Capital Health
IWK Health Centre

Research focus

anesthesia, pain management and perioperative

Researchers in the Department of Anesthesia, Pain Management and Perioperative Medicine are improving patient safety, outcomes and quality of life – not only related to procedures requiring anesthesia, but also to postoperative care, critical care and a variety of pain conditions. They aim to:

- introduce new agents and technologies to protect patients' organs and tissues during anesthesia procedures
- ensure optimum pain and inflammation management during and after surgery
- effectively treat – and possibly even prevent – sepsis, blood clots and other serious postoperative complications
- predict which patients are most vulnerable to developing chronic pain as a result of surgery or childbirth and intervene to prevent chronic pain
- develop safer, more effective approaches to managing pain conditions

These researchers include anesthesiologists, basic scientists, nurses, psychologists and professionals in many other fields, working at Capital Health, IWK Health Centre and Dalhousie Medical School. Many travel to other countries through global outreach and research initiatives aimed at improving patient safety and wellbeing in the developing world.

The Department of Anesthesia, Pain Management and Perioperative Medicine takes a strategic, innovative and collaborative approach to research, with a focus on solving the most pressing clinical problems. Its researchers work closely with each other and with local colleagues in such fields as surgery, pharmacology, psychology, psychiatry, pediatrics, obstetrics, nursing, engineering, business, and computer science, and with collaborators across Canada and around the world. They are highly successful in funding competitions, winning awards from the Canadian Institutes of Health Research, Canada Foundation for Innovation, Atlantic Canada Innovation Fund, Canada Grand Challenges, and Nova Scotia Health Research Foundation, among many other programs and agencies.

Safe and superior pain-blocking techniques

Drs. Kwesi Kwofie and Jennifer Szerb want to improve the safety of regional anesthesia by ensuring the accuracy of ultrasound-guided needle-tip placements. "There's a growing focus on regional anesthesia, which provides exceptional pain blocking without the side effects of general anesthesia," says Dr. Szerb, who has pioneered the use of regional blocks in Halifax. Adds Dr. Kwofie: "They also provide very effective postoperative pain relief, reducing the need for opioids, such as morphine, and the risk of developing chronic pain." The two are launching a research program to compare ultrasound images of nerves and surrounding tissues with the real tissues in cadavers. "We want to make sure that our interpretations of what we see in the ultrasound truly match the patient's tissues," notes Dr. Szerb. "Then we can precisely place the needle in the location that best blocks pain, with confidence that we will not hit and possibly damage a nerve."

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New technology protects the aging brain during anesthesia

Dalhousie assistant business professor Dr. David Roach (left), biomedical engineering PhD student Florentin Wilfart (centre) and anesthesiologist and professor Dr. Michael Schmidt (right) are commercializing new technologies that protect the brain and other organs during anesthesia.They have received $1.25 million from the Atlantic Innovation Fund and local partners to pursue this work.

The risks of surgery and anesthesia rise with age – in particular, the risks to the brain. As anesthesiologist and professor Dr. Michael Schmidt explains, this is because brain cells gradually die as we age, leaving older people with fewer brain cells in reserve. This puts these patients at a higher risk of cognitive declines after surgery, because compounds produced in the anesthesia process have toxic effects on brain cells.

"We have to remove the patient's exhaled carbon dioxide from the air they're breathing, or they will suffocate," says Dr. Schmidt. "Current agents used to absorb the carbon dioxide react with the anesthesia medications and produce neurotoxic compounds. This is not such a problem for younger people, who have billions of neurons available to fill in, but can lead to life-altering loss of cognitive function for older people."

Dr. Schmidt is determined to reduce the cognitive risk of anesthesia – and he and his research collaborators are well on the way. He and biomedical engineering PhD student Florentin Wilfart have invented a new scrubbing agent, called ZeroSorb, which removes carbon dioxide without producing toxic compounds. He has also launched a spin-off company, DMF Medical Inc., and enlisted the business acumen of Dr. David Roach from Dalhousie's school of business administration to help the company develop a solid business plan and marketing strategy.

"We are pooling our expertise to create workable solutions to clinical problems and get those solutions into use around the world," says Dr. Schmidt.

In addition to ZeroSorb, Dr. Schmidt and Mr. Wilfart are investigating several approaches to protecting the organs, including brain and spinal cord, during anesthesia. One of these is xenon – a noble gas that has to be extracted from the atmosphere – which may actually protect brain cells when used as an anesthetic. As Dr. Schmidt says, "Our focus is on new agents, new procedures and new devices to make anesthesia as safe as possible for patients of all ages."

Breathe easy: new devices for safer anesthesia

The anesthesiologist performs many delicate adjustments while a patient is under general anesthesia, to ensure optimal oxygen saturation, heart rate and level of consciousness for the patient's safety. Drs. Orlando Hung and Andrew Milne are developing new devices to make patients even safer – starting with the breathing tube.

"We have two or three minutes to place the ventilation tube in the patient's airway once they're under general anesthesia," says anesthesiologist and assistant professor Dr. Milne, who is also a professional engineer. "The clock is ticking, because general anesthesia suppresses the breathing process."

To ensure the breathing tube can be placed accurately and quickly, Drs. Hung and Milne are working with an engineer from Dalhousie's Innovations in Design Lab to develop the next generation of a device called the Light Wand. "It is fitted with a light we can see through the skin when it is placed properly," explains anesthesiologist and professor Dr. Hung. "If you can't see the light, you know the breathing tube did not go into the windpipe, so you can remove it and place it again without losing much time."

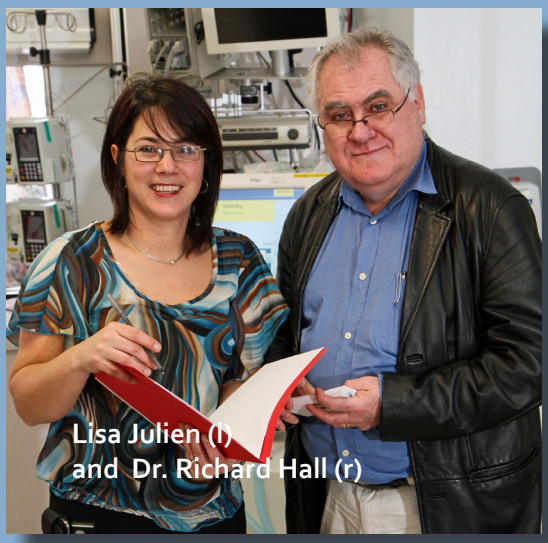
Dr. Hung has also invented a device called Flowcheck, which monitors the flow of intravenous anesthesia medication and rings an alarm when the bag is about to run dry, as well as a gravity-powered pump for IV medications. "These devices do not need motors, so they are cheap and portable," he notes. "They can be used in ambulances, war zones and developing countries, as well as modern hospitals."


Drs. Orlando Hung (l) and Andrew Milne (r)

Meanwhile, Dr. Milne works with Dr. Greg Dobson and Paul Brousseau in the anesthesia department's quality improvement office to assess the function and safety of airway management devices. They've also been collecting and analyzing data about anesthesia procedures performed by department members since 2003. As Dr. Milne says, "Our goal is to ensure the quality and safety of the care we provide."

Clinical trials advance critical care

Critical care research manager Lisa Julien works closely with anesthesiologist and professor Dr. Richard Hall to conduct a wide range of studies involving patients in the Intensive Care Unit at the QEII Health Sciences Centre. With as many as six studies going on at any one time, they are testing new medications for treating sepsis, new approaches to preventing blood clots, and new ways of assessing and treating injuries to the kidneys, lungs, brain and other organs. Dr. Hall is particularly interested in exploring new agents that may help critically ill patients, and how inflammation may affect the flow of drugs across the blood-brain barrier. The QEII/Capital Health is one of the top-recruiting sites in the Canadian Critical Care Trials Group. Involving more than 40 hospitals across Canada, this is one of the most active critical care research groups in the world.


Lisa Julien (l) and Dr. Richard Hall (r)

Making a PACT to improve perioperative care

The Department of Anesthesia, Pain Management and Perioperative Medicine has joined forces with its counterparts across Canada to form a new clinical trials research group. Dr. Richard Hall is national lead of the group, called PACT (Perioperative Anesthesia Clinical Trials). "Our focus is on launching multi-site investigator-initiated studies of key anesthesia issues during and after surgery," notes Dr. Hall. "For instance, we want to explore how oxygen levels in the brain can best be monitored during anesthesia, and how we can more safely provide anesthesia and postoperative pain management to patients with sleep apnea."

In their role as providers of perioperative care, anesthesiologists are involved in treating patients who have developed sepsis following surgery. Dr. Christian Lehmann (front) and his research team are looking for ways to prevent sepsis from progressing into a life-threatening condition. Back (l to r): Dr. Nadia Al-Banna (postdoctoral fellow), Dr. Karim Wafa (postdoctoral fellow), Joel Sardinha (MSc candidate), Ian Burkovskiy (MSc candidate), Dr. Juan Zhou (research associate), Dr. Nivin Sharawi (postdoctoral fellow).

Sepsis: Outsmarting a relentless killer

Researchers in the Department of Anesthesia, Pain Management and Perioperative Medicine are learning how sepsis develops from the body's normal response to healing an injury into an out-of-control immune response that overwhelms the entire system.

"Sepsis is the third leading cause of death in modern countries," notes Dr. Christian Lehmann, an anesthesiologist and professor with scientific appointments in Dalhousie's departments of Microbiology & Immunology and Pharmacology. "The odds of surviving sepsis are only 50 to 60 per cent – once this hyper-activated immune response is triggered, it's almost impossible to stop."

Dr. Lehmann and his research team are learning how sepsis affects the microcirculation – the tiniest blood vessels in the body, which deliver oxygen and nutrients to the tissues. "The microcirculation is the battleground of sepsis," he says. "The flood of immune cells into the bloodstream destroys these delicate vessels, so the immune cells go into the tissues and do even more damage." At the same time, oxygen flow to the tissues and organs is disrupted. Ultimately, vital organs fail and the person dies.

Sepsis most commonly occurs in older people recovering from surgery, trauma or severe illness. Taking steps to protect the microcirculation in the gut could prevent many of these patients from succumbing to sepsis. "The gut plays a crucial role in sepsis," Dr. Lehmann explains. "When we're sick, our bodies divert blood away from the gut to the vital organs, but after awhile lack of blood causes the protective inner lining of the gut to break down. This is when millions of toxic gut bacteria are able to pass into the bloodstream, which is incredibly dangerous. If we can protect the intestines, we can protect the patient from this big second hit."

Dr. Lehmann and his team have found that one potential strategy is to use a synthetic cannabis compound that has no psychoactive effects. "Our intestines naturally produce cannabinoid-like substances as protection against inflammation," he explains. "We've found in pre-clinical studies that synthetic cannabinoids can reduce immune activation and protect the microcirculation in the gut."

Sepsis is caused by a complex chain of events involving millions of immune cells and every system in the body so, as Dr. Lehmann says, "It will never be just one drug. We need to work with many targets and many different agents."

Short-circuiting the hyperactive immune response is another strategy. To this end, Dr. Lehmann and his team are monitoring patients' microcirculation using an innovative technique called intravital microscopy. "We want to detect the changes that indicate the beginnings of sepsis," he says. "Maybe we can find a target for preventive treatment, to stop the deadly chain of events."

When kids need surgery, research helps to ease the pain

While children's postoperative pain is carefully controlled in hospital, it's not always well managed once they return home. To improve postoperative pain management at home, researchers must learn more about the pain that children experience and what they and their families are doing about it.

"We need to get a handle on how much pain children are feeling after surgery, how or if it's being treated, how long it lasts, and the impact it has on their lives," says IWK clinical psychologist and pain researcher Dr. Jill Chorney. "It could be that prolonged postoperative pain interferes with their ability to return to school and other activities, or it could even lead to chronic pain later in life."

The Canadian Institutes of Health Research has awarded Dr. Chorney $725,000 over five years to lead a Canada-wide study of young people undergoing spinal fusion surgery for severe scoliosis. She has teamed up with orthopedic surgeons, anesthesiologists and nurses at the IWK – and collaborators at seven hospitals across the country – to conduct this groundbreaking study.

The study will reveal what factors cause children to experience the most pain. "Medical factors, like the degree of spinal curvature and the amount and type of pain medications used, psychological factors like fear and anxiety, and social factors like parents' attitudes and behaviours, can all influence how much pain a child will experience and how long it will last," explains Dr. Chorney. "Understanding how these factors impact children's pain will help us predict which children are most at risk for significant post-operative pain and determine how we can intervene to minimize their pain."

The IWK Health Centre is renowned for its research in the area of children's pain. IWK anesthesiologist and professor Dr. Allen Finley (l) is a pediatric pain researcher who helps other countries transform the way they care for children's pain. IWK psychologist and assistant professor Dr. Jill Chorney (r) is leading studies in Canada to improve the surgery experience for children and their families.

Dr. Chorney and her collaborators also want to understand the emotional and economic impact that a child's major surgery has on the family. "Learning more about surgery's effects on children and their families will help us develop new ways to buffer those impacts," Dr. Chorney says. "A big part of it is learning how we can help families be better prepared."

Making a world of difference

Dr. Patty Livingston is leading projects to help anesthesiologists and anesthesia technicians in Rwanda build their skills so they can provide safer and more effective anesthesia to patients across the country – especially mothers in labour. The anesthesiologist and associate professor has received $100,000 from Grand Challenges Canada to launch a simulation and skills training centre at the National University of Rwanda. At the same time, she is helping Rwandan anesthesia providers develop a mentorship network to improve obstetric anesthesia care – and thereby reduce the numbers of maternal and infant deaths in the country.

Examining the impact of childbirth on women's risk of chronic pain

Women are far more likely than men to experience chronic pain conditions and their pain is often more difficult to treat. Researchers at the IWK Health Centre want to know why – and they've formed the Women's Pain Multidisciplinary Research Group to find out.

"We're starting by examining one of the most significant pain events in many women's lives – giving birth," says Dr. Ron George, an associate professor at Dalhousie and a women's and obstetric anesthesiologist at the IWK. "We have to wonder if extreme pain in childbirth could trigger pain processes that make women more susceptible to chronic pain throughout their lives."

Dr. George has teamed up with IWK psychologists Drs. Natalie Rosen and Jill Chorney, and nursing researcher Dr. Erna Snelgrove-Clark, to launch a large study of first-time mothers. The researchers are enrolling the women during an early pre-natal visit to the IWK. At this stage, they're surveying the women to learn more about their psychological traits – such as anxiety about pain or a tendency to catastrophize – that may heighten their risk of experiencing pain. They will compare the results of these assessments to the women's experience of pain during labour and delivery – and the year after giving birth.

"We'll be examining all the factors around each birth, including the progress of labour and whether or not it was induced, the method of delivery, what if any analgesia was used, and how much pain the woman reported," notes Dr. George. "Then we'll be following up with the women at home to find out what kinds of pain they may still be feeling and how long it persists."

It's important to know if women are having prolonged pain after delivery, Dr. George says, because pain may affect their mental state and ability to care for themselves and their newborns. It may also contribute to postpartum depression and the risk of future chronic pain conditions.

"The data from this first study will form the foundation of what we hope will become a large-scale, long-term study of the impact of childbirth and postpartum pain on women's lifetime risk and experience of chronic pain," Dr. George says. "It will be powerful data."

The researchers will use their findings to develop tools to better assess a woman's risk of severe pain in childbirth, inform her of the potential long-term impacts on her health, and advise her about pain relief long before labour begins. As Dr. George says, "We want to empower women to take steps to support their long-term wellbeing."

Dr. Ron George and his colleagues perform approximately 3,500 spinal and epidural anesthesia procedures each year at the IWK. He wants to know if reducing childbirth pain can help protect women from developing chronic pain conditions later in life.

Creative approaches to chronic pain

Researchers in the Pain Management Unit at the QEII Health Sciences Centre know that medication is only part of the picture when it comes to coping with chronic pain. That's why they've embraced alternative approaches such as art therapy, qigong, acupuncture and yoga, with positive results for their patients.

In recent studies, Dr. Mary Lynch and her team have found that qigong practice reduces pain and improves sleep and daily function in people with fibromy-algia, and that creating art is highly thera-peutic in managing debilitating pain.

Clinician and researcher Dr. Mary Lynch and anesthesia department research facilitator Sara Whynot work with the team in the Pain Management Unit at the QEII Health Sciences Centre on a multitude of studies. These include clinical trials of various medications as well as drug-free approaches to managing chronic pain.

Exploring possible links between surgery, chronic pain and addiction

Researchers in the Department of Anesthesia, Pain Management and Perioperative Medicine are compiling and analyzing data on more than 150,000 patients who've undergone surgery at Capital Health. By linking surgical data with Nova Scotia Prescription Monitoring Program data, they hope to shed light on any links that may exist between surgery, chronic pain and addiction.

"We're tracking opioid prescriptions for six months after surgery," notes Dr. Peter MacDougall, an associate professor at Dalhousie and anesthesiologist at the QEII and IWK who is also director of the Atlantic Mentorship Network for Pain and Addictions. "If people still require opioids, they may be still experiencing pain or they may have developed a dependency. While the risk of dependency is slight, we want to know, for instance, if it is greater for people who received opioids before surgery to control severe pain."

The data may also indicate which surgeries are most strongly associated with a risk for chronic opioid use, and what doses and types of opioids are most associated with a risk of long term use. These findings will help physicians and patients make the best and safest decisions about pre- and post-surgery medication.

Chronic pain: harnessing the power of cannabinoids

Evidence is mounting that cannabinoids effectively relieve intractable chronic pain. In fact, compounds derived from cannabis, or marijuana, are showing they can safely provide many benefits beyond pain control – including relief from muscle spasms and nausea, and protection from inflammation, nerve damage and bone loss.

"Our research is finding that cannabinoids provide us with another option for patients with neuropathic pain, where other treatments have failed," says Dr. Mary Lynch, a clinician and professor in the psychiatry, anesthesia and pharmacology departments at Dalhousie and head of research in the Pain Management Unit at the QEII Health Sciences Centre. "These include people with nerve damage caused by chemotherapy, diabetes, HIV, multiple sclerosis, traumatic injuries and other problems."

Dr. Lynch and colleagues at Dalhousie Medical School are learning how cannabinoids can best be harnessed to treat not just pain but the inflammation behind it – from arthritis to a potentially blinding eye disease called uveitis. At the same time, they're working with colleagues to pioneer new formulas and delivery systems that sidestep the problems of marijuana. These include topical creams and ophthalmic drops for localized pain and inflammation, and inhalers developed by anesthesiologist and professor Dr. Orlando Hung.

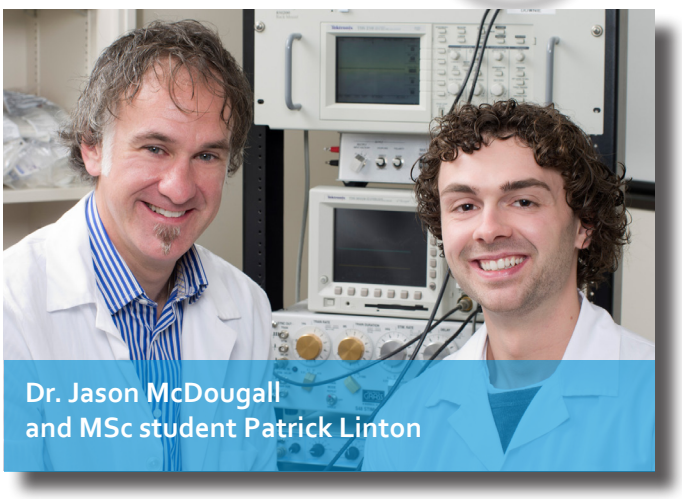
"We're developing alternatives to marijuana," says Dr. Lynch. "For example, our colleague at Hebrew University – Dr. Raphael Mechoulam, who first isolated and synthesized THC, the main psychoactive ingredient of marijuana – has synthesized a cannabinoid that does not contain THC. It relieves pain and inflammation without creating a high."

In contrast to opioids like morphine and oxycodone – with their addictive properties and potential for fatal overdoses – cannabinoids pose no risk of overdose and little of addiction. "Unlike opioids, cannabinoids do not suppress cardiac or respiratory centres in the brain," Dr. Lynch explains. "And while they are naturally less addictive than opiates, we want to remove the risk of addiction or abuse altogether by removing the psychoactive component. Then we will have an incredibly safe drug that can help many people."

A new path to soothing arthritis pain

Arthritis is the #1 cause of chronic pain and disability in Canada. It causes immense human suffering and costs the Canadian economy an estimated $33 billion a year.*

Dr. Jason McDougall wants to discover exactly what's happening inside the joints as rheumatoid arthritis or osteoarthritis develops. "We're studying neurochemicals and the pathways they follow to induce inflammation and resulting damage in the joints," says Dr. McDougall, an associate professor in Dalhousie's departments of pharmacology and anesthesia. "And we want to know what triggers sensory nerves in the joints to feel so much pain."



Dr. Jason McDougall and MSc student Patrick Linton

As Dr. McDougall explains, arthritis pain is not simply caused by damage. "It's a mystery, because pain and damage do not necessarily correlate – sometimes people with minimal damage are in a great deal of pain, while others with extensive damage feel little pain at all."

Charting the biological pathways that lead to both joint destruction and pain will reveal new targets for arthritis therapies. "We don't just want to treat the pain, we want to stop the destruction as well," Dr. McDougall says. "It will require going after a number of different targets."

Dr. McDougall and his colleagues are already working on a novel treatment that mimics a self-protection mechanism in our joints. "Our joint tissues produce cannabis-like chemicals that protect against inflammation and relieve pain – but this system is deficient in arthritis," he explains. "We're developing a topical cannabinoid cream that people could rub on affected joints." The cream will contain a synthetic cannabinoid formulated to relieve pain and inflammation in the joints, without producing any "highs" in the brain.

"We want to lead the way to a new era in arthritis treatment," Dr. McDougall says. "Current treatments focus on pills and injections, but these have side effects throughout the entire body. We want to get away from this, with targeted local treatments that provide maximum relief with minimal side effects."

*according to a study released by the Arthritis Alliance of Canada in 2011

Pain institute and endowed chair to transform research, education and care

The anesthesia department is a key player in a large-scale local effort to launch the Dalhousie Pain Institute. This ambitious initiative seeks to transform the understanding and management of pain – acute and chronic, across the lifespan – through nimble and collaborative research ventures and diligent efforts to share and translate new knowledge into practice.

"We are fortunate to have world-renowned pain researchers, clinicians and educators in this community," says one of the initiative's leaders, Dr. John Clark, anesthesia professor and medical director of pain services for Capital Health. "But to take our research to the next level – and generate a more powerful impact on health care systems' and professionals' approach to pain – we have to start pooling our resources and working more closely together in teams."

At the same time, the department is working with Dalhousie University External Relations to raise more than $5 million for an endowment that will enable the university to fund a pain research chair in perpetuity. "The endowed chair in pain research will provide long-term leadership and vision for a multi-faculty, multi-disciplinary pain research effort based out of the Dalhousie Pain Institute," says Dr. Clark. "The two initiatives together will position us to realize our potential to be world leaders in effectively addressing the problem of pain."

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