Department of Medical Imaging

2015-2016 Annual Report and 5 Year Summary
Message from Unified Department Head

On behalf of the department of Medical Imaging I would like to present to you our 2015/2016 departmental report. The Department of Medical Imaging represents a wonderful amalgamation of faculty, trainees, technologists and support staff who all support the provision of clinical imaging services (both diagnostic and therapeutic) and academic medical imaging activities across the province of Saskatchewan. This report encapsulates the academic activities of our departmental members over the past 5 years and illustrates the many exciting research activities performed and reflects the strengths present within our membership.

Integrating Learning into the Practice of Medical Imaging

To practice medicine means we must not only provide excellent care today, it also means we commit to track and improve our results over time. I would like to take a few moments to reflect on our practice of medical imaging and the integration of learning into our daily activities. As members of an academic department, we have a similar mandate to provide excellent care and track our departmental outcomes. We also commit to ensure that the care we provide as a whole continually improves.

To do this successfully means we must work towards establishing a system that allows us to continually include new knowledge and skills into what we do and teach. One way that we do this is through our practice and encouragement of research. As a community of imaging scientists and radiologists historically we have been quite successful over the past decades with the introduction of new imaging modalities such as U/S, CT, and MRI and their refinements.

Indeed we have devoted much of our research activities towards better understanding of our imaging modalities and how to better use our imaging tools. One such example from my own research is the exploration of the value of Whole Body magnetic resonance imaging for imaging children. This work takes advantage of the superb tissue contrast of MRI and the many recent advances in MRI technology to explore its benefits for oncologic imaging and imaging of other disorders such as vasculopathies and spondyloarthropathies. However will our focus on imaging modality research allow us to meet today’s challenges? Is such research alone enough?

A significant aspect of today’s challenges includes the impact of the ever-increasing complexity of medicine and medical imaging in our daily work environment. We have a continuing explosion of new knowledge overwhelming our individual abilities. We must couple this with a number of significant challenges including increasing patient expectations for enhanced patient safety, better access and faster more accurate results, from referring physicians for 24/7 presence and care, from payors to decrease costs while simultaneously improving our capabilities and the benefits we provide.

To address these challenges means we must better understand our work in broader context across the imaging cycle. As radiologists we expend most of our thoughts on the performance of desired procedure and its interpretation. However we must broaden this viewpoint. Pre-procedure we must extend our questions from how to use these imaging modalities to when best to use, incorporating choosing wisely and appropriateness into our understanding. We all know the detriments of having inappropriate studies both to the individual patient with unnecessary radiation or other risks and to the system as a whole with delays in patient diagnosis. Post-procedure we have increased concern for the right level and timing of communication to our referring clinicians. New words
like patient handoffs and synoptic reporting have entered our vocabulary.
As Goethe once said “Knowing is not enough. We must apply and do”. New knowledge from research is not enough. We must better integrate this knowledge with lessons learned from patient safety and quality improvement and ensure that generalized knowledge is translated into our specific work settings. How do we incorporate our new knowledge into our daily routine? What skills do we need?

**We shape our buildings and thereafter they shape us**
--Winston Churchill

This quote from Winston Churchill illustrates the value and the constraints imposed upon us by our organizational structures. We must examine our organization at the departmental level and more broadly within our Health region and University communities. Effective learning requires attention to the ways in which an organization learns at the individual, group and organizational levels. The individual process of learning from experience is not easy but even harder at an organizational level.

We know that individual learning is subjective, certainly limited and can lead to different viewpoints for same experience. We need to counteract this subjectivity. Lack of learning at the individual level precludes any ability to move such knowledge to higher organizational levels. Indeed learning from experience is an enormously challenging process.

We need to make such learning actionable for all organizational members. Knowledge development is competence development- we need strategically important knowledge to be defined. Learning occurs within communities of practice and across functional teams. We must be strategic in our learning. We must think in terms of core competencies and core capabilities. What knowledge do we need for future success?

Organizational learning is critical. Various structures within our organization hold knowledge in one form or another including our databases, other information stores, work processes, procedures, formal reporting structures, service architectures, performance management systems, resource allocation processes create the context where learning occurs. Learning must migrate from individuals to the organization. This is also where outside knowledge feeds into our organization. Organizations can establish communities to facilitate learning that should be cross-disciplinary. Communities of practice with the mandate to explore solutions and new knowledge are powerful mechanisms for problem solving and the integration of specialized knowledge. We must form these groups and they will need to be nurtured and supported.

As you review this material please reflect on the strides our departmental members have made. Let us also commit to maintain our purpose to continue our “practice” of medicine in the coming years.

Dr. Paul Babyn, Department Head & Professor
Mission Statement for Medical Imaging Department

The Department of Medical Imaging within Saskatoon Health Region and University of Saskatchewan, College of Medicine is committed to improving the healthcare of patients by providing excellence of diagnostic imaging and treatment.

The Department of Medical Imaging is dedicated to setting standards of excellence of radiological care and training of personnel including residents, appropriateness criteria, clinical and imaging protocols and outcome expectations.

The Department of Medical Imaging will disseminate information and thus educate healthcare providers, residents and medical students so as to optimally utilize medical imaging techniques.

The Department of Medical Imaging will promote scientific inquiry among its members for the advancement of imaging through clinical research, basic biomedical research and technology assessment and clinical practice guidelines and outcomes research.

The goals of the Department of Medical Imaging are that its members provide comprehensive diagnostic imaging by the most appropriate radiological evaluation and deliver the highest professional quality of care with optimal patient outcome.
University of Medical Imaging
Consultants:
Bell, Clifford
Burbridge, Brent
Chatterson, Leslie
Dabirzadeh, Hamid
Dhir, Anita
Ellchuk, Tasha
Fladeland, Derek
Gitlin, Josh
Karjala, Geoff
Leswick, David
Obaid, Haron
Otani, Rob
Rashidi, Farid
Rodriguez, Carl
Shepel, Michael
Stoneham, Grant
Szkup, Peter
Tan, Jon
Theoret, Tina
Waddell, Ian
Wiebe, Sheldon

Regina Associated Radiologists:
Adams, W.
Barnes, Adam G.
Butcher, M.
Clarke, W.
Cupido, Brindley D.
Devitt, N.
Farooq, S.
Goyal, Kunal
Hillis, J.
Janse van Rensburg, P.
Jeon, A.
Kapoor, N.
Kraushaar, G.
Le, Brian
Lembke, E.
Lim, C.
Patel, Bijal
Patel, R.
Phillipson, R.
Rice, J.
Schulte, Paul
Suchet, I.
Verma, A.

Saskatoon Associated Radiologists:
Almgrahi, Abdulaziz
Beck, Maxine
Buglass, Tiffany
Chavarria, Cesar
Chow, Vance
Flegg, Carolyn
Fraser, Don
Gordon, Heather
Jacob, Preman
Kenny, Anne
Lim, Meng
Marshall, Geoffrey
Mack, Tyson
McIntosh, Don
Niijar, Sundeep
Norval, Ivan
Preman, Jacob
Rakheja, Rajan
Ross, Todd
Scott, Andrew
Sinclair, Nicolette
Tremeer, Cory
Verrall, John
Wall, Chris
Waslen, Tom

MJH Imaging:
Hendel, Mary-Jane

Division of Nuclear Medicine:
Almgrahi, Abdulaziz
Niijar, Sundeep
Ollenberger, Glenn
Rakheja, Rajan
Trivedi, Vijay

Adjunct Faculty:
Lewis, Robert
Menk, Ralf Hendrick
Venugopal, Niranjan

Post-doctoral Fellow:
Wanasundara, Nalantha
Wesolowski, Michal

Residents:
Alport, Brie
Dressler, Danielle
Du, Yang
Horne, David
Huynh, James
Kalra, Neil
Kanga, Kavita
Lynch, Meredith
MacDonell, Sarah
Parvez, Aatif
Patel, Adarsh
Perkes, Nicole
Russell, Paul
Sahota, Navdeep
Vassos, Nicholas
Wang, Jimmy
Watson, Gage
Wright, Matt
Zheng, James

Research & Cross Appointed Faculty
Chapman, Dean
Fonge, Humphrey
Kelly, Michael
Mickleborough, Marla
Peeling, Lissa
Phenix, Christopher
Sarty, Gordon
Vanderby, Sonia
Wesolowski, Carl

Administrative Assistants:
Bandivadekar, Prachi
Newman, Kristin

Unified Head & Professor:
Babyn, Paul S.
Education

Visiting Professors

May 15, 2015
Manrajheran, M.D., FRCPC
“Restoring Order in the Chaotic World of Vascular Anomalies: Aids in Diagnosis and Management”

May 21, 2015
Karen Finlay, M.D.
“Targeted Ultrasound of the Upper Extremity: Extensor Surface of the Wrist and Targeted U/S of the Elbow”

August 24, 2015
Mohammed Nayeemuddin, M.D., MBBS, MCRS, FRCR, FRCPC, EBIR
“Central Venous Catheters, Their Complications and Management”

August 28, 2015
Steven Cooper, M.D., FRCPC, DABR
“Yttrium-90 Radioembolotherapy of Hepatic Malignancy”

May 15, 2016
Stephen Miller, M.D., FRCPC
“A Few Common Skeletal Dysplasias and Syndromes: Opening the Black Box”

March 14, 2016
Dr. Carlos Torres
“Brachial Plexus Imaging” and “Cord Imaging: Case-based Approach”

Rounds

Practice Quality Improvement

15Sept Neil Kalra “MRI appropriateness in Canada - a literature review on current practices”
17Nov Brie Alport “Percutaneous Transhepatic Cholangiography and Biliary Drainage - Is it worth it?”
19Jan Navdeep Sahota “Pre-MRI Patient Questionnaire: Clinical Audit”
15Mar Jimmy Wang “Thyroid Nodule Sonography in SHR”
17May Faculty Development “Competency Based Medical Education (CBME) The Future in Medical Imaging”

Grand Rounds

13Oct Paul Babyn “Patient Safety in Medical Imaging”
10Nov David Li “2015 Canadian Expert Panel Recommendations for MRI Use in Multiple Sclerosis”
8Dec Brent Burbridge “MISTR - Medical Imaging Solutions for Teaching and Research”
12Jan Haron Obaid “Soft Tissue Tumor”
8Mar Sheldon Wiebe “Fetal MR”
14Apr Dr. Pathak “Joint GR with Dept of Surgery: The Manitoba Thyroid Cancer Cohort”
10May Peter Szkup “Non-Aneurysmal Cortical SAH Part II”
14Jun Jon Tan “Radioembolization”

Morbidity/Mortality

20Oct Sarah MacDonell “Patient + Exam Mislabelling: How Big of an Issue it is?”
15Dec Jimmy Wang “Thoracentesis and Paracentesis Complications”
16Feb Neil Kalra “Emergency Medicine in the Radiology Department”
19Apr Gage Watson “Abdominal Pain: When should Unenhanced CT be Done?”
21June James Huynh “Review of Diagnostic Errors and Potential Causes”
Research Day: May 22, 2015

**Shandy Fox**  
Inter-rater Reliability of Distal Radius Measurements: Radial Inclination, Ulnar variance and Radial Tilt

**Rohit Sachdeva**  
In-vivo Investigation of Architectural Changes in the Supraspinatus following Surgical Repair

**S Salajeghe**  
Image reconstruction of RF encoded MRI signals in an inhomogeneous B1 field

**Gage Watson**  
A Simple Method for Determining Split Renal Function from Scintigraphic Data

**Surajith N Wanasundara**  
Accurate and Precise Plasma Clearance Measurement Using Four 99mTc-DTPA Plasma Samples Over Four Hours

**Yasmin Carter**  
Clinical Imaging in the Classroom and Beyond: the Creation of MISTR an Online Image Education Resource

**Nick Vassos**  
A Clinical Audit of MSK radiographs prior to MRIs: Do We Follow the Guidelines?

**Danielle Dressler**  
Timelines of Communication with the ER department for CT studies at a University Teaching Hospital – A QA Project with Cross Canada Survey

**Jimmy Wang**  
Thyroid Nodule Sonography in the Saskatoon Health Region

**James Huynh**  
Retrospectively Conducted First Cycle of Practice Quality Improvement Evaluating the Technique of Liver Span Measurement Used by Sonographers

**Aatif Parvez**  
Clinical Audit of MRI Synoptic Reporting of Primary Rectal Cancer

**Meredith Lynch**  
Gestational Sac Shape and Pregnancy Outcome: A Review of the Literature

**David Horne**  
A Novel Technique for Volumetric Measurement of the Supraspinatous Muscle on MRI

**Brie Alport**  
Can Sonographic Placental Thickness Be Used as a Tool to Predict IUGR and Adverse Pregnancy Outcomes in the Second Trimester?

**James Zheng**  
Accuracy in Determination of Liver Span: Physical Examination Compared to Imaging

**Navdeep Sahota**  
Posterior Ankle Labral Changes at MRI: A Preliminary Study

**Aatif Parvez**  
CT Colonography: Comparative Analysis of VEO vs. ASIR
Fabio Accorsi
MRI Safety screening for endoscopically placed clips: Canadian wide policy survey and local practice review

Neil Kalra

Ian Y.M. Chan
The Effectiveness of Learning Anatomy and Medical Imaging Using the Anatomage Table Compared with Prosections

Hager Haggag
Quality of CT Images Acquired with Power Injection of an Arm Port

Haven Roy
To CT, or not to CT? The influence of computed tomography on the diagnosis of appendicitis in obese pediatric patients

Paul Russell
Long Bone Fractures at Less than Twelve Months of Age and Non-Accidental Trauma Work-Up

Adarsh Patel
Sonographic description of thyroid nodules: Have we improved?

A Day in Medical Imaging
Medical Imaging Residents 2015 - 2016

PGY-1
- Yang Du
- Kavita Kanga
- Nicole Perkes
- Matt Wright

PGY-2
- Neil Kalra
- Sarah MacDonell
- Jimmy Wang
- Gage Watson

PGY-3
- Brie Alport
- Danielle Dressler
- Navdeep Sahota
- Nicholas Vassos

PGY-4
- David Horne
- James Huynh
- Meredith Lynch
- James Zheng

PGY-5
- Aatif Parvez
- Adarsh Patel
- Paul Russell
Research Officer Summary of Responsibilities

As Research Officer for the Saskatoon Health Region MRI department, I have been given a wide range of responsibilities, which aid researchers, radiologists, managers and technologists with patient throughput and advanced imaging procedures. My daily tasks include developing my own research projects, facilitating clinical scans for other researchers, optimizing MRI sequences, implementing advanced clinical protocols, reviewing safety procedures and assisting with medical physics education as shown below.

Developing Research Projects:
One of my core responsibilities is to work with radiologists and other University of Saskatchewan/Saskatoon Health Region staff to develop research projects. This may include writing grants, ethics applications, protocol and sequence development, patient recruitment, data collection and analysis, or submission to journals. Figure 1 shows data from a project aiming to study the relationship between venous flow and midbrain iron levels for Parkinson’s patients. Figure 1-A,B show SWI magnitude and corresponding phase data. ROI’s can be drawn and post processing implemented to determine the accumulated iron levels in deep brain structures such as the red nuclei and substantia nigra. Figure 1-C shows a contrast enhanced MRA of the head and neck. Blood flow within major vessels can be quantified without contrast by acquiring phase-contrast images temporally for a single axial slice over the at various temporal points over the cardiac cycle. Figure 1-D shows a phase contrast image taken at the C6-C7 level.

Another project involves the quantification of fat and water within tissues of the body. Figure 2, which shows a coronal image of the pelvis produced using a GRE-Dixon based sequence. Signal intensity in this image represents the fat percentage within each tissue. Areas with high fat content such as subcutaneous tissue are bright, whereas areas with low fat content like muscle are dark. Interestingly, this sequence may be able to distinguish the fat distribution of bone marrow. Regions of the skeletal system expected to contain yellow marrow such as the femur show higher fat content than areas expected to contain red marrow such as the sacrum and ilium.

Other projects include a DotTM knee analysis, implementation of Ultra-short Echo (UTE) sequences for diagnosing cortical bone lesions and iron analysis for blood products within joint spaces.

Implementing Advanced Protocols and Sequences:
I have been assigned to ensure advanced imaging protocols meet clinical requirements. Figure 3 shows a 2-chamber StiR (A), a short-axis cine image with automated LV function contour (B), a 4-chamber T2 (C), and a 3-chamber cine image (D) alignment using the DotTM cardiac software available on the Siemens 3T Skyra system at RUH. This new software has the potential to improve image plane alignment and reproducibility for several commonly used body regions and protocols. Furthermore, the 3T Skyra has the capability of analyzing tissue stiffness using the MR elastography (MRE) equipment. Figure 4 shows a coronal Haste image (B) collected on the 3T system. The green line through image (B) corresponds to the axial MRE slice through the liver (A). The MRE image depicts an accurate assessment of tissue stiffness through the liver. MRE is currently being tested for the application to other organs within the abdomen.
Similarly, I have been assigned to optimize MRI sequences and protocols already in use clinically. One issue with the RUH’s C-Spine protocol involves the acquisition of sagittal-oblique images for the visualization of nerve root compression. The oblique images currently used significantly add to the protocol time and cannot be reformatted to better visualize all nerve roots. A 3D isotropic coronal Space sequence of the C-spine has been developed to minimize tissue wrap and improve the oblique image plane for all as shown in Figure 5. This sequence ensures radiologists can visualize the nerve roots for all levels of the C-Spine by post-processing high resolution sagittal-oblique images with the MPR tool. Other sequences currently in development include high resolution DWI, DTI and Continuous-Scan Whole Body MRI.

Facilitating Research Scans:

I also act as a consultant on projects by assisting with the facilitation and acquisition of MRI scans for several research groups affiliated with the Saskatoon Health Region and the University of Saskatchewan. Figure 6 shows a high resolution, 0.25mm isotropic SWI image for a cadaver brain with known MS lesions. This specimen was scanned to assess and compare iron levels within the MS lesions using MRI and the Synchotron. Figure 7 A-C show a 3D T1-Space dataset of a canine prostate acquired in the coronal plane (B) on the 3T Skyra while the canine was anesthetized. Each canine was given injections to stimulate benign prostatic hyperplasia (BPH) and then imaged using X-ray, Ultrasound, MRI, PET-CT and the Synchotron for comparison to histopathology.

Shawn Kisch, B.A.Sc., M.Sc., R.T.M.R.
Clinical Trials in PET/CT

FDOPA/ Parkinson’s Disease:
- Using FDOPA-PET/CT to Monitor the Effectiveness of Fetal Dopaminergic Grafts in Parkinson Disease Patients.
  BO29337
  Bio # 14-245-OCOG-2013-Lustre
- A randomized trial of medically inoperable stage 1 non-small cell lung cancer patients comparing stereotactic body therapy versus conventional radiotherapy.
  BO21005 (GOYA)
- This is a Phase III, multicenter, open-label, randomized trial comparing the efficacy of G-CHOP versus R-CHOP in previously untreated patients with CD20-positive diffuse large B-cell lymphoma (DLBCL). The primary endpoint of this study is investigator-assessed progression-free survival, which is defined as the time from randomization to the first occurrence of progression or relapse, using a modified version of the Revised Response Criteria for Malignant Lymphoma, or death from any cause.
  RTOG 1216
- Randomized phase II/III trial of surgery and postoperative radiation delivered with concurrent cisplatin versus docetaxel and cetuximab for high risk squamous cell cancer of the head and neck.
  RTOG 1106/ACRIN 6697
- RANDOMIZED PHASE II TRIAL OF INDIVIDUALIZED ADAPTIVE RADIATION THERAPY USING DURING-TREATMENT FDG-PET/CT AND MODERN TECHNOLOGY IN LOCALLY ADVANCED NON-SMALL CELL LUNG CANCER (NSCLC)
  Millenium 25003
- Intergroup Randomized Phase II Four Arm Study In Patients With Previously Untreated Mantle Cell Lymphoma Of Therapy With: Arm A = Rituximab+ Bendamustine Followed By Rituximab Consolidation (RB → R); Arm B = Rituximab + Bendamustine + Bortezomib Followed By Rituximab Consolidation (RBV→ R), Arm C = Rituximab + Bendamustine Followed By Lenalidomide + Rituximab Consolidation (RB → LR) or Arm D = Rituximab + Bendamustine + Bortezomib Followed By Lenalidomide + Rituximab Consolidation (RBV → LR)
  LY.16 (LYSARC RELEVANCE Trial)
- A PHASE III OPEN-LABEL RANDOMIZED STUDY TO COMPARE THE EFFICACY AND SAFETY OF RITUXIMAB PLUS LENALIDOMIDE (CC-5013) VERSUS RITUXIMAB PLUS CHEMOTHERAPY FOLLOWED BY RITUXIMAB IN SUBJECTS WITH PREVIOUSLY UNTREATED FOLLICULAR LYMPHOMA
  NRG HN002
- A randomized phase II trial for patients with p16 positive, non-smoking associated, loco-regionally advanced oropharyngeal cancer.

Development of Synchotron-Based Imaging Tools for Prostate Cancer Research Using an Induced Canine Model
- This study will develop improved imaging methods to detect prostatic disease in humans though the use of dogs with induced benign prostatic hyperplasia (BPH) and a synchrotron based x-ray source for the imaging and therapy of at the Canadian Light Source. The study will compare the Synchrotron imaging, ultrasound, CT, 3T MRI and PET/CT with each other and subsequent microscopic analysis. This will allow for the development of improved non-invasive diagnostic imaging protocols for both men and dogs.
Research Grants of Faculty: 2011-2015

2011
Title: Treatment of human glioblastoma multiforme (GBM) xenografts with direct intra-tumor delivery of targeted anti YB-1 therapy using cell permeable peptide (CPP) versus liposomal doxorubicin, alone or in combination with collimated minibeam radiation,
Ali S (Co-principal Investigator), Kundapur V (Co-principal Investigator), Wiebe S (Co-investigator), Dunn S (Co-investigator), Sidu N (Co-investigator), Chapman L (Co-investigator), Chibbar R (Co-investigator).
Agency: Saskatchewan Cancer Agency.
Date: 2011-03-17 to 2013-03-17
Amount: $199,874.00

2012
Title: Salter-Harris Fracture of the Distal Fibula: Clinical Suspicion Versus Reality
Boutis K (Principal Investigator), Babyn P (Collaborator).
Agency: Physicians’ Services Incorporated Foundation.
Date: 2012 to 2014
Amount: $170,000.00

Title: Improving the Measurement of Renal Function with Radionuclide Techniques
Babyn P (Principal Investigator), Wesolowski C (Principal Investigator).
Agency: Canadian Centre for Nuclear Medicine (CCNI).
Date: 2012 to 2014
Amount: $108,790.00

2013
Title: Power Injectable vs. a Non-Power Injectable, Upper Arm, Totally Implanted Venous Access Devices (TIVAD) for the treatment of Breast Malignancy,
Burbridge B (Principal Investigator).
Agency: This is a randomized clinical trial using two different TIVAD devices, Cook Inc. and Angiodynamics. Cook, Inc. USA.
Date: 2013-07 to 2015-06
Amount: $30,000.00
Comment: This grant required an application to Cook inc. Canada who forwarded it to their Research Division in Bloomingtion, IN, USA. This was approved by the Global Product Manager for Interventional devices, Anthony Hammack.

Title: Molecular Imaging Research Support
Babyn P (Principal Investigator)
Agency: Royal University Hospital Foundation
Date Awarded: January 2013
Amount: $500,000.00
2014

Title: One Health Imaging Group
Fonge H, Rakheja R, Babyn P
Agency: Saskatchewan Health Research Foundation
Date: January 2014
Amount: $60,000.00

Title: Assessing Interictal Cognitive Effects and Cortical Excitability in Migraine and Epilepsy
Mickleborough M, Babyn P
Agency: Saskatchewan Health Research Foundation
Date Awarded: 2014
Amount: $30,000.00

Title: One Health Imaging Research Group
Babyn P, Singh B
Agency: Sask Health Research Foundation
Date Awarded: 2014
Amount: $30,000.00

Title: Fellowship for Michal Wesolowski: International Collaboration on the Translation of Quantitative 2D Coded Aperture Phase Imaging from the Synchrotron to the Preclinical Laboratory
Wesolowski M, Babyn P
Agency: Berroughs Wellcome Fund
Date Awarded: 2014
Amount: $10,000.00

Title: Saskatchewan Program in Nuclear Imaging (nuclear faculty funding and infrastructure grant)
Paul Babyn (Principal Investigator) Humphrey Fonge, Co-applicant: Clarence Ronald Geyer; Darrell Mousseau; Dave Palmer; Ed Kroll; IldikoBadea; Kishor Wasan; Mark de Jong; Sina Adl; Susan Abrams; Zisis Papandreou
Agency: Fedoruk Centre
Date: 2014/10 - 2019/9
Amount: $5,200,000
Funding Competitive: Yes

Title: Targeted molecular imaging and therapy of insulin growth factor type 1 (IGF-1R) positive cancers
Principal Investigator: Humphrey Fonge Co-investigator: Dr. Xiongxin Dai; Ronald C Geyer
Agency: Sylvia Fedoruk Centre for Nuclear Innovation | Bi-annual calls - summer 2013
Date: 2014/1 - 2015/12
Amount: $172,000.00
Funding Competitive: Yes
Title: Imaging gene delivery nanoparticles targeted to melanoma  
Principal Investigator: Indiko Badea Co-investigator: Humphrey Fonge  
Agency: Fedoruk Centre | Bi-annual grant program  
Date: 2014/9 - 2016/8  
Amount: $192,000.00  
Funding Competitive: Yes

Title: Development and commercialization of biologic molecular imaging agents  
Principal Investigator: Clarence Ronald Geyer Co-investigator: Konstantine Sarafis; Paul Babyn, Humphrey Fonge  
Agency: Western Economic Diversification Canada  
Date: 2014/11 - 2017/10  
Amount: $2,250,000  
Funding Competitive: Yes

Title: Health Research Group Grant  
Principal Investigator: Humphrey Fonge Co-investigator: One Health Imaging Group  
Funding Sources: Saskatchewan Health Research Foundation (The) (SHRF)  
Date: 2014/1 - 2015/12  
Amount: $60,000.00  
Funding Competitive: Yes

Title: New faculty Start-up grant | New Investigator Start-up Grant  
Principal Investigator: Humphrey Fonge  
Agency: Royal University Hospital Foundation (Saskatoon, SK)  
Date: 2014/1 - 2014/12  
Amount: $100,000.00  
Funding Competitive: No

**2015**

Title: Alpha particle labelled antibodies for targeted alpha therapy (TAT)  
Principal Investigator: Humphrey Fonge Co-investigator: Clarence Ronald Geyer  
Date: 2015/4 - 2017/3  
Amount: $20,000.00  
Funding Competitive: Yes

Title: [18F]FDOPA PET/CT to monitor the effectiveness of fetal dopaminergic Grafts in parkinson patient  
Principal Investigator: Rajan Rakheja Co-investigator: Humphrey Fonge  
Agency: Fedoruk Centre | Bi-annual grant program  
Date: 2015/2 – 2017/1  
Amount: $29,900.00
Title: Development of Molecular Imaging Agents to Measure HER3 Expression and Activation in Breast Cancer
Principal Investigator: Clarence Ronald Geyer Co-investigator: Humphrey Fonge
Agency: Fedoruk Centre | Bi-annual grant program
Date: 2015/2 – 2017/1
Amount: $211,715.00
Funding Competitive: Yes

Title: Development of theranostic agents for melanoma
Principal Investigator: Ildiko Badea Co-investigator: Kamaljit Kaur; Kishor Wasan; Humphrey Fonge
Agency: Saskatchewan Health Research Foundation (The) (SHRF) Collaborative innovative development grants
Date: 2015/6 – 2016/5
Amount: $40,000.00
Targeted Molecular Imaging and Therapy of Cancer

Dr. Humphrey Fonge, PhD, MBA
Radiopharmacist, Clinical Assistant Professor, CoM, UofS

Research Group/Team & Research Associates
1) Dr. Raja Viswas – joined in 2016
2) Dr. Elahe Alizadeh - joined in 2016

Post-doctoral Fellows
1) Dr. Siddana Hartimath - joined in 2015
2) Dr. Rufeal Chekol - joined in 2014
3) Dr. Istvan Hadju (co-supervised with Dr. Ildiko Badea) - joined in 2014
4) Dr. Amal Makhlouf (co-supervised with Dr. Ildiko Badea) - joined in 2015

PhD Student
1) Mohamed Yehia - joined in 2016

Summer Students
1) Georgia Bailey (3rd year pharmacology (May – August 2016)
2) Kayla Wharton (1st year pharmacy (May – August 2016: co-supervised with Dr. Ildiko Badea)

New Recruitment
In view of our recent collaboration with the Canadian Isotope innovation we are looking for a new post-doc to join the group.

Preclinical Research Activities
The preclinical research activities of my group focus on four key research themes:

1) Development of radiolabeled antibodies and antibody fragments as PET or SPECT imaging agents
2) Development of antibody drug conjugates and alpha particle labeled radioimmunoconjugates (radiolabeled antibodies) as novel cancer therapeutics
3) Development of dual labeled (fluorescent + radiolabeled) probes for improved image-guided surgery of solid tumours
4) Cyclotron production of medical isotopes. Under this activity we have initiated research on the production of 89Zr in collaboration with Advanced Cyclotron Systems Inc (ACSI; Richmond BC)

Key Collaborators - Preclinical Research Activities
CR Geyer - Professor of Pathology and Lab. Medicine – CoM, UofS
Ildiko Badea, Associate Professor of Pharmacy and Nutrition, UofS
Examples of antibody imaging and therapeutic agents currently under development include:

**Anti-ICAM-1 antibodies**

ICAM-1, or intracellular adhesion molecule 1, we are currently pursuing atherosclerosis, and triple negative breast cancer. ICAM-1 encodes a cell surface glycoprotein typically expressed on endothelial cells and cells of the immune system. It binds integrins of type CD11a/CD18 or CD11b/CD18 (RefSeq Jul 2008). ICAM-1 is a general marker of inflammation and is therefore a marker for a variety of diseases including atherosclerosis, cardiac transplant rejection, multiple sclerosis, diabetes, radiation-induced brain injury, stroke and potentially Alzheimer’s and Parkinson’s. It has also been found upregulated in some tumors including triple negative breast cancer. ICAM-1 is an FDA approved drug target, antibodies targeting ICAM-1 include: 1.) BI-505 (human IgG) which has been granted orphan drug designation for multiple myeloma by the US Federal Drug Administration (FDA) and European Medicines Agency (EMA). 2.) Enlimomab (discontinued), which was in clinical trials in Europe. 11-4 H4, is a humanized lama antibody (VHH) isolated by the National Research Council of Canada (NRC) targeting ICAM-1. As part of our development program, we have established a collaboration with the NRC to reengineer their lama VHH. We are currently testing its ability to target triple negative breast cancer in collaboration with NRC, and developing additional intellectual property.

**Anti-EGFR antibodies**

EGFR, or Epidermal growth factor receptor, we are pursuing for oncology. EGFR is a transmembrane glycoprotein that is a member of the protein kinase superfamily. Binding of the protein to a ligand induces receptor dimerization and tyrosine autophosphorylation and leads to cell proliferation (RefSeq Jul 2010).

EGFR is an FDA approved drug target, notable antibodies include 1.) Cetuximab (FDA approved 2004), 2.) Necitumumab (FDA approved 2016) 3.) Panitumumab (FDA approved 2006).

Nimotuzumab, is a humanized antibody (IgG1-kappa) developed by Center of Molecular Immunology (CIM). Nimotuzumab has orphan drug status in the US and European Union. The toxicity and safety profile of Nimotuzumab compared to other EGFR antibodies is highly favorable. We are currently developing additional intellectual property on this antibody in collaboration with CIM and partners. As part of our development program, we have established a collaboration with the Centre of Molecular Immunology (CIM) in Cuba to reengineer their cancer therapeutic antibody, Nimotuzumab, for medical imaging diagnostics. This therapeutic antibody is being marketed in Singapore, China, India and several other countries including pending marketing application in Europe for head and neck, pancreatic and bowl cancers, by CIM’s licensing and joint venture industry partners Innocimab in Singapore, Biocon in India and Daiichi Sankyo in Japan.

We are in the process of engaging CIM’s industry licensees to partner with us, in order to support our pre-clinical development and clinical trials for this antibody for diagnostic imaging, to identify patients that can benefit from this and similar therapeutics as well as to guide surgical intervention to remove tumors without damaging surrounding tissue. Additionally, we intend to pursue joint ventures with these entities to establish a spin-off in Canada as well as license our antibody imaging agents for jurisdictions where these companies currently market cancer therapeutic antibodies.
**Radiopharmaceutical Therapy with alpha particle 223RaCl2 (xofigo):**

Xofigo is an alpha particle radiopharmaceutical that is approved for the treatment of bone lesions in prostate cancer patients with bone metastasis. The drug has been in use at a few sites in the country but was only recently available for Saskatchewan patients. Patients qualify for xofigo under a very strict selection criteria and the coordinating their treatment must be carefully planned. In the department (joint efforts of colleagues in the department including nuclear medicine physicians, Valerie Yanu (radiopharm tech), Jenna Frey (RSO), we have coordinated/planned (in consultation with Saskatchewan Cancer Agency) the treatment of patients with this drug. The first patient received treatment on July 21.

We are also currently having discussions with Bayer Healthcare to initiate clinical studies using xofigo in other (other than prostate cancer) clinical settings. To the best of our knowledge we may be the first Canadian site to carry out clinical studies in other cancers using xofigo.

**Knowledge Translation Activities: International/National Collaborations**

**Some Examples of National and International Collaborations:**

1) **Kalsruhe, Germany** Alpha particles in particular 213Bi and 225Ac are two of the most potent therapeutic radioisotopes. However, these are expensive ($4,200/mCi) and availability is always an issue. The Institute of Transuranium Element is a key supplier of these isotopes. They also have a world-class facility to produce immunoconjugates labeled with these isotopes with enormous radiochemistry experience. Under this collaboration we will share expertise on the production of antibodies and radiochemistry of antibodies.

2) **Collaborative R&D with Center of Molecular Immunology (CIM: Havana, Cuba).** We recently signed a collaborative agreement with CIM to develop diagnostic (companion imaging agents) and radiotherapeutic agents using therapeutic antibodies developed by CIM. CIM has many antibodies in clinical trials including anti-EGFR nimotuzumab which is approved in many jurisdictions (e.g. India, China). Under this agreement we will develop and commercialize these probes/radiotherapeutics.

3) **Research collaboration with the National Research Council (NRC) of Canada:** The NRC is interested in studying the biological properties of a range of antibodies and peptides that they are developing. They are also interested to develop companion imaging agents or diagnostics from these antibodies. On these bases we have recently signed a collaborative R&D to provide these expertise (radiochemistry, antibody engineering and molecular imaging) to the NRC as well as commercialize promising antibody/peptide imaging agents.

4) **Research collaboration with Canadian Nuclear Laboratory (CNL; formally Atomic Energy Agency of Canada Limited (AECL)).** The focus of this collaboration is to develop Actinium-225 (225Ac) labelled alpha particle radioimmunotherapeutics (RIT). Remarkable efficacy has been observed some alpha particle therapeutics and 225Ac is the most potent alpha particle. Under this agreement the CNL will produce 225Ac and share expertise on the development of RIT. It is worth noting that the CNL is the only facility in Canada that is engaged in the production of 225Ac. In the long term this collaboration will allow us have a constant supply of this scare but vital isotope. This constant supply is important if these agents are to be translated to the clinics.
5) Collaboration with Advanced Cyclotron Systems Inc (ACSI; Richmond, BC): Our collaboration with ACSI involves the development and testing of a solid targetry system and the use of the solid targetry system for the production of radiometals. The initial collaboration has been focused on the production of Zirconium-89 (89Zr). The radionuclide has ideal properties for PET imaging of antibodies and nanodelivery systems that have a long circulating half-life. This collaboration will be extended to other radiometals such as Scandium-44. These are isotopes that are critical for my imaging research program. This development program will support the research efforts at the University of Saskatchewan and lead to commercial opportunities for ACSI.

6) Collaboration with the Drs. Monique Mayer and Jerome Gagnon (WCVM, UofS): There is overwhelming evidence that companion animals are a better model of human disease. At UofS we are uniquely positioned to use large animal models bearing spontaneous cancers as models of human disease. Under our collaboration with vet radiation oncologist Drs. Gagnon and Mayer we will 1) use companion animals to generate data needed for clinical trials with Health Canada and FDA for alpha particle radiotherapeutics and 2) develop and treat cancers in companion animals using companion animal specific radiotherapeutic agents developed in the lab.

7) Collaboration with Canadian Innovation Isotope (CII): CII is Saskatchewan based radiopharmaceutical company that is uniquely positioned to produce a wide range of medical isotopes using a safe, efficient non-reaction-based electron linear accelerator technologies. For the first time in Canada 99Mo/99mTc has been produced using CII’s non-reactor based electron linear accelerator. Their most advanced product 99Mo/99mTc will address the anticipated shortage in 99mTc supply – the most widely used medical isotope. A collaboration between the Royal University Hospital (RUH) Saskatoon, UofS and CII headed by Drs Fonge, Babyn, Rakhejan and Mangera (CII) will allow CII to further develop and translate 99mTc in patients

Knowledge Mobilization Activities: Symposiums

1) We organized a one-day on “Symposium on radiopharmaceutical therapy” on October 16, 2015 that was attended by close to 100 participants from the USA and Canada.

2) We obtained Review Ethics Board (REB) and Health Canada Approval for a clinical study on “Monitoring the effectiveness of fetal dopaminergic transplant using [18F]FDOPA PET/CT imaging”
Resident Publications: 2011-2015

2011


2012


2013


2014


2015


Faculty Publications: 2011-2015

2011


Thakur N, Leswick DA. “Case of the month #167: flexor hallicus longus tendon tear distal to the master knot of Henry.” Can Assoc Radiol J. 2011 May;62(2): 154-7


2012


**Burbridge B, Matte G, Roy H.** “Intravascular Contrast in Computed Tomography: Chemistry, Administration Strategies, and Imaging Implications.” Vascular Access 2013: 7(3); 9 - 14


**Sheldon Wiebe,** Glendon Rhodes, Zhouping Wei, Alan Rosenberg, George Belev, Dean Chapman “Understanding Refraction Contrast using a Comparison of Absorption and Refraction Computed Tomographic Images” Journal of Instrumentation, Volume 8, May 2013

Zhouping Wei, **Sheldon Wiebe,** Dean Chapman “Ring Artifacts Removal from Synchrotron CT Image Slices” Journal of Instrumentation, Volume 8, June 2013


Desai S, Deiner T, Tan BJK, Nowry NJ, Talukdar C, Chrusch WM, Wiebe S "An Unusual Case of Vaccine Associated Paralytic Poliomyelitis (VAPP)” Canadian Journal of Infectious Disease and Medical Microbiology, Vol 24 No 4


2015


Dressler D, **Leswick D**. “Canadian association of radiologists annual scientific meetings: how many abstracts go on to publication?” Can Assoc Radiol J. 2015 May;66(2):96-101. doi: 10.1016/j.carj.2014.05.005. Epub 2015 Jan 10

Huynh J, **Obaid H** “Thigh Pain” Skeletal Radiol. 2015 May;44(5):763-4


Rosenberg A , Roades G, **Wiebe S**, Cooper D, Belev G, Wong A, Chapman D
"Diffraction Enhanced –Computer Tomography Imaging of Growing Joints Using a Synchrotron Light Source" Journal of Comparative Medicine, Vol 65, No4 2015

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