SPECIAL REPORT



CLINICAL PERFUSIONIST

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Thank you to the clinical perfusionists and other health professionals at the Institut de cardiologie de Montréal (ICM) for the photos in this Special Report.



In this Special Report, the scope of practice and activities engaged in by a clinical perfusionist are presented according to the legal terms of the Regulation respecting the professional activities that can be engaged in by a clinical perfusionist and those in the Medical Act. Thus, the professional practice is described in words balancing legal terminology and those used in the current practice of clinical perfusionists in Québec.

HERE, WE UNDERSTAND CLINICAL PERFUSIONISTS

The FIQ and FIQP includes 76,000 nurse, licensed practical nurse, respiratory therapist and clinical perfusionist members. Although barely a few dozen clinical perfusionists practise in Québec, their contribution to resolving problems linked to heart disease is invaluable. Therefore, with this Special Report, the Federation wants to help in promoting the clinical perfusionist profession and make it better known to everyone on the care team and the public.

By reading these pages, you will notice that scientific rigor and agility are the order of the day to practise in the world of clinical perfusion. Moreover, you will see how communication between the surgeon and clinical perfusionist is vital to ensure safe cardiac surgery and a worry-free postoperative recovery.

Sizeable challenges loom for the profession. This includes the recognition of clinical perfusionists in the Québec professional system and demand for their autonomy beyond the physicians' control. Furthermore, according to a Canadian Society of Clinical Perfusion (CSCP) survey conducted in 2017, there will be more than fifteen positions to fill during the next year and this number could increase to more than 50 within five years. Hence, the FIQ believes it has a significant role to play making representations with the decision-makers on workforce planning and human resources management. The Federation wants to ensure that clinical perfusionists and the Québec people do not pay the price for poor workforce management, that working and practice conditions do not adversely affect the profession's attractiveness and, in turn, access to specialized care.

We sincerely hope that this publication will help show the clinical perfusionists' valuable contribution to Quebecers' health, because they are specialists on all matters in cardiac, pulmonary and circulatory support.

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Nancy Bédard, President

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Here, we understand health care.



PROFESSIONAL PRACTICE

Professional activities of a clinical perfusionist

According to the *Regulation respecting the professional activities that can be engaged in by a clinical perfusionist,* the specific goal of a clinical perfusionist is to contribute to maintaining a human being's bodily functions during a treatment requiring the temporary support or replacement of cardiac, pulmonary or circulatory functions.

A clinical perfusionist takes over the artificial management of various cardiac, pulmonary or circulatory functions during a surgical procedure or for a patient waiting for a heart transplant. Maintaining bodily functions is then made possible with specialized devices and circulatory supports that the clinical perfusionist chooses, organizes, assembles and operates.

More specifically, there are seven recognized professional activities for the clinical perfusionist:

- 1. Operate and ensure the operation of cardiac, pulmonary or circulatory assistance, autotransfusion or apheresis equipment
- Provide clinical supervision of the condition of persons connected to cardiac, pulmonary or circulatory assistance, autotransfusion or apheresis equipment
- Administer and adjust prescribed medications or other substances
- **4.** Mix substances in order to complete the preparation of a medication, according to a prescription
- Take specimens from catheters already in place or through the circuit of the circulatory supports, according to a prescription
- **6.** Perform treatments through the circulatory supports, according to a prescription
- Program a pacemaker or defibrillator, according to a prescription

DID YOU KNOW THAT?

Autotransfusion refers to an intravenous injection of the patient's own washed red blood cells. There are different types of autotransfusion based on when they are done:

- A deferred autotransfusion takes place in the month prior to the surgical procedure. The samples are taken in the weeks prior to surgery and transfused during or following surgery.
- Intraoperative autotransfusion is done during surgery when the blood lost is salvaged and transfused to the patient.
- Preoperative hemodilution consists of taking blood a few days or hours before surgery, and replacing it with a liquid so that the patient's total blood volume can be maintained.

Apheresis is a technique to preserve blood which consists of removing a specific component of blood, notably plasma, platelets and red and white blood cells, to more appropriately respond to the receiver's need for blood products, based on the identified pathology.

There are two bodies that contribute to professional development and improvement of the quality of professional practice:

- The Association des perfusionnistes du Québec inc. (APQI), formed on the initiative of two clinical perfusionists from the Montréal area, enables its members to network through various conferences and events. The Association also sees to the professional development of clinical perfusionists and focuses its representation on relations with authorities intervening in different areas of practice.
- The mission of the Canadian Society of Clinical Perfusion (CSCP) is to encourage and support clinical perfusionists' professional growth by offering them a variety of training and certifications. The Society helps its

members upgrade their training, maintain their certification, meet and exchange on their various clinical experiences.

To date, clinical perfusionists do not have a recognized professional order in Québec, but steps have already been taken in this direction. The Collège des médecins du Québec (CMQ), (College of Physicians) through the *Medical Act and its Regulation respecting the professional activities that can be engaged in by a clinical perfusionist,* is the only body that governs the clinical perfusionists' professional practice in Québec.

DID YOU KNOW THAT?

A pacemaker and defibrillator do not support the same types of heart failures. These failures can happen after a heart attack or following certain infections and sometimes cause arrhythmias. A rapid heart rate is called tachycardia and is more than 100 beats a minute for a person at rest. Tachycardia is dangerous and can lead to cardiac arrest, especially if it is ventricular tachycardia. A defibrillator can detect an arrhythmia and send the necessary shock to restore normal rhythm. A pacemaker regulates rhythm when there is bradycardia (heart rate of less than 60 beats a minute) or when there is an irregular heartbeat. A pacemaker and defibrillator generate and deliver electricity to regulate heart rate.



Practice setting and interdisciplinary collaboration

A clinical perfusionist practises mainly in the operating room with cardiopulmonary assist equipment (extracorporeal circulation) necessary for the procedure. Continuous monitoring of the patients' hemodynamic and biochemical parameters, as well as precise and rapid adjustments maintain life during surgery and



contribute to a better postoperative experience. As soon as the cardiopulmonary assist support begins, the surgeon, anaesthesiologist and clinical perfusionist are in close contact

and maintain clear and targeted channels of communication until the end of the procedure. The trio ensure the surgery's progress, each one adapting to the other's pace depending on her practice and speciality.

Whether it is before or after the surgery, the clinical perfusionist also collaborates with the nurse and respiratory therapist to ensure coordination and follow-up of care. Besides cardiac surgery, the clinical perfusionist practises in several other specialties such as vascular or thoracic surgery, trauma, oncology and sometimes, even when cases involve more than one speciality.

The clinical perfusionist also works in centres of



activities such as hemodynamics where she helps with setting up assist devices, such as Impella, and ensures followup until the patient reaches the intensive **care unit**, according to the care teams' needs. She is always the resource for maintaining circulatory assistance.



The clinical perfusionist is the resource for postsurgical **clinical follow-up** for cardiac circulatory assist

devices. She teaches the patient and his family about all the care and monitoring necessary for a safe return home. She participates in the development of and applies the various installation, maintenance and weaning protocols for these devices.

Based on where she works, a clinical perfusionist may be asked to accompany the surgical team for the removal of a heart or lungs from a donor, even if she is in another institution, in addition to being present for the organ transplant. Her role then consists, according to her scope of practice, of protecting and preserving the organs, by more specifically ensuring adequate perfusion.



Interesting statistics from the IUCPQ

In 2016-2017, the Institut universitaire de cardiologie et de pneumologie de Québec (IUCPQ) did more than 3,000 heart surgeries, more than 11,000 hemodynamic and electrophysiology procedures, more than 1,300 pacemaker and defibrillator insertions as well as 15 heart transplants.

Geographic location of FIQ clinical perfusionists

Currently, more than 70 clinical perfusionists work in Québec health institutions and the great majority of them are members of the FIQ. Because they practise in specialized cardiac surgical services, mainly in third-line health institutions, they are essentially found in Saguenay-Lac-St-Jean, the Capitale-Nationale, Estrie and Montréal.



Special Report

Introduction to extracorporeal circulation

Several heart surgeries require that the heart be stopped and blood removed from the heart cavities to make the surgery possible or facilitate it. That is why the clinical perfusionist's presence is indispensable. It seems appropriate to introduce extracorporeal circulation (ECC) to better understand her professional reality.

ECC is blood circulation outside the body, by bypass, through the artificial heart-lung machine. It allows for cardiopulmonary bypass, oxygenation and a decarboxylation of blood which ensures homeostasis of the other organs in the human body. The heart-lung machine, run by the clinical perfusionist, provides the physiologic functions normally assumed by the patient's vital organs. Its four main components are:

- A heat exchanger
- An oxygenator
- A pump system with rollers or centrifuges
- A cardioplegic system





Mathieu Chaput, Clinical Perfusionist at the Institut universitaire de cardiologie et de pneumologie de Québec (IUCPQ), describes how a surgery with ECC and constant communication with the surgeon usually proceeds:

"At the very beginning of heart surgery, the clinical perfusionist informs the surgeon that the

ECC is functioning well, enabling cardiac output for optimal perfusion of all patient organs and adequate oxygenation of the blood.

Once the patient's vital parameters are reached, the ventilator will be stopped and oxygenation of the blood will only be through the heart-lung machine oxygenator. Then, the heart has to be inert and blood-free for the surgeon to perform the operation. To do this, the clinical perfusionist prepares a cold sanguine solution with a high potassium level that allows the surgeon to completely isolate the heart with a clamp.

From the moment the clamp is applied, myocardial ischemia begins. To avoid an infarction caused by complete heart ischemia, the cardioplegic solution previously prepared is administered to the heart at regular intervals. This solution has two functions: provoke a mechanical heart stoppage – therefore, no movement, and provide it with oxygen reserves between intervals.

The surgeon can then perform the heart surgery while the clinical perfusionist administers and manages the ECC and ensures the artificial survival of vital organs. Myocardial protection is an inherent responsibility of the clinical perfusionist. A mistake in carrying out this mission can have various consequences, the most severe being myocardial infarction.

Once the surgery is done and the aortic clamp removed, the heart can resume its role of orchestra conductor of the circulatory system. After the clamp is removed, the heart spontaneously resumes its rhythm. If this does not occur, the patient can be given an electric charge. The clinical perfusionist ensures that all the vital parameters are adequate and the ventilator is re-enabled. By mutual agreement with the surgical team, the patient can be weaned off extracorporeal circulation. The anaesthesia team, including the respiratory therapist, then takes over its role with the patient."

For better systemic and myocardial protection, the clinical perfusionist can induce flexible hypothermia based on the needs of the different organs and the type of surgery, thanks to the heart-lung machine. The body can be cooled until severe hypothermia, or kept warm while the heart is kept cold to limit the metabolic demands between doses of cardioplegia.



Cardiac cannulation, a step in ECC

Technologies in cardiopulmonary assistance care

Although the ECC is an important aspect of the clinical perfusionist's work, she may also have to use a broad range of technologies to improve the health of patients with cardiac problems and save lives. Obviously, the choice of a device is closely linked to the medical diagnosis, because cardiopulmonary supports specifically respond to the detected cardiac or respiratory problems.

This Special Report does not present the different cardiopulmonary supports in a comprehensive manner, but the description of the following devices* is intended to show the technological complexity that the clinical perfusionist must master every day.



The left ventricular assist device is the Heartmate II,

a pump which helps the left ventricle pump blood. It is inserted in the operating room, under ECC. The pump, placed under the heart, is connected to the left ventricle and another part is connected to the aorta. The latter then sends oxygenated blood to the rest of the body, satisfying the oxygen needs of the lungs and other organ cells. The heart pump can be used over a short period, for example while waiting for a transplant, or over a long period, when it is a definitive treatment. A cable exiting the abdomen is attached to another cable which transfers information to a control base, called the "control system", a small computer that verifies the

functioning. Using this controller, the patient can follow the system's operational status, particularly the battery level, connection problems, alarms



or manage the backup system in the event the main system fails, and adequately respond to the device's demands for ensuring optimal operation.

The pump's general operation is ensured by a mobile station or batteries, thus allowing the patient to use one or the other of the power sources to go about his everyday activities. At follow-up visits with the clinical perfusionist, the different parameters are studied and adjustments or patient and family teaching are done.

* The manufacturers' names or products may vary from one institution to another

Interesting statistics from the ICM

Every year, the Institut de cardiologie de Montréal (ICM) performs nearly 2,000 heart surgeries, including inserting about a hundred intra-aortic balloon catheters, about ten Heartmate left ventricular assist devices and about fifteen heart transplants. A mechanical heart is inserted once or twice a year.



The Impella CP is a left ventricle assist blood pump. It is a circulatory or cardiovascular assist system for clinical use in cardiology or during heart surgeries. It is inserted percutaneously into the femoral artery under fluoroscopy and threaded into the left ventricle in the cardiac catheterization laboratory. It circulates the blood from the inlet area in the left ventricle to the exit site in the aorta. Since it can only be used for a maximum of five days, the catheter is used when a patient presents reduced left ventricular function, after acute myocardial infarction to protect the heart muscle, or during coronary bypass surgery to give cardiovascular assistance to a patient presenting with a low injection fraction.



ECMO (*ExtraCorporeal Membrane Oxygenation*) means oxygenation by extracorporeal membrane. The **Cardiohelp**, the device used to perform ECMO, gives cardiac or pulmonary assistance to patients whose heart, lungs or both cannot supply adequate gas exchange or cardiac output to sustain life. During ECMO, the body's deoxygenated blood is first extracted from the patient with cannulas, then it is passed through a membrane which eliminates the carbon dioxide (CO_2) before oxygenating it and, lastly, reinjecting it into the patient's circulation.

The two main types of ECMO are ECMO by veno-venous (VV) means and ECMO by venoarterial (VA) means. ECMO VV is useful with respiratory failure, but when cardiac function is normal (for example, with a pulmonary embolus or septic shock). The blood is extracted from venous circulation in order to be oxygenated and then returned to the right atrium, in the venous circulation. ECMO VA partially or completely supports cardiac function (for example, when a patient is waiting for a heart transplant or after a myocardial infarction). The blood is then extracted from the venous circulation to oxygenate it and is returned to the aorta.

This device is used in Emergency, in the cardiac resuscitation room, to give short or long-term assistance. Patients under ECMO are sent to intensive care units and the duration of the oxygenation varies according to the pathology and reaction to treatments. Because of the compact format of the device it can be used during ambulance, helicopter and airplane transfers between health institutions.





The Syncardia total temporary artificial heart

is a blood pump that can be implanted in patients' chests suffering from biventricular cardiac insufficiency. The artificial heart is composed of two artificial ventricles which temporarily replace defective ventricles until a heart transplant is possible. It is supplied by the blood from the circulatory system and pumps it to the rest of the body to ensure adequate perfusion to all organs.

Two formats of external controller are available to supply the artificial heart. The one used in health institutions is bigger, but once the patient is able to return home with his artificial heart to wait for a transplant, he is given a more user-friendly and lighter controller: the Freedom Portable Driver. Attached by two cannulas exiting the patient's body, it emits the necessary pulses of air to fulfill its role of replacement heart.

TRAINING

Before 1996, all Canadian clinical perfusionists had to follow training in Toronto or Vancouver, equivalent to a Québec technical studies program. In 1996, the Université de Montréal created an undergraduate program, a certificate in extracorporeal perfusion. Today, these same three teaching centres, the British Colombia Institute of Technology, Michener Institute of Education and the Université de Montréal still offer training in clinical perfusion.

Since 2007, clinical perfusionists in Québec complete a bachelor's degree in biomedical sciences and a specialized post-graduate degree in extracorporeal perfusion. The program's mission is to ensure that clinical perfusionists are trained so that third-level (tertiary) health institutions can maintain and develop their cardiac, vascular and thoracic surgery and trauma programs.

Clinical perfusion students come from various professional settings. Eligibility conditions for the program are specified on the Université de Montréal website, at umontreal.ca. The demand for this specialized manpower is high at the moment and graduates' employment rate is 100%. The number of positions to fill in the coming years should be particularly high because of retirements. The teaching centres and health institutions will need to analyze the situation.



Continuing education requirement

Continuing education is mandatory for clinical perfusionists. The Canadian body that offers the certification requires that the professional practise with 80 patients as the main clinical perfusionist every two years. Moreover, she has to obtain 24 credits of continuing education in different ways, according to the education activities followed: conventions, training sessions, as a participant or presenter, etc. By their own admission, the clinical perfusionists have a strong culture of community scientific knowledge. Because their expertise affects technological and scientific areas that are in constant evolution and in order to respect the highest standards, they have relationships marked by influence and dialogue. Solid data often inspires them to create new protocols specific to the settings where they practise.

Setting for professional exchanges

There are four types of commissions at the FIQ and FIQP, respiratory therapist commission, nurse commission, licensed practical nurse commission and **clinical perfusionist commission**. The commission is a preferred forum for discussion and analysis on the important issues affecting the different job-title groups. Delegates can meet together in the clinical perfusion commission and, ultimately, exercise their power of submitting recommendations to the Provincial Council. The involvement of clinical perfusionists in this commission has identified the need to promote their profession and spearheaded this Special Report.

HISTORY OF THE PROFESSION

1916 is marked by the discovery of heparin, a natural anticoagulant which prevents the formation of blood clots. This was major progress, because blood coagulation must be avoided during the use of the artificial heart-lung machine, so that external perfusion can be done and is safe for the patient.

It was in 1937 that protamine, a peptide that neutralizes the anticoagulant action of heparin, was discovered. In 1953, both were chosen for the very first operation on a human: a surgery with heartlung bypass, a procedure similar to ECC.

In 1950, at the end of their research on lab animals, two Canadian physicians discovered that it was possible, by putting the body into hypothermia, to reduce its oxygen needs. Two years later, during an open heart surgery, it was noticed for the first time that by lowering the body's temperature, the procedure becomes much less risky. In 1952, the first heart surgery was done at the Hôpital Laval, today known as the Institut de cardiologie et de pneumologie de Québec (IUCPQ).



In 1953, the artificial heartlung bypass device was successfully used during an open heart procedure. Invented by John Heysham Gibbon, this extracorporeal circulation device has a pump and oxygenator. For many American clinical perfusionists, 1953

is considered the year the clinical perfusionist profession was born.

In 1956, the automaker, General Motors (GM), participated in developing a device that cools and reheats blood, as needed, during heart surgery. Until then, a cooling blanket was used to induce hypothermia. In 1957, the first open heart surgery in Québec was performed at the Institut de cardiologie de Montréal (ICM).

In 1958, the first open heart surgery on a child in Québec was performed at the Montréal Children's Hospital.

In 1968, the first heart transplant in Canada was performed at the ICM.

On May 26, 1969, the Association des perfusionnistes du Québec inc. (APQI) was created. Its mission is to promote the professional aspects of clinical perfusion and to work on the growth and development of its members' specific skills.

It was not until 1971 that a heart-lung bypass was performed successfully on a patient. Previously, the equipment required for the surgery did not have an "oxygenator" to oxygenate and remove carbon dioxide from the blood. Patients only survived a few hours before developing fatal blood disorders such as hemolysis (destruction of red blood cells) or a coagulopathy (clotting disorder).

In 1976, the APQI applied for union certification and negotiated the clinical perfusionsts' first collective agreement which went into effect on July 30.

In 1993, the APQI took steps with the Collège des médecins du Québec (CMQ) to get a regulation passed authorizing the clinical profusionists' professional activities and legalizing their practice.

In April 2003, ten years later, the CMQ passed the *Regulation respecting the professional activities that can be engaged in by a clinical perfusionist.*

In 2005, clinical perfusionists in Québec joined the FIQ. Under *Bill 30*, they are classified in the Class 1 job category, "nursing and cardiorespiratory care". On June 30th of that same year, Québec clinical perfusionists were allocated medical acts specific to their profession with the passing of a government decree, the *Regulation respecting the professional activities that can be engaged in by a clinical perfusionist.*

In 2012, a first transplant in Québec, combined with a lung and liver transplant, was performed by two multidisciplinary teams composed of about twenty professionals at the Centre hospitalier de l'Université de Montréal (CHUM).

In 2018, the FIQ represents more than 70 clinical perfusionists in Québec, the great majority of those practising in the province.

Every year at the FIQ, the month of May is devoted to the recognition of the healthcare professionals' essential role. Therefore, the Federation marks Licensed Practical Nurse's Day on May 5th, Nurse's Day on May 12th, Respiratory Therapist's Day on May 19th and **Clinical Perfusionist's Day on May 26th**.

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Regulation respecting the professional activities that can be engaged in by a clinical perfusionist c. M-9, r.3.1

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