging from 23% to 27%.

CONCLUSIONS: Variations by anatomic region indicate that focused exam request evaluation or screening methods could substantially reduce inappropriate imaging.

Prevalence of Bone-Cartilage Mismatch in the Tibial Plateau on Knee MRI

Danielle Dressler*, Haron Obaid*, Michael Shepel*, and Emily McWalter**

Departments of Medical Imaging* and Mechanical Engineering**,
University of Saskatchewan

Research Project

OBJECTIVE: Bone-cartilage mismatch is a joint abnormality in which the surface curvature of cartilage is incongruent with the underlying bone. Mismatch between bony and cartilaginous morphology has previously been reported in the femoral trochlea and associated with patellar instability. However this phenomenon has not yet been studied in the tibial plateau. The purpose of the study is to investigate the prevalence of bone-cartilage mismatch in the tibial plateau on knee MRI.

METHODS: A retrospective analysis of 101 knee MRI scans (3T) was carried out for patients who met the following criteria: (a) age between 20 and 49, (b) no history of knee trauma, surgery, or infection, (c) no cartilage degeneration in the tibiofemoral compartment, and (d) no meniscal tear, cruciate or collateral ligamentous injury. The medial plateau was visually assessed by three patterns: (1) Concave bone and concave cartilage; (2) Concave bone and flat cartilage; (3) Concave bone and convex cartilage. Measurements of bone and cartilage depth were also obtained. For the lateral plateau, a visual assessment of bone-cartilage congruency was performed and objective measurements of the downslopes were obtained. From this evaluation, the prevalence of bone-cartilage mismatch was determined.

RESULTS: For the medial plateau, 56% of individuals were type 1 morphology (concave bone/cartilage), 39% were type 2 morphology (concave bone/flat cartilage), and 5% were type 3 morphology (concave bone/convex cartilage). Bone concavity depth ranged from 0.5 to 4 mm with a mean of 2.3 mm. Cartilage depth ranged from 2.5 mm concavity to 1.6 mm of convexity with an average of 0.6 mm concavity. In the lateral plateau, bone slope ranged from 0.7 to 16.0 degrees with an average of 7.5 degrees. Cartilage slope ranged from 2.0 to 19.8 degrees with an average of 10.1 degrees. By subjective assessment, 75% of lateral plateaus were congruent and 25% were incongruent.

CONCLUSION: We hypothesize that bone-cartilage mismatch in the tibial plateau affects the dynamics of walking. Further kinematic studies will be needed to confirm our findings.

MRI Imaging Features of Soft Tissue Sarcoma with Biopsy Correlation: Imaging Criteria for Malignancy

Nicholas Vassos*, Haron Obaid*, Nicolette Sinclair**

University of Saskatchewan Department of Medical Imaging* & Associated Radiologists**

Research Study (Work in Progress)

OBJECTIVES: To establish updated MRI imaging criteria for soft tissue tumors with the goal of identifying characteristics that help distinguish benign from malignant neoplasms.

METHODS: This is a retrospective study. The study is compliant with HIPA as per the Research Ethics Board. A montage search was performed with the search terms including "soft tissue tumor," "soft tissue mass," and "soft tissue sarcoma." 1229 reports were identified using these search terms. Each result was then assessed with patients being excluded if the sarcoma was not in the soft tissues (retroperitoneal or organ system), if the pathology was lymphoma, if no pre-treatment or pre-biopsy imaging was available, or if the search result was for a patient already enrolled in the study.

RESULTS: After the exclusion criteria, 111 patients were left in the study. The characteristics of the soft tissue tumors of each of these patients was then assessed, including size, location, margins, signal intensity, neurovascular involvement, bone involvement, joint involvement, enhancement characteristics, necrosis, hemorrhage, edema, deep fascial involvement, fat content, and pain. 18 of these patients have no pathology reports available on Sunrise Clinical Manager, so Pathology will be involved to help obtain the pathology report on these patients. Once this has been performed, the acquired data will be sent to statistics for further analysis.

Comparison of Surgeon vs. Patient Questionnaires for Musculoskeletal MRIs

Nicholas Vassos*, Robert Cole Beavis**, David A Leswick*

University of Saskatchewan Department of Medical Imaging* and Division of Orthopedics Department of Surgery**

Research Project (Work in Progress)

OBJECTIVES: At Royal University Hospital patients who undergo musculoskeletal MRI fill out joint specific questionnaires regarding their history and symptoms. This study will assess how well forms completed by orthopedic surgeons correlate with those from patients, and how the pathologic MRI findings compare to the completed questionnaires.

METHODS: This will be a prospective study. Orthopedic surgeons will enroll patients requiring urgent knee or shoulder MRIs. The surgeon will complete a patient information sheet and MRI requisition at the time of referral. Study patients will be identified and scheduled for scanning at RUH.

As per usual protocol, patients will complete the standard patient questionnaire at the time of MRI. Both the surgeon and patient questionnaires will be scanned into PACS. We are attempting to recruit a total of four surgeons, with the aim of including 25 shoulder and 25 knee patients per surgeon (total n= 200). The data from both the patient and surgeon forms will be analyzed for each enrolled participant looking for agreement and/or additional information between them. Additionally, the MRI findings will be reviewed with each surgeon to see how well they correlate with symptoms and other information on the completed questionnaires.

PRELIMINARY RESULTS: All 50 patients from Dr. Beavis have been enrolled and the data analyzed. Preliminary assessment of these patients revealed: 23/25 shoulder and 20/25 knee MRIs were scanned at RUH with both clinician and patient info sheets archived on PACS. Total number of discrepancies for each category was as follows: surgical history - 3 shoulder & 2 knee; location of pain – 8 shoulder & 8 knee; mechanism of injury – 14 shoulder & 14 knee; suspected injured structure - 13 shoulder & 18 knee; duration symptoms – 17 shoulder &10 knee, We are currently awaiting participation from the other orthopedic surgeons.

CONCLUSIONS: Pending.

Knee MRI: How Fast Can We Go?
A Comparison of Routine and Fast Knee MRI protocols

Brie Alport*, David Leswick*, Haron Obaid*, Shawn Kisch*, Rhonda Bryce** and Hyun Lim**

Departments of Medical Imaging* and Community Health and Epidemiology**,
University of Saskatchewan

Research Project – Work in progress

OBJECTIVE: To assess lesion detectability in routine and modified fast MRI knee protocols.

BACKGROUND: MRI studies are limited by high cost, system availability and high demand. Advances in MRI technology allow for faster scan times or improved image quality. Unfortunately, faster scans come with a penalty of slightly degraded image quality. At RUH a fast knee MRI protocol has been employed for patients over 50 years of age. Although anecdotally the image quality of these fast scans is good, a direct comparison between the routine and fast exams has never been performed. This study will compare image quality of the two protocols for knee MRI. If results are comparable; the fast protocol could be adopted for use with all patients.

METHODS: Approval was obtained from SHR and University of Saskatchewan Biomedical Research Ethics Boards.   A series of test protocols were conducted on each sequence utilizing parallel MRI imaging techniques. After qualitative analysis the protocol with the shortest scan time without significant subjective compromise in image quality was selected as the fast protocol for this study. Thirty patients between the ages 7 and 50 with symptoms related to knee trauma were scanned using the routine and fast knee protocols on RUH's 3T Siemens Skyra system (Erlangen, Germany).

Using a structured reporting system, these images will be interpreted by two MSK trained radiologists. Assessment will include image quality of each sequence, confidence of visualization of several structures and lesion detection when lesions are present. The results will be compared between the protocols.

Changing Utilization of Imaging for Suspected Ureterolithiasis in a Saskatoon Emergency Department

James Zheng[*], Tom Elliott[**], Karen Mohr[***]
Hyun Lim[****], Rhonda Bryce[****] and David Leswick[*]

Departments of Medical Imaging[*], Palliative Care[***], Community Health and Epidemiology[****]
University Saskatchewan, Department of Family Medicine[**], University of Calgary,

Research Project

OBJECTIVE: Determine if there is changing practice patterns for imaging of suspected renal/ureteric colic in Saskatoon Health Region (SHR) from 2005 to 2015. Specifically this focuses on use of CT and ultrasound for diagnosis in patients with first and repeat presentations at the Royal University Hospital Emergency Department (RUH ED).

METHODS: All CT KUB studies at SHR hospitals were identified through Radiology Information System (RIS). Also, patient charts from RUH ED with the exit diagnosis of renal/ureteric colic during summer months (June - September) from 2005-2015 were reviewed.

RESULTS: 6241 CT KUB scans were performed in SHR between 2006 and 2015 (RIS data was incomplete for 2005). In 2006 SHR performed 579 CT KUB scans, peaking with 733 scans in 2009, and decreasing to 544 scans in 2013.

Of 1139 charts reviewed, the percent of discharges without imaging investigation decreased from 26% (2005) to 18% (2015). CT KUB scans peaked in 2007/2008 with 68% and 67% utilization respectively with a decrease of 22% in 2015. Ultrasound use increased from 9% (2005) to 20% (2015). Of patients with a previous imaging diagnosis of renal/ureteric colic, CT use during the current visit decreased from 51% (2005) to 28% (2014) while ultrasound use increased from 4% (2005) to 32% (2013).   Full statistical analysis in pending.

CONSLUSIONS: There is a trend towards less usage of CT and increased usage of ultrasound for suspected renal colic, particularly in patients presenting with a previous imaging diagnosis of renal/ureteric colic.

Medical Imaging Resident after Hours on Call Imaging at the University of Saskatchewan: An Assessment of Busyness Including Inter-Resident Variability (Call Karma)

James Huynh*, David Horne*, Brenda Downing*,
Rhonda Bryce**, Hyun Lim**, and David Leswick*

Department of Medical Imaging* and Community Health and Epidemiology**, University of Saskatchewan

Research Project

BACKGROUND: Anecdotally resident medical imaging call is becoming more demanding with increased patient volumes with variation between case loads on different shifts, and possibly between different residents. The current call volumes are getting to the point where considerations are being made at changing the call schedule to improve resident well being and ensure high quality interpretations of all cases. Although it is a cultural misappropriation of the term "karma", call karma refers to the superstition business of a particular resident is predictable variable that follows physicians whenever they are on-call.

OBJECTIVE: To determing true caseload of on call imaging shifts, and determine if there is consistent variability between call business for different residents.

METHODS: After hours CT cases dictated by medical imaing residents between July 1st 2012 and January 9th 2017 was assessed. General on call busyness was assessed as the total and average average number of cases and body regions scanned during call shifts (17:00-08:00 on weekdays and 08:00-08:00 on weekends), with subset assessment of number of exams during day times (08:00-17:00 on weekends only) evening (17:00-24:00) and night (00:00-08:00). Trending was assessed to determine if there is increasing case load on annual basis between 2012-2017. Variability of the resident work load was assessed as the mean number of cases and body regions scanned per shift by each resident during an academic year. Additionally, a brief survey was distributed to residents, radiologists and CT technologists regarding perceptions on work load, call karma and superstitions.

RESULTS: A total of 22,952 individual patient CT scans were performed by the resident cohort on call at Royal University Hospital between July 1st 2012 to January 9th 2017. Average number of cases and body regions scanned was 10.7 ± 3.7 and 14.2 ± 5.4 for weekday shifts, and 20.9 ± 6.5 and 27.2 ± 9.1 for weekend shifts over the whole study period. There was an increase in number of cases and body regions scanned seen between 2012 and 2017, and some variability was seen between residents over this time period as well. Further data and survey results will be presented at research day.

Risk of Thrombosis Following the Use of Two Implantable Venous Devices: A Randomized Study

James Huynh*, Brent Burbridge*, Christopher Plewes** and Grant Stoneham*

Department of Medical Imaging University of Saskatchewan* and University of Alberta**

Research Project

BACKGROUND: The study describes comparison in the development of venous thrombosis between two types of totally implanted venous access devices (TIVAD), hypothesizing that the characteristics of a larger bore device would result in increased rates of thrombus formation. Venous thrombosis is a significant complication for patients who have venous access devices.

METHODS: We performed a prospective study to assess the veins of the ipsilateral arm, chest, and base of the neck amongst a cohort of 209 subjects randomized to receive one of two different totally implanted venous access devices. Subjects were randomized to one of two different TIVAD by a computer-generated randomization table. The two devices investigated were either a power injectable or a non-power injectable device. Subjects were scheduled to have an ipsilateral arm, chest, and base of neck venous doppler ultrasound 3 months after venous access device implantation.

RSEULTS: Of the 209 who received randomized arm ports, 143 subjects opted to continue on with the study and had venous doppler ultrasound within three months of the implantation of their venous access device. 76 power-injectable and 67 non-power injectable devices were placed. Three ultrasounds were performed earlier than three months to investigate symptoms of venous thrombosis while 140 ultrasounds were performed at 3 months as part of the study protocol. There were a total of 22 subjects who developed venous thrombosis, 3 symptomatic and 19 asymptomatic. 14 of 76 (18.4%) cases of venous thrombosis were identified in the power-injectable and 8 of 67 (11.9%) in the non-power injectable group. Statistical analysis failed to demonstrate any significant differences between venous access device design (power injectable or not), venous catheter size, gender, age, or type of malignancy with p-values ranging from 0.28 to 0.99.

CONCLUSION: Despite our concern that the larger catheter associated with the power injectable venous access device would lead to a statistically larger number of venous thrombosis; this hypothesis was not substantiated.

Lunch & Prizes:

Please join us for lunch and prizes in the department's Pet/CT conference room at 13:00 for a lunch and the best medical student project award. This year GE Healthcare has kindly provided us with a grant for research day that was used towards organization costs, and the lunch and snacks throughout the day. The best medical student project will be presented at the lunch, with the remainder of prizes at the departmental event later this evening.

Prizes are as follows:
'Stuart Houston Award for Medical Imaging Research at the University of Saskatchewan'
- awarded to best resident project:
- $750 - cosponsored by Associated Radiologists and University Medical Imaging Consultants

Best Quality Assurance Project:
- $250 - Cosponsored by Associated Radiologists and University Medical Imaging Consultants

Best Medical Student Project:
- $500 – Sponsored by Saskatoon Medical Imaging

RSNA Roentgen Research Award:
- Sponsored by the RSNA

Past Prize Winners

We would like to again recognize prize winners from previous years as follows:

Stuart Houston Award for Medical Imaging Research at the University of Saskatchewan

- 2016: **Meredith Lynch** (with D Leswick, S Kisch*, R Bryce & H Lim for the project "Image Quality in Day Optimizing Throughput (Dot) Knee MRI vs Routine Knee MRI"
- 2015: **Navdeep Sahota and Nasir Khan** (with M Shepel and H Obaid) for the project "Posterior Ankle Labral Changes at MRI: A Preliminary Study"
- 2014: **Christopher Plewes** (with B Burbridge) for the project "Comparison of a Power Injectable Versus a Non Power Injectable Totally Implanted Venous Access Device in the Upper Arm"
- 2013: **Nasir Khan** (with H Obaid, M Shepel & D Leswick) for the project "An MRI Study to Correlate between Increased Lateral Tibial Slope and Articular Cartilage Changes in the Knee"
- 2012: **Christopher Plewes** for the project "Towards Efficient MR Utilization"
- 2011: **Darin White** (with D Fladeland) for the project "Dual-Energy CT Pulmonary Angiography – Part I: Image Quality"
- 2010:**Adelaine Wong** (with D Leswick, H Nikota & S Webster) for the project "Dose Reduction in Scoliosis Surveys"

Best Quality Assurance Project

- 2016: **Navdeep Sahota** (with H Obaid) for the project "Pre-MRI Patient Questionnaire: Clinical Audit"
- 2015: **James Huynh** (with D Leswick and F Rashidi) for the project "Retrospectively Conducted First Cycle of Practice Quality Improvement Evaluating the Technique of Liver Span Measurement Used by Sonographers at a Single Institution"
- 2014: **Meredith Lynch** (with B Burbridge) for the project "Use of Power Injectable Ports fir Contrast Enhanced CT and MR"
- 2013: **Brandy Sessford** (with V Chow) for the project "Management of Asymptomatic Adnexal Cysts identified on Ultrasound: A Clinical Audit Project at the Saskatoon Health Region"

Past Prize Winners

Best Medical Student Project

- 2016: **Scott Adams** (with B Burbridge, A Badea, L Langford, L Bustamante, I Mendez & P Babyn for the project "Initial experience using a telerobotic ultrasound system to perform adult abdominal examinations"

- 2015: **Haven Roy** (with B Burbridge) for the project "To CT, or not to CT? The influence of computed tomography on the diagnosis of appendicitis in obese pediatric patients"

- 2014: **Danielle Dressler** (with D Leswick) for the project "Canadian Association of Radiologists (CAR) Annual Scientific Meetings: How Many Abstracts Go On to Publication?"

- 2013 (split award): **David Horne** (with D Leswick & H Lim) for the project "The Case Breast Radioprotection During Abdominal CT"

- 2013 (split award): **Neil Kalra** (with B Burbridge, D Pinelle, G Malin & K Trinder) for the project "USRC: A Novel Method for Incorporating Diagnostic Radiology Images into the Medical School Curriculum"

- 2012: **Anuj Dixit** (with P Babyn) for the project "Contrast Media Safety and Education"

- 2011 (split award): **Larissa Breanne Irving** (with D Leswick, D Fladeland & H Lim) for the project "Knowing the Enemy: Health Care Provider Knowledge of CT Dose & Associated Risks"

- 2011 (split award): **James Zheng** (with D Leswick & D Fladeland) for the project "CT Dose to Patients Receiving Scans of Multiple Body Sites at a Single Visit in Saskatoon"

- 2010: **Patricia Jo** (with D Leswick, D Fladeland, R Otani & H Lim) for the project "Reduced Dose with Maintained Image Quality Utilizing 100 kVp Carotid CT Angiography"

- 2009: **Chance Dumaine** (with D Fladeland, D Leswick, and H Lim) for the project "Improving Radiation Dose from Diagnostic CT Examinations in Saskatchewan"

- 2008: **Sumeer Mann** (with Grant Stoneham) for his projects "Reproduction of a Phantom and Development of a 3D CT Reconstruction Protocol for the Assessment of Ventricular Volumes" and "Comparison of CT 3D Volumetric Analysis of Ventricular Size to Visual Radiological Assessment" and "Correlation of Frontal and Occipital (F/O) Horn Ratio to Ventricular Volume in Patients of Varying Ages, and Comparison with Evan's Ratio"

Past Prize Winners

Resident Research Award (awarded 2007 to 2009)
- 2009: Leslie Chatterson (with D Leswick*, D Fladeland, M Hunt & S Webster) for the project " Lead Versus RADPAD® Shielding for Fetal Dose Reduction during Maternal CT Pulmonary Angiography"
- 2008: Jennifer Tynan (with M Duncan and B Burbridge) for the project "Reduction of Adult Fingers Visualized on Pediatric Intensive Care Unit (PICU) Chest X-rays Following Radiation Technologist and PICU Staff Radiation Safety Education"
- 2007: Greg Kraushaar (with C King) for the project "Back to the Future: Shortening the Z Axis on Helical CT PE Studies without Compromising Diagnostic Power"

Resident Research Second Place Award (awarded 2008 to 2012)
- 2012: Nicolette Sinclair (with B Burbridge) for the project "Fluoroscopy of the Cook Vital Arm Port at the time of Removal"
- 2011: Andrew Scott (with D Leswick) for the project "Shaken or Swirled? Mixing Gadolinium for Arthrography"
- 2010: Aileen Rankin (with D Leswick) for the project "Patient Positioning in CT and the Induction of Sternoclavicular Joint Pneumatosis"
- 2009: Christina Theoret (with G Stoneham) for the project "Fibroid Size Reproducibility US vs MRI at Royal University Hospital"
- 2008: Sharon Goo for the project "Does Percutaneous Balloon Cryoplasty Improve Hemodialysis Access Longevity"

RSNA Roentgen Research Award:
- 2016:None
- 2015: Chris Plewes
- 2014: None
- 2013: James McEarchern
- 2012: Andrew Scott
- 2011: Leslie Chatterson
- 2010:Matylda Machnowska