

NEURO

ANNUAL REPORT
2019-2020

CARE IN THE TIME OF COVID

Dr. Davide Martino and
nurse Karen Hunka care
for a patient at Foothills
Medical Centre

Department Vision

Caring, Educating, Innovating. Together.

Department Mission

By building healthy teams, collaborating with patients, outstanding care providers, researchers, educators and health care administrators, the Department of Clinical Neurosciences will provide compassionate, equitable, and high-quality care to people dealing with neurological problems. While doing this, we will constantly strive to learn and to improve.

Department Goals

- Provide compassionate, timely and high quality care to patients and their families.
- Lead in neuroscience research.
- Build innovations in care delivery.
- Train the specialists and leaders of tomorrow.
- Flourish in a fulfilling collaborative work environment.
- Communicate transparently within and outside our organization.
- Measure and optimize patient outcomes.

Department of Clinical Neurosciences

Room 1195 – Foothills Medical Centre
1403 29th Street N.W.
Calgary, Alberta
T2N 2T9
403-944-1260



Cover photo

Neurologist Dr. Davide Martino visits with a patient at Foothills Medical Centre

CLINICAL
NEURO
SCIENCES
CALGARY + CANADA



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Message from the Department Head

Dr. Rajiv Midha

It has been a year like no other. What started as a normal year — with exceptional research, training and patient care — transformed rapidly into a PPE-fuelled marathon that impacted all our faculty.

Our members stepped up to the challenge.

They learned to adapt; they found creative ways to care for patients; and they volunteered to be on the front lines of the COVID-19 pandemic.

Despite the challenging environment, our residency programs continued to train an impressive cohort of physicians. The quality of their training is demonstrated by the fact that half of our faculty recruits were former DCNS residents.

Our clinical and translational researchers had their work interrupted when outpatient restrictions were introduced in hospitals and when University of Calgary labs were closed.

As HBI director and Translational Neurosciences member David Park noted, researchers had to “find the silver lining” in the disruptions. “It’s a sign of great people when they adapt to the circumstances,” he says.

We are extremely proud that two of our members—Shalina Ousman, PhD, and Dr. Paolo Federico—were successful in the Spring 2020 CIHR project grant competition.

And we continued to celebrate the numerous clinical research projects that our department is involved in, including Calgary-led ESCAPE-NA1 trial, which published in The Lancet on Feb. 20. The stroke team’s work pointed to promising signs that neuroprotection may be possible in ischemic stroke patients when the drug nerinetide is combined with endovascular therapy.



On the clinical front, I can’t stress enough how proud I am that our teams have maintained world-class patient care in these difficult times.

We navigated hospital-based outbreaks and staffing shortages as we provided critical inpatient care. We learned to perform some patient consultations via phone and video, which is challenging when diagnosing neurological issues.

In Neurosurgery, we’ve had to postpone many elective surgeries and reschedule others. But from the early days of this pandemic our members have ensured that all urgent and emergent cases—such as brain tumour surgeries—have continued.

Dr. Christine McGovern, head of the Section of Physical Medicine and Rehabilitation, summarizes our work incredibly well:

“Quality care to individuals that require it remains our top priority, both prior to the pandemic, during, and following. Some of the care has changed in how it is delivered, but we remain committed and continue to work alongside our colleagues to provide care where needed.”

Thank you for taking the time to learn about our department. We hope you enjoy our annual review.

Dr. Rajiv Midha
Professor and Head
Department of Clinical Neurosciences

RECRUITMENT AT DCNS

The Department of Clinical Neurosciences has been very fortunate to recruit a number of talented physicians in 2019-2020, including a number of former residents.



Camila Aquino
Neurologist



Jennifer Litzenberger
Physiatrist



Carlos Camara-Lemmaroy
Neurologist



Wei-Qiao Liu
Neurologist



Fady Girgis
Neurosurgeon



Theodore Mobach
Neurologist



Rebecca Iwanicki
Physiatrist



Marcin Partyka
Physiatrist

Not pictured:

Jonathan Fridhandler
Neurologist



Andrea Salmon
Neurologist

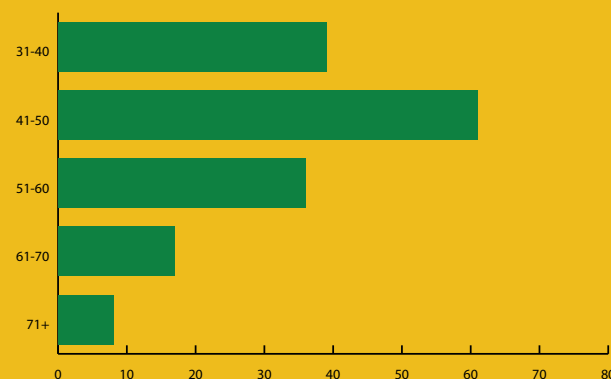
MEMBERSHIP

Our department continues to grow in its three clinical areas: Neurology, Neurosurgery and Physiatry.

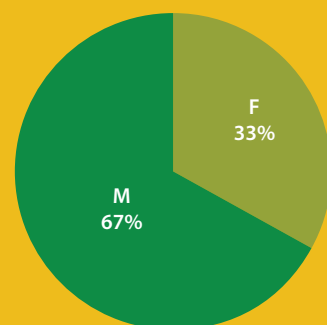
We have 122 members in our department and their roles are roughly split between Clinical/Adjunct, Major Clinical and GFT.

We celebrate equity, inclusion and diversity in our ranks and strive to improve our hiring, promotion and leadership processes across the department.

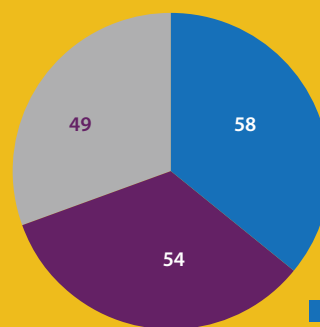
Age Distribution



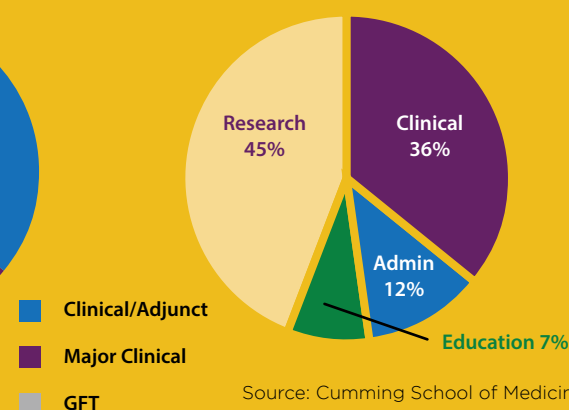
Gender 122 Faculty Members



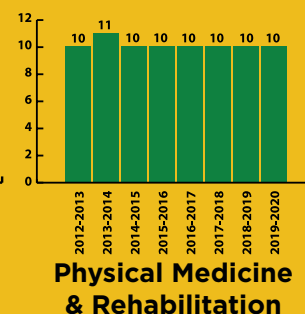
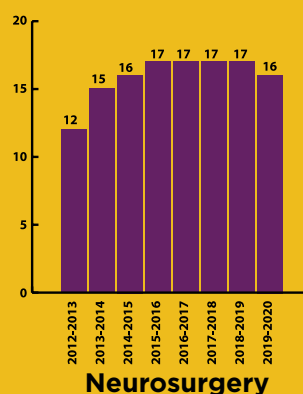
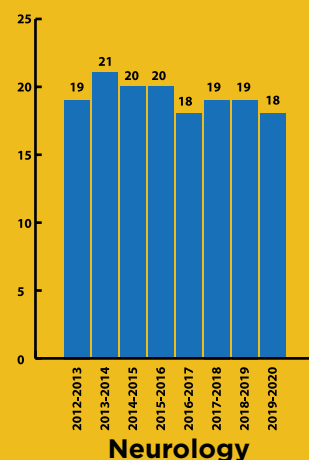
Appointments to Faculty in DCNS



GFT -Activity Profile (47 FTE in DCNS)



Resident Education by Section



The Department of Clinical Neurosciences is exceptionally proud of our three residency programs that are home to 44 talented residents doctors.

ACCOMPLISHMENTS

In spite of the challenges that COVID has brought, our members have much to celebrate.

Multiple department members were recognized for their accomplishments. As an example, **Dr. Luanne Metz** was appointed to the **Canadian Academy of Health Sciences**.

Department researchers were well represented in the Spring 2020 **Canadian Institutes of Health Research (CIHR)** project grant competition.

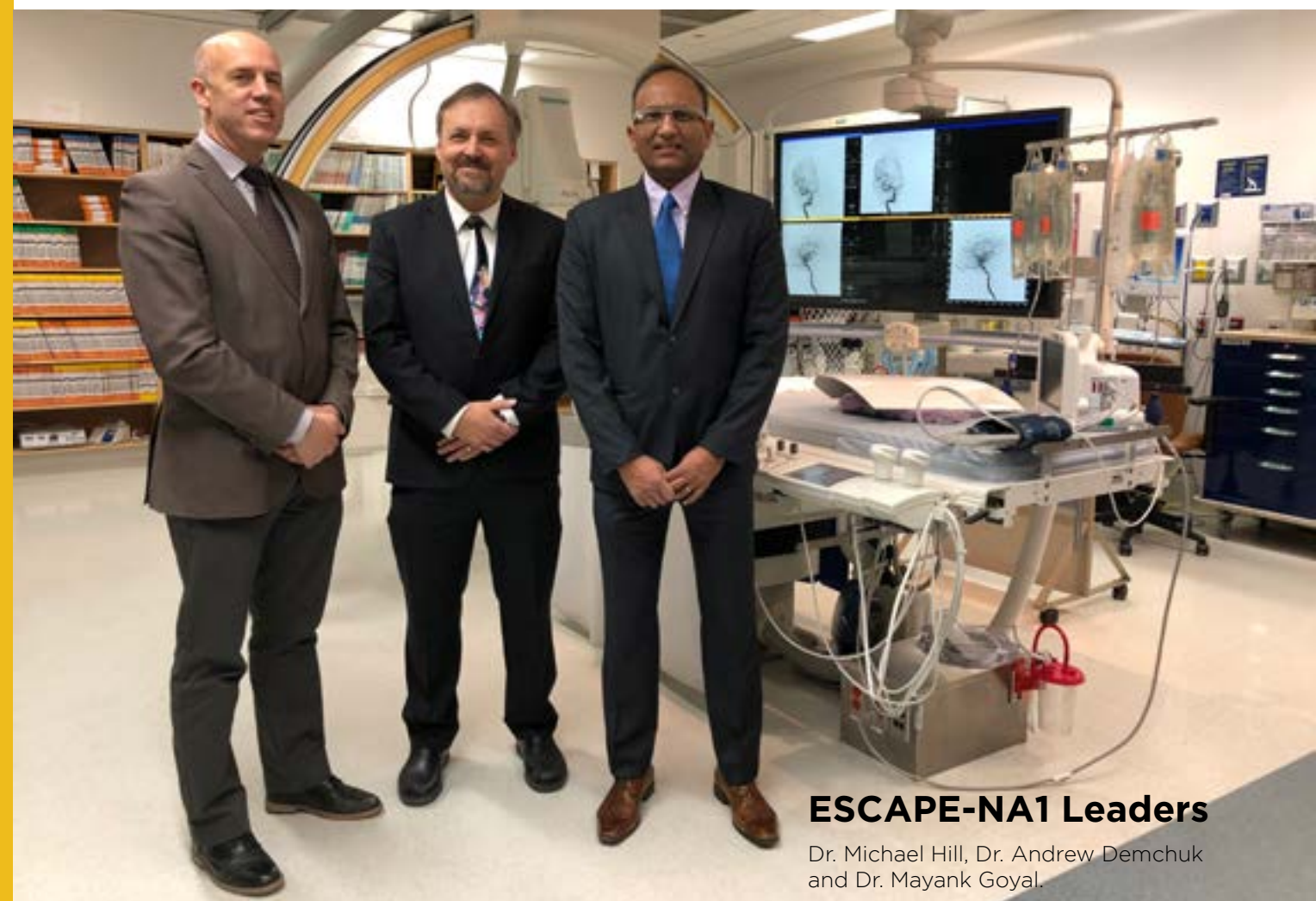
Shalina Ousman, PhD, received funding for “The injured peripheral nervous system and aging.” **Dr. Paolo Federico** was awarded for his work “Improving epilepsy surgery outcome through better surgical target identification.”

Our stroke team published the results of their UCalgary-led international trial, **ESCAPE-NA1**.

Their work pointed to promising signs that neuroprotection may be possible in ischemic stroke patients when the drug nerinetide is combined with endovascular therapy. Results from the multi-centre, double-blinded, randomized trial were published in The Lancet on Feb. 20.

“Compared to placebo, almost 20 per cent more patients who received nerinetide along with endovascular treatment, but did not receive alteplase, recovered from a devastating stroke—a difference between paralysis and walking out of the hospital,” said neurologist **Dr. Michael Hill**.

The trial enrolled 1,105 patients between March 2017 and August 2019 at centres in North America, Europe, Australia, and Asia – a global academic collaboration bringing together scientists, clinicians, funding agencies, and industry.



ESCAPE-NA1 Leaders

Dr. Michael Hill, Dr. Andrew Demchuk and Dr. Mayank Goyal.

CHALLENGES

As with other departments, COVID has affected all areas of our work.

Research programs, especially those involving patients, were put on hold in the Spring. Some researchers found innovative ways to continue with their work—and others have used the downtime to regroup, collaborate virtually, or plan for 2021.

Education, a large part of our department's mandate, was similarly affected. Medical students were unable to attend courses and access hands-on clinical learning; symposiums and lectures were cancelled; and residents scrambled to cover staff shortages.

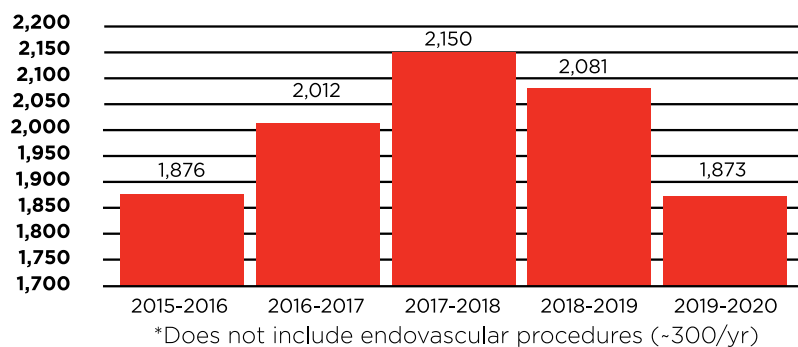
Our clinicians juggled ever-changing rules about outpatient visits and adopted PPE to protect themselves and their patients. Virtual visits provided an opportunity to safely consult with patients—but not without obvious challenges. Neurological conditions are difficult to diagnose at the best of times. Subtle changes are easy to miss during phone or video calls—especially when a physical exam is a critical part of the diagnosis.

Neurosurgeons had to cope with elective procedure cancellations while ensuring that urgent and emergent surgeries—especially brain tumour procedures—were never delayed. With resumption of OR slates, postponed patients were quickly rebooked and operations completed.

All our members—in Neurology, Neurosurgery, and Physical Medicine and Rehabilitation—rose to the challenge of COVID and we are exceptionally proud of their dedication to patient care.



Surgical OR Cases Neurosurgery at FMC



QUALITY IMPROVEMENT

For many years, the Department of Clinical Neurosciences has recognized the value that QI plays in patient safety, satisfaction and operational efficiency.

Our Quality Council—led by full-time QI consultant Erin Barrett and Dr. Megan Yaraskavitch—includes six faculty members, over a dozen operational members, and three patient and family advisors. The team is in the process of adding a data analyst position.

One of its major undertakings, supported by an AHS QI Grant to Megan, has been “Improving the Care of Patients with Neurological Symptoms Discharged from the Emergency Department.”

The project was focused on ensuring that ED patients were seen by the Urgent Neurology Clinic within one week of their discharge. In 2017, 60 per cent of referrals to the UNC did not meet the “urgent” criteria—resulting in declined referrals and a delay for those patients who did have urgent needs.

The project produced:

- updated UNC referral criteria;
- a “Where Does My Patient Go?” flowchart for referring providers;
- electronic referral orders for ED physicians;
- patient materials and a patient-focused website.

Working with clinic staff and Emergency Departments they achieved a 23 per cent decrease in (inappropriate) referrals to the UNC. As a result of this decrease, 30 per cent fewer referrals were declined.



EQUITY, INCLUSION & DIVERSITY

The makeup of our department has changed dramatically over its nearly 40-year history.

Through our actions, policies and recruitments, we define ourselves and our commitment to equity, inclusion and diversity.

Our progress is discussed regularly by leadership and we are planning special events (including a regular Health Equity Rounds) next year.

We celebrate our diversity and understand it is a core strength of our department.



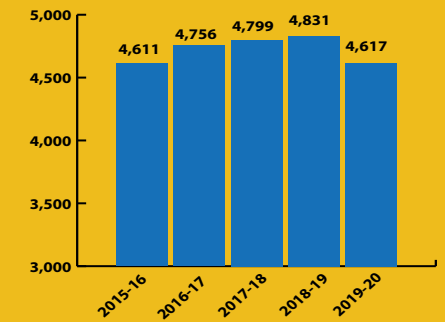
METRICS: CLINICAL

Total Outpatient Visits

Site	2014-2015	2015-16	2016-17	2017-18	2018-19	2019-20
FMC	32,423	34,115	36,745	37,792	39,128	36,634
PLC	1,285	2,541	2,536	3,987	5,334	555
RGH	2,778	5,380	5,916	5,333	5,653	3,481
SHC	11,663	12,599	12,628	13,289	15,410	13,783
ACH (Ped NSx)	1,961	2,318	2,493	2,845	2,108	1,441
Total	50,110	56,953	61,229	64,411	69,251	55,897

Total excludes off hospital site visits

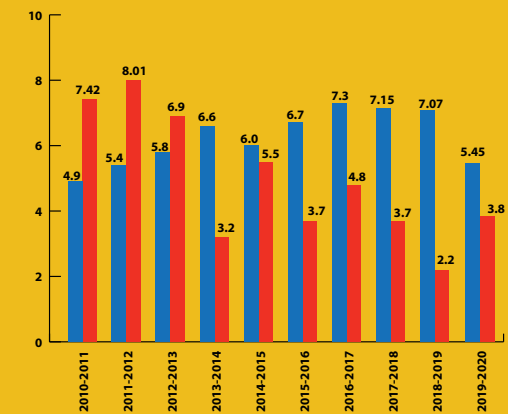
Total Discharges



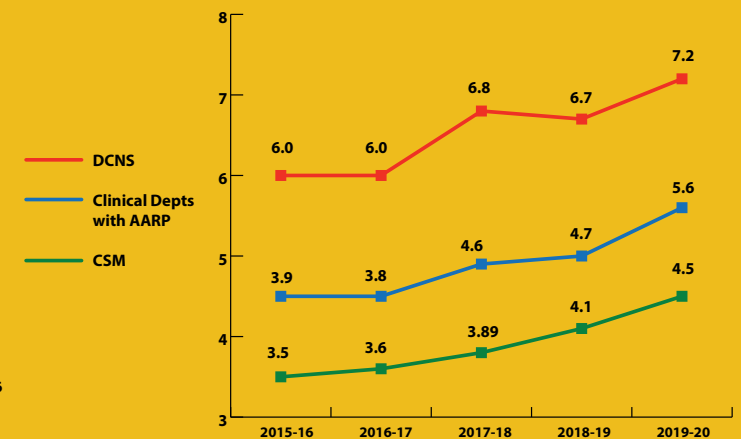
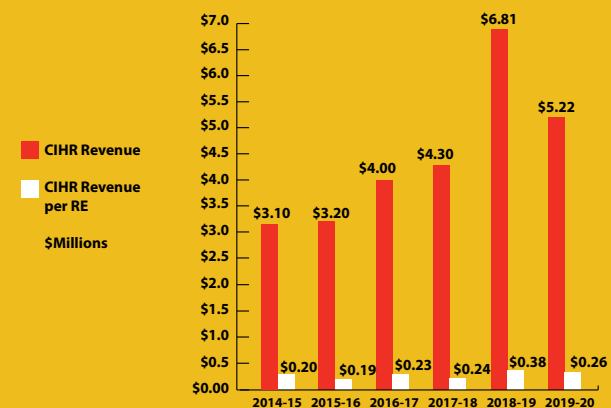
SMU Admissions/ Wait Times



EMG Outpatient Volumes/ Wait Times



METRICS: ACADEMIC



The Section of Neurology

Section Head: Dr. Lara Cooke

THE SECTION OF NEUROLOGY is one of the largest neurology groups in Canada. We have 65 neurologists serving four adult hospitals, community neurology clinics, and providing outreach to rural areas and inner city primary care clinics where needed. In the last fiscal year, we developed a strategic plan for the coming years, focused on excellent, equitable clinical care, innovation, education, and a healthy organizational culture. This past year has brought us ample opportunity to continue to work on our strategic goals, across the board.

Clinical Care

During the 2019-2020 academic year, we were very fortunate to recruit several new section members:

- Dr. Carlos Camara-Lemarroy (Multiple Sclerosis)
- Dr. Andrea Salmon (Epilepsy)
- Dr. Camila Henriques de Aquino (Movement Disorders)
- Dr. Theo Mobach (Neuromuscular)
- Dr. Jonathan Fridhandler (Multiple Sclerosis and General Neurology)
- Dr. Wei-Qiao Liu (Multiple Sclerosis and General Neurology)

As a group we provided roughly 50,000 ambulatory visits and care for almost 10,000 hospital patients. Quality Improvement projects, led by Erin Barrett, Dr. Megan Yaraskavitch and our outstanding inpatient management teams led to improvements in discharge planning, enhanced processes for neurological follow-up after patients are discharged from emergency rooms in Calgary, and strategies to enhance team communication in hospital and ambulatory settings.

Innovation

Innovation occurs in the form of research, but also in novel models of care delivery.

Research and academic output has remained very strong in the Section of Neurology, with over \$18 million in research revenues, \$2 million in CIHR revenues, and another \$10 million in clinical



research revenues. Our research teams made 595 contributions to peer reviewed publications in their field.

In terms of care delivery, the global pandemic has driven innovation across the entire health care system. In the Section of Neurology, we were pleased to be able to continue to deliver care at 95% of normal capacity to outpatients throughout the early months of the pandemic using virtual platforms. We were able to rebook thousands of patients using virtual platforms and collaboration with vital community neurology partners so that they still received care despite required service slowdowns in many parts of the hospital systems in Calgary in Spring of 2020. The pandemic has required neurology physicians, trainees, managers, and operational leaders to be creative, flexible, responsive, and action oriented on a daily basis for many months. Never has there been a time where there was greater need to pull together as a team to look after not only our patients and their families, but one another as well.

Members of this section have risen to the occasion in the truest sense—they have shone in their ability to respond to abrupt changes in direction and to step in to cover for one another in response to stringent isolation requirements leading to absences and the need to change how we operate as a group.

Despite the many challenges arising from the pandemic, through innovations in care delivery models and central triaging, and collaborations with community partners, we have been able to make major positive changes to waitlists for subspecialty care in headache and movement disorders, meaning there will be improved access for patients living with these conditions.

Education

Education remains a priority for the Section of Neurology. In the 2019-2020 academic year, we were fortunate to have 18 outstanding neurology residents learning their discipline within our section. In addition, neurology contributed to the training of another 59 residents from other areas of medicine and 62 clerks, and several nurse practitioner trainees, comprising hundreds of hours of specialty education for medical trainees. We were proud to see all four of our outstanding fifth year residents successfully pass their fellowship examinations and move on to prestigious fellowship programs in stroke, epilepsy, movement disorders, cognition and neuro-ophthalmology.

Residents have been key players in our ability to maintain services during the pandemic. Like the neurologists, they have had to be patient, pivot frequently, and step up to cover for illnesses more than ever before. Beyond their usual duties, our senior residents in the last year also took leadership roles in driving COVID-related clinical trials and supervising and training hundreds of COVID contact tracers under the leadership of Public Health Officers. We could not be more proud of the selfless contributions of all of our residents during this challenging year.

In summary, great things have been accomplished by this group in the past year. The pandemic, while undoubtedly one of the greatest challenges of our collective careers, has represented an opportunity as well—an opportunity to see the strength of character and dedication of the group to ensuring the safety and wellbeing of our patients, and our team members during the most difficult of circumstances.

The Calgary Comprehensive Epilepsy Program

Program Lead: Dr. Samuel Wiebe

Overview

Through its strong academic and clinical arms, the Calgary Comprehensive Epilepsy Program (CEP) focuses on achieving the best outcomes for patients suffering from epilepsy. This is accomplished through new developments in clinical research, quality improvement initiatives, and comprehensive, interdisciplinary clinical care. The interdisciplinary team includes a highly skilled group of specialists in epilepsy comprising neurologist epileptologists, epilepsy neurosurgeons, neuropsychiatrists, clinical psychologists, neuropsychologists, neuroradiologists, nuclear medicine specialists, clinical assistant physicians, nurses, EEG technologists, clinical neurophysiologists and administrative staff.



Dr. Samuel Wiebe

The research team has strong collaborations with the Hotchkiss Brain Institute (HBI), the O'Brien Institute for Public Health, and the Alberta Children's Hospital Research Institute. The team includes basic scientists (HBI), health outcomes and health services researchers, and advanced imaging researchers. The CEP clinical research team also continues to have strong collaborations with, and support from, the Brain and Mental Health Research Clinics; an initiative partially funded by DCNS.

As a tertiary care centre, the CEP provides care for a wide breadth of persons with epilepsy, including those with complex epilepsies, and those requiring complex surgical investigations and interventions. Complex and surgical adult and pediatric cases are discussed weekly in multidisciplinary conferences in conjunction with pediatric epilepsy colleagues.

Core clinical facilities available at the CEP include:

- State-of-the-art neurophysiologic assessment, including long-term video-EEG monitoring, day-time video-EEG monitoring, 24-hour ambulatory

EEG monitoring, intracranial EEG using multiple modalities of implantation and electrodes, electrocorticography, functional brain mapping, and intraoperative monitoring and evoked potentials. Analysis of high frequency oscillations (HFOs) is available and automated detection of HFOs has been developed to facilitate EEG source localization.

- Advanced functional imaging includes PET, SPECT, functional MRI with capacity for mapping of cortical function, voxel-based relaxometry and arterial spin labeling, as well as EEG-fMRI interictal and ictal studies.
- The EEG laboratory operates at four hospital sites and the Seizure Monitoring Unit (SMU) operates at the Foothills Medical Centre and the South Health Campus. Continuous video-EEG monitoring is provided at all hospital sites for diagnostic purposes in hospitalized patients, and for seizure management in critically ill patients at all four adult sites in the Calgary Zone.
- Neuropsychologists, clinical psychologists and neuropsychiatrists focusing on epilepsy provide care to patients in the CEP.
- The CEP registry increasingly encompasses neurosurgical, genetics and clinic datasets. In particular the clinic dataset is being incorporated into routine care by providing one-page clinical summaries for every patient, which includes measures of well-being, mental health and clinical aspects. These summaries are made available at the time of patient encounters to facilitate and ensure comprehensive care.
- Epilepsy surgery for drug-resistant epilepsy is guided by scalp and intracranial EEG. Surgical techniques include subdural and depth electrodes, robotic and frame-based stereo-EEG, cortical mapping, the entire breadth of procedures for cortical resection and disconnections, and neuromodulation including vagus nerve stimulation and deep brain stimulation. MR guided Laser Interstitial Thermal Therapy (Mrg-LITT), a minimally invasive technique for lesioning epileptic foci, is the newest addition.

Research and Leadership

The CEP houses world-class research teams in prediction models, health services research and outcomes research (Dr. Samuel Wiebe and Dr. Colin Josephson), genomics (Dr. Karl Martin Klein), and in advanced imaging in epilepsy (Dr. Paolo Federico). Members of the CEP serve in leadership positions in organizations such as the Canadian League Against Epilepsy, the International League Against Epilepsy (ILAE), the North American Commission of the ILAE, the Latin American Commission of the ILAE, the Commission on Diagnostics of the ILAE, and the Task Forces on Big Data, epilepsy in the elderly, and guidelines of the ILAE.

Important initiatives spearheaded this year by Dr. Wiebe as president of the International League Against Epilepsy include: 1) the development and publication of the Competencies-Based Curriculum for Education in Epileptology. This systematically developed curriculum and learning objectives are now being used internationally to develop a large variety of educational tools, including distance learning, that can lead to an Assessment-Based Certificate in Epileptology in countries around the world. 2) Creation of the ILAE Academy, a comprehensive portal for online education in epilepsy; 3) Creation of ILAE Councils on Education, Congresses, Publications and Global Outreach. 4) Producing, in collaboration with the WHO and the International Bureau for Epilepsy, the first Global Report on Epilepsy. 5) Creation of the Next Generation Initiative in Epilepsy to engage early career professionals in the field of epilepsy.

Dr. Federico has started his two-year term as President of the Canadian League Against Epilepsy. He is also the chair of Neuroimaging Task Force of the International League Against Epilepsy. As chair, he has organized an on-line neuroimaging course that is freely available to all ILAE members. He is also organizing a three-month web-based course on basic and advanced topics related to neuroimaging in epilepsy.

Quality of Care

The CEP has developed a thriving quality of care program that systematically evaluates clinical care and patient outcomes in the SMU and in the epilepsy clinics. This year, the CEP database has expanded significantly in scope and aims to

promote patient outcomes through integrating clinical, EEG, MRI, genomic, and electronic health records data. Additionally, funding has been secured to create a multicentre consortium on epilepsy clinical data, led by Drs. Josephson and Wiebe, using the CEP clinical database model and structure.

Highlights

- The CEP, like every other programme has had to adapt to the unique circumstances of the COVID-19 pandemic. Outpatient clinic, inpatient consultations, seizure monitoring unit, and inpatient and outpatient EEG laboratory services, have followed rigorously the guidelines of our health authorities to prevent COVID-19 spread. At the same time, we have continued to provide all services listed above, with the necessary restrictions, including telemedicine, physical distancing, decreased patient density in seizure monitoring units, freeing up beds for pandemic emergencies, covering back-up call for epilepsy, and adapting our EEG protocols for safe practices. Not least, we are mindful of the important toll the pandemic takes on the well-being and mental health of our patients and our staff and are mindful to provide the necessary support.
- The CEP held a very successful third Banff International Epilepsy Symposium in February 2020 on the topic of "Epilepsy Care in the 21st Century: Precision Medicine and Novel Surgical Techniques." In addition to our local speakers, the one-day symposium featured renowned international researchers Heather Mefford (USA), Nathan Fountain (USA), and Fabrice Bartolomei (France). A successful Western Epilepsy Workshop was held after the Banff symposium, organized by the Calgary Epilepsy Programme, featuring lively case presentations from colleagues across Western Canada.
- The 2019 Mary Anne Lee Memorial lecturer in epilepsy was Dr. Robert Gross from Emory University, who spoke about "The New Era of Minimally Invasive Surgery."
- The CEP held its annual epilepsy research retreat, in conjunction with the HBI, with presentations by trainees and prizes for best trainee presentations.

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- Dr. Paolo Federico is conducting a clinical trial looking for a new indication for ibuprofen and nifedipine to prevent postictal hypoperfusion.
- Dr. Federico was awarded a six-year CIHR operating grant for the project “Improving epilepsy surgery outcome by mapping high frequency oscillations. The application was ranked 2nd out of 57 applications reviewed.
- Dr. Walter Hader has implemented the first MR guided laser interstitial thermal therapy (MRg-LITT) treatment for intractable epilepsy secondary to mesial temporal sclerosis was performed in Calgary in February, 2020. The LITT program was recently established as a result of a philanthropic joint venture between the Alberta Children’s Hospital Foundation and Calgary Health Trust in support of the Epilepsy surgery program. The Mrg-LITT procedure is performed in an all inclusive Epilepsy Surgery Suite, the Seamen MR Centre, housing an IMRIS 3T intraoperative MRI, ROSA robotic assistant and Visualase Laser Platform.
- Dr. Fady Girgis joined the neurosurgery epilepsy team, with a focus on functional neurosurgery and neurostimulation.
- Drs. Sophia Macrodimitris and Ruby Sharma run a successful cognitive behavioural therapy program for epilepsy patients with anxiety and depression, and they offer much needed psychological support for epilepsy patients. They train psychology practicum students through the University of Calgary and residents through the Calgary Clinical Psychology Residency Program. They also provide support for patients with functional neurological symptom disorder (Conversion Disorder) presenting as epileptic seizures. Dr. Joanne Stephen provides psychological services for epilepsy patients at the South Health Campus.
- Drs. Lisa Partlo and Kim Goddard use standardized procedures for neuropsychological testing in epilepsy patients across hospitals, providing a uniquely strong team for our CEP. Drs. Brienne McLean and Aaron Mackie, neuropsychiatrists affiliated to the CEP, provide invaluable support to our many patients with psychiatric comorbidities.

There are important developments in pediatric epilepsy this year:

- Dr. Julia Jacobs from Freiburg, Germany is now the director of the pediatric epilepsy program
- Dr. Pierre Levan, also from Freiburg, is now a member of the Alberta Children’s Hospital Institute and the Hotchkiss Brain Institute to continue his work on advanced imaging in epilepsy.

In the basic sciences, the Hotchkiss Brain Institute continues to be a strong partner in various fronts:

- Dr. Cam Teskey’s CIHR-funded research program discovered that a severe hypoperfusion/hypoxic event follows a seizure, which has implications for postictal behavioural dysfunction including paralysis, memory disturbances and Sudden Unexpected Death in Epilepsy.
- Dr. Quentin Pittman’s lab employs multiple approaches to investigate neuronal function from the entire organism to the single cell.

This year we will welcome two Epilepsy and EEG fellows in the adult program —Dr. Guillermo Delgado Garcia from Mexico, and Dr. Laura Gill, from British Columbia. The paediatric epilepsy programme will also welcome Dr. Marvin Braun as an epilepsy fellow later during this term.

Dr. Karl Martin Klein runs a research program on epilepsy genetics and genomics, as well as precision medicine. Consenting patients provide a blood or saliva sample of which DNA is extracted, stored and analyzed. Details on the patients’ epilepsy are documented in a database that is linked to the CEP database. His group has recently established somatic DNA extraction from brain cells that remain on depth electrodes used for intracranial video EEG monitoring and also from LITT probes (laser surgery).

These samples allow the identification of somatic mutations i.e. genetic variants that occur during development and are only present in the brain. DNA samples and phenotypic information are used in local and international collaborative projects to identify new genes for epilepsy in multiplex families with epilepsy, patients with epileptic encephalopathies and common epilepsies and to characterize the associated phenotype. The combination of the genetic data with the detailed prospective data in the CEP database also allows to address pharmacogenomic questions.

Dr. Klein coordinates an international consortium (RAISE-GENIC, funded by the ERA PerMed Cofound) which aims to develop tools that help physicians to select the anti-seizure drug with the best chance of success. This collaborative effort involves additional PIs at the University of Calgary (Dr. Colin Josephson) and three European countries (Germany, Finland, Belgium) and uses big data strategies to integrate clinical data, raw EEG and raw MRI data as well as exome sequencing data.

Dr. Colin Josephson leads the big data and data linkage initiatives within the CEP. He has made important inroads in linking granular clinical data with raw imaging and EEG data. Linkage with genetic data and administrative health records is an ongoing project. Dr. Josephson’s research has resulted in milestone publications related to predictive models and clinical-epidemiological aspects of epilepsy utilizing machine learning and traditional statistical models. These contributions have been published in flagship journals such as JAMA Neurology, Journal of Nuerology, Neurosurgery and Psychiatry, and Epilepsia. Additionally, Dr. Josephson leads the Canada-wide epilepsy registry initiative (CANOE) which is closer now to being implemented. Dr. Josephson also serves in several Task Forces of the International League Against Epilepsy including Epilepsy and driving and Big Data.

Dr. Billie Au (Medical Genetics), Dr. JP Appendino (Pediatrics) and Dr. Karl Martin Klein have established the Genetic Epilepsy Clinic for patients with unsolved genetic epilepsies.

Dr. Wiebe continues to lead the overall CEP. Dr. Paolo Federico is lead of the SMU and EEG laboratories. Dr. Colin Josephson is the leader of the epilepsy clinics. Drs. Shaily Singh and Colin Josephson are the co-directors of education and fellowships. Dr. Karl Martin Klein overviews clinical assistants and Dr. William Murphy overviews clinical trials.

Dr. Wiebe chairs the Clinical Research Unit for the Cumming School of Medicine, and is serving his third year as president of the International League Against Epilepsy.

Members

Adult Epileptology: Dr. Paolo Federico, Dr. Alexandra Hanson, Dr. Colin Josephson, Dr. Brain Klassen, Dr. Karl Martin Klein, Dr. William Murphy, Dr. Andrea Salmon, Dr. Shaily Singh, Dr. Samuel Wiebe
Pediatric Epileptology: Dr. Juan Pablo Appendino, Dr. Alice Ho, Dr. Morris Scantlebury, Dr. Julia Jacobs
Neurosurgery: Dr. Walter Hader, Dr. Yves Starreveld, Dr. Fady Girgis
Neuropsychiatry: Dr. Aaron Mackie, Dr. Brienne McLean
Clinical psychology: Dr. Sophia Macrodimitris, Dr. Ruby Sharma, Dr. Joanne Stephen
Adult Neuropsychology: Dr. Lisa Partlo, Dr. Kim Goddard, Dr. Linette Savage
Psychometrists: Danielle Croft, Gerry Ceballos, Ryan Kasper
Neuro-Intensive Care: Dr. Julie Krom
Pediatric Neuropsychology: Brian Brooks, Marsha Vasserman, Naddley Desire, Sandra Mish, Taryn Fay-McClymont, William MacAllister
Adult Neuroradiology: Dr. James Scott
Nuclear Medicine: Dr. Christine Molnar, Dr. Leonard Numerow, Dr. Ruban Gnanakumar
Pediatric Neuroradiology: Dr. Xing-Chang Wei
Basic Science: Dr. Cam Teskey, Dr. Quentin Pitmann, Dr. Pierre Levan
Clinical Assistants: Dr. Reynaldo Avendano, Dr. Salma Hanna. This year we bid Adieu to both Drs. Avendano and Hanna. We wish them success in their new endeavours. We will be welcoming two new clinical assistants to the epilepsy program.
Adult Epilepsy Fellows: We will be welcoming Dr. Guillermo Delgado Garcia from Mexico, and Dr. Laura Gill, from British Columbia
Pediatric Epilepsy Fellows: The Paediatric program will be welcoming Dr. Marvin Braun
Epilepsy Nurses: Meliza Camerino, Amira Jivraj, Jackie Martini, Michele Zulinick, Andrea Palmer, Wendy Chen
Dietician: Shannon Josey

The Calgary Stroke Program

Program Lead: Dr. Andrew Demchuk

Overview

The Calgary Stroke Program (CSP), a collaboration between the University of Calgary (DCNS and Hotchkiss Brain Institute) and Alberta Health Services (AHS), continues to lead and contribute to the field of stroke care. Our program figured prominently nationally and internationally on a number of fronts. We continue to strive to meet our vision of “Creating the Future of Stroke Care.”



Dr. Andrew Demchuk

The collective H-index of the clinician scientists within the program is 163, with over 127,000 citations and 1,122 publications cited at least 10 times.

Highlights/Key Publications

As the major CSP led publication of the year, Dr. Michael Hill, Mayank Goyal (PIs) and colleagues published the main results of the ESCAPE NA-1 trial

entitled: Efficacy and safety of nerinetide for the treatment of acute ischaemic stroke (ESCAPE-NA1): a multicentre, double-blind, randomised controlled trial”. Lancet 2020;395:878-887.

An ongoing achievement of the program continues to be a leadership role in the HERMES Collaboration, led by Dr. Mayank Goyal. The collaboration successfully brought together all seven predominantly stent retriever based randomized clinical trials of mechanical thrombectomy in stroke (five published in NEJM 2015). This HERMES collaboration continues to roll out many publications—Lancet (1), JAMA (1), Lancet Neurology (3), JAMA Neurology (1), Stroke (7), Neurology (1) and JNIS (3)—that are influencing guidelines for EVT care throughout the world by clarifying when and how endovascular treatment is effective. Several of these manuscripts have been first or senior authored by CSP members, including Dr. Goyal, Dr. Michael Hill, Dr. Bijoy Menon and Dr. Mohammed Almekhlafi.

Clinical Trials

Dr. Coutts (PI) is leading the multicentre TEMPO-2 trial examining Tenecteplase (2nd generation tPA) for patients with mild stroke with a proven

intracranial occlusion. Sites are active in Canada, UK, Ireland, Austria, Spain, Brazil and Australia. 527 subjects have been enrolled.

Dr. Hill and Dr. Goyal (PIs) are now pushing forward to begin a second pivotal trial of the NA-1 neuroprotectant focused on patients undergoing endovascular treatment but ineligible for IV TPA. The ESCAPE-NEXT trial is collaboration between The Calgary Stroke Program and NoNO Inc (Toronto). This trial will enroll 1,100 subjects at over 50 sites in multiple countries. First enrolled patient expected by Nov 2020.

Dr. Menon, Dr. Hill, Dr. Goyal, Dr. Brian Buck and Dr. Rick Swartz have initiated the CIHR funded “Alteplase Compared to Tenecteplase in patients with Acute Ischemic Stroke: QulCR & OPTIMISE Registry based Pragmatic Randomized Controlled Trial”. In only a few short months, 283 subjects have been enrolled across Canada at multiple centers with 2-3 patients now enrolled per day.

Dr. Demchuk (co-PI) will soon initiate recruitment locally of a phase 2/3 randomized trial of endovascular treatment in mild stroke entitled ENDOLOW in conjunction with co-PIs at Emory University (Atlanta), University of Cincinnati (Ohio) and Heidelberg University (Germany). This is a 200 patient study at 30 centres in four countries. 3 subjects are now enrolled with many sites coming on-line in the next few months including Canada.

Dr. Almekhlafi and Dr. Goyal (PIs) have initiated the CIHR funded “Evaluating oral peri-operative acetylsalicylic acid in patients undergoing endovascular coiling-only of unruptured brain aneurysms. A Phase 3 Multicenter Randomized Placebo-Controlled Trial”. Recruitment to the EVOLVE trial is soon to begin.

Dr. Phil Barber continues to lead the “Predementia Neuroimaging of Transient Ischemic Attack (TIA) – PREVENT Study”.

Team Grant/Core Lab Progress

Dr. Demchuk is now winding down the “CaSTOR Canadian Stroke Trials for Optimized Results” national stroke clinical trials network funding by CIHR/ Institute of Circulatory and Respiratory Health. This \$1.5 million emerging networks grant

(2015-2020) is a collaboration with the Canadian Stroke Consortium and Canadian Partners for Stroke Recovery. A second global early career workshop is planned in December post WSC/ESOC 2020 to follow-up from the first one led by GAINS.

The Stroke Imaging Core Lab coordinates brain MRI and CT imaging for observational studies and clinical trials, with more than 15,000 brain scans analyzed. Imaging endpoints include strokes, hemorrhages, vascular occlusions, brain perfusion, and others. These endpoints are critical for understanding the natural history of stroke and the effectiveness of new treatments. The most significant accomplishment from the imaging core lab was the analysis of MRI imaging after non-cardiac surgery in participants in the NeuroVISION study published in the Lancet in August, showing that 7% of post-operative patients had a covert brain infarct and that those with covert brain infarcts had lower cognition than those without covert brain infarcts at one year. (NeuroVISION Investigators. Perioperative covert stroke in patients undergoing non-cardiac surgery (NeuroVISION): a prospective cohort study. Lancet. 2019;394:1022-1029. DOI 10.1016/S0140-6736(19)31795-7.)

The acute stroke imaging research program has expanded to now have research fellows from countries as diverse as The Netherlands, South Korea, UK, Switzerland, Saudi Arabia, Japan and China. The program has a full time imaging scientist, post docs and graduate students along with stroke fellows, neurology and radiology residents and summer students.

Personal Achievements/Appointments/Awards

Dr. Hill and Goyal were two of eight scientists at University of Calgary named as a “Web of Science highly cited researcher (top 1%) 2019.” Dr. Goyal was named the Heart and Stroke Foundation Chair in Stroke Research for a five year term.

Dr. Sean Dukelow received the honor of paper of the year at the Canadian Association of Physical Medicine and Rehabilitation entitled “Comparing CST Lesion Metrics as Biomarkers for Recovery of Motor and Proprioceptive Impairments After Stroke.”

Dr. Sean Dukelow and Dr. Demchuk continued as co-leads of the Leadership Council for Canadian Partnership for Stroke Recovery which replaces the role of Chief Scientific Officer with CPSR.

Dr. Andrew Demchuk was elected Chair of the Board of Directors of the Canadian Stroke

Consortium in Nov 2019. His first act in this role was to gain approval amongst its national membership that the CSC be the official professional organization for stroke physicians in Canada. He is now in the process of transforming the organization to meet that professional status as a value and designation based professional organization for Canada’s stroke docs.

On behalf of the Calgary Stroke Program, Dr. Hill, Goyal and Demchuk received the Scientific Breakthrough Award from the American Brain Foundation 2020.

Clinical Care Achievements

Initial planning of a new integrated stroke unit at Foothills Medical Centre has been completed. Architectural firm Group 2 and AHS (Nora Smith, lead) have led the planning sessions. A functional plan draft document has now been circulated describing the critical elements needed for a new unit and architectural renderings of how it might look. This is a critical step toward a future capital fundraising campaign and ultimate build of a new world-class integrated stroke unit.

Education

As of June this year, our program is training and/or has graduated 94 stroke fellows from 21 countries, including Canada.

Members

Stroke Neurology: Dr. Mohammed Almekhlafi, Dr. Simer Bal, Dr. Phil Barber, Dr. Philippe Couillard, Dr. Shelagh Coutts, Dr. Andrew Demchuk, Dr. Michael Hill, Dr. Adam Kirton (Pediatrics), Dr. Gary Klein, Dr. Bijoy Menon, Dr. Alekys Mineyko (Pediatrics), Dr. Steve Peters, Dr. Eric Smith, Dr. Peter Stys, Dr. Suresh Subramaniam, Dr. Julie Kromm
Stroke Physical Medicine and Rehabilitation: Dr. Sean Dukelow, Dr. Ken Lam, Dr. Gentson Leung, Dr. Steve McNeil
Physician Assistant: Allen Szabon
Vascular Neurosurgery: Dr. Alim Mitha, Dr. Garnette Sutherland, Dr. John Wong
Interventional Neuroradiology: Dr. Muneer Eesa, Dr. Mayank Goyal, Dr. Will Morrish
Nurse Practitioner: Nancy Newcommon
Stroke Program Manager: Samantha Arnott
Stroke Fellowship Program Administrator: Emily Collins
Stroke Observership/Sabbatical Program Administrator: Lori Herard

The Cognitive Neurosciences Program

Program Lead: Dr. Eric Smith

Overview

The Cognitive Neurosciences Clinic provides expert medical consultation for patients with cognitive disorders; educates undergraduate and postgraduate learners; and conducts research on the causes, medical evaluation, and treatment of cognitive disorders and dementia. The program is directed by Dr. Eric Smith.



Dr. Eric Smith

Our multidisciplinary physician workforce is a unique aspect of our program, allowing us to provide comprehensive evaluations for complex neurological and psychiatric disorders as well as overlap syndromes. There are six neurologists

(Drs. Philip Barber, Alicja Cieslak, Bijoy Menon, David Patry, Dawn Pearson, and Eric Smith) and five psychiatrists (Drs. Robert Granger, Zahinoor Ismail, Aaron Mackie, Brienne McLane, and Dallas Seitz) who see patients at the two clinic sites at Foothills Medical Centre and the South Health Campus. We welcomed a new physician member: Dr. Dallas Seitz was recruited from Queen's university to join the Cumming School of Medicine as Associate Professor in the Department of Psychiatry.

Clinical Care Highlights

Following the onset of the COVID pandemic, the Clinic rapidly adopted innovative methods for remote cognitive assessment including online questionnaires and video cognitive testing. Dr. Ismail, Seitz and Smith were invited members of a task force on COVID and dementia convened by the Alzheimer's Society of Canada, that Issued guidance on triaging persons with dementia for acute care and for telephone and video cognitive testing. Dr. Ismail co-Chaired the 5th Canadian Conference on Diagnosis and Treatment of Dementia that Issued evidence-based guidelines for dementia care In Canada, published in the journal Alzheimer's & Dementia.

Focus on Education

Medical students and residents participate in the Cognitive Neuroscience Clinic at the Foothills and South Health Campuses as part of ambulatory and elective rotations. We run a practice examination station on cognitive disorders to prepare our neurology residents for their final year qualifying examination by the Royal College. We will welcome Dr. Aravind Ganesh as Clinical Fellow in July 2020.

Research training is another important activity. Drs. Smith, Ismail, Barber and Seitz combined to supervise two post-doctoral fellows, three PhD students, and six master's students in Neurosciences and Community Health Sciences at the University of Calgary.

Research Highlights

With basic scientist Dr. Roger Thompson, Dr. Smith co-leads the Hotchkiss Brain Institute Dementia and Cognitive Disorders Neuroteam. Eligible clinic patients are offered participation in clinical trials and the observational COMPASS-ND cohort study of the Canadian Consortium on Neurodegeneration in Aging. Dr. Ismail

Dr. Eric Smith holds the Katthy Taylor Chair in Vascular Dementia from the University of Calgary and is funded by a Canadian Institutes of Health Research Foundation Award. Drs. Barber, Ismail and Seitz hold competitive peer-reviewed awards from the Canadian Institutes of Health Research and the Heart and Stroke Foundation of Canada. Dr. Ismail directs the Board of the Canadian Conference on Dementia.

Members

Neurology: Dr. Eric Smith (Director),
Dr. Philip Barber, Dr. Alicja Cieslak,
Dr. Bijoy Menon, Dr. David Patry,
Dr. Dawn Pearson
Psychiatry: Dr. Robert Granger, Dr. Zahinoor Ismail,
Dr. Aaron Mackie, Dr. Brienne McLane,
Dr. Dallas Seitz
Nursing: Karyn Fischer, Heather Jones,
Patricia Mueller,
Neuropsychology: Dr. Catherine Burton,
Dr. Kim Goddard

Calgary Headache Assessment and Management Program

Program Lead: Dr. Lara Cooke

Overview

The CHAMP Program has had an exciting year. A strategic planning retreat last year helped us to focus on our priorities of outstanding clinical care, innovative care models, education, and clinical and epidemiological research. Through a collaboration with the Hotchkiss Brain Institute Brain and Mental Health Research Clinics and the Section of Pediatric Neurology's Dr. Serena Orr, the CHAMP team has developed a headache patient registry, which is now built, and will go live in early 2021. Plans for the registry include exploring patient outcomes, patient-reported outcomes, and optimizing best practices for headache patients.

We were delighted to receive permanent funding for a nurse practitioner with many years of experience in headache management. Our NP has spearheaded the rejuvenation of our



Dr. Lara Cooke

group education sessions for lifestyle and self-management, assists with motivational interviewing to reduce medication overuse, and has helped us to manage the huge volume of work involved in helping to support headache patients through the process of accessing three exciting new antibody treatments that have come on the market for the management of migraine headache.

In addition, through strong ties with our general neurology colleagues, and altering our care model, the CHAMP program has been able to greatly reduce what has historically been a very long waitlist for patients with complex headache problems to be seen by subspecialty headache specialists.

This means that CHAMP is ready to innovate. Plans for 2020-2021 include enhancing access to multidisciplinary programs by leveraging online platforms, developing a stream for urgent headache assessments, and building our academic capacity through the launch of the headache registry and recruitment of a new headache specialist for July of 2021.

The Multiple Sclerosis (MS) Program, MS and Neuroimmunology Clinics

MS Program Lead: Dr. Michael Yeung
Neuroimmunology Lead: Dr. Katayoun Alikhani

Overview

The Multiple Sclerosis (MS) Program provides multidisciplinary, population-based care to people with MS and other Central Nervous System (CNS) demyelinating disorders living in Southern Alberta and Southeastern British Columbia. We are “one program on two sites” with clinics at both Foothills Medical Centre and South Health Campus. The clinics look after ~4500 patients living with CNS demyelinating disorders.



Dr. Michael Yeung

The services provided by our specialized clinical team, based on a chronic disease management approach, include medical, nursing, rehabilitation and counseling. Our goal is to prevent or lessen disability and optimize wellness. Our team also provides leadership in care delivery and regularly provides advice regarding policies related to MS care.

The Neuro-Immunology Clinic located at the South Health Campus provides multidisciplinary care to patients with various immune-mediated disorders, including autoimmune encephalitides, vasculitides, neurosarcoidosis, and other systemic immune-mediated disorders affecting the nervous system. Both the MS Program and the Neuro-Immunology Clinic continue to expand in terms of numbers of patients and numbers of physicians.

Education

The MS Program supports the education of trainees at all levels. Neurology residents do MS Clinic rotations in their junior and senior years. MS fellows are involved in care and research. MS fellowships at the University of Calgary MS Program can be either clinical- or research-based, and can be from one to two years. Previous MS Fellows are now practicing across Canada (Edmonton, Vancouver



Dr. Katayoun Alikhani

Island, Montreal, Saskatoon, Red Deer, Calgary), the United States (Nebraska), Saudi Arabia (Riyadh, Jeddah), and Trinidad/Tobago (Port of Spain) in both academic and community settings.

Research

The MS program is well recognized for its research strengths. In association with the Hotchkiss Brain Institute, research includes translational research, clinical and epidemiological research, basic science, innovations in imaging and trial design, and clinical trials. Several investigator-initiated trials are ongoing in RRMS and progressive MS.

COVID-19 Pandemic

The COVID-19 pandemic affected the processes of the MS and Neuro-Immunology Clinics. For 10 weeks, the SHC nursing and clerical staff of the MS clinic were amalgamated into the FMC clinic as these SHC staff were re-deployed in response to the pandemic. This was a hectic time for nursing and clerical at FMC. Clinic “visits” were primarily “virtual”.

Some treatments were also delayed or cancelled. In addition to the tireless efforts of the nursing and clerical staff, the program’s early and effective use of electronic (“paperless”) documentation, communications, and test result delivery were important factors in providing the necessary clinical care during this time. The clinics have continued to evolve and adapt as more knowledge is gained about the pandemic and its effect upon our patient population.

New referrals are triaged as urgent, semi-urgent or routine. Wait times for new referrals have been tracked

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The General Neurology Program

Program Lead: Dr. Megan Yaraskavitch

Overview

The General Neurology Program involves many of the members of the Section of Neurology. These members provide outpatient clinical services to patients at each of the four adult hospital sites and in the community.



Dr. Megan Yaraskavitch

Highlights

Over the past several years the General Neurology Program in Calgary has implemented many innovations in care delivery and system processes. Our Neurology Central Access and Triage (NCAT) has expanded to involve all specialties within neurology (with the exception of Stroke and Urgent Neurology) to simplify the referral process for referring practitioners.

Additionally, we have worked with the Primary Care Network to provide a telephone consult service, Specialist Link and eReferral which includes timely telephone and electronic advice for referring physicians who have general neurology questions about their patients.

Additional innovations have been implemented to help improve quality of care and access, including

increased usage of multidisciplinary services for general neurology patients.

Education

Residents, clerks and medical students commonly spend time in the general neurology clinics.

Members

FMC:
Dr. Jodie Burton, Dr. Alexandra Hanson, Dr. Michael Hill, Dr. Phil Barber, Dr. Lara Cooke, Dr. Steven Peters, Dr. Alicja Cieslak, Dr. Gerald Pfeffer, Dr. Carlos Camara-Lemarroy, Dr. Theo Mobach

SCH:
Dr. Katie Wiltshire, Dr. David Patry, Dr. Farnaz Amoozegar, Dr. Jephtha Davenport, Dr. Gary Klein, Dr. William Murphy, Dr. Shaily Singh, Dr. Megan Yaraskavitch

PLC:
Dr. Brian Klassen, Dr. Hamid Ebadi, Dr. Simer Bal, Dr. Yanjun Duan, Dr. Tyson Brust

RGH:
Dr. Ronak Kapadia, Dr. Kevin Busche, Dr. Wei Liu

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Members

MS Clinic:

Neurologists: Katayoun Alikhani, Tyson Brust, Jodie Burton, Kevin Busche, Carlos Camara-Lemarroy, Jonathan Fridhandler, Chris Hahn, Marcus Koch, Scott Jarvis, Wei-Qiao Liu, Luanne Metz (Research Lead), David Patry, Michael Yeung
Physiatrist: Dan McGowan

Neuro-psychiatrists: Aaron Mackie, Scott Patten, Rory Sellmer

Nurse Practitioner: Colleen Harris

Neuroimmunology Clinic:

Neurologists: Katayoun Alikhani, Chris Hahn, Tyson Brust
Rheumatologist: Aurore Fifi-Mah

Neuropsychiatrist: Aaron Mackie

University of Calgary researchers involved in clinical and translational studies over the past year: Kathleen Chaput, Fiona Costello, Jeff Dunn, Gordon Fick, Nils Forkert, Richard Frayne, Bradley Goodyear, Manish Joshi, Shunaha Kim-Fine, Hedwich Kuipers, Shalina Ousman, Stacey Page, Gerald Pfeffer, Bruce Pike, Magali Robert, Peter Stys, V. Wee Yong, Yunyan Zhang

The Movement Disorder Program

Program Lead: Dr. Davide Martino

Overview

The Movement Disorders Program at the University of Calgary is a multi-disciplinary team comprised of neurologists, psychiatrists, a geriatrician, a psychologist, a neurosurgeon, a social worker, specialist nurses and basic scientists. The clinical team provides treatment for a variety of movement disorders, including Parkinson's disease, essential tremor, dystonia, Huntington's disease, Tourette syndrome, drug-induced movement disorders, and ataxias.



Dr. Davide Martino

Highlights

Our program has grown! Dr. Camila Aquino is a new GFT Assistant Professor and Neurologist in the program and new leader of the Deep Brain Stimulation service. Dr. Fady Girgis (Functional Neurosurgeon) has joined our program and the Deep Brain Stimulation service. We are excited for their arrival and look forward to their outstanding contributions to our program!

The MR-guided High-intensity Focused Ultrasound surgical treatment for refractory tremor (essential tremor, dystonic tremor and refractory tremor-predominant Parkinson's disease) has been active for three and a half years, in collaboration with the FUS Research Team. This ablative procedure has been life-changing for patients.

The clinical program is subdivided into the following subspecialty clinics:

- Botulinum toxin clinics for the treatment of hyperkinetic movement disorders, including ultrasound- and EMG-guided injections
- General movement disorders clinics – primary focus being treatment of Parkinson's disease
- Multidisciplinary Huntington's disease clinics – comprehensive management of Huntington's disease through collaborative care by neurology, psychiatry, nursing and social work
- Drug-induced movement disorder clinic
- Deep brain stimulation screening and post-operative monitoring for a variety of movement disorders

- Pre- and post-operative assessment for MR-guided high-intensity focused ultrasound thalamotomy for medically refractory tremor
- Duodopa program for the advanced treatment of Parkinson's disease

Apomorphine subcutaneous injections and sublingual films are now available in our program to treat severe motor fluctuations in Parkinson's disease.

Research

The Movement Disorders Program has a local research registry and database that benefits the members of the Movement Disorders NeuroTeam and facilitates collaborations with other centres provincially, nationally and internationally. This is part of a larger initiative named the Calgary Parkinson's Research Initiative (CaPRI; <https://capriresearch.org/> - also on Twitter: @CalgaryCapri). Our Tourmaline Oil Chair in Parkinson's disease (Dr. Oury Monchi) has launched the Canadian Open Parkinson Network (C-OPN), the first pan-Canadian clinical research network on Parkinson's disease and other parkinsonisms that includes national a clinical data registry and biorepositories.

A large-scale study led by Dr. Oury Monchi and involving various researchers and clinicians of the Movement Disorders NeuroTeam is exploring biomarkers (including neuroimaging, clinical, genetic and other molecular ones) that are predictive of dementia in Parkinson's disease (PD) and compare cognitive decline in PD with mild cognitive impairment found at the prodromal stages of other neurodegenerative diseases, such as Alzheimer's disease.

An observational study led by Dr. Martino, currently ongoing, focuses on the analysis of kinematic, electrophysiological and imaging endophenotypes related to the progression of idiopathic isolated dystonia and of the psychiatric spectrum of idiopathic dystonia.

An observational study led by Dr. Martino, in collaboration with UBC, is exploring the gut

microbiome diversity and its association with immune-inflammatory markers in relation to cognitive progression in Parkinson's disease. Another cross-disorder observational study led by Dr. Martino is investigating gut microbiome-related pathways associated with tics, obsessive-compulsive symptoms, ADHD symptoms and autistic symptoms, in collaboration with the Alberta Children's Hospital Research Institute and the Owerko Foundation.

An observational study of high intensity focused ultrasound thalamotomy for tremor is currently underway, led by Dr. Zelma Kiss.

An interventional study is currently ongoing (led by Dr. Martino) about the effect of multiple sessions of cathodal transcranial direct current stimulation of the bilateral supplementary motor area during the application of habit reversal strategies on the severity of tics in adolescents and adults with Tourette syndrome, and associated patterns of functional activity and connectivity as observed with resting-state fMRI.

Another interventional study of alternating current stimulation in tremor is being launched by Dr. Martino

Interventional studies of the effect of apomorphine and botulinum neurotoxin on off-dystonia in PD, and a larger multidisciplinary observational study to investigate pain phenomenology and pathomechanisms in PD are led by Dr. Veronica Bruno. Dr. Martino and Bruno have developed a new rating scale for pain in dystonia, currently undergoing validation.

Dr. Bin Hu's Ambulosono trial now encompasses other national and international sites.

Other multicentre clinical trials include:

- A randomized, double-blind, placebo-controlled multiple dose study to assess efficacy, safety, tolerability and pharmacokinetics of intravenous ABBV-8E12 in Progressive Supranuclear Palsy

- COSMOS – co-medication study assessing mono- and combination therapy with levodopa carbidopa intestinal gel
- CADENCE – observational study in patients treated with Duodopa to assess long-term outcomes
- Observational study of Huntington's disease (ENROLL-HD trial) – recruitment ongoing

Members

Neurologists: Dr. Camila Aquino, Dr. Veronica Bruno, Dr. Alicja Cieslak, Dr. Sarah Furtado, Dr. Scott Kraft, Dr. Davide Martino, Dr. Tamara Pringsheim, Dr. Justyna Sarna

Psychiatrists: Dr. Jeremy Quickfall,

Dr. Aaron Mackie, Dr. Brienne McLane

Neurosurgeon: Dr. Fady Girgis, Dr. Zelma Kiss

Geriatrician: Dr. Zahra Goodarzi

Psychologist: Dr. Angela Haffenden

Social Worker: Melinda Hatfield

Researchers (PhD): Dr. Brandy Callahan, Dr. Taylor Chomiak, Dr. Bin Hu, Dr. Oury Monchi, Dr. David Park, Dr. Samuel Pichardo, Dr. G. Bruce Pike

Nurses: Karen Hunka, Nancy Labelle, Meliza Camerino, Pia Lawrence, Carol Pantella, Eric Tse

Research Co-ordinator: Lorelei Tainsh

Administrative Staff: Bonita Woytowich, Jordana Fife

The Neuromuscular Program

Program Lead: Dr. Lawrence Korngut

Overview

The Department of Clinical Neurosciences Neuromuscular Program provides health care services for people with disorders of the peripheral nervous system. The Neuromuscular Program clinical activity is consolidated at the South Health Campus, which provides a unique opportunity to provide patient-centred multidisciplinary care, including a broad range of expert Allied Health services. The program includes the following clinics:

ALS and Motor Neuron Disease Clinic: For people with amyotrophic lateral sclerosis (ALS) and related motor neuron diseases.

Neuromuscular Clinic: For people with disease of nerve, neuromuscular junction and muscle. Examples include Guillain-Barré syndrome, myasthenia gravis, and inclusion body myositis.

Neuromuscular Genetics Interdisciplinary Clinic: A clinic that focuses on improving function in people with neuromuscular diseases while receiving further genetic diagnostic evaluations and followup (combined rehabilitation team, psychiatry and neurology).

Neuromuscular Rehabilitation Clinic: A clinic that focuses on improving function in people with neuromuscular disease. Dr. Stephanie Plamondon and the clinic were recognized by Muscular Dystrophy Canada for their innovative model and tremendous care provided to patients.

Peripheral Nerve Clinic: A clinic to serve people with nerve injuries or disorders that may benefit from surgical intervention.

Electromyography Clinics: Diagnostic clinics for those with disorders of the peripheral nervous system.

All of the above clinics are multi-disciplinary. Depending on clinic needs, patients may see multiple physicians (neurologist, physiatrist,

respirologist, palliative care doctor, plastic surgeon, or neurosurgeon), nurses, Allied Health care providers (physiotherapist, occupational therapist, speech and language pathologist, dietitian, social worker, neuropsychologist, respiratory therapist) or EMG technologist.

Research

The Neuromuscular Research Program is composed of two parts. The clinical program, led by Dr. Lawrence Korngut, had several important contributions this past year. It conducted four randomized clinical trials in ALS and Facioscapulohumeral Muscular Dystrophy (FSHD). The Canadian Neuromuscular Disease Registry (CNDR) continued to operate under Dr. Korngut's leadership and promote collaborative research and clinical care excellence across Canada. Dr. Rodney Li Pi Shan developed a tool to simplify the level of certainty in the diagnosis of ALS.

The basic science program, led by Dr. Gerald Pfeffer, investigates genetic causes of hereditary neuromuscular disorders using next-generation sequencing studies of families with undiagnosed conditions and in carefully phenotyped clinical cohorts. Dr. Pfeffer's lab also performs mechanistic studies using human cellular models to understand how gene mutations cause disease. Other projects are investigating RNA-based biomarkers for neurogenetic disorders.

Education

The Neuromuscular Education Program is headed by Dr. Sam Chhibber. The program provides education in neuromuscular disease diagnosis and management, including EMG. The outstanding performance of our trainees is a testament to the training program. This year, neurologists Dr. Daniel Fok and Dr. Theo Mobach completed their training as neuromuscular fellows.

Neuromuscular Neurology: Dr. Sam Chhibber, Dr. Hamid Ebadi, Dr. Chris Hahn, Dr. Lawrence Korngut, Dr. Theo Mobach, Dr. Gerald Pfeffer, Dr. Chris White

Neuromuscular Psychiatry: Dr. Rodney Li Pi Shan, Dr. Stephen McNeil, Dr. Stephanie Plamondon



Dr. Lawrence Korngut

The Neuro-Oncology Program

Program Lead: Dr. Paula de Robles

Overview

The Neuro-Oncology Program focuses in the diagnosis, treatment and followup of patients with primary central nervous system tumours, neurological complications of cancer, and neurological paraneoplastic syndromes. We are a multidisciplinary program that works closely with the surgical neuro-oncology, neuropathology, and palliative care programs.

The majority of referrals are seen within 14 days. Cases are reviewed in weekly neuro-oncology multidisciplinary rounds, which include the participation of neuro-oncology, radiation oncology, neuroradiology, neurosurgery, neurology, neuropathology, pharmacy, psychosocial services, nursing, research staff, and trainees. Brain tumour patients are then seen in a multidisciplinary clinic.



Dr. Paula de Robles

Research

Our brain tumour patients are offered participation in multiple investigator-initiated and multi-centre clinical trials. Trainees have the opportunity to gain

wet lab experience in the Clark Smith Brain Tumour Centre in the Charbonneau Cancer Institute at the University of Calgary.

Education

The Neuro-Oncology Program trains medical oncology, radiation oncology, internal medicine, and neurology residents. We also provide fellowship training in neuro-oncology.

Members

Neuro-Oncologists: Dr. Roger Tsang, Dr. Gloria Roldan Urgoiti, Dr. Gregory Cairncross, Dr. Paula de Robles
Radiation Oncologists: Dr. Gerald Lim, Dr. Salman Faruqi, Dr. Shaun Loewen
Neurologist: Dr. Alexandra Hanson
Neurosurgeons: Dr. Mark Hamilton, Dr. John Kelly, Dr. Yves Starreveld
Clinical Psychologist: Dr. Guy Pelletrier
Nurses: Caroline Warner, Deenar Alwani, Cindy Yorke, Ginny Holm, Diane Jahraus
Nurse Practitioner: Catriona Leckie
Research Nurse: Luanne Crawford
Pharmacist: Frances Folkman
Clinical Trial Co-ordinator: Sonali Deshpande

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Neuromuscular Respirology: Dr. Karen Rimmer, Dr. Andrea Loewen, Dr. Marcus Povitz

Peripheral Nerve Surgery: Dr. Rajiv Midha, Dr. Christiaan Schragg, Dr. Brett Byers, Dr. Kate Elzinga, Dr. Robertson Harrop

Palliative Care: Dr. Marisa Dharmawardene

Clinic Nurses: Kris Jagt RN, Jodie Gill RN, Christine Roberts RN, Helena Ogilvie RN, Liz Czapski RN

ALS Clinic Coordinator: Denise Hartley OT

Allied Health: Cristiane Yamabyashi PT, Mikhaila Fitzsimmons PT, Monic Brunet OT, Stephanie Molzan SLP, Leon Mitchell SW, Dr. Kim Goddard,

Neuropsychology, Sandy Jensen DH, Mary Anne Bautista TA, Julie Boyko RD, Kim Walker, SLP, Ray Tye RT, Margaret Hass PT

Pharmacists: Darcy Padula, Robert Hou, Wenli Zhou

Fellows: Dr. Shafina Sachedina, Brian Satchfield

Clerical Team: Lindy Wright (ALS and Peripheral Nerve Clinics), Jennifer Coish (NMC), Samantha Tallerico (NMC), Paula Baumann (NMC)

Clinical Research Team: Janet Petrillo, Jose Martinez, Josh Lounsberry, Victoria Hodgkinson

Basic Science Research Team: Kristina Martens (lab manager), Carly Pontifex (PhD candidate in neuroscience), Robyn Wells (PhD student in neuroscience), Matthew Joel (MSc student in neuroscience), Mehul Gupta (BSc researcher), Jamie Leckie (BSc researcher)

The Neuro-Ophthalmology and Neurovestibular Programs

Program Lead: Dr. Suresh Subramaniam

Overview

The Neuro-Ophthalmology Program, located at the Rockyview General Hospital Eye Clinic, focuses on disorders of vision and eye movement caused by neurological diseases such as multiple sclerosis, brain tumour and stroke. The Neurovestibular Program, located at South Health Campus, focuses on vertigo and dizziness. Both programs provide state-of-the-art diagnosis and treatment, including lab testing and physical and occupational therapy.



Dr. Suresh Subramaniam

Highlights

In the past year, there were over 2,800 visits to the Neuro-Ophthalmology and Neurovestibular Clinics. Most patients in the Neuro-Ophthalmology Clinic are referred by specialists in ophthalmology, neurology or neurosurgery. The Neurovestibular Program tested over 2,000 patients in the vestibular laboratory and provided over 1,300 vestibular physiotherapy visits.

Education

The Neuro-Ophthalmology Program trains specialty residents learning to be neurologists or ophthalmologists. The Neurovestibular Program trains neurology and otolaryngology residents. Both programs hold regular educational rounds, provide learner evaluations, and teach medical students and Allied Health staff.

Research

Projects in Neuro-Ophthalmology include studies of the rehabilitation of homonymous hemianopia; the roles of hormones, vitamin D and novel therapies in optic neuritis; structural changes related to pituitary tumours, pregnancy and cardiovascular health; and the role of optical coherence tomography in monitoring patients with multiple sclerosis or tumours affecting the optic nerves or chiasm. Projects in the Neurovestibular Program include the study of a prototype rotary chair in the diagnosis of vestibular dysfunction and the role of physiotherapy in vestibular migraine.

Members

Medical Staff: Dr. William Fletcher, Dr. Fiona Costello, Dr. Suresh Subramaniam, Dr. Beth Lange (Otolaryngology), Dr. Euna Hwang (Otolaryngology)

Allied Health and Administrative Staff: Neuro-Ophthalmology Program – Cindy Koberlenz-Slade, Tracy Ducharme.

Neurovestibular Program - Melanie Oszust, Gina Quinn, Michelle Pushka, Jacqueline Townsend, Cristiane Yamabayashi.

The Tourette Syndrome and Pediatric Movement Disorders Program

Program Lead: Dr. Tamara Pringsheim

Overview

The Tourette Syndrome and Pediatric Movement Disorders Clinic provides consultation and continuing care for children and adults with Tourette syndrome and children with movement disorders such as dystonia, tremor, cerebral palsy and complex motor stereotypies.



Dr. Tamara Pringsheim

Research

Research at the clinic is focused on:

- Promoting rational and safe use of medications in children with neurodevelopmental disorders
- Exploring novel therapeutic strategies for tics
- Understanding longitudinal outcomes and sensorimotor function in children with tics and tremor

Thanks to the generosity of the Owerko family and the Owerko Centre on Neurodevelopment and Child Mental Health, we received funding to support clinical research activities at the Tourette Syndrome and Pediatric Movement Disorders Clinic. Current studies at the clinic include:

- Investigation of the gut microbiome in children with chronic tic disorders
- Longitudinal outcomes in children with tics
- Dietary fibre to reduce antipsychotic induced metabolic effects in children with tics
- Clinical and neurophysiological characterization of essential tremor in children

In 2019, we received funding from the Maternal, Newborn Child and Youth Strategic Clinical Network to develop the Tourette OCD Alberta Network. Currently, the only specialized clinics for

children with Tourette syndrome and obsessive-compulsive disorder in Alberta are in Calgary at the Alberta Children’s Hospital, resulting in a provincial service delivery gap. The goal of the Tourette OCD Alberta Network is to increase capacity and improve access to comprehensive patient and family centered care for children and youth with TS and OCD provincially. We will accomplish this by providing a range of support services to patients and families, including education, support and care navigation, and by working with community-based addiction and mental health clinic health care professionals to improve their knowledge and skills in this area.

In addition, we are collaborating with neuroscientist Dr. Frank McMaster on a CIHR-funded randomized controlled trial of the addition of transcranial magnetic stimulation to habit reversal therapy for the treatment of tics.

Education

We provide training to medical students, residents in pediatrics and neurology as well as fellows in movement disorders. Residents in neurology spend time in the clinic as a part of their movement disorders rotation and residents in pediatrics during their developmental pediatrics rotation.

Members

Neurologists: Dr. Tamara Pringsheim, Dr. Justyna Sarna, Dr. Davide Martino
Nursing: Tracy Hammer
Program Co-ordinator: Julian Fletcher
Clinical and Research Fellows: Dr. Nicholas Cothros, Dr. Alex Medina

Pediatric Neurosciences

Program Lead: Dr. Michael J. Esser

THE SECTION OF PEDIATRIC NEUROLOGY based at the Alberta Children’s Hospital (ACH) provides comprehensive neurological care to all infants and children from Southern Alberta and neighboring Saskatchewan/British Columbia. The section is also actively engaged in research spanning the range of bench-to-bedside-to backyard that is transforming knowledge and care.



Dr. Michael Esser

Our faculty is comprised of neurologists with subspecialty expertise in epilepsy, headache, stroke, neuromuscular diseases, neurocritical care and brain injury, demyelinating and other neuro-immune conditions, neonatal neurology and brain malformations, movement disorders, and overlapping disciplines related to developmental, cognitive, neurogenetic and metabolic diseases.

As an integral part of the section, an extensive team of trainees and Allied Health professionals engage in both inpatient and outpatient clinical programs, as well as globally recognized clinical and translational research.

New to the program and Section during this reporting period is Dr. Eric Payne. Dr. Payne joins the group with extensive experience in refractory epilepsy, critical care EEG monitoring, and an interest in the role of neuroinflammation in refractory epilepsy and status epilepticus.

Other ongoing research and program advances from various members of the section include:

The Calgary Childhood Epilepsy Program continues to be a leader in research and clinical care for all children, but particularly those with refractory epilepsy and those needing surgical evaluation and intervention. The program is led by Dr. Julia Jacobs-Levan who has a very established research program in EEG monitoring. Other ongoing efforts include areas such as sleep and epilepsy, neurocritical care monitoring, ketogenic diet, a targeted infantile spasms clinic and research program, and animal modelling platforms.

The ACH Headache Program is led by Dr. Serena Orr, who along with her clinical and research colleagues have established a translational program grounded on a foundation of personalized, evidence-based medicine to improve the current standard of headache care. The program also strives to educate care providers and the community about how to optimize headache care as a significant proportion of patients develop refractory headache disorders and suffer from substantial disability. By better understanding baseline risk factors that predict a refractory course in pediatric headache disorders, Dr. Orr and her colleagues will be able to chart the course for a more personalized approach to headache care and improved outcomes for children with headaches.

The Pediatric Neuromuscular Program, led by Dr. Jean Mah, continues to expand its role in the delivery of cutting edge care. The clinical workload of the program has significantly increased due to the approval of intrathecal nusinersen injections for children and youth with spinal muscular atrophy (SMA), funded by Alberta Health. The program also provides early access to other potential disease modifying treatments for pediatric patients with SMA, Duchenne muscular dystrophy, and other neuromuscular disorders through their participation in clinical trials. Ongoing efforts also include a SMA newborn screening program for Alberta (funded by ACHF, the Love for Lewiston Foundation, and other community partners).

The Pediatric Neurocritical Care (NCC) Program continues to provide exceptional service to neonates, children and adolescents admitted to our ICUs. Through imbedded research, advanced technologies, clinical algorithms and educational initiatives, the program is improving outcomes for critically ill children with brain-at-risk. Under the NCC program, a research-oriented biobanking and bioanalytical core facility (ACH BioCore) provides a platform for biological sample storage and multi-omic analysis for research projects through the ACH, ACHRI and CSM.

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The Urgent Neurology Clinic

Program Lead: Dr. Alexandra Hanson

Overview

The Urgent Neurology Clinic was established in 2000 so adult patients requiring an urgent outpatient neurological consultation could be seen in a timely manner. The Urgent Neurology Clinic’s mandate is to see patients within five business days. Further investigations are then expedited as needed.

Referrals to the Urgent Neurology Clinic are triaged by a neurologist at FMC. Patients are seen at two sites: FMC and RGH. The SHC site moved back to RGH in November 2019.



Dr. Alexandra Hanson

This past year, the Urgent Neurology Clinic has been involved in the QI project: Improving the Care of Patients with Neurological Symptoms after Discharge from an Emergency Department, led by Dr. Megan Yaraskavitch and Erin Barrett, QI Coordinator. The criteria for the Urgent Neurology Clinic have been revised and clarified. The Urgent Neurology Clinic continues to work in conjunction with General Neurology Central Access and Triage

to ensure patients are seen in the most appropriate clinic.

When the ambulatory clinics were restricted during the COVID-19 pandemic, the Urgent Neurology Clinic continued to see those patients who needed to be seen urgently. Where possible, however, appointments were by telephone.

The Urgent Neurology Clinic is an excellent clinic for both resident teaching and evaluation.

Members:

FMC: Judi Santos, RN (Nina Castrogiovanni, RN); Dale Gyonyor and Uche Odili (clerks).

Dr. Tyson Brust, Dr. Jodie Burton, Dr. Alicja Cieslak, Dr. Jephtha Davenport, Dr. Sarah Furtado, Dr. Paula de Robles, Dr. Yanjun Duan, Dr. Alexandra Hanson, Dr. Wei Liu, Dr. Theo Mobach, Dr. Steven Peters, Dr. Michael Yeung.

RGH: Andrea Nicholson, RN; Jo Ann Gerundio (clerk).

Dr. Farnaz Amoozegar, Dr. Ronak Kapadia, Dr. Wei Liu, Dr. Dave Patry, Dr. Shaily Singh, Dr. Katie Wiltshire, Dr. Megan Yaraskavitch.

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These advances, and platforms, will accelerate the development of disease biomarkers to enhance patient care, and will also facilitate innovative translational research of underlying pathogenic mechanisms.

The Calgary Pediatric Stroke Program (CPSP), led by Dr. Adam Kirton, continues to expand on the world’s largest population-based cohort of children and families with perinatal stroke. Advanced brain mapping techniques are defining human models of developmental plasticity after early injury that are translated into novel non-invasive neuromodulation approaches including the first multicenter Phase 3 clinical trial currently underway. The program also leads the University of Calgary’s Non-invasive Neurostimulation Network (N3), and founded the ACH Pediatric Brain Computer Interface (BCI)

Program—a patient-centered clinical research team focused on developing BCI to advance independence and quality of life for severely disabled children.

The Pediatric Neurology Residency Training Program is a Royal College of Physicians and Surgeons of Canada (RCPSC)-accredited direct entry program that is among the oldest and largest in Canada. The program, led by Dr. Coleen Curtis continues to maintain a 100 per cent success rate at the Royal College exam. All section members are actively engaged in teaching through undergraduate, medical school, residency, graduate student, and post-doctoral and clinical fellowship levels. As part of the educational and training mandate, a rich scholarly environment now includes more than 10 academic rounds and conferences per week.

The Section of Neurosurgery

Section Head: Dr. Steve Casha

THE SECTION OF NEUROSURGERY at the University of Calgary and Alberta Health Services is fully integrated with its partner sections of Neurology, Physical Medicine and Rehabilitation (PM&R) and Translational Neurosciences within the Department of Clinical Neurosciences.

With its highly integrated and collaborative programmatic approach, the section provides sub-specialized care to the patient population. That population includes the geographic region of Southern Alberta as well as Eastern British Columbia in the Kootenay Region and Western Saskatchewan, encompassing an approximate catchment population of 2.5 million. Care is provided by 16 sub-specialist academic neurosurgeons, all of whom also provide general and emergency neurosurgical services.

Specialized programs include cerebrovascular and endovascular neurosurgery, epilepsy neurosurgery, adult hydrocephalus surgery, neuro-oncology, skull base surgery, pediatric neurosurgery, peripheral nerve surgery, functional neurosurgery, stereotactic radiosurgery and spine surgery.

In partnership with neurology, rehabilitation medicine, orthopedic surgery, neuroradiology, and radiation oncology, our members provide the highest quality of sub-specialized care for this patient population.

The total operative volume delivered by neurosurgeons was 2,240 cases in 2018-19. There were approximately 100 cases of bedside and Intensive Care Unit procedures, about 300 cases of endovascular procedures in the neuro-interventional suite, and about 100 radiosurgery cases. In addition, the section saw 11,590 out-patient visits in 2018-19.



Highlights

- We remain very proud that the Charles Taylor Memorial Lectureship pays homage to Calgary's first neurosurgeon. In 2019, Dr. Antonio Chiocca (chairman of the Department of Neurosurgery at the Brigham and Women's Hospital in Boston, and the Harvey W. Cushing professor of Neurosurgery at the Harvard Medical School) was the 15th annual Charles Taylor lecturer.
- Numerous other respected professors and neurosurgeons visited us this past academic year: Dr. Marcel Aries (University of Groningen, The Netherlands), Dr. Peter Dirks (University of Toronto), Dr. David Clarke (Dalhousie University), Dr. Adam Sachs (University of Ottawa), Dr. Darrel Brodke (University of Utah), and Dr. Chris Ogilvie (Brain Aneurysm Institute, Beth Israel Deaconess Medical Center, Boston).

- For the 12th year running, the highly regarded Spine and Peripheral Nerve Anatomy and Surgery Course exposed neurosurgery and orthopedic residents from across the country to the nuances of spine and peripheral nerve surgery in a hands-on, supportive environment using didactic and cadaveric methods.

Education

The neurosurgery residency training program continues to be the pride of the section. Two new residents are accepted each year, within a current allotment of 16 trainees. The program is known for providing training in a collaborative and collegial environment where the highest quality of service and education are delivered.

In addition to hands-on and didactic teaching of residents, the faculty contributes significantly to undergraduate medical education teaching in the small group curriculum, as well as clerkship rotations.

Numerous fellows joined our section in various sub-specialties, which is another positive indicator of Calgary's strong reputation for excellent training and care.

Research

Members continue to be involved in intensive research, with several of them conducting peer-reviewed and funded basic science and/or clinical research programs. Collectively, the section benefited from over \$2.5 million in funding revenue in 2018-2019 and published 63 manuscripts.

Many of these members partner with the Hotchkiss Brain Institute and the Alberta Children's Hospital Research Institute, and several faculty members have been granted full or affiliated membership.

Areas of research strength and accomplishment include clinical trials in spinal cord injury research, basic bench research in nerve regeneration, functional neurosurgery and deep brain stimulation, traumatic brain injury, laboratory work using brain tumour-initiating stem cells, intravascular stent development, pain management and hydrocephalus. We also proudly house one of the world's foremost laboratories in surgical robotics.

Notable recognitions in 2018-19 were received by: Dr. Garnette Sutherland, who was awarded the 2019 Governor General's Innovation Award; Dr. Jay Riva-Cambrin and collaborators, who were awarded a \$9.6 million NIH grant for a randomized control trial in pediatric hydrocephalus; and Dr. Alim Mitha and Dr. John Wong, whose startup venture, Fluid Biotech, received the top prize at the Inventures' Tenet i2c competition.



▲ Dr. John Wong and Dr. Alim Mitha, whose Fluid Biotech startup won at the TENET i2c competition.

Alberta Radiosurgery Centre

Program Leads: Dr. Gerald Lim, Dr. Yves Starreveld

Overview

This radiosurgery program was the first of its kind in Canada to use an innovative technology called the Novalis system. It is a collaborative effort between the sections of Neurosurgery and Radiation Oncology.

The technology offers focused radiation treatment for diseases of the brain and spinal cord in single or multiple sessions as appropriate. This avoids lengthy hospital stays associated with standard surgical treatments. By reducing risks of therapy, and allowing a rapid return to normal activities, this treatment offers greater patient satisfaction.

Since its inception in 2002, the program has served an increasing number of patients in Alberta and across the western provinces.

Highlights

Referrals to our spine radiosurgery program are increasing. We have started to treat patients with

epilepsy, including mesial temporal lobe epilepsy.

Education

The program provides fellowship training for both radiation oncologists and neurosurgeons.

Research

Projects include a study on the effect of contouring variability on dosimetric parameters for brain metastases. Our quality improvement initiative has lead to impressive gains in efficiency of treatment, and ongoing revisions to our patient care pathways.

Members

Neurosurgery: Dr. Yves Starreveld, Dr. Zelma Kiss, Dr. John Kelly, Dr. Brad Jacobs, Dr. John Wong
Radiation Oncology: Dr. Gerald Lim, Dr. Rob Nordal, Dr. Jon-Paul Voroney, Dr. Shaun Loewen
Medical Physics: David Spencer, Alana Hudson, Nicholas Ploquin, Greg Pierce
Nursing: Rhonda Manthey

Calgary Spine Program

Program Lead: Dr. Bradley Jacobs

Overview

The University of Calgary Spine Program is a multidisciplinary clinical and academic group focused on the care of individuals affected by conditions of the spinal column and spinal cord. Our mission is to provide world quality health care to individuals with spinal disorders through the pursuit of excellence in research, teaching and bedside clinical care. The program is centered at the Foothills Hospital and Alberta Children's Hospital within Alberta Health Services.

Members of the Spine Program have joint appointments in the Section of Neurosurgery, Department of Clinical Neurosciences and Section of Orthopedic Surgery, Department of Surgery. The Spine Program provides care for patients with spinal injury, infection, neoplasia and degenerative disease. Clinical care is closely linked to clinical education and research in a supportive academic setting.

The program has representation from Neurological Surgery, Orthopedic Surgery, Nursing, and Orthotics. The program offers a comprehensive spinal surgery fellowship, combining orthopaedic and neurosurgical clinical experience. Foothills Medical Centre is the tertiary referral centre for Southern Alberta, Saskatchewan and Southeastern British Columbia, and the Spine Program provides support for other programs such as Trauma, Cancer and Bone and Joint.

Members

Dr. W. Bradley Jacobs, Program Lead
Dr. Fred Nicholls, Fellowship Director
Dr. Ken Thomas, Research Director
Dr. Fábio Ferri-de-Barros, Pediatric Fellowship Director
Dr. Jacques Bouchard, Dr. David Cadotte, Dr. Steven Casha, Dr. Roger Cho, Dr. Stephan du Plessis, Dr. Peter Lewkonja, Dr. David Parsons, Dr. Paul Salo, Dr. Alex Soroceanu, Dr. Ganesh Swamy

The Hydrocephalus Program

Program Lead: Dr. Mark Hamilton

Overview

In 2003, the University of Calgary's adult hydrocephalus clinic was established with the goal to standardize and enhance the care for adult patients with hydrocephalus. Hydrocephalus patients had typically been assessed and cared for by individual physicians in an unstructured and unfocused clinic environment. The population of adult patients with hydrocephalus is increasing as diagnostic and therapeutic techniques improve identification and survival. Hydrocephalus represents a treatable cause for approximately five per cent of adult patients with a diagnosis of dementia.

The Adult Hydrocephalus Program was developed in response to the strengths of the adult hydrocephalus clinic. A clinical research program was initiated, and a basic science research program is in development. Targeting the care of adult patients with hydrocephalus in a specialty clinic has aided in understanding the natural history of adults with both treated and untreated hydrocephalus.

The program has helped to standardize the treatment strategies for patients with a potential diagnosis of hydrocephalus and it has helped to improve the management of patients using shunts and endoscopic techniques. In 2019, there were about 3,000 patients followed in the adult hydrocephalus clinic. There were approximately 1,500 outpatient assessments and 180 surgical procedures performed.

Highlights

- Dr. Hamilton is the chair for the Adult Hydrocephalus Clinical Research Network (AHCNRN), which has two centres in Canada, five in the United States and one in England. AHCNRN has enrolled 1,800 patients in 60 months and has completed a pilot randomized clinical trial for patients with normal pressure hydrocephalus.
- Dr. Hamilton is a board member and president of the Hydrocephalus Society—The International Society for Hydrocephalus and Cerebrospinal Fluid disorders.
- Dr. Hamilton is a member of the board of directors of the Hydrocephalus Association and the vice-chair of the medical advisory board of the Hydrocephalus Association.

- Dr. Hamilton is helping to develop a Canadian hydrocephalus strategy and he is a member of the board of directors of Hydrocephalus Canada, which was inaugurated in November 2017.
- Multiple quality improvement projects have been undertaken to improve patient access, surgical techniques for hydrocephalus care, and surgical outcomes.
- A formal protocol has been established to facilitate transition of care for pediatric patients with hydrocephalus when they turn 18 years of age.

Education

The Hydrocephalus Program offers fellowship training for neurosurgeons interested in subspecialty training in the diagnosis and management of adult patients. The first trainee completed his fellowship training in June 2012.

Research

- Initiation of the Adult Hydrocephalus Clinical Research Network
- Epidemiology of hydrocephalus
- Transition care for pediatric patients with hydrocephalus
- Neuroendoscopy treatment and outcome for adult patients with hydrocephalus
- Neuropsychological effects of endoscopic treatment of patients with hydrocephalus
- Infections in patients with ventricular catheters and shunts
- Improving surgical outcomes for treatment with ventriculoperitoneal and ventriculoatrial shunts
- Treatment of patients with idiopathic normal pressure hydrocephalus
- Endoscopic management of patients with ventricular brain tumors

Members

Neurosurgeons: Dr. Mark Hamilton, Dr. Clare Gallagher, Dr. Walter Hader
Medical and Surgical Assistant: Dr. Geberth Urbaneja
Neuro-ophthalmologists: Dr. Fiona Costello, Dr. Suresh Subramaniam
Geriatrician: Dr. David Hogan
Nurse Practitioners: Ron Prince, Patti Long
Research Coordinator: Jarred Dronyk

Image-Guided Medical Robotics Program

Program Lead: Dr. Garnette Sutherland

Overview

The importance of intra-operative imaging for lesion localization and resection control in neurosurgery, ushered in the world's first intraoperative MRI (iMRI) technology based on ceiling-mounted moveable high field magnet developed by Dr. Garnette Sutherland. The initiative, 20 some years ago, resulted in the build of the Seaman Family MR Research Centre at University of Calgary - Foothills Hospital. Now with interlinked MR Research Program based on a fixed magnet, this centre has become a world-class entity on advanced clinical imaging research including stroke and other CNS disorders. The recent inclusion of MR-guided Focus Ultrasound Technology for patient care further validates its importance.



Dr. Garnette Sutherland

Linked to the iMRI environment is another world's first - the image-guided MR-compatible robot called neuroArm. Again developed by Dr. Sutherland in collaboration with MacDonald, Dettwiler and Associates, Brampton ON, (MDA - that built Canadarm and Dextre), neuroArm is Canada's gift to the world of medical robotics, unique to microsurgery and stereotaxy within the iMRI suite. Project neuroArm, the internationally visible Image-guided Medical Robotics Program at the University of Calgary, thus established, continues to advance surgical robotics and smart technologies that incorporate sensors and machine learning. With neuroArm continuing to be clinically used in neurosurgical patients here at the Foothills Medical Centre, and SYMBIS (2nd generation neuroArm, FDA approved for stereotaxy through IMRIS-Deerfield MN, USA), in early 2019 Project neuroArm team began the build of the 3rd generation system called the neuroArmPLUS. Funding support from various governmental and philanthropic organizations, and generous individuals, has made this possible.

Pipeline Technologies - Robotics and Intelligent Systems

The neuroArmPLUS: The neuroArmPLUS is a compact, efficient and intelligent robotic system for brain surgery and whole body applications. The

system will incorporate the recently developed microsurgery-specific haptic handcontroller neuroArmPLUSHD as the intuitive human-machine interface. As stated above, thanks to ongoing governmental and philanthropic funding support, the technology has multiple scientific manuscripts, an international patent filed in various countries, product development ensued early 2020 with immersive workstation and innovative toolset prioritized for stage 1 milestone. OrbSurgical Ltd., Project neuroArm spin-off for IP protection and commercialization, continues the quest to digitize surgical performance and increase accessibility globally through state-of-the-art robotic technologies and data-driven platforms.

The SmartForceps System: Continuing technology assessment of the medical grade SmartForceps System here at the Foothills Medical Centre, the SmartForceps System recently passed the IEC 60601-1-2 Compliance mandated by FDA and Health Canada, pending final approvals for both. Systematically validated through multiple high impact publications including JAMA Surgery and a patent, commercialization process is in place with 10 early adopters identified and pre-orders secured. Focused on big-data mining and machine learning, the SmartForceps technology pushes the envelop towards data-rich proactive surgeon experience and performance of surgery. Using cloud computing for global connectivity, remote access and learning in real time, a future of standardized surgical care and improved safety seems much closer - much similar to that set forth by aerospace standards.

Linked Research & Development (R&D)

The underlying principle of Project neuroArm remain "Seeing what you cannot see; Feeling what you cannot feel; Hearing what you cannot hear - the augmented reality for robotics and linked technologies". All ongoing R&D thus fall under this philosophy and include but are not restricted to:

- i. Molecular Neuroscience-Brain Tumour and Trauma (Seeing what you cannot see): Ongoing national phase entry of patent (awarded 2018, with NRC, Ottawa) has re-enforced the translatability of molecular and genetic interrogation of CNS disorders, including brain



Photos courtesy Project neuroArm, University of Calgary

- tumour, trauma and neurodegenerative disease. The idea and innovation form the basis of cell-specific contrast agents for intra-operative visualization and/or diagnostics - A paradigm for transforming surgery from the present organ level to cellular, i.e. the invention of CellARM robotic system.
- ii. Computer Science/Simulation/Software (Feeling what you cannot feel): Various in-house and acquired haptic technologies and interface allow for advanced surgical performance and training paradigms. Skull base and CNS pathology, spine and hepatobiliary surgery simulation platforms form the current library.
- iii. Atomic Force Microscopy-Vibrational Profiling of CNS Neoplasia (Hearing what you cannot hear): Collaboration with Microscopy & Imaging Facility has enabled the translation-modulation of nanoscale cellular frequency to the hearing domain. Again, the innovation and its transferability would be valuable in its incorporation to smart robotic toolset for neuroArmPLUS and CellARM.

- iv. Project neuroArm Space endeavours: True to its heritage, the team continues its long-term vision of advancing and applying the neuroArm telerobotic platform back to space! Aligning with NASA's Deep Space Exploration and recent Lunar Gateway Mission (CSA-MDA for Canadarm3), the team has aspirations of siting a lightweight tele-operated robot (a version of neuroArmPLUS) in the International Space Station or beyond, with a sensory-immersive control station on earth.

Highlight

In January 2020, the Canadian Space Agency hosted Dr. Garnette Sutherland to present and educate the Advisory Council on Deep Space Healthcare. With a shared recognition amongst space-faring nations of the need for humans to now reach beyond low Earth orbit and to explore the Moon and Mars, the session held at CSA Headquarters Montreal and chaired by Dr. Robert Thirsk (Retired Astronaut and Chancellor Emeritus-University of Calgary), discussed Canada's edge in robotics for ongoing and future leadership in space exploration and healthcare innovations.

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The neuroArmPLUS project received funding award from NRC-IRAP (OrbSurgical Ltd.) and the Government of Alberta Major Innovation Funds for Autonomous System Initiative (UofCalgary co-lead with UofAlberta).

Members
(includes collaborators/students/trainees)

Engineering: Hamidreza Hoshyarmanesh, Amir Baghdadi, Mohammadsaleh Razmi, Kazi Ishfaq Ahmed, Rahul Singh (Data Science and Business Dev), Starr Tze (Business Consultant), Mojtaba Esfandiari, Rachael L’Orsa, Mahdi Tavakoli, Chris Macnab, Qiao Sun, Yaoping Hu, Salvatore Federico

Science: Dustin Proctor (in Clinical Biochemistry sabbatical), Corrina Fowlow, Fahad Iqbal, Sonny Chan, Boguslaw Tomanek, Mehdi Arbabi, Frank van Veggel, Matthias Amrein, Guido van Marle

Medicine: Andrea Becking, Melissa Nielsen, Joseph Dort, Francis Sutherland, Andrew Kirkpatrick, Paul McBeth, Abdulrahman Albakr, Madeleine de Lotbiniere-Bassett, Fangwei Yang, Phil Park, Sanju Lama, Garnette Sutherland

Administrative Support: Miwa Shibuya, Randi Nicole Pearson

Industrial Partners: MDA (Brampton, ON); Deerfield-IMRIS (Minnetonka, MN); Medtronic (Minneapolis, MN); Stryker Corporation (Kalamazoo MI); Bissinger GmbH Teningen Germany; Improving Inc., (Calgary; OrbSurgical Ltd. (Calgary)

Institutional Partners: National Research Council Canada, Canadian Space Agency, University of Manitoba, University of Alberta, University of Victoria, Queen’s University, University of Vienna - Austria, Hokkaido University School of Medicine - Sapporo, Japan, National Hospital for Neurology and Neurosurgery, London UK

The Project neuroArm (and OrbSurgical Ltd.) team acknowledges the multiple funding institutions (provincial, federal, international), individuals, families and foundations for their generous support and trust in Project neuroArm’s ongoing endeavours; special thanks to all DCNS, and Section of Neurosurgery members for support and participation in ongoing clinical integration and projects.

Neuromodulation Program

Overview

Neuromodulation is the altering/modulation of nervous system function by means of implantable devices or neural prostheses. It includes peripheral nerve, spinal cord and brain electrical stimulation, as well as drug delivery devices. Many conditions are treated, including movement disorders, epilepsy, pain, angina, depression, spinal cord injury, headache, and spasticity.



Dr. Zelma Kiss

News

This year marked new beginnings. Dr. Magali Robert was named the new Director of the Chronic Pain Centre. Her experience with neuromodulation for bladder control, having done sacral nerve stimulation for decades, has fueled her interest in developing pain neuromodulation fully in Calgary. In April we welcomed Dr. Fady Girgis, a stereotactic & functional neurosurgeon back to Calgary. Dr. Girgis did his medical school and residency at U of C, followed by a stereotactic and functional fellowship in Cleveland. He practiced as an academic functional neurosurgeon in California at the University of California Davis for several years prior to returning to Calgary and joining our group. Dr. Camila Aquino, a new movement disorders neurologist and epidemiologist, arrived at the end of this academic year. Her practice and research will focus on patients with DBS for Parkinson disease.

Education

Dr. Darren Clark was the Parkinson Alberta fellow, also working part time for a biomedical start-up company. Rachel Sondergaard and Linda Kim continued in their PhD programs studying the pathophysiology of dystonia and new targets for DBS in humans and animal models. Dr. Vishal Varshney completed his residency in pain medicine and started his practice at UBC. Summer students from Mount Royal and the University of Calgary

studied neuromodulation and neurophysiology in 2019. One of them, Nicole Zalasky, liked it so much she started an MSc on this topic in 2020.

Research

We continued collecting prospective data on all patients undergoing stimulation procedures. Just before retiring, Dr. Becker published a commentary on sphenopalatine ganglion stimulation for chronic cluster headache in Lancet Neurology . Highlights were the publication of the outcome of our Alberta Innovates Health Solutions randomized double-blind cross-over clinical trial of DBS for depression in Lancet Psychiatry in January 2020. This paper was the subject of a commentary in this high impact journal. Several additional papers ensued defining predictors of response to DBS, including papers in J Affective Disorders , Brain Stimulation , and Neuropsychopharmacology . We also published a case study in Journal of Neurophysiology investigating a mechanism of DBS in dystonia, and a commentary in Brain Stimulation critiquing the medical device industry about its so-called “improvements”. Our trainees figured prominently in these papers being first and/or second author in all original work.

Conferences

COVID-19 reduced conference presentations significantly. Prior to the pandemic we participated in the Canadian Neuromodulation Society meeting in Iqaluit in July 2019 and a panel discussion organized by Dr. Pereira as President of the Alberta Pain Society in Lake Louise in October 2019. Dr. Kiss was invited to participate in the Cleveland Course for Advanced Neuromodulation at Case Western University in August 2019.

Despite AHS freezing our neuromodulation budget, we still managed to send 2 key team members, Kara Hallett RN and Philis Heffner PT, to the North American Neuromodulation Society meeting in Las Vegas in January, from where they brought back new knowledge to the pain group.

Post-pandemic shut down we participated a virtual panel discussion for the Canadian Pain Society. While Dr. Kiss was the Chair of the poster session for the American Society for Stereotactic and Functional Neurosurgery, this turned into an abstract review committee as the meeting went virtual and instead moderated the psychiatric neurosurgery session in June 2020.

Future Directions

The coming year will depend somewhat on COVID-19 restrictions, however we anticipate working with the CPC to develop the optimal care pathways for pain patients to access neuromodulation therapies. Additional emphasis of the focused ultrasound program at the University of Calgary will be towards using ultrasound for neuromodulation. Also, we will be establishing an intracranial cognitive neurophysiology research program using epilepsy patients with implanted brain electrodes for epilepsy.

Members

Cardiology: Dr. Todd Anderson
Neurology: Dr. Camila Aquino, Dr. Werner Becker, Dr. Veronica Bruno, Dr. Davide Martino
Neurosurgery: Dr. Fady Girgis, Dr. Walter Hader, Dr. Mark Hamilton, Dr. Zelma Kiss
Nursing: Laina McAusland and Maida Khan (UofC research), Kara Hallett, Colleen Harris, Karen Hunka, Pia Lawrence, Jackie Martini, Raj Parmar, Valerie Sherwood, Meredith Wild
Pain Physicians: Dr. Ted Findlay, Dr. John Pereira, Dr. Kelly Shinkaruk (mat leave) (Chronic Pain Centre)
Physical Medicine and Rehabilitation: Dr. Rebecca Charbonneau (mat leave), Dr. Dan McGowan
Physiotherapy: Cliona Corbett, Philis Heffner
Psychiatry: Dr. Aaron Mackie, Dr. Brienne McLane, Dr. Raj Ramasubbu
Psychology: Dr. Arlene Cox, Dr. Angela Haffenden
Respirology/Thoracic surgery: Dr. Sean McFadden, Dr. Karen Rimmer

Neurovascular Program

Program Lead: Dr. John Wong

Overview

The Neurovascular Program is a collaborative effort of specialists and Allied Health staff from multiple disciplines to combat stroke and neurovascular disease. Many patients are treated in a single day using minimally invasive endovascular approaches, thereby avoiding long hospital stays.

Expertise is maintained in the provision of open cerebrovascular neurosurgery to Albertans. In conjunction with our internationally recognized Calgary Stroke Program, the Neurovascular Program has become an important partner in stroke care and research.



Dr. John Wong

Highlights

We have seen continued growth in the number of procedures, especially mechanical stroke thrombectomy, and now about 400 patients are treated annually via minimally invasive endovascular means such as aneurysm coiling, vascular malformation embolization, carotid stenting and endovascular stroke treatment.

An integrated relationship with the Alberta Radiosurgery Centre has allowed the non-invasive and safe treatment of patients with complex arteriovenous malformations. Over the years we have consolidated the outpatient experience and launched the Neurovascular Clinic in Calgary in conjunction with specialists from neurosurgery, neurology, radiology and nursing. This has allowed the rapid, same-day triage and evaluation of stroke patients to provide high-quality care and further opportunities for teaching and clinical studies.

Approximately 1,900 patients with neurovascular disease were seen in the past year in our specialized outpatient clinic for evaluation and follow-up.

Education

Our brain aneurysm patient support network, led by our nursing team, continues to enjoy widespread acceptance amongst patients, their families, and the community. Our growing reputation for clinical care, teaching, and research has enabled the competitive selection and recruitment of clinical fellows in endovascular training and open neurosurgical techniques.

Research

Academic initiatives have centered upon Dr. Alim Mitha’s biomedical engineering laboratory for developing new intravascular devices for brain aneurysm therapy. Technology from the laboratory is being spun out into a startup venture, Fluid Biotech, which aims to commercialize a new bio-absorbable stent for treating brain aneurysms.

We continue to participate with the Calgary Stroke Program in multiple clinical research projects that have led to numerous publications and grants.

Members

- Dr. John Wong
- Dr. Alim Mitha
- Dr. Garnette Sutherland
- Dr. William Morrish
- Dr. Mayank Goyal
- Dr. Muneer Eesa
- Dr. Mohammed Almekhlafi
- Nursing: Michelle Gillies, Leslie Zimmer
- Fellows: Dr. Nima Kashani (Neuro-intervention)
- Dr. Mohammed Suheel (Vascular Neurosurgery)

Pediatric Neurosurgery Program

Program Lead: Dr. Walter Hader

Overview

The Pediatric Neurosurgical Program offers all aspects of neurosurgical care in children including: management of hydrocephalus, brain and spinal injury, myelomeningocele, occult spinal dysraphism, refractory epilepsy surgery, spasticity, craniofacial disorders, and pediatric brain tumour. While pediatric neurosurgery operates within the section of Pediatric Surgery at Alberta Children’s Hospital, all members’ primary affiliation is with the Department of Clinical Neurosciences,



Dr. Walter Hader

Highlights

Congratulations goes out to Dr. Jay Riva-Cambrin, present program director for the neurosurgery residency program, who was promoted to the rank of Full Professor.

Thanks to the generous contributions of the Alberta Children’s Hospital Foundation and Calgary Health Foundation (1.23 Million dollars), the MR-guided Laser Interstitial Thermal Therapy (MRg-LITT) program of the Epilepsy Surgery Program treated its first pediatric patient with intractable epilepsy in March, 2020.

The procedure performed in the Western Canada’s first Epilepsy Surgery Suite, Seamen MR suite, combines IMRIS Intraoperative 3T MR technology developed by Dr. Garnette Sutherland, with ROSA robotic assistant for stereotactic laser implantation and a Visualase Laser console.

The successful minimally invasive laser ablation, in a patient with a rare epileptic disorder caused by a hypothalamic hamartoma (HH), provided instant relief of seizures from a pathology and location

very difficult to treat with conventional open surgical approaches. In addition to HH, patients with focal seizure disorders secondary to MTS, focal cortical dysplasia and developmental tumors stand to benefit from this new minimally invasive technology.

Research

The Pediatric Neurosurgery section continues to be an active participant in the Hydrocephalus Clinical Research Network and the Canadian Pediatric Neurosurgery research study group, with Dr. Riva-Cambrin co-ordinating the efforts for both. Dr. Riva-Cambrin was lead author on a seminal HCRN collaborative paper that helped to delineate the population of infants most likely to benefit from ETV+CPC (endoscopic third ventriculostomy+choroid plexus cauterization), a procedure that has forever changed North American practice for the treatment of infantile hydrocephalus.

Dr. Nick Sader, senior neurosurgical resident, with Dr. Riva-Cambrin and Dr. Hader, recently published a local collaborative effort with Dr. Valerie Kirk, Pediatric Respirologist, on the Relationship Between Chiari 1.5 Malformations and Sleep-Related Breathing Disorder on Polysomnography. Both were published in the Journal of Neurosurgery: Pediatrics.

Members

- Neurosurgeons:
 - Dr. Walter Hader,
 - Dr. Clare Gallagher,
 - Dr. Jay Riva-Cambrin
- Nurse Practitioner: Kelly Bullivant
- Nurse Clinician: Kelly Hogue

Peripheral Nerve Program

Program Lead: Dr. Rajiv Midha

Overview

The Surgical Peripheral Nerve Program is a multi-disciplinary and inter-disciplinary program encompassing clinical, physiotherapy and electro-diagnostic services. Our program focuses on the diagnosis and non-operative and surgical treatment of a variety of peripheral nerve problems including complex peripheral nerve injuries, nerve tumours, brachial plexus surgery and advanced nerve repair, and nerve transfer techniques. Our goal is to minimize pain and to maximize function, providing a better quality of life for patients with these disabling disorders.



Dr. Rajiv Midha

Highlights

The Multidisciplinary Peripheral Nerve Clinic is seeing more patients with spinal cord injuries, offering nerve transfer procedures to improve function. We are part of a funded multi-centre study to evaluate the benefits of extensive rehab after nerve transfers in this patient population.

Research

Research is an important aspect of the Peripheral Nerve Program. Dr. Midha runs an independent CIHR-funded basic science research laboratory,

in association with the Hotchkiss Brain Institute, investigating various facets of peripheral nerve regeneration and repair. For more information on these research initiatives, visit www.hbi.ucalgary.ca.

Education

We support the educational initiatives of residents within the three clinical sections of DCNS, neuromuscular fellows, and residents and fellows in plastic surgery. We have a robust fellowship program. The following are recent peripheral nerve fellows within the program:

Dr. Toby Loch-Wilkinson and Dr. Vanessa Sammons (2017)

Dr. Saud Alzahrani (2018-19)

Dr. Daniel Umansky 2019-20

Members

Medical Neurologists, Physiatrists & Electrodiagnostics:
Dr. Chris White, Dr. Stephen McNeil
Neurosurgeon: Dr. Rajiv Midha
Plastic Surgeons: Dr. Christiaan Schrag, Dr. Robertson Harrop, Dr. Brett Byers, Dr. Kate Elzinga
Physiotherapy: Margaret Hass
Intraoperative Electrophysiology Support: Jamie Johnston, Joy Boldt, Michael Rigby, Erin Mercer

The Surgical Neuro-oncology Program

Program Lead: Dr. Mark Hamilton

Overview

As a multi-disciplinary program in DCNS, the Surgical Neuro-oncology Program was established to focus on neurosurgical care for brain tumor patients. The program provides excellent care and it improves care in the future through education, research and advocacy.

Our patients have both low grade and malignant brain tumors, including those involving the brain and the skull base. Neurosurgeons work in concert with neuro-oncologists, neuroradiologists, neuropathologists, and radiation oncologists specializing in the treatment of brain tumors. Regular clinical meetings and teaching rounds occur to co-ordinate care plans for patients. We are also able to offer access to unique treatment modalities, such as the intraoperative MRI theatre for assisting in the surgical treatment of brain tumor and intraoperative monitoring or cortical mapping for complex brain tumor resection.



Dr. Mark Hamilton

Our program provides:

- Surgical treatment of patients with malignant brain tumor
- Surgical management of patients with low-grade glioma
- Clinical trials for adjuvant treatment of patients with malignant brain tumor
- Treatment wait times and outcomes for brain tumor patients
- Endoscopic treatment of patients with skull base or pituitary tumors

Education

The program provides fellowship training for neurosurgeons who want to develop special skills in surgical neuro-oncology.

Research

Members of the program are actively involved in clinical research to test new and innovative therapies to treat patients with brain tumors. Dr. Mark Hamilton and Dr. John Kelly are members of the Arnie Charbonneau Cancer Institute and the Hotchkiss Brain Institute.

All neurosurgeons have been participants in multi-center clinical trials, including those involving convection-enhanced delivery of agents into the brain to treat brain tumors and brain tumor vaccines. In addition, the Brain Tumor Tissue Bank is available to store tissue from consenting patients for current and future research.

Members

Neurosurgeons: Dr. Mark Hamilton, Dr. Yves Starreveld, Dr. John Kelly, Dr. Garnette Sutherland
Neuro-Oncologists: Dr. Paula de Robles, Dr. Greg Cairncross, Dr. Gloria Roldan
Radiation Oncologists: Dr. Rob Nordal, Dr. Gerald Lim
Nurse Clinician: Patricia Randall
Surgical Neuro-Oncology Nurse: Chelsea Demler

The Section of Physical Medicine & Rehabilitation

Interim Section Head: Dr. Christine McGovern



PHYSICAL MEDICINE AND REHABILITATION is a branch of medicine that is focused on improving quality of life and maximizing independence in activities of daily living. A physician with specialty training in Physical Medicine and Rehabilitation is called a physiatrist.

We have 40 members of our section. We have many different programs within our section that focus on patient populations with a variety of different medical conditions. These would include many individuals with neurologic conditions such as stroke, spinal cord injury, acquired brain injury, neuromuscular disorders, cerebral palsy, and musculoskeletal conditions such as neck and back pain or individuals with amputations. Physiatrists have training in working within interdisciplinary care settings and often work in teams including social workers, psychologists, physical therapists, occupational therapists, speech therapists, and others.

This most recent year started in a usual manner with everyone working away in their clinical, research, and educational domains. Retreats were planned, grants were obtained, and clinics and inpatient wards continued to see many patients.

Unit 58, our Tertiary NeuroRehabilitation inpatient unit at Foothills Medical Centre, was renamed the “TNR Unit” as recognition that the focus on our

unit is a little different than the other acute medical units within Foothills. A simulation program was developed with the assistance of a grant and simulation assessments were held jointly with the Department of Psychiatry in order to advance training and assessments in both residency programs. Quality improvement activities were undertaken to improve patient care—including a fun compression challenge on the TNR Unit to update and improve accuracy for chest compressions during CPR—including physicians, nurses, and Allied Health.

Then along came the COVID-19 pandemic, which disrupted many aspects of care and planning. Our members continued to contribute the medical community at large. Members were on working groups for COVID rehabilitation practices for the province and helped review the COVID-19 Scientific



▲ The Spinal Cord Injury Symposium—held in Fall 2019—was a huge success.

Advisory Group Rapid Evidence Report. We were part of a speaker series put on by the University of Calgary called COVID Corner. We learned how to do clinic assessments by telephone and virtual means whenever possible. Contingency plans were made for Phase 1 of the pandemic, many of which did not need to be enacted. However, the plans are now in place in case they are needed for Phase 2.

We continue to be very proud of our residency program. Our graduating residents were successful in completing their Royal College examinations. We have an excellent set of residents who always bring their best to the forefront. Several residents stepped up when the clinical learning opportunities were limited and worked as contact tracers for the pandemic.

Quality care to individuals that require it remains our top priority, both prior to the pandemic, during, and following. Some of the care has changed in how it is delivered, but we remain committed and continue to work alongside our colleagues to provide care where needed.

The Amputee Rehabilitation Program

Program Lead: Dr. Kenneth Lam

Overview

The Amputee Rehabilitation Program provides comprehensive care to patients with limb loss across the continuum of care. Both inpatient and outpatient services are provided. In 2019-2020, over 100 new patients with limb loss entered the program. Amputation occurs at all hospital sites so peri-amputation consultative services are provided citywide.

One of the key components of this program is to optimize the timing and level of amputation by close partnership with our surgical colleagues.

Outpatient rehabilitation is organized through the Community Accessible Rehabilitation (CAR) Program. With close partnership with the CAR Program we have garnered expertise in managing complex amputees. We have started a new collaboration with our local plastic surgeons in looking at novel approach to neuroma treatment and targeted muscle reinnervation.



Dr. Kenneth Lam

We are also exploring the use of the Bento Arm, developed by the University of Alberta, for upper limb myo-electric prosthetic training.

Education

The program is dedicated to medical education and training. Physiatry residents complete a mandatory three-month period in the program during their residency. Vascular surgery residents are now spending one month in the program during their residency.

The program is also involved in the education and certification of prosthetists in training. In-service lectures are also delivered to Allied Health and nursing staff on a regular basis.

Members

Dr. Kenneth Kui Sai Lam
Dr. Gentson Leung

The Burn Rehabilitation Program

Program Lead: Dr. Vincent Gabriel

Overview

The Burn Rehabilitation Program has continued providing a continuum of care through the pandemic with this year taking in 1015 new patients, having 3654 follow up appointments and carrying out 204 virtual clinic visits for our patients.



Dr. Vincent Gabriel

Our research program continues enrolling subjects in clinical trials and working on translational projects and medical device development.

We are undergoing an internal review to identify areas for ongoing improvement including nursing and allied health certifications.

The Calgary Brain Injury Program

Program Lead: Dr. Rodney Li Pi Shan

Overview

The Calgary Brain Injury Program addresses the rehabilitation needs of individuals with acquired brain injuries which may arise from trauma, infection, aneurysm rupture, hypoxia, tumour resection or other causes. The affected individuals cross the spectrum from mild to severe levels of injury.

Service

The service includes both an inpatient and an outpatient component. The inpatient service includes a physiatry consultation service for individuals in acute care, as well as 15-16 inpatient beds on a tertiary neurorehabilitation unit (TNR) at the Foothills Hospital. The primary goal of the TNR unit is to provide intensive rehabilitation services for the inpatients. The patient experience team continues to provide one-on-one peer support on the neurorehabilitation unit. There is also a facilitated group meeting every two weeks for individuals as well as their families to provide an opportunity for connection and support. The music therapy program on the neurorehabilitation unit has also been well received and funding to continue the program has been established.

The Early Supported Discharge Program is a home-based program where people discharged from hospital can receive interdisciplinary rehabilitation. This service is for patients who do not require nursing care at night and have appropriate supports at home. It allows these patients to leave hospital earlier and apply their rehabilitation to practical goals that are immediately relevant to them. Evaluation of the program showed it was equally effective to tertiary inpatient rehabilitation and saved a significant number of inpatient bed days and associated costs. The program is now ongoing, in association with the stroke early supported discharge program.



Dr. Rodney Li Pi Shan

The outpatient service is based upon a centralized referral system which provides triage and advice from our community case manager for access to several different services, including:

- Sub-acute concussion education sessions delivered approximately every two weeks. This consists of symptom management advice in a group format to individuals affected by concussion within three months of injury. An early concussion education module for patients is also available at <https://myhealth.alberta.ca/learning/modules/Early-Concussion>.
- A Brain Injury Rehabilitation Clinic provides assessment and treatment by physiatrists for moderate and severe brain injury. Social workers are also associated with the clinic.
- Liaising with the Community Accessible Rehabilitation program in order to arrange interdisciplinary rehabilitation for individuals as required.
- Contracting for services with the Association for Rehabilitation of the Brain Injured, a community-based program, to provide rehabilitation services for appropriate individuals.

Education

We continue to be actively involved in teaching at many different levels. We support learning by medical students, residents, graduate students, Allied Health students, and nursing students. Many of our members contribute to undergraduate medical teaching. Drs. Grant, Francis, McGovern and Li Pi Shan all teach the physical exam portion of the Neuroscience course and small group sessions. As well, Dr. Debert provides an hour-long lecture on concussion. Our members provide teaching for post-graduate training programs and we provide lectures for our residents in half day as well as for psychiatry and neurology.

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Grants and Research

The Calgary Brain Injury research program, led by Dr. Debert, allows residents, graduate students, and undergraduate students to participate in clinical and basic science research. Researchers lead and collaborate on grants funded by the Cumming School of Medicine, Hotchkiss Brain Institute (HBI), Foundations for Physical Medicine and Rehabilitation and New Frontiers Funding (CIHR, NSERC) and the Department of National Defense of Canada.

We have a relationship with the Integrative Concussion Research Program and we are actively involved in the non-invasive neurostimulation initiative and the Brain and Mental Health Research Clinics—both HBI funded research initiatives. Members of the Calgary Brain injury Program are also involved with the HBI Traumatic Brain Injury neuroteam.

The program also has four research assistants, 3 post-graduate trainees (2 PhD students and 1 MSc), four undergraduate trainees, and two ongoing residency projects, involved in the Calgary Brain Injury Program.

As well, over the last fiscal year Dr. Debert’s team was involved in 12 peer reviewed publications.

Members

Managers: Jason Knox, Lisa Patel, Kim Kennedy

Community Case Manager: Heather Murison, Alison Barnfather

Inpatient Brain Injury Nurse Clinician: Jill Congram

Physiatrists: Dr. Christine McGovern, Dr. Rodney Li Pi Shan, Dr. Chantel Debert, Dr. Christopher Grant, Dr. George Francis

Psychiatrist: Dr. Jeremy Quickfall

Clinic Social Workers: Valerie Bunz, Melissa Ehrlich

Neuropsychologists: Dr. Stewart Longman, Dr. Amy Siegenthaler, Dr. Ashley Fischer

Administration Support: Kendra McDonald, Susan Morson, Brenda Festa, Ashley Derksen, Marj Moon, Shelby O’Connell

Pediatric and Young Adult Rehabilitation Medicine Program

Program Lead: Dr. Lee Burkholder

Overview

The program provides inpatient and outpatient rehabilitation medicine services at the Alberta Children’s Hospital (ACH) to pediatric populations, including children with neurological disorders such as brain injury, cerebral palsy, myelomeningocele/spinal cord injury, neuromuscular conditions, and other neurodevelopmental disorders as well as musculoskeletal disorders such as limb deficiency and arthrogryposis.

The program is also responsible for the Young Adult Rehabilitation Clinics, outpatient clinics located at the Sheldon M. Chumir Health Centre and Foothills Medical Centre, which are dedicated to adult patients with child-onset neurological and musculoskeletal conditions. These clinics provide comprehensive rehabilitation medicine management and assist patients transitioning from pediatric care to the adult world.

Clinical Care Updates

The Pediatric Rehabilitation Medicine inpatient consultation service assessed and treated 46 children, many within the context of the ACH interdisciplinary neuro-rehabilitation team, while admitted to hospital. An additional 20 patients were followed during admission to the ACH Dr. Gordon Townsend School (GTS) Intensive Rehabilitation and Education Program for ongoing management of medical and rehabilitation issues. The program also provided 1,163 pediatric outpatient consultation and follow-up appointments, including 895 direct patient appointments and 268 virtual patient appointments, through various ACH Physiatry clinics. A further 435 outpatient appointments, including 291 direct patient appointments and 144 virtual patient appointments, were attended by adult patients through the Young Adult Rehabilitation Clinic. The program continued as a primary contributor to the interdisciplinary ACH Spasticity Assessment Program (SAP), which provides comprehensive assessment and management recommendations to children with complex hypertonicity issues. The SAP assessed five children for possible neurosurgical tone management with intrathecal baclofen via

pump implant or selective dorsal rhizotomy. Instrumented gait analysis, collaborative with Orthopedic Surgery, Physiotherapy and Orthotics, for recommendation of therapeutic interventions continued through the C.H. Riddell Movement Assessment Centre at the ACH with 27 patients undergoing evaluation.

Education

Program educational pursuits were related to post-graduate medical education as well as research training. The program had six post-graduate medical trainees, including PM&R, Developmental Pediatrics and Pediatric Neurology residents, on service for 12 of 13 academic blocks. Dr. Condliffe provided academic supervision and research mentorship for one post-doctoral fellow, one allied health clinician, two Master of Science students and four undergraduate students. Dr. Condliffe also served as a committee member, examiner or neutral chair for five additional graduate students. Dr. Gnanakumar is the Physician Lead for PM&R medical student clinical electives. Dr. Burkholder is a member of the Pediatric Neurology Residency Training Committee.

Research

Dr. Condliffe was collaborating on or leading 17 research projects, including four registered clinical trials. In addition, Dr. Condliffe presented the results of children with cerebral palsy attending a summer camp focused on providing exposure to adapted sports programs at the American Academy of Cerebral Palsy and Developmental Medicine Annual Meeting and the N3 Day at the University of Calgary on using transcranial magnetic stimulation with regards to neuroplasticity in the cerebral palsy population.

Dr. Gnanakumar is the Calgary Site Lead for a clinical study focused on optimizing the management of pain and irritability in children with severe neurological impairments. Dr. Burkholder is a Calgary Site Co-lead for the Canadian Cerebral Palsy Registry.

Members

Dr. Lee Burkholder, Dr. Elizabeth Condliffe, Dr. Vithya Gnanakumar, Dr. Janet Tapper

PM&R Musculoskeletal and Chronic Pain Programs

Program Lead: Dr. Noorshina Virani

Musculoskeletal (MSK) Program

Community PMR MSK practice has expanded with the opening of Dr. Arun Gupta’s Infini Health clinic. Dr. Gupta completes all procedures for pain management including radiofrequency ablation and regenerative techniques. This clinic’s intent is to extend clinical learner and research opportunities in Musculoskeletal pain medicine.

Dr. Ranita Manocha is heavily involved in research and clinical initiatives. In addition to the Bracing and Mobility clinic, she has developed the Hypermobility Syndromes Rehabilitation Clinic and the Bracing Bunch,(quarterly bracing rounds for therapists, physicians, learners, orthotists, etc). Clinicians interested in participitating can contact Dr. Manocha.



Dr. Noorshina Virani

Dr. Manocha and Dr. Rebecca Iwaniki, from Kinesis, have created collaborative opportunities with other departments. Dr. Iwanicki has joined the Foot and Ankle orthopedics group at monthly Complex Case Rounds. They are looking forward to soon launching a central triage program for foot and ankle orthopedics, (similar to the Alberta Hip and Knee Clinic). Dr. Manocha has given formal outreach talks to both Orthopedics and Emergency Medicine.

Inpatient MSK Physiatry consults at Carewest Glenmore Park, Rockyview General Hospital, and Carewest Vernon Fanning Centre, unit 2W are fielded by Dr. Gentson Leung

Research

- Merkobrada, S. Ultrasound analysis of cervical paraspinal muscles for needle EMG examination. Muscle & Nerve 2020; 61(6): 754-758.
- Manocha RHK, Johnson JA, King GJW. The effectiveness of a hinged elbow orthosis in medial collateral ligament injuries: an in vitro biomechanical study. Am J Sport Med 2019;47(12):2827-2835.

Published abstracts

Russell M, Kuntze G, Jivan S, Ronsky JL, Manocha RHK. Differences in wrist and scapular kinematics when using axillary versus forearm crutches. Clin J Sport Med 2020;30(3):e100.

Grants

Upper extremity kinematics and muscle activity with crutch use
Funding Source: Cumming School of Medicine and Alberta Health Services
Program Name: Clinical Research Fund – Data Collection Grant
Principal Investigator: Dr. Ranita Harpreet Manocha
Role: Principal Investigator
Total Amount: \$10,000.00
Support Period: 09/19 to 08/21
Co-Investigators: Drs. Gregor Kuntze, Janet L. Ronsky

Conference Podium Presentations

Jivan S, Kuntze G, Ronsky JL, Manocha RHK. Crutch length effects on scapular kinematics. McCaig Institute Summer Student Symposium, Calgary, Alberta, August 16, 2019.

Peer-reviewed conference poster presentations:

- Russell M, Kuntze G, Jivan S, Ronsky JL, Manocha RHK. The effect of axillary crutch length on wrist and scapular kinematics. Available at: <https://drive.google.com/file/d/1WHqOp02oZ6-M1KMKV6C-GTqOrlOiyjyM/view>. Hotchkiss Brain Institute Research Day, Calgary, Alberta, May 28, 2020.
- Russell M, Kuntze G, Jivan S, Ronsky JL, Manocha RHK. Differences in wrist and scapular kinematics when using axillary versus forearm crutches. Canadian Academy of Sport & Exercise Medicine Conference, Banff, Alberta, April 29, 2020 [cancelled due to COVID-19].
- Jivan S, Kuntze G, Ronsky JL, Manocha RHK. Crutch length effects on upper extremity kinematics. The Arthritis Society Calgary Walk for Arthritis, Calgary, Alberta, June 2, 2019.

Education

Dr. Vithya Gnanakumar has taken over as the Course 2 Chair for Musculoskeletal medicine in the undergraduate curriculum at the Cumming School of Medicine. Several Physiatrists participate in teaching undergraduate Course 2 lectures, including Drs. Ken Lam, Gentson Leung and Noorshina Virani.

Due to COVID-19 restrictions, Family Medicine residents can no longer attend the AHS Chronic Pain Centre (CPC) in person. As such, a virtual teaching program of pain related cases was developed by Drs. Ted Findlay and Yasmin Majeed at CPC. Dr. Noorshina Virani from the AHS Chronic Pain Centre (CPC), is one of three clinicians participating in this monthly teaching program.

Chronic Pain Program

There are three streams of patient delivery at the AHS Chronic Pain Centre (AHS CPC) in Calgary, including the neuromusculoskeletal (NMSK), pelvic and headache teams. Currently, 966 patients are on the NMSK wait list as of Sept. 30, 2019. An additional 135 patients are on the pelvic and 72 patients are on the headache team waitlists. NMSK physicians assessed 538 new patients in the reporting period, while pelvic and headache teams assessed 89 and 43 new patients respectively. Average wait time until the

first patient-physician visit to the NMSK team, is reduced to approximately 9.7 months. Wait times for the headache team has increased to 11.3 months and to the pelvic team to 7.6 months. This does not include visits to lectures, groups or other Allied Health providers, which may occur prior to the first physician visit.

The CPC is a mandatory rotation site for Family Medicine, Anesthesia and Physiatry residents. Unfortunately, due to COVID-19 restrictions, only Anesthesia residents, in addition to one Pain Medicine Resident, have rotated through since March 2020. For the reporting period, 29 clerks/ students, 11 off service residents and one Pain Medicine resident have rotated through the CPC.

Members

AHS Chronic Pain Centre (AHS CPC):
Dr. Nwamara Dike, Dr. Noorshina Virani

Community and Inpatient Practitioners:
Dr. Maryana Apel, Dr. Brian Benson, Dr. Darren Chiu, Dr. David Flaschner, Dr. George Francis, Dr. Tony Giantomaso, Dr. Arun Gupta, Dr. Chris Huang, Dr. Rebecca Iwanicki, Dr. Les LaPlante, Dr. Daniel LeBlond, Dr. Jennifer Litzenberger, Dr. Serge Mrkobrada, Dr. David Nabeta, Dr. Daniela Porter, Dr. Paul Reglin, Dr. Jordan Raugust, Dr. Vishal Tuls, Dr. Andrew Malawski, Dr. Gentson Leung, Dr. Ranita Manocha

The Spinal Cord Injury Rehabilitation Program

Program Lead: Dr. Denise Hill

Overview

The Spinal Cord Injury (SCI) Rehabilitation Program provides tertiary inpatient and outpatient rehabilitation services to persons with traumatic and non-traumatic SCI for Southern Alberta and Southeastern British Columbia.

The outpatient rehabilitation SCI clinic offers consultation services for people with spinal cord injuries. This clinic held 448 physician-patient visits, 118 physician-patient phone call followups, 125 nurse or nurse practitioner visits, and 93 nurse or nurse practitioner phone call followup visits (for a total of 566 patient encounters) between July 1, 2018 and June 30, 2019. Sixty-seven patients were admitted for acute inpatient rehabilitation on Unit 58.



Dr. Denise Hill

Highlights

Planning for a Foothills Medical Centre (FMC) SCI symposium got underway this year. The design of the symposium aims to foster networking among acute care and tertiary neurorehab staff and to provide education pertaining to care of the person with SCI across the continuum.

The Spinal Cord Injury registry—which was originally funded by Brain Canada with support from the Alberta Paraplegic Foundation, the Praxis Spinal Cord Institute (previously Rick Hansen Institute), the University of Alberta’s Neuroscience & Mental Health Institute and the University of Calgary’s Hotchkiss Brain Institute—is no longer conducted by the SCI rehabilitation program. However, work continues to embed aspects of the registry into standard clinical care and to expand enrollment opportunities to all persons living with an SCI in Alberta. The registry serves as a foundational platform to continue to track, evaluate and address patient outcomes and concerns.

In late 2018, the SCI Program was invited by the Toronto Rehabilitation Institute/University Health Network to participate in a sub-grant study supported by the Craig H. Nielsen Foundation to validate a newly developed pressure injury risk screening instrument called the SCI Pressure Sore

Onset Risk Screening (SCI-PreSORS). In order to evaluate the generalizability of the SCI-PreSORS to other sites and to calculate its sensitivity and specificity, they requested access to previously collected data (from the Spinal Cord injury Knowledge Mobilization Network project, 2011-2016) and supplemented it with additional data (i.e., demographics and functional independence measure scores). This work continues and a manuscript will be submitted for publication within the next year.

In March 2019, Dr. Charbonneau and the SCI teams on both the Tertiary Neurorehabilitation Unit at FMC and the SCI Unit at the Glenrose Rehabilitation Hospital completed a project standardizing bladder management practices for SCI patients. The project was supported by an award of a provincial seed grant from the Alberta Paraplegic Foundation. The primary project goal was to standardize bladder management practices to support equitable, optimal, evidence-informed care. This was accomplished through the development and implementation of decision-making pathways and resource guides for staff and patients/families as well as training and coaching for staff. Learnings from this project will support future projects pertaining to bowel management and the management of autonomic dysreflexia.

Physiatry contributes to the diaphragm pacing program, neuromodulation meetings, the Alberta Functional Electrical Stimulation Interest Group, and the local activities of the Praxis Spinal Cord Institute. The program, through Dr. Charbonneau, published the following papers this year:

- Hubbard ME, Phillips AA, Charbonneau R, Squair JW, Parr AM, Krassioukov A. PRES secondary to autonomic dysreflexia: A case series and review of the literature. Journal of Spinal Cord Medicine. 2019 May 31.
- Squair JW, Dhaliwal R, Cragg JJ, Charbonneau R, Grant C, Phillips AA. National Survey of Bladder and Gastrointestinal Dysfunction in People with Spinal Cord Injury. J Neurotrauma. 2019 June 17.

Members

Dr. Denise Hill, Dr. Rebecca Charbonneau, Dr. Dan McGowan, Raj Parmar (Nurse Practitioner)

The Stroke Rehabilitation Program

Program Lead: Dr. Sean Dukelow

Overview

Stroke rehabilitation services at both the Foothills Medical Centre and the Dr. Vernon Fanning Care Centre are provided by physiatry. Our group also provides physiatry support for outpatient stroke rehabilitation in the community through Early Supported Discharge (ESD), Community Accessible Rehabilitation (CAR), Association for Rehabilitation of the Brain Injured (ARBI), and other private rehabilitation providers. We accept referrals from across Southern Alberta for patients who require stroke rehabilitation expertise.



Dr. Sean Dukelow

Highlights

This year, Dr. Dukelow’s research team won Paper of the Year at the Canadian Association of Physical Medicine and Rehabilitation annual meeting for their article “Comparing CST Lesion Metrics as Biomarkers for Recovery of Motor and Proprioceptive Impairments after Stroke”.

This article was published in the journal Neurorehabilitation and Neural Repair and was the final work of lead author Dr. Sonja Findlater.

Education

Our team was involved in teaching several physiatry and neurology residents, acute stroke fellows, and medical students in our clinics. Further, our members spent time teaching on the ward and in classroom sessions.

Research

The Stroke Rehabilitation Program published 15 papers last year. Dr. McNeil and Dr. Dukelow co-authored a manuscript entitled “Practical Guidance for Outpatient Spasticity Management During the Coronavirus (COVID-19) Pandemic: Canadian Spasticity COVID-19 Task force”. Dr. Dukelow lectured on “Stroke Recovery in Canada” at the International Stroke Rehabilitation and Recovery Alliance meeting in Melbourne, Australia in October of 2019.

A number of funded clinical trials are underway including the CIHR-funded RESTORE trial examining robotic rehabilitation early after stroke, the Brain Canada funded FLOW trial examining Fluoxetine and its effect on lower extremity motor recovery and the Heart and Stroke Foundation funded REMAP trial examining the use of Transcranial Magnetic Stimulation and Multi-Modal Aphasia Therapy for post-stroke aphasia.

Members

Dr. Sean Dukelow
Dr. Ken Lam
Dr. Steve McNeil
Dr. Gentson Leung
Allen Szabon, Physician Assistant

The Section of Translational Neuroscience

Section Head: Dr. V. Wee Yong

THE SECTION OF TRANSLATIONAL NEUROSCIENCE (STN)

in the Department of Clinical Neurosciences consists of seven primary members distinguished by their PhD background. Research areas for members include neurodegenerative diseases, movement disorders and multiple sclerosis (MS), with a focus on understanding the pathogenesis of these disorders and the discovery and translation of new therapies into the clinic. These therapies include those that may reduce injury to the compromised nervous system and those to promote brain repair.

- **Dr. V. Wee Yong** is a professor who co-directs the Multiple Sclerosis (MS) Brain and Mental Health Team at the Hotchkiss Brain Institute (HBI) and he is the director of the Alberta MS Network. His research interests have been guided by MS and glioblastomas, and findings have been translated into clinical trials in these conditions. Dr. Yong's publications have been cited over 22,500 times (Web of Science, h index: 85). His research activities are supported by CIHR (Foundation grant), the MS Society of Canada, and the Canadian Cancer Society. Dr. Yong is the recipient of the 2017 Allyn Taylor International Prize in Medicine for "transformational discoveries in MS". He is a fellow of both the Royal Society of Canada and the Canadian Academy of Health Sciences. Dr. Yong takes pride in his laboratory supervision: in the past 4 years, 6 trainees graduated from their PhD programs and 4 postdoctoral trainees have taken on faculty positions in Canada and Germany.
- **Dr. Minh Dang Nguyen** received an Alberta Prion Research Institute award—Alzheimer's Research Program grant—to investigate the ApoE/ApoER2 axis in cerebrovascular dysfunction in Alzheimer disease (\$150K for two years, 2019-2021). The funded project is complementary to the CIHR Operating Grant he secured in 2018 (~\$987K for five years) that studies the roles of the Alzheimer's disease predisposition



factor CD2AP in cerebrovascular dysfunction. Dr. Nguyen is currently collaborating with Dr. Eric Smith and Dr. Gerald Pfeffer to understand the impact of CD2AP polymorphisms in human patients with cognitive dysfunction and dementia. He has also extended his basic research on the gut-brain axis in amyotrophic lateral sclerosis (ALS) to the study of the oral microbiome in ALS patients in collaboration with Dr. Gerald Pfeffer, Dr. Lawrence Korngut and Dr. Matthew Stephens (Snyder Institute).

- **Dr. Shalina Ousman** is an associate professor and a member of the Multiple Sclerosis (MS) and Spinal Cord/Nerve Injury and Pain Brain and Mental Health Teams at HBI. Her research is focused on investigating endogenous protective mechanisms in MS and peripheral nerve regeneration. In regards to her MS work, Dr. Ousman is investigating the molecular

factors that drive dysfunction of astrocytes as well as why relapsing-remitting MS patients switch to a progressive form of the disease. Her peripheral nerve injury studies are focused on understanding why Schwann cells become dysfunctional in the injured aging peripheral nervous system. Her research is currently funded by CIHR.

- **Dr. Bin Hu** is a professor specializing in Parkinson's disease (PD) research. He is a member of the HBI, and directs an international program of rehabilitation therapy for patients living with PD. The Ambuloso program currently has a large group of active users in seven countries, which has attracted broad attention not only from academic institutions but business and art communities that support music and mind research. He has published a series of articles documenting the power of music in helping Parkinson's patients in overcoming freezing gait. Dr. Hu's research has been supported by CIHR, Parkinson Association of Alberta, AIHS and Branch-out Foundation for Neurological Diseases. Alberta Health has recently announced that they will provide Dr. Hu with a large team grant to help multiple non-government organizations in the province to set up an online system entitled ACSCON (Access-Connect) through which patients will be able to receive non-pharmaceutical and rehabilitation assistance from health coaches.
- **Dr. Oury Monchi** is a professor, the Clinical Research Director of DCNS, the CaPRI/Movement Disorders Brain and Mental Health team lead, the Tourmaline Oil Chair in Parkinson's disease and the Canada Research Chair (Tier 1) in non-motor symptoms of PD. In fall 2018 he obtained a platform grant from

Brain Canada-Parkinson Canada for the creation of the Canadian-Open Parkinson Network which he directs. This network has 10 PIs and more than 50 members—mostly in Canada but also abroad. Dr. Monchi's lab was the first to show that the Mild Behavioral Impairment-checklist (MBI-C), a tool to measure rapidly sustained changes in neuropsychiatric symptoms in populations over 50 years, strongly correlates with cognitive deficits in Parkinson's disease. This work was published in the Journal Neurology in 2019. Dr. Monchi and his colleagues obtained a project grant in the spring 2019 CIHR competition to study whether the MBI-C is predictive of cognitive decline longitudinally in PD using a combination of clinical assessments, neuroimaging and machine learning.

- **Dr. Hedwich Kuipers** is an assistant professor of neuroimmunology and joined the HBI MS NeuroTeam in April 2018, holding a membership at the Snyder Institute for Chronic Diseases as well. Her research is aimed at understanding the interaction between immune cells entering the CNS and its resident cells. Her main focus is on astrocytes, whose role in neuroinflammation is often overlooked. She has shown before that these cells, which are highly abundant in the brain, can release factors that help T lymphocytes infiltrate into CNS tissue. She currently investigates how astrocytes interact with these T cells and how they shape their responses, using molecular and cell biology approaches, as well as animal models of MS. In addition, she studies how astrocytes are affected by the oxygen levels they encounter, which can vary in different disease states. Dr. Kuipers's research is supported by the MS Society of Canada, the Canadian Foundation for Innovation and the HBI.

- **Dr. David Park** is a professor and Director of HBI. His research program focuses on the mechanism of neural injury in stroke and Parkinson's disease (PD) as well as some fundamental aspects of neural development. He is also the lead of the Brain and Mental Health Strategy for the University of Calgary and he chairs Campus Alberta Neuroscience which knits together the three major sites of brain research in Alberta (Calgary, Edmonton, and Lethbridge). Since 2019, he has published seven papers in journals such as Aging Cell, J Biological Chemistry, J Neurochem., Cell Death and Disease, and Science Translational Medicine. His current interests are focused on understanding how genes associated with PD function or dysfunction to lead to disease progression. In this regard, he has recently shown that the LRRK2 gene may play a critical role in immune function and regulation, and he is currently screening drugs for potential candidates for human trials.

Education

Members offer graduate and postdoctoral fellowship studies in basic and translational neurosciences, as well as year-round research projects for senior undergraduates and summer research programs.

Translational Program

STN is in a unique position to foster cutting edge translational neuroscience research. We are somewhat different from the basic science departments in that our program has a clear mandate to facilitate and integrate research and education between the clinic and the laboratories.

Work by our members, in collaboration with our neurology, neuro-oncology and neurosurgery colleagues, has resulted in a successful Phase III clinical trial in MS, an ongoing Phase III trial in traumatic spinal cord injury, and a soon-to-start Phase I/IIa trial of niacin in glioblastoma.

Undergraduate Medical Education in Clinical Neurosciences — Course 5

Co-Chairs: Dr. Erika Dempsey, Dr. Philippe Couillard,
Dr. Gary Klein

Evaluation Coordinator: Dr. Scott Jarvis

Course Coordinator: Kelsey O'Donnell

Overview

The Undergraduate Medical Education (UME) office of the Cumming School of Medicine (CSM) at the University of Calgary oversees the course, entitled Course V – Neurosciences, Aging and Special Senses.

Medical students learn about neurosciences, special senses, and aging during August, September and October each year, in the first course of the second year of the undergraduate medical education curriculum. The neurosciences component is combined with content from geriatrics, otolaryngology, ophthalmology, pain and palliative care.

Course content is delivered through a combination of lectures, patient presentations, small group seminars, and bedside teaching sessions. The neurosciences content in the course begins with a series of lectures on the functional anatomy and physiology required to evaluate patients presenting with neurological complaints. The remainder of the content covers clinical presentations of neurological illness, with certain sessions devoted to specific neurological conditions. The curriculum is taught by approximately 130 teachers, including 60 from the Department of Clinical Neurosciences.

The course in 2019 was another success, enjoyed by students and faculty alike. This year's course (2020) came with new challenges amidst an ongoing pandemic, with nearly all presentations, small groups, and anatomy teaching transitioned to a virtual format. A special thanks to Dr. Gary Klein (past course 5 chair, who stepped in mid-pandemic to help), Drs. Erika Dempsey and Philippe Couillard, and all the staff and faculty at the UME, for leading the course through a dramatic and rapid change. We have learned a lot about the opportunities and challenges of delivering a predominantly virtual

neurosciences curriculum and hope to continue to improve the delivery of the course through future iterations. Moving forward, Course 5 welcomes its newest co-chair, Dr. Ronak Kapadia, who will be taking over from Drs. Klein and Couillard.

Course V Committee:

Philippe Couillard
Erika Dempsey
Gary Klein
Scott Jarvis
Ronak Kapadia
Tyson Brust
Steven Peters
Veronica Bruno
Alicja Cieslak
Julie Kromm
Paolo Federico
Dawn Pearson
Jeptha Davenport
Christopher Hahn
David Patry
Gerald Pfeffer
Dan McGowan
Martina Kelly
Alice Ho
JP Appendino
Clare Gallagher
Darren Burback
Heather Jamniczky
John Huang
Lori Montgomery
Paul Marck
Paula Pearce
Ron Spice
Vivian Hill



Resident Research Day winners Dr. Gordon Jewett (left) and Dr. Nicholas Sader (right) with Dr. Midha.

Resident Research Day

RESIDENT RESEARCH DAY, which was held on Nov. 22 last year, is celebrated within the Department of Clinical Neurosciences and is a highlight of our Grand Rounds calendar.

Residents from Neurology, Neurosurgery, Physical Medicine & Rehabilitation and Pediatric Neurology have their abstracts and presentations judged by a panel of faculty members and the strongest are chosen for two prestigious awards.

Abstracts from 14 residents were presented in front of their peers, faculty and the judges — Dr. David Cadotte, Dr. Chantel Debert, Dr. Gerald Pfeffer, Dr. Minh Dang Nguyen and Dr. Rajiv Midha.

For 2019, the J. Gregory Cairncross Award for Excellence in Clinical Research was awarded to Dr. Nicholas Sader for his presentation “Quality of Life and Neurodevelopmental Outcomes in Surgical versus Conservative Treatment of Non-Syndromic Children with Craniosynostosis.”

The Doug W. Zochodne Award for Excellence in Basic Science Research was won by Dr. Gordon Jewett for his work “Measurement of Incremental Response is Repeatable in Amyotrophic Lateral Sclerosis.”

Congratulations to all who participated!

Neurology Residency Program

Program Director: Dr. Michael Yeung

Program Administrator: Christopher Smith

Number of positions per year: 3-4

Accreditation: Royal College of Physicians and Surgeons of Canada

Length of Training: 5 years

The University of Calgary Adult Neurology Residency Training Program is dedicated to educating residents in neurology. The program has trained over 50 neurologists since its inception in 1981 and these specialists practise neurology in community and academic institutions throughout the world. The program currently has 16 residents from across Canada and two international medical graduates.



Dr. Michael Yeung

Upon completion of training in neurology, a resident is expected to be an expert in the prevention, diagnosis and management of patients with diseases of the nervous system; and to integrate all of the CanMEDS roles (Medical Expert, Communicator, Collaborator, Leader, Health Advocate, Scholar and Professional) to provide optimal, ethical and patient-centred medical care.

We emphasize the pursuit of excellence in clinical and academic neurology and instill intellectual curiosity of the discipline for the academic leaders of tomorrow.

As with all neurology programs across Canada, we will be launching Competence by Design—the Royal College of Physicians and Surgeons of Canada’s revamp of medical education within residency programs—in July 2020. This will facilitate learning through timely and specific feedback to learners as well as faculty.

Our residents have presented their research at national and international conferences and have been the recipients of grants and scholarships for their clinical and academic pursuits. Our residents

also support the learning of medical students throughout their training, either on the inpatient units, the outpatient clinics, or through teaching at the medical school.

The first wave of the COVID-19 pandemic affected residency training programs across the country. In Calgary, out-patient clinics were “closed” to learners as clinical visits went “virtual”. Residents were re-deployed to critical areas including contact tracing. One of our PGY-5 residents, Dr. Vikram Karnik, was instrumental in helping to organize medical students and residents as classes and clinical rotations were cancelled. He took the lead on a social media campaign, leading a group of physicians, journalists, graphic designers, and marketing experts in developing a social media strategy to combat misinformation (called the C19 Collective). This has subsequently morphed into a national public health conglomerate led by public health in Calgary. Because of Dr. Karnik’s contributions, as well as that of other Neurology residents in contact tracing, the Adult Neurology Residency Training Program was recognized for its contribution by the Alberta COVID-19 Exposure Response Team (ACERT).

The pandemic also affected the timing of the Royal College of Physicians and Surgeons Neurology specialty examinations. They were delayed from the spring to the fall, and were in written format only. All four PGY5 residents were successful in the examinations – these residents have moved on to Fellowship programs in Movement Disorders (Harvard, Boston), Epilepsy (University of Washington, Seattle), Stroke (University of Calgary), and Neuro-Ophthalmology (Emory, Atlanta).

As the pandemic continues, the Neurology Residency Training Program at the University of Calgary evolves and adapts as we prepare our residents to become specialists in neurology, whether their primary interest is clinical or academic

Physical Medicine and Rehabilitation (PM&R) Residency Program

Program Director: Dr. Gentson Leung

Program Administrator: Selena Huang

Number of positions per year: 2

Accreditation: Royal College of Physicians and Surgeons of Canada

Length of Training: 5 years

The University of Calgary Physical Medicine and Rehabilitation (PM&R) Residency Training Program strives to provide excellent educational experiences to both undergraduate and postgraduate learners, to help them excel in their clinical and academic pursuits.

We recognize the unique privilege and responsibility of training the next generation of physiatrists, and are excited to continue to improve upon the training we provide.

To that end, the PM&R residency program prepared over 2019 and the first half of 2020 to successfully launch the Competence by Design (CBD) curriculum in July 2020. Our program has been actively planning, training, and preparing both staff and residents for this major shift in medical education. This includes leveraging electronic tools and platforms to facilitate more timely and specific feedback to the trainees and faculty.

In addition to the training of psychiatry residents, the Section of PM&R continues to provide support to the University of Calgary medical school in Course 2 (Musculoskeletal Medicine) and Course 5 (Neurology) teaching for small groups, lectures, and clinical skills. Many of the faculty and residents participate in teaching the medical students.

The use of simulation as a teaching and educational tool is growing in medical education, and our program has been actively pursuing opportunities to implement its use. Simulation can be used to supplement the training our residents receive and is useful for addressing rare but important clinical situations, as well as improving interdisciplinary



Dr. Gentson Leung

communication in a low-stakes environment. There are a number of PM&R faculty members who have attended the Royal College Module Simulation Scenario Development Training, and have successfully implemented interdisciplinary simulation training scenarios involving PM&R faculty, residents, nurses, hospitalists and Allied Health in partnership with the Advanced Technical Skills Simulation Laboratory (ATSSL) at the University of Calgary.

The impact of the COVID-19 pandemic in the first half of 2020 has been widespread, and the PM&R Residency Training Program was no exception. However, the pandemic has also created opportunities to explore different strategies related to medical education. This included using virtual learning for the academic curriculum, as well as partnering with other Canadian residency programs to plan and implement virtual OSCE (objective structured clinical examination) assessments. Finally, I am extremely grateful to the faculty and residents during the pandemic, as they have been flexible and resilient through it all. I would like to particularly thank those residents who stepped up to do their part and help their colleagues in need, including Drs. Joan Stilling and Philip Motyka who volunteered with the team responsible for contact tracing, as well as Drs. Jacqui Stone, Rehana Murani, and Michael Poscente who volunteered to be redeployed to acute medical units.

Since the residency program's inception in 2004, our graduating PM&R residents have all successfully passed their Royal College Certification examinations. As well, all of our trainees who have challenged the licensing examination for EMG (electromyography) have been successful, which is a reflection of the strong partnership that Psychiatry has with our neuromuscular colleagues and the excellent training that our residents receive.

Neurosurgery Residency Program

Program Director: Dr. Jay Riva-Cambrin

Program Administrator: Patti Sullivan

Number positions per year: 2

Accreditation: Royal College of Physicians and Surgeons of Canada

Length of Training: 6 years

Mandatory Research: 1 block in PGY1; entire PGY4 year or more

Education of our postgraduate and undergraduate students remains one of the highest priorities of DCNS and the Section of Neurosurgery. The teaching faculty consists of a large complement of dynamic key opinion leaders representing all subspecialties of neurosurgery, including pediatric, vascular, interventional, intracranial lesions, skull base, epilepsy, functional and peripheral nerve. In addition, the University of Calgary boasts the largest comprehensive spinal surgery program in Canada with a total of 11 full-time spine surgeons coming from both neurosurgical and orthopedic backgrounds.

From the moment residents enter the program, they are continuously involved in research and education initiatives. Considerable resources are dedicated each year to facilitating academic activities through faculty participation, existing peer-reviewed grants, project funding from sectional and department sources and a minimum of 12 months of clinical or basic science research. The neurosurgery educational half-day runs each week for three hours on Monday afternoons and incorporate neuroanatomy and the simulation lab. Sessions are led by the residents and supervised by the faculty, creating a learning environment within the realm of neurosurgical expertise.

A number of our residents continue to garner awards and scholarships for their outstanding clinical and academic endeavors in addition to a few celebrating engagements, marriages, and births.



Dr. J. Riva-Cambrin

Some of these include:

- **Dr. Stefan Lang** was awarded a PhD from the University of Calgary and was named PhD student of the year at the Hotchkiss Brain Institute
- **Dr. Albert Isaacs** was awarded simultaneous PhDs from both the University of Calgary and Washington University (St. Louis)
- **Dr. Magalie Cadieux** was awarded a Masters degree in Medical Education from Harvard University
- **Dr. Michael Yang** is a chief resident and has secured a very prestigious fellowship in Spine Neurosurgery at the University of Miami.
- **Dr. Candice Poon** is a chief resident and has secured a very prestigious fellowship in Neuro-oncology at the MD Anderson Cancer Center in Houston, TX.
- **Dr. Branavan Manoranjan** has had two major, impactful, and first author publications in Nature Communications and Oncogene this year stemming from his previous PhD from McMaster University with Dr. Sheila Singh.

Team relationships outside the hospital are of equal importance to the Section of Neurosurgery as they are within the hospital. The program offers a well-rounded exposure to all aspects of neurosurgery within a close and collegial environment.

Non work-related, team-building events held throughout the year provide a healthy balance against a busy lifestyle choice.

The end result is a recipe for one of the most cohesive, dedicated and high-performing resident groups in all of Canada and a group that we are proud to call our own.

Research in Clinical Neurosciences

Overview

The Department of Clinical Neurosciences (DCNS) was founded in 1981 on the premise that excellence in patient care and excellence in research go hand in hand. We see them not only as inseparable, but synergistic.

Many of the physicians and surgeons in Clinical Neurosciences are actively engaged in research, however some focus exclusively on patient care. The spirit of research and innovation are integral to our team and are continuously fostered. Members lead a variety of research programs—facilitated by strong partnerships with the Hotchkiss Brain Institute, clinical departments within the Calgary Zone of Alberta Health Services, as well as other public and private organizations. Our members' research efforts focus on the following areas:

- **Basic Research:** The study of biology and mechanisms of disease.
- **Translational Research:** Involves taking findings from basic research and moving them quickly and efficiently into medical practice to improve disease treatment or other health outcomes.

- **Clinical Trials Research:** The comparative testing of new treatment ideas against current standards of care to determine which is superior.
- **Health Services Research:** The study of health care access and health care delivery to detect deficiencies and design improvements. Health services research often involves careful analysis of databases.
- **Population Health Research:** The study of disease in populations to find risk factors and design prevention methods.

Our research-focused doctors and scientists are also members of the Cumming School of Medicine, Alberta Health Services and the Hotchkiss Brain Institute, from which they receive invaluable assistance, mentorship and support. Indeed, much of our success in research as a clinical group can be traced to these very strong linkages.

Our faculty members publish the results of their studies in the top medical and scientific journals and they play leading roles in local, national, and international academic and professional organizations. Their efforts are supported by grants from a wide range of external agencies.

Fellowships in Clinical Neurosciences

Overview

The Department of Clinical Neurosciences (DCNS) at the University of Calgary offers one and two year basic science, clinical and/or research fellowships designed to provide enhanced broad-based clinical training and responsibility beyond the certification level, as well as clinical research opportunities.

DCNS averages 30 fellows each year who work and study in the following specialties:

- Stroke
- Spinal Neurosurgery
- Peripheral Nerve
- Functional Neurosurgery
- Stereotactic and Functional Neurosurgery
- Neuro-oncology
- Endovascular Neurosurgery
- Epilepsy
- Headache
- Multiple Sclerosis
- Neuromuscular

As a joint department in both the University of Calgary and Alberta Health Services, DCNS is uniquely positioned to advance research from the laboratory directly to the patient's bedside.

These opportunities have helped the department attract fellows from a wide variety of backgrounds seeking further subspecialty experience. Their presence has enriched the clinical and academic environment for all.

We are also pleased that many of our fellows have received international awards during their fellowship training and numerous have gone on to faculty positions worldwide.

For more information on fellowship opportunities, please contact us at <https://cumming.ucalgary.ca/departments/dcms/education/fellowships>

NEUROLOGY



Yahya Agha-Khani



Katayoun Alikhani



Mohammed Almekhlafi



Farnaz Amoozegar



Camila Aquino



Simerpreet Bal



Philip Barber



Veronica Bruno



Tyson Brust



Jodie Burton



Kevin Busche



Greg Cairncross



Carlos Camara-Lemarroy



Sameer Chhibber



Alicja Cieslak



Lara Cooke



Fiona Costello



Shelagh Coutts



Jephtha Davenport



Andrew Demchuk



Paula de Robles



Yanjun Duan



Hamid Ebadi



Paolo Federico



William Fletcher

NEUROLOGY



Sarah Furtado



Chris Hahn



Alexandra Hanson



Michael Hill



Scott Jarvis



Colin Josephson



Ronak Kapadia



Brian Klassen



Gary Klein



Karl Martin Klein



Marcus Koch



Jagdeep Kohli



Lawrence Korngut



Scott Kraft



Wei-Qiao Liu



Davide Martino



Bijoy Menon



Luanne Metz



Theodore Mobach



William Murphy



David Patry



Dawn Pearson



Steven Peters



Gerald Pfeffer



Neelan Pillay



Tamara Pringsheim



Lisa Rosenegger



Andrea Salmon



Justyna Sarna



Shaily Singh



Eric Smith



Peter Stys



Suresh Subramaniam



Chris White



Samuel Wiebe



Scott Wilson



Katie Wiltshire



Megan Yaraskavitch



Michael Yeung

NEUROLOGY

NEUROSURGERY



David Cadotte



Steven Casha



Stephan du Plessis



Clare Gallagher



Fady Girgis



Walter Hader



Mark Hamilton



Bradley Jacobs



John Kelly



Zelma Kiss



Rajiv Midha



Alim Mitha



Jay Riva-Cambrin



Yves Starreveld



Garnette Sutherland



John Wong

PHYSICAL MEDICINE & REHABILITATION



Lee Burkholder



Rebecca Charbonneau



Darren Chiu



Elizabeth Condliffe



Chantel Debert



Nwamara Dike



Sean Dukelow



George Francis



Vincent Gabriel



Vithya Gnanakumar



Chris Grant



Arun Gupta



Denise Hill



Chris Huang



Rebecca Iwanicki



Les LaPlante



Daniel LeBlond



Gentson Leung



Rodney Li Pi Shan



Jennifer Litzenberger

PHYSICAL MEDICINE & REHABILITATION



Andrew Malawski



Ranita Manocha



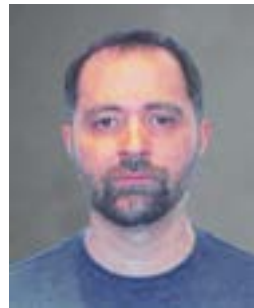
Christine McGovern



Dan McGowan



Stephen McNeil



Serge Mrkobrada



Dave Nabeta



Marcin Partyka



Stephanie Plamondon



Daniela Porter



Jordan Raugust



Paul Reglin



Janet Tapper



Vishal Tulsi



Noorshina Virani



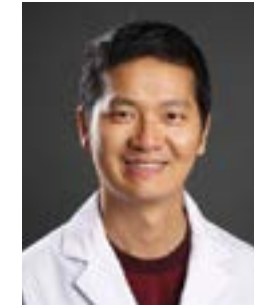
Bin Hu



Hedwich Kuipers



Oury Monchi



Minh Dang Nguyen



Shalina Ousman



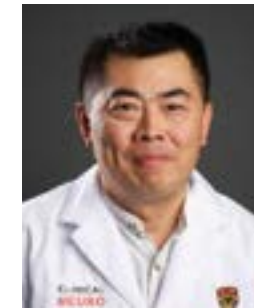
David Park



Boguslaw Tomanek



V. Wee Yong



Zonghang Zhao



Werner Becker



Keith Brownell



Tom Feasby



Manuel Hulliger



John Latter



Francis LeBlanc



Robert G. Lee



Terry Myles

TRANSLATIONAL NEUROSCIENCE

EMERITUS