National Perfusion Survey Report 2017

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Introduction:

Since its inception in the 1950's, there have been a number of advancements in cardiac surgery leading to vastly improved outcomes. Perfusion has been an active partner in these developments in terms of both clinical practice and technology.

Both clinical perfusion practice and technology continue to advance as we strive to optimize the care of our patients. This is not done in isolation, however. As a member of the cardiac surgical team, we accommodate our surgical colleagues as their practice changes to embrace evolving best practice models.

The demographics of cardiac surgery patients has changed with innovations in the cardiac catheratization laboratories enabling these physicians to expand their scope of practice. For example, our patients are now older and have increasingly longer lists of co-morbidities. This makes the '*CABG x 2 in a young, otherwise healthy patient*' increasingly rare and the '*aortic valve with CABG x 3 in a patient with long-standing diabetes, renal failure, history of strokes and ejection fraction less than 30%*' increasingly more common.

How does perfusion evolve to support this change in practice? Do more centers provide ventricular-assist device support, if so what type? Have we changed our cardioplegia strategy to help support these sicker hearts?

While the STS (*Society of Thoracic Surgeons*) database was established as an initiate for quality improvement and captures a number of *critical* data points for cardiac surgical practice including outcomes and comparisons with similar cardiac centers, it *overlooks many aspects of perfusion practice*.

The goal of the current national perfusion survey, was to capture some of these key metrics and to take a 'snapshot' of our current practice, with the goal of comparing with future surveys to identify trends in our national practice.

Methods:

The adult perfusion survey was constructed with the assistance of other perfusionists, as well as cardiac anesthetists and surgeons to capture relevant data for our current, perfusion-related practices. The

resulting survey was composed of questions divided into two modules: *center and perfusion-specific questions*. *Centre-specific* questions included staffing numbers, numbers and case demographics, ECMO numbers and details, IABP, cell salvage and other perfusion roles. *Perfusion-specific* questions included details on hardware and consumables used, practices such as CBP temperature, dealing with residual pump volume, transfusion triggers, and point-of-care devices employed. However, these categories contain overlapping aspects.

Data presented represent means and result ranges are in brackets.

Results:

The survey was sent out to all 32 adult cardiac surgery centers (translated to French for the centers in Quebec), with 17 of 32 (53%) responding.

Staffing: The mean number of cases per center was 1125 (400-2500), with mean perfusionist (FTE), anesthesia and surgeon numbers being 9.7 (4-18.5), 14.2 (5-28) and 6.0 (3-11), respectively. This translates into the average number of cases per perfusionist (FTE) of 117 (60-226).

Case demographics: The mean number of heart transplants was 25.5 (96-43) with 6 of the 17 responding centers reporting performing these procedures. The mean number of lung transplants was 97.8 (52-170) with 3 of 17 responding centers reporting doing lung transplants. The number of TAVI cases was 73 (25-200) with 15 of 17 responding centers reporting doing TAVIs. Of the 15 centers doing TAVIs, 12 provided details on the level of perfusion involvement with 7 centers providing standby primed pumps and 1 center with a dry pump, 2 providing standby ECMO, a single center providing a dry *Maquet Cardiohelp®* pump if requested and a single center providing no TAVI coverage.

Extracorporeal Membrane Oxygenation: The mean number of V-A ECMO was 17.2 (1-40) with 13 of 17 centers reporting doing V-A ECMO. The mean number of V-V ECMO was 11.6 (1-45) with 13 of 17 centers reporting doing V-V ECMO. One of the centers reporting a V-A ECMO did not doing a V-V ECMO, while another that did V-V ECMO reported not doing a V-A ECMO. Platforms used included *Maquet Cardiohelp®* (4 centers), *Medtronic Biomedicus®* (1 center), *Maquet Rotaflow ®*(3 centers), *LivaNova Revolution®* (6 centers) and *Thoratec CentriMag®* (3 centers).

Intra-aortic balloon pump: The average number of IABP was 70 (15-250) with 15 of 17 centers reporting using IABP. Platforms used included *Arrow Teleflex®* (6 centers) and *Maquet Datascope®* (8 centers). Perfusion was responsible for insertion in 15 of 17 centers, with 3 of these only being responsible for insertion in the OR.

Ventricular assist devices (VADs): The average number of short-term VADs was 9.5 (2-28) with and 12.9 (5-26) long-term VADs. The platforms for short-term VADs were *ABIOMED Impella®* (5 centers), *Medtronic Biomedicus®* (1 center), *Maquet Rotaflow®* (1 center), *LivaNova Revolution®* (2 centers), *Thoratec CentriMag®* (5 centers). The average number of long-term VADs was 12.8 (5-26). Platforms included: *Heartware®* (4 centers), *Thoratec Heartmate II®* (5 centers) and Thoratec *Heartmate III®* (4 centers).

Cell Salvage: The average number of cell savers used was 536 (30-1900) with perfusion solely responsible at 14 of 17 centers, while sharing the responsibility at the remaining 3 centers with either nursing or anesthesia assistants. Platforms included: *Medtronic autoLog®* (5 centers), *Fresenius Kabi C.A.T.S®* (5 centers), *LivaNova Electa®* (1 center) and *Xtra®* (7 centers).

Hyperthermic Intraperitoneal Chemotherapy (*Sugarbaker*) procedures were conducted at 3 of 17 centers with an average of 13.7 (12-17). All centers used the *Belmont® Hyperthermic Pump*. None of the responding centers reported doing isolated limb perfusion.

Equipment:

Heart-lung machines used included: *LivaNova S3®* (5 centers), *LivaNova S5®* (13 centers) and *Maquet HL20®* (2 centers). In terms of main pumps, roller pumps were used at 5 centers and centrifugal pumps at 6 centers with 5 centers using both styles. There were a number of different oxygenators used including the *LivaNova D903/905®* (1 center), *Synthesis®* (1 center) and *Inspire®* (4 centers), *Terumo FX®* (5 centers), *Maquet Quadrox®* (3 centers), and *Medtronic Affinity®* (3 centers) and *Fusion®* (3 centers). All centers used coated circuits including: *LivaNova Physio®* (6 centers) and *SMART®* (1 center), *Maquet Softline®* (1 center) and *Bioline®* (1 center), *Medtronic Balance®* (3 centers), *Cortiva®* (1 center) and *Trillium®* (3 centers) and *Terumo X-Coating®* (4 centers).

In terms of cardioplegia delivery, the majority of centers used the pump system on their respective HLMs, while 5 centers used the *Quest MPS®* and 1 center used a *Baxter®* syringe pump. A number of cardioplegia strategies were used ranging from 4:1 to all-blood cardioplegia with varying recipes, temperatures and implementation of hotshots.

In terms of CPB temperature strategy, the majority of centers reported that these were case and surgeon specific with the most common strategy being to drift.

Residual pump blood was pumped back to the patient prior to arterial de-cannulation at 10 of 16 responding centers, while patient-dependent at 3 centers. Residual blood was bagged and given to anesthesia to re-administer to the patient at 8 of 16 responding centers and was case/surgeon-specific at 5 centers. This blood was processed using a cell saver at 6 of 16 centers, while case/surgeon-specific at 3 centers.

For blood transfusion on CPB, 8 of 16 responding centers indicated they had a specific transfusion trigger, 6 centers did not, while 2 centers indicated that the trigger was patient/surgeon-specific, with the most common trigger being a hemoglobin 70 g/dL.

Near-infrared spectroscopy (NIRS) evaluation was the standard of care at 5 of 16 responding centers. For data collection, manual charting was used at 9 of 16 centers, 6 used electronic and 1 center used both manual and electronic charting. *LivaNova CONNECT®* was used at 5 centers, *Medtronic Spectrum Medical®* and *Maquet JOCAP XL®* were each used at a single center.

Point of care (POC) devices: Fifteen of 16 centers had minimal ACT (480 seconds for 13 of 16 responding centers, single centers used minimums of 400 and 425), a single center indicated that the minimum ACT was case-dependent. Platforms used included: *Accriva Hemochrone®* (all versions) (7 centers), *Abbott iSTAT®* (3 centers), *Helena Actalyke®* (1 center*), Medtronic ACT II® or ACT Plus®* (5 centers). Three of 16 responding centers indicated they did not have their blood gas POC in the OR. Platforms used included

Instrumentation Laboratory GEM4000® (7 centers), *Radiometer ABL90®* (4 centers) and *ABL800®* (3 centers), *Siemens epoc®* (1 center) and *RAPIDPoint500®* (1 center). In terms of additional coagulation monitoring, 1 of 14 responding centers used INR, 3 centers used *Helena Plateletworks®*, 5 centers used *Haemoview Diagnostics ROTEM®*, 5 centers used *Haemonetics TEG®* and 3 centers did not use such devices. Use of these devices was the standard of care at 3 of 11 responding centers, while these devices were used on-demand at 8 of 14 centers. These devices were used prior to administration of pro-coagulation products (platelets, plasma, fibrinogen, etc) at 9 of 13 responding centers. Fibrinogen concentrate was used at 8 of 14 responding centers.

Discussion:

The current report represents the *first national perfusion survey* in Canada and creates a '*snapshot'* of our current practices. In total, these data represent findings from 17 of 32 adult cardiac surgery. The goal is always a 100% response rate but given the amount of time required for a busy perfusion managers/leads to complete, this is a reasonable starting point and the authors would to sincerely thank those who made the time to participate.

With the amount of data contained herein, it is both tempting and intimidating to attempt a thorough discussion of all points. Perhaps, instead it would be prudent to *informally* discuss questions that arise from such a survey.

'*What is the clinical relevance of the survey?*'

While clinical data, such as outcomes are not captured here and are better left to the STS database, snapshots captured by participating in similar surveys in the future should reflect trends, changes in attitudes and concepts that are hopefully fueled by research dedicated to identifying and homing in on best practice.

In terms of capturing trends, 15 of 17 centers now participate in a TAVI program. If long-term data demonstrate good patient outcomes, we could anticipate that all centers will be involved. However, as these procedures become more common, the role of perfusion may fade to the point that we are only called in for ECMO rescues should the need arise. Further, our center is currently conducting a cost-analysis of 'open' aortic valve replacements from patient in the hospital to leaving the hospital to compare with the total cost of a TAVI procedure. Depending on this analysis, our hospital (and other hospital) administrators *could* choose to reduce or not increase TAVI funding.

Follow-up surveys will permit the CSPC to chronicle changes in practice.

'*What value do these data hold for our surgical and anesthesia colleagues?*'

I took inspiration from a manuscript on pulmonary endarterectomies that I wrote with an anesthesia co-worker. He conducted an international survey on this complex surgery in terms of perfusion, anesthesia and ICU perspectives. As it took significant time between him conducting the survey, moving across the Atlantic, getting set up in a new practice, an astute reviewer noticed this and suggested we do a mini re-survey to see if the data were still relevant. The changes in practice were worth a paper in and of itself

and hence why I felt tracking perfusion practice over time to be relevant to us. An example of change in perfusion practice that was identified was that in the original survey, a large portion of centers *didn't* use coated CPB circuits, but all did in the follow-up survey.

Furthermore, it has been my experience that when I have suggested any changes to surgery/anesthesia, the first question they ask is '*what are other centers doing?*' followed by '*how many centers do this and how many do what we do?*' I suspect this occurs at other centers across the country when change is suggested. The data contained in the current report may be able to answer some of these questions.

An aspect that was of particular interest to our surgical/anesthesia colleagues regarding practice dealing with post-pump blood. Our regular practice is to bag it and give to anesthesia to administer as needed before the patient leaves the OR. A subset of our anesthesia have an interest in either having perfusion re-administering to the patient prior to arterial line removal or processing it with a cell saver. By knowing the practice of other centers across the country, our anesthesia team will weigh changing their practice.

Another important aspect of this survey is communication between centers. For example, if a center was the only one that cell saved post-pump blood and another center was considering this, communication could be established and insight into this practice could be distributed.

We also have anesthesia partners that have an academic interest in evaluating post-op bleeding. Hence, questions pertaining to devices used to evaluate adequate coagulation post-protamine (ROTEM vs TEG) and strategies to manage non-surgical bleeding (fibrinogen concentrate vs fresh-frozen plasma/cryoprecipitate) come into play. For example, since our center has begun using fibrinogen concentrate, we no longer administer cryoprecipitate. Speaking to fellow CSCP members at recent meetings, I was surprised that some members were not aware that fibrinogen concentrate was available in Canada. Further, our center has realized a cost savings since using fibrinogen concentrate.

Overall, this survey can be a useful tool, should the members take the time to contribute and read the resulting reports. It is not perfect, but will evolve and hopefully stimulate the membership's interest in using it to compare practices. The membership is encouraged to provide feedback on the content of the survey in order to improve this tool for future iterations.