Laurent MATHIEU
Nicolas ROUGIER
CHU Bordeaux

Recommandations pour la CEC pédiatrique

Quoi de neuf en 2023 ?

Françaises

Européennes

Nord américaines

Les recommandations

Les recommandations Nord-américaines

AmSECT (2019)

"Élaboration de normes et recommandations pour les CEC pédiatriques"

- 275 études randomisées
- 100 perfusionnistes pédiatriques et congénitaux

Special Feature

American Society of ExtraCorporeal Technology: Development of Standards and Guidelines for Pediatric and Congenital Perfusion Practice (2019)

Molly Elisabeth Oldeen, MS, CCP, FPP[1], Ronald E. Angona, MS, CCP, FPP[2], Ashley Hodge, MBA, CCP, FPP[3], and Tom Klein, BS, CCP, FPP[4]

Abstract

The development of standards and guidelines by professional societies offers clinicians guidance toward providing evidence-based care. The ultimate goals of standards and guidelines are to standardize care and improve patient safety and outcomes while also minimizing risk. The American Society of ExtraCorporeal Technology (AmSECT) currently offers perfusionists several clinical resources, primarily the *Standards and Guidelines for Perfusion Practice*; however, no document exists specific to pediatric perfusion. Historically, the development of a pediatric-specific document has been limited by available scientific evidence due to smaller patient populations, sample sizes, and variable techniques among congenital perfusionists. In the current setting of evolving clinical practices and increasingly complex cardiac operations, a subcommittee of pediatric perfusionists developed the *Standards and Guidelines for Pediatric and Congenital Perfusion Practice*. The development process included a comprehensive literature review for supporting evidence to justify new recommendations or updates to the existing AmSECT Adult Standards and Guidelines document. Multiple revisions incorporating feedback from the community led to a finalized document accepted by the AmSECT membership and made available electronically in May 2019. The *Standards and Guidelines for Pediatric and Congenital Perfusion Practice* is an essential tool for pediatric perfusionists and serves as the backbone for institutionally based protocols, promotes improved decision-making, and identifies opportunities for future research and collaboration with other disciplines. The purpose of this manuscript is to summarize the process of development, the content, and recommended utilization of AmSECT's *Standards and Guidelines for Pediatric and Congenital Perfusion Practice*.

Keywords

congenital heart disease, cardiopulmonary bypass, pediatric, perfusion, standards, practice guidelines

Submitted June 12, 2020; Accepted August 17, 2020.

Background

The American Society for ExtraCorporeal Technology (AmSECT) has supported the perfusion profession by providing standards and guidelines for both adult perfusion practice and mechanical circulatory support.[1,2] There are also a select number of clinical practice guidelines offered on topics including anticoagulation, temperature management, inflammatory response, and blood conservation.[3-6] These documents are endorsed by or written in collaboration with other professional societies, including the American Association for Thoracic Surgery, the Society of Thoracic Surgeons, and the Society of Cardiovascular Anesthesiologists.

As stated on AmSECT's website, "These documents are intended to serve as a useful guide for teams in developing institution-specific protocols to improve the reliability, safety, and effectiveness of extracorporeal support services."[7] Standards and guidelines also seek to improve the quality of care provided, minimize risk, and validate practices that impact patient care and outcomes. These documents offer a source

[1] Division of Cardiovascular-Thoracic Surgery, Ann & Robert H. Lurie Children's Hospital of Chicago, IL, USA
[2] University of Rochester Medical Center, Strong Memorial Hospital, Rochester, NY, USA
[3] Cardiothoracic Surgery, The Heart Center, Nationwide Children's Hospital, Columbus, OH, USA
[4] Cincinnati Children's Hospital Medical Center, OH, USA

This article has been copublished in *World Journal for Pediatric and Congenital Heart Surgery* and in *Journal of ExtraCorporeal Technology*.

Corresponding Author:
Molly Elisabeth Oldeen, Division of Cardiovascular-Thoracic Surgery, Ann & Robert H. Lurie Children's Hospital of Chicago, 225 E Chicago Avenue, Box 22, Chicago, IL 60611, USA.
Email: moldeen@luriechildrens.org

Oldeen et al. world Journal for Pediatric and Congenital Heart Surgery (2019)

Les recommandations Nord-américaines

① **Standard :** Norme, doit être respectée

"**Doit**": exigence, obligation

② **Guideline :** Recommandation, doit être considérée

"**Devrait**": indique une recommandation

Special Feature

American Society of ExtraCorporeal Technology: Development of Standards and Guidelines for Pediatric and Congenital Perfusion Practice (2019)

Molly Elisabeth Oldeen, MS, CCP, FPP[1], Ronald E. Angona, MS, CCP, FPP[2], Ashley Hodge, MBA, CCP, FPP[3], and Tom Klein, BS, CCP, FPP[4]

Abstract

The development of standards and guidelines by professional societies offers clinicians guidance toward providing evidence-based care. The ultimate goals of standards and guidelines are to standardize care and improve patient safety and outcomes while also minimizing risk. The American Society of ExtraCorporeal Technology (AmSECT) currently offers perfusionists several clinical resources, primarily the *Standards and Guidelines for Perfusion Practice*; however, no document exists specific to pediatric perfusion. Historically, the development of a pediatric-specific document has been limited by available scientific evidence due to smaller patient populations, sample sizes, and variable techniques among congenital perfusionists. In the current setting of evolving clinical practices and increasingly complex cardiac operations, a subcommittee of pediatric perfusionists developed the *Standards and Guidelines for Pediatric and Congenital Perfusion Practice*. The development process included a comprehensive literature review for supporting evidence to justify new recommendations or updates to the existing AmSECT Adult Standards and Guidelines document. Multiple revisions incorporating feedback from the community led to a finalized document accepted by the AmSECT membership and made available electronically in May 2019. The *Standards and Guidelines for Pediatric and Congenital Perfusion Practice* is an essential tool for pediatric perfusionists and serves as the backbone for institutionally based protocols, promotes improved decision-making, and identifies opportunities for future research and collaboration with other disciplines. The purpose of this manuscript is to summarize the process of development, the content, and recommended utilization of AmSECT's *Standards and Guidelines for Pediatric and Congenital Perfusion Practice*.

Keywords

congenital heart disease, cardiopulmonary bypass, pediatric, perfusion, standards, practice guidelines

Submitted June 12, 2020; Accepted August 17, 2020.

Background

The American Society for ExtraCorporeal Technology (AmSECT) has supported the perfusion profession by providing standards and guidelines for both adult perfusion practice and mechanical circulatory support.[1,2] There are also a select number of clinical practice guidelines offered on topics including anticoagulation, temperature management, inflammatory response, and blood conservation.[3-6] These documents are endorsed by or written in collaboration with other professional societies, including the American Association for Thoracic Surgery, the Society of Thoracic Surgeons, and the Society of Cardiovascular Anesthesiologists.

As stated on AmSECT's website, "These documents are intended to serve as a useful guide for teams in developing institution-specific protocols to improve the reliability, safety, and effectiveness of extracorporeal support services."[7] Standards and guidelines also seek to improve the quality of care provided, minimize risk, and validate practices that impact patient care and outcomes. These documents offer a source

[1]Division of Cardiovascular Thoracic Surgery, Ann & Robert H. Lurie Children's Hospital of Chicago, IL, USA
[2]University of Rochester Medical Center, Strong Memorial Hospital, Rochester, NY, USA
[3]Cardiothoracic Surgery, The Heart Center, Nationwide Children's Hospital, Columbus, OH, USA
[4]Cincinnati Children's Hospital Medical Center, OH, USA

This article has been copublished in *World Journal for Pediatric and Congenital Heart Surgery* and in *Journal of ExtraCorporeal Technology*.

Corresponding Author:
Molly Elisabeth Oldeen, Division of Cardiovascular Thoracic Surgery, Ann & Robert H. Lurie Children's Hospital of Chicago, 225 E Chicago Avenue, Box 22, Chicago, IL 60611, USA.
Email: moldeen@luriechildrens.org

Les recommandations Nord-américaines

Revue de la littérature (2019)

"Tendances et mises à jour sur la CEC en chirurgie cardiaque pédiatrique"

- Le circuit
- Le priming

Journal of Cardiothoracic and Vascular Anesthesia 33 (2019) 2804–2813

Contents lists available at ScienceDirect

Journal of Cardiothoracic and Vascular Anesthesia

journal homepage: www.jcvaonline.com

Review Article

Trends and Updates on Cardiopulmonary Bypass Setup in Pediatric Cardiac Surgery

Ravi Medikonda, BA*, Chin Siang Ong, MD†, Rajeev Wadia, MD‡, Dheeraj Goswami, MD†, Jamie Schwartz, MD†, Larry Wolff, MD†, Narutoshi Hibino, MD†, Luca Vricella, MD†, Daniel Nyhan, MD†, Viachaslau Barodka, MD‡, Jochen Steppan, MD†,‡

*Johns Hopkins School of Medicine, Baltimore, MD
†Department of Surgery, Johns Hopkins University, Baltimore, MD
‡Department of Anesthesiology and Critical Care Medicine, Johns Hopkins University, Baltimore, MD

Perfusion strategies for cardiopulmonary bypass have direct consequences on pediatric cardiac surgery outcomes. However, inconsistent study results and a lack of uniform evidence-based guidelines for pediatric cardiopulmonary bypass management have led to considerable variability in perfusion practices among, and even within, institutions. Important aspects of cardiopulmonary bypass that can be optimized to improve clinical outcomes of pediatric patients undergoing cardiac surgery include extracorporeal circuit components, priming solutions, and additives. This review summarizes the current literature on circuit components and priming solution composition with an emphasis on crystalloid, colloid, and blood-based primes, as well as mannitol, bicarbonate, and calcium.

Key Words: pediatric cardiac surgery; perfusion; pediatric perfusion

SINCE THE ADVENT of cardiopulmonary bypass (CPB) in the 1950s, several advances have been made to optimize perfusion protocols and improve patient outcomes.[1] Studies of CPB perfusion strategy are frequently performed in adults and then extrapolated to the pediatric population. However, the unique facets of pediatric perfusion, such as patient size variability, type of surgery performed, complex shunt physiology, anatomy, and the pathophysiologic response to CPB, must be considered. The combination of patient size and bypass circuit volume variability can lead to significant hemodilutional effects, which are most pronounced when nonblood priming solutions are used in infants and children. Therefore, it is not uncommon to prime the bypass circuit with blood for pediatric patients.[2] Evidence-based strategies to reduce blood product exposure are evolving for aspects of CPB, such as tubing choice, circuit components, and priming solution composition. However, no specific practice guidelines for pediatric cardiac surgery perfusion have become widely accepted.[3–5] Hence, most protocols for pediatric perfusion are based on institutional policy and the experience and training of the surgeon, anesthesiologist, and perfusionist. This hodgepodge of practices has made it difficult to establish clear, universally accepted pediatric CPB setup guidelines.[6] In this review, the current literature on pediatric CPB setup is discussed, including the components of the CPB circuit and priming solution composition.

Tubing and Cannulae

Suboptimal tubing and cannula sizes can increase total prime volume and adversely affect bypass hemodynamics. Total prime volume correlates directly with the need for perioperative transfusion, and lower prime volumes are associated with lower transfusion volumes during CPB.[7,8] Furthermore, lower priming volumes are associated with improved perioperative water

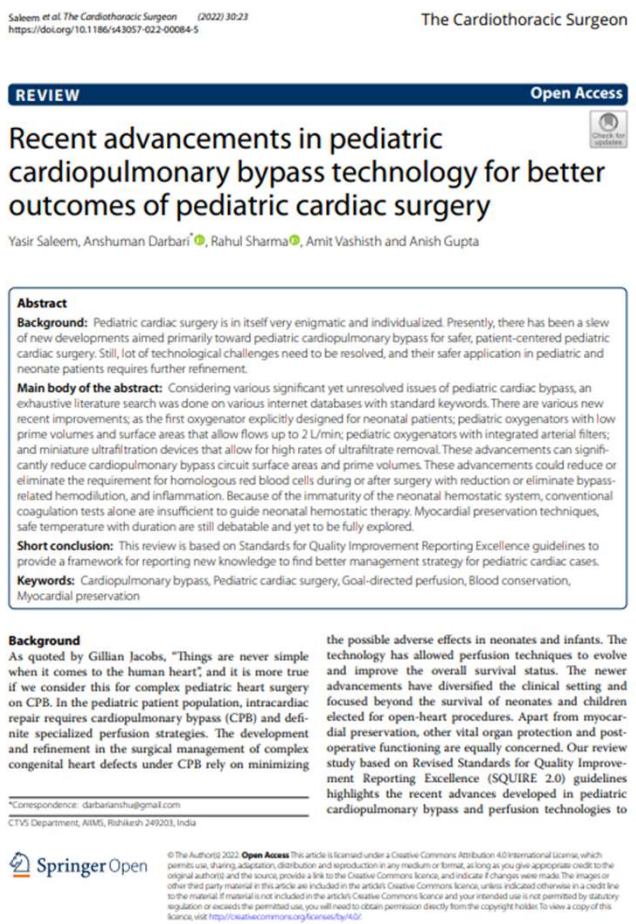
Address reprint requests to Jochen Steppan, MD, DESA, Department of Anesthesiology and Critical Care Medicine, School of Medicine, Johns Hopkins University, 1800 Orleans St., Zayed 6208N, Baltimore, MD 21287.
E-mail address: J.Steppan@jhmi.edu (J. Steppan).

https://doi.org/10.1053/j.jvca.2019.01.025
1053-0770/© 2019 Elsevier Inc. All rights reserved.

Les recommandations Nord-américaines

Revue exhaustive de la littérature
(2022)

"Dernières avancées en CEC pédiatrique pour un meilleur résultat de la chirurgie cardiaque"



Saleem et al. The Cardiothoracic Surgeon (2022) 30:23
https://doi.org/10.1186/s43057-022-00084-5

The Cardiothoracic Surgeon

REVIEW Open Access

Recent advancements in pediatric cardiopulmonary bypass technology for better outcomes of pediatric cardiac surgery

Yasir Saleem, Anshuman Darbari*, Rahul Sharma, Amit Vashisth and Anish Gupta

Abstract

Background: Pediatric cardiac surgery is in itself very enigmatic and individualized. Presently, there has been a slew of new developments aimed primarily toward pediatric cardiopulmonary bypass for safer, patient-centered pediatric cardiac surgery. Still, lot of technological challenges need to be resolved, and their safer application in pediatric and neonate patients requires further refinement.

Main body of the abstract: Considering various significant yet unresolved issues of pediatric cardiac bypass, an exhaustive literature search was done on various internet databases with standard keywords. There are various new recent improvements; as the first oxygenator explicitly designed for neonatal patients; pediatric oxygenators with low prime volumes and surface areas that allow flows up to 2 L/min; pediatric oxygenators with integrated arterial filters; and miniature ultrafiltration devices that allow for high rates of ultrafiltrate removal. These advancements can significantly reduce cardiopulmonary bypass circuit surface areas and prime volumes. These advancements could reduce or eliminate the requirement for homologous red blood cells during or after surgery with reduction or eliminate bypass-related hemodilution, and inflammation. Because of the immaturity of the neonatal hemostatic system, conventional coagulation tests alone are insufficient to guide neonatal hemostatic therapy. Myocardial preservation techniques, safe temperature with duration are still debatable and yet to be fully explored.

Short conclusion: This review is based on Standards for Quality Improvement Reporting Excellence guidelines to provide a framework for reporting new knowledge to find better management strategy for pediatric cardiac cases.

Keywords: Cardiopulmonary bypass, Pediatric cardiac surgery, Goal-directed perfusion, Blood conservation, Myocardial preservation

Background

As quoted by Gillian Jacobs, "Things are never simple when it comes to the human heart", and it is more true if we consider this for complex pediatric heart surgery on CPB. In the pediatric patient population, intracardiac repair requires cardiopulmonary bypass (CPB) and definite specialized perfusion strategies. The development and refinement in the surgical management of complex congenital heart defects under CPB rely on minimizing the possible adverse effects in neonates and infants. The technology has allowed perfusion techniques to evolve and improve the overall survival status. The newer advancements have diversified the clinical setting and focused beyond the survival of neonates and children elected for open-heart procedures. Apart from myocardial preservation, other vital organ protection and postoperative functioning are equally concerned. Our review study based on Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) guidelines highlights the recent advances developed in pediatric cardiopulmonary bypass and perfusion technologies to

*Correspondence: darbarianshu@gmail.com
CTVS Department, AIIMS, Rishikesh 249203, India

Saleem et al. The Cardiothoracic Surgeon (2022)

Special Feature

American Society of ExtraCorporeal Technology: Development of Standards and Guidelines for Pediatric and Congenital Perfusion Practice (2019)

Molly Elisabeth Oldeen, MS, CCP, FPP[1], Ronald E. Angona, MS,
Ashley Hodge, MBA, CCP, FPP[3], and Tom Klein, BS, CCP, FPP

Abstract

The development of standards and guidelines by professional societies offers clinicians g
care. The ultimate goals of standards and guidelines are to standardize care and impro
minimizing risk. The American Society of ExtraCorporeal Technology (AmSECT) ou
resources, primarily the Standards and Guidelines for Perfusion Practice; however, no doc
Historically, the development of a pediatric-specific document has been limited by
patient populations, sample sizes, and variable techniques among congenital perfusio
practices and increasingly complex cardiac operations, a subcommittee of pediatri
Guidelines for Pediatric and Congenital Perfusion Practice. The development process in
supporting evidence to justify new recommendations or updates to the existi
document. Multiple revisions incorporating feedback from the community led to
membership and made available electronically in May 2019. The Standards and
Practice is an essential tool for pediatric perfusionists and serves as the backbo
improved decision-making, and identifies opportunities for future research and
of this manuscript is to summarize the process of development, the content, and
and Guidelines for Pediatric and Congenital Perfusion Practice.

Keywords

congenital heart disease, cardiopulmonary bypass, pediatric, perfusion, stand

Submitted June 12, 2020; Accepted August 17, 2020.

Background

The American Society for ExtraCorporeal Technology
(AmSECT) has supported the perfusion profession by provid-
ing standards and guidelines for both adult perfusion practice
and mechanical circulatory support.[1,2] There are also a select
number of clinical practice guidelines offered on topics includ-
ing anticoagulation, temperature management, inflammatory
response, and blood conservation.[3-6] These documents are
endorsed by or written in collaboration with other professional
societies, including the American Association for Thoracic
Surgery, the Society of Thoracic Surgeons, and the Society
of Cardiovascular Anesthesiologists.

As stated on AmSECT's website, "These documents are
intended to serve as a useful guide for teams in developing
institution-specific protocols to improve the reliability, safety,
and effectiveness of extracorporeal support services."[7] Stan-
dards and guidelines also seek to improve the quality of care

Journal of Cardiothoracic and Vascular Anesthesia 33 (2019) 2804–2813

Contents lists available at ScienceDirect

Journal of Cardiothoracic and Vascular Anesthesia

journal homepage: www.jcvaonline.com

Review Article

Trends and Updates on Cardiopulmonary Bypass Setup in Pediatric Cardiac Surgery

Ravi Medikonda, BA*, Chin Siang Ong, MD†, Rajeev Wadia, MD†, Dheeraj Goswami, MD†, Jamie Schwartz, MD†, Larry Wolff, MD†, Narutoshi Hibino, MD†, Luca Vricella, MD†, Daniel Nyhan, MD†, Viachaslau Barodka, MD†, Jochen Steppan, MD†,‡

*Johns Hopkins School of Medicine, Baltimore, MD
†Department of Surgery, Johns Hopkins University, Baltimore, MD
‡Department of Anesthesiology and Critical Care Medicine, Johns Hopkins University, Baltimore, MD

Perfusion strategies for cardiopulmonary bypass have direct consequences on pediatric cardiac surgery outcomes. Howev
results and a lack of uniform evidence-based guidelines for pediatric cardiopulmonary bypass management have led to c
in perfusion practices among, and even within, institutions. Important aspects of cardiopulmonary bypass that can be optir
cal outcomes of pediatric patients undergoing cardiac surgery include extracorporeal circuit components, priming soluti
review summarizes the current literature on circuit components and priming solution composition with an emphasis on
blood-based primes, as well as mannitol, bicarbonate, and calcium.

Key Words: pediatric cardiac surgery; perfusion; pediatric perfusion

SINCE THE ADVENT of cardiopulmonary bypass (CPB) in the 1950s, several advances have been made to optimize perfusion protocols and improve patient outcomes.[1] Studies of CPB perfusion strategy are frequently performed in adults and then extrapolated to the pediatric population. However, the unique facets of pediatric perfusion, such as patient size variability, type of surgery performed, complex shunt physiology, anatomy, and the pathophysiologic response to CPB, must be considered. The combination of patient size and bypass circuit volume variability can lead to significant hemodilutional effects, which are most pronounced when nonblood priming solutions are used in infants and children. Therefore, it is not uncommon to prime the bypass circuit with blood for pediatric patients.[2] Evidence-based strategies to reduce blood product exposure are evolving for aspects of CPB, such as tubing choice, circuit components, and priming solution composition. H
guidelines for pediatric cardiac sur
widely accepted.[3–5] Hence, most
sion are based on institutional pe
training of the surgeon, anesthesi
hodgepodge of practices has ma
universally accepted pediatric
review, the current literature
cussed, including the compone
ing solution composition.

Tubing and Cannulae

Suboptimal tubing and c
volume and adversely affe
volume correlates directly
fusion, and lower prime
transfusion volumes duri
volumes are associate

*Address reprint requests to Jochen Steppan, MD, DESA, Department of Anesthesiology and Critical Care Medicine, School of Medicine, Johns Hopkins University, 1800 Orleans St., Zayed 6208N, Baltimore, MD 21287.
E-mail address: J.Steppan@jhmi.edu (J. Steppan).

https://doi.org/10.1053/j.jvca.2019.01.025
1053-0770/

Saleem et al. The Cardiothoracic Surgeon (2022) 30:23
https://doi.org/10.1186/s43057-022-00084-5

REVIEW

The Cardiothoracic Surgeon

Open Access

Recent advancements in pediatric cardiopulmonary bypass technology for better outcomes of pediatric cardiac surgery

Yasir Saleem, Anshuman Darbari*, Rahul Sharma, Amit Vashisth and Anish Gupta

Abstract

Background: Pediatric cardiac surgery is in itself very enigmatic and individualized. Presently, there has been a slew of new developments aimed primarily toward pediatric cardiopulmonary bypass for safer, patient-centered pediatric cardiac surgery. Still, lot of technological challenges need to be resolved, and their safer application in pediatric and neonate patients requires further refinement.

Main body of the abstract: Considering various significant yet unresolved issues of pediatric cardiac bypass, an exhaustive literature search was done on various internet databases with standard keywords. There are various new recent improvements; as the first oxygenator explicitly designed for neonatal patients; pediatric oxygenators with integrated arterial filters; prime volumes and surface areas that allow flows up to 2 L/min; pediatric oxygenators with low and miniature ultrafiltration devices that allow for high rates of ultrafiltrate removal. These advancements can signifi-cantly reduce cardiopulmonary bypass circuit surface areas and prime volumes. These advancements could reduce or eliminate the requirement for homologous red blood cells during or after surgery with reduction or eliminate bypass-related hemodilution, and inflammation. Because of the immaturity of the neonatal hemostatic system, conventional coagulation tests alone are insufficient to guide neonatal hemostatic therapy. Myocardial preservation techniques, safe temperature with duration are still debatable and yet to be fully explored.

Short conclusion: This review is based on Standards for Quality Improvement Reporting Excellence guidelines to provide a framework for reporting new knowledge to find better management strategy for pediatric cardiac cases.

Keywords: Cardiopulmonary bypass, Pediatric cardiac surgery, Goal-directed perfusion, Blood conservation, Myocardial preservation

Background

As quoted by Gillian Jacobs, "Things are never simple when it comes to the human heart", and it is more true if we consider this for complex pediatric heart surgery on CPB. In the pediatric patient population, intracardiac repair requires cardiopulmonary bypass (CPB) and defi-nite specialized perfusion strategies. The development and refinement in the surgical management of complex congenital heart defects under CPB rely on minimizing the possible adverse effects in neonates and infants. The technology has allowed perfusion techniques to evolve and improve the overall survival status. The newer advancements have diversified the clinical setting and focused beyond the survival of neonates and children elected for open-heart procedures. Apart from myocar-dial preservation, other vital organ protection and post-operative functioning are equally concerned. Our review study based on Revised Standards for Quality Improve-ment Reporting Excellence (SQUIRE 2.0) guidelines highlights the recent advances developed in pediatric cardiopulmonary bypass and perfusion technologies to

*Correspondence: darbarianshu@gmail.com
CTVS Department, AIIMS, Rishikesh 249203, India

Le circuit

Le perfusionniste **doit** limiter la longueur et le diamètre du tubing pour réduire l'hémodilution et le contact sang / tubing

- Diminuer la réponse inflammatoire
- Limiter l'agrégation plaquettaire et l'activation la coagulation
- Diminuer la transfusion

Le circuit

Le perfusionniste **DOIT** :

Sélectionner le circuit en tenant compte :

- Du poids et de la taille
- Du volume de remplissage
- Des besoins métaboliques du patient
- De la sécurité

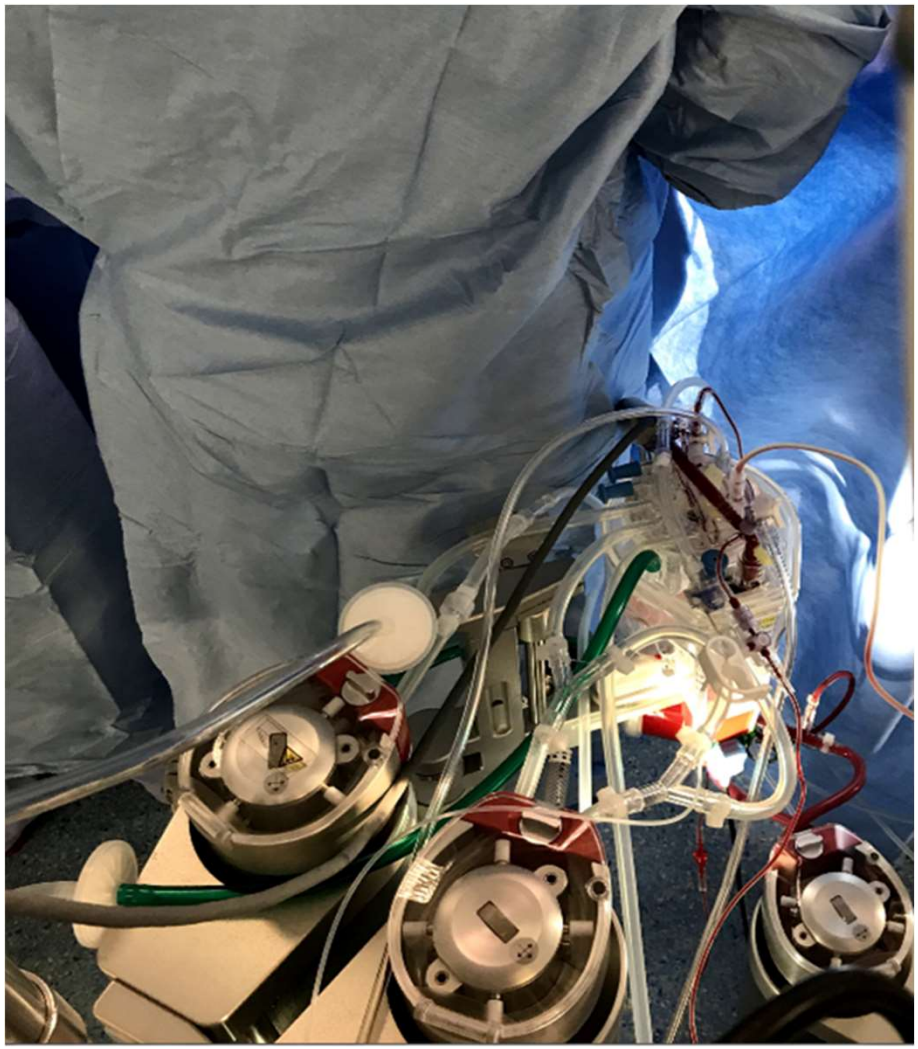
Le perfusionniste **DOIT** :

- Mesurer le débit après tous les shunts intra circuits
- Limiter le nombre de shunts (Vol, hémolyse)

Le circuit

Les circuit avec coating diminuent la réponse inflammatoire

- La tête de pompe **doit** être au plus près du patient
- Le réservoir **doit** être en hauteur pour diminuer la longueur du tubing
- Le perfusionniste **doit** utiliser le retour veineux assisté



Drainage veineux actif : VAVD

Drainage veineux actif : VAVD

<u>Pédiatrie</u> : pas de recommandation

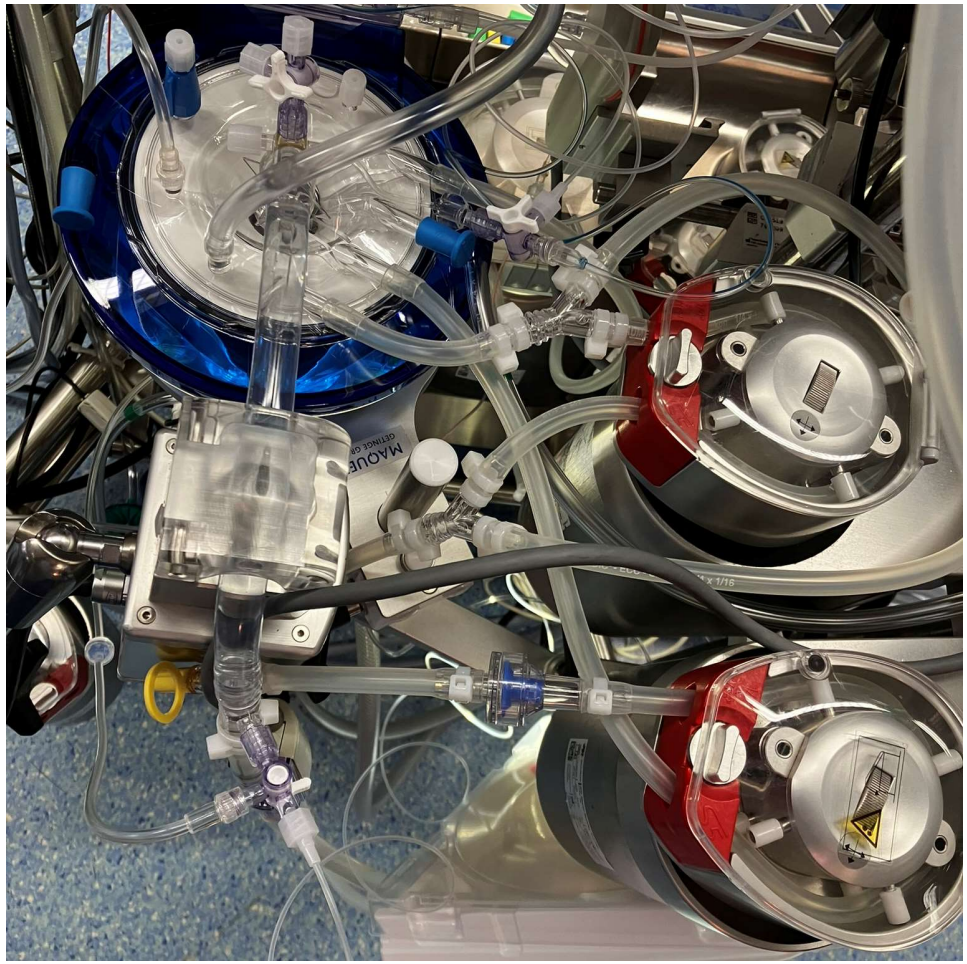
AMERICAN SOCIETY OF EXTRACORPOREAL TECHNOLOGY
Lead - Collaborate - Educate - Care

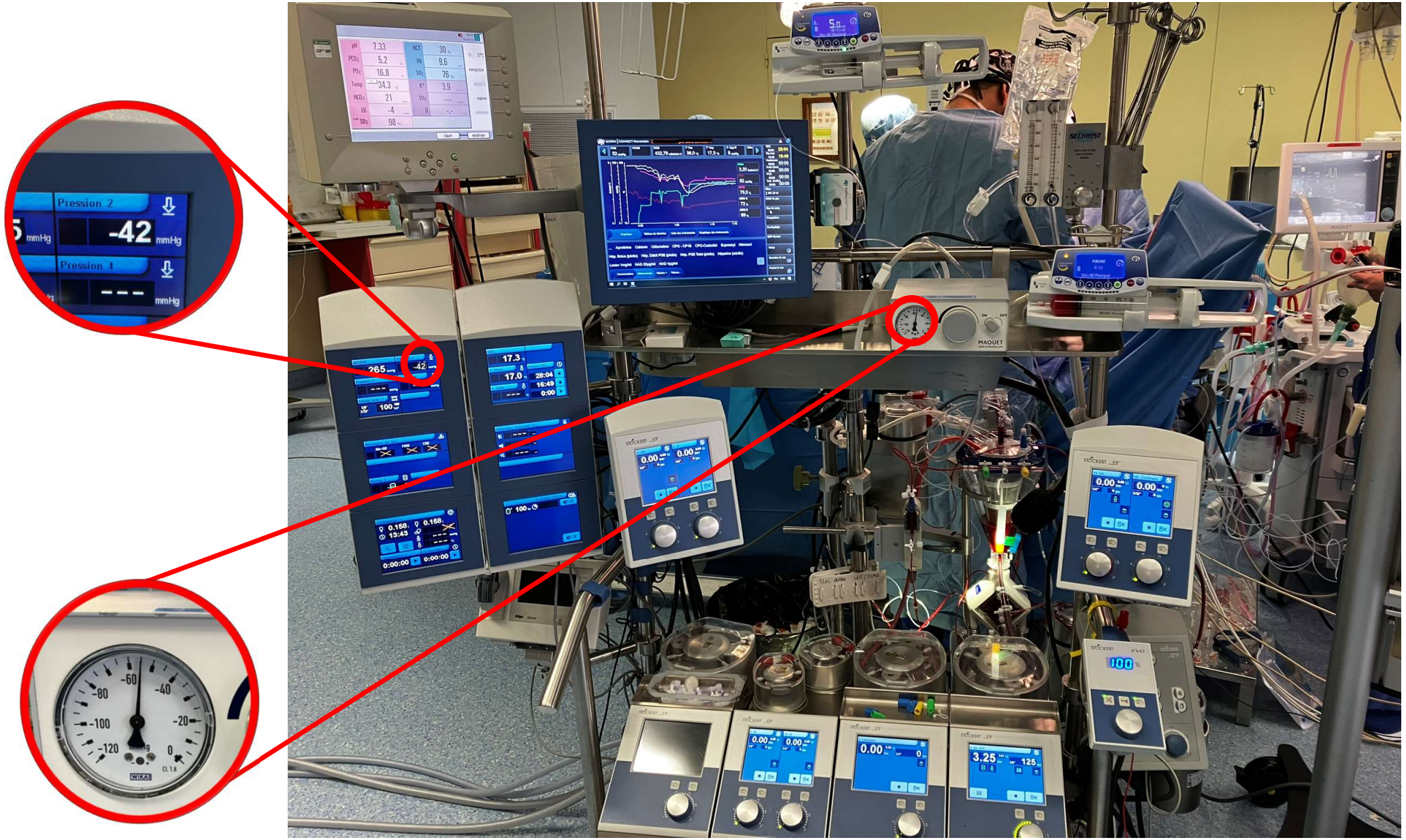
SPECIAL REPORT: STS WORKFORCE ON EVIDENCE BASED SURGERY

2011 Update to The Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists Blood Conservation Clinical Practice Guidelines*

<u>Adulte</u> :

Pression négative nette maximale d'environ -80,83 à -90,83 mmHg




Pression 2
-42
mmHg
Pression 4
---
mmHg
WIKA

Les pompes

Type de pompe

Type de pompe	Avantages	Limites
Pompe occlusive	• Contrôle précis du débit • Réutilisable • Pas de flux rétrograde	• Risque de surpression • Mauvaise occlusion (sur ou sous-occlusion) • Hémolyse
Pompe centrifuge	• Moins d'activation des facteurs de coagulation et de la fibrinolyse • Moins d'hémolyse	• Priming plus importants • Plus cher • Flux rétrograde possible • Peut augmenter la durée d'hospitalisation

- Pas de recommandation claire -

Type de pompe

Enquête mondiale sur les pratiques des perfusionnistes en 2016

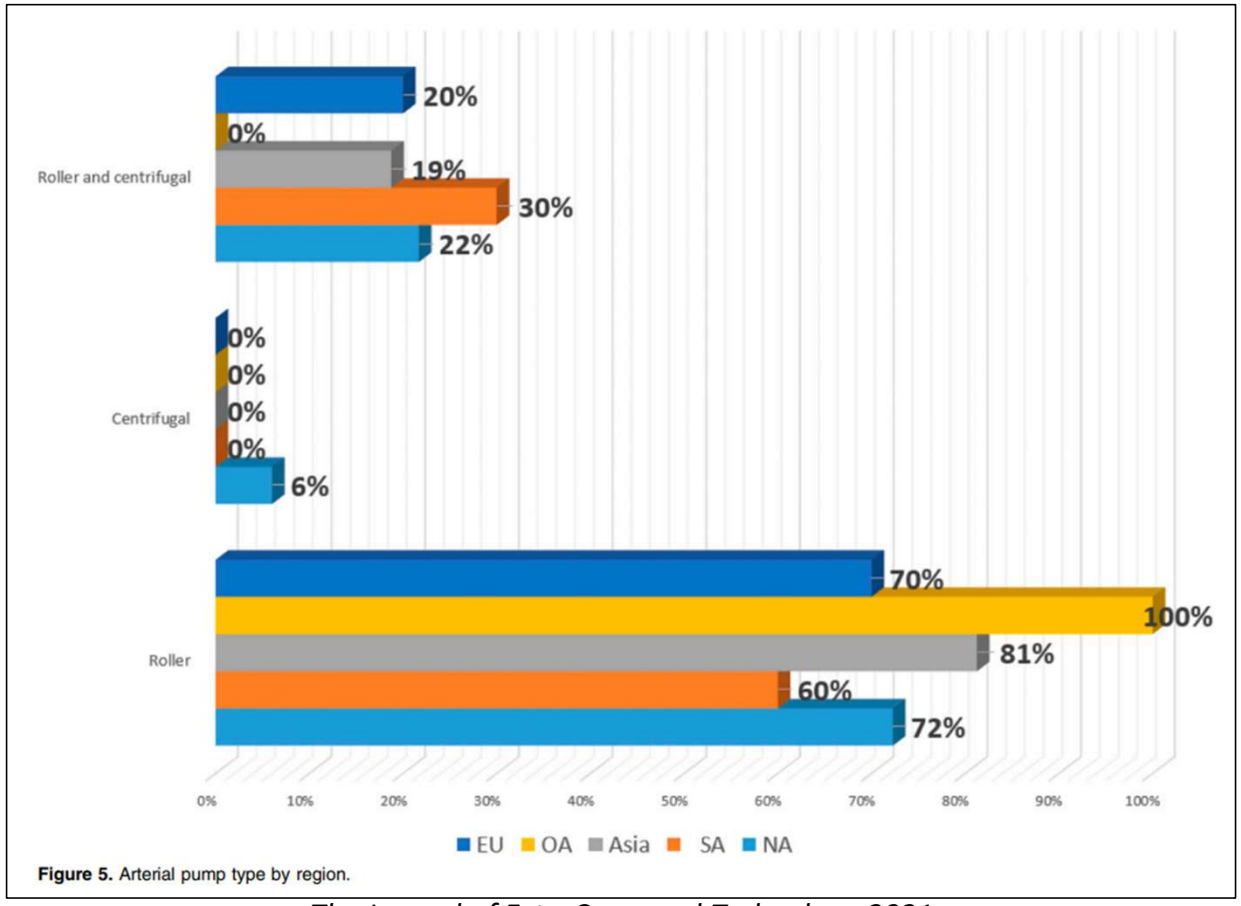
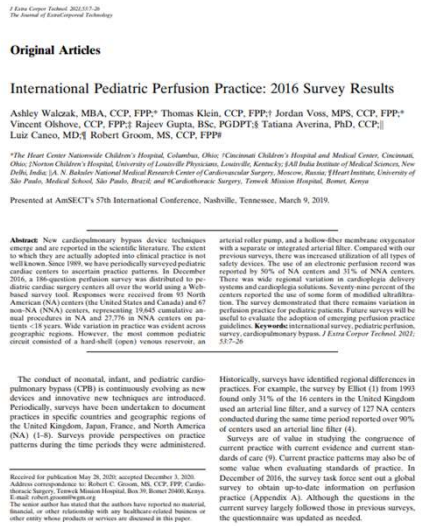


Figure 5. Arterial pump type by region.

The Journal of ExtraCorporeal Technology 2021



J Extra Corpor Technol. 2021;53:7-26
The Journal of ExtraCorporeal Technology

Original Articles

International Pediatric Perfusion Practice: 2016 Survey Results

Ashley Walczak, MBA, CCP, FPP;* Thomas Klein, CCP, FPP;† Jordan Voss, MPS, CCP, FPP;* Vincent Olishove, CCP, FPP;‡ Rajeev Gupta, BSc, PGDPT;§ Tatiana Averina, PhD, CCP;‖ Luiz Caneo, MD;¶ Robert Groom, MS, CCP, FPP#

**The Heart Center Nationwide Children's Hospital, Columbus, Ohio; †Cincinnati Children's Hospital and Medical Center, Cincinnati, Ohio; ‡Norton Children's Hospital, University of Louisville Physicians, Louisville, Kentucky; §All India Institute of Medical Sciences, New Delhi, India; ‖A. N. Bakulev National Medical Research Center of Cardiovascular Surgery, Moscow, Russia; ¶Heart Institute, University of São Paulo, Medical School, São Paulo, Brazil; and #Cardiothoracic Surgery, Tenwek Mission Hospital, Bomet, Kenya.*

Presented at AmSECT's 57th International Conference, Nashville, Tennessee, March 9, 2019.

Abstract: New cardiopulmonary bypass device techniques emerge and are reported in the scientific literature. The extent to which they are actually adopted into clinical practice is not well known. Since 1989, we have periodically surveyed pediatric cardiac centers to ascertain practice patterns. In December 2016, a 186-question perfusion survey was distributed to pediatric cardiac surgery centers all over the world using a Web-based survey tool. Responses were received from 93 North American (NA) centers (the United States and Canada) and 67 non-NA (NNA) centers, representing 19,645 cumulative annual procedures in NA and 27,776 in NNA centers on patients <18 years. Wide variation in practice was evident across geographic regions. However, the most common pediatric circuit consisted of a hard-shell (open) venous reservoir, an arterial roller pump, and a hollow-fiber membrane oxygenator with a separate or integrated arterial filter. Compared with our previous surveys, there was increased utilization of all types of safety devices. The use of an electronic perfusion record was reported by 50% of NA centers and 31% of NNA centers. There was wide regional variation in cardioplegia delivery systems and cardioplegia solutions. Seventy-nine percent of the centers reported the use of some form of modified ultrafiltration. The survey demonstrated that there remains variation in perfusion practice for pediatric patients. Future surveys will be useful to evaluate the adoption of emerging perfusion practice guidelines. **Keywords:** international survey, pediatric perfusion, survey, cardiopulmonary bypass. *J Extra Corpor Technol. 2021; 53:7-26*

The conduct of neonatal, infant, and pediatric cardiopulmonary bypass (CPB) is continuously evolving as new devices and innovative new techniques are introduced. Periodically, surveys have been undertaken to document practices in specific countries and geographic regions of the United Kingdom, Japan, France, and North America (NA) (1–8). Surveys provide perspectives on practice patterns during the time periods they were administered.

Historically, surveys have identified regional differences in practices. For example, the survey by Elliot (1) from 1993 found only 31% of the 16 centers in the United Kingdom used an arterial line filter, and a survey of 127 NA centers conducted during the same time period reported over 90% of centers used an arterial line filter (4).

Surveys are of value in studying the congruence of current practice with current evidence and current standards of care (9). Current practice patterns may also be of some value when evaluating standards of practice. In December of 2016, the survey task force sent out a global survey to obtain up-to-date information on perfusion practice (Appendix A). Although the questions in the current survey largely followed those in previous surveys, the questionnaire was updated as needed.

Received for publication May 28, 2020; accepted December 3, 2020.
Address correspondence to: Robert C. Groom, MS, CCP, FPP, Cardiothoracic Surgery, Tenwek Mission Hospital, Box 39, Bomet 20400, Kenya. E-mail: rgroom@tenwek.com.
The senior author has stated that the authors have reported no material, financial, or other relationship with any healthcare-related business or other entity whose products or services are discussed in this paper.

Le priming

Le priming

- Le perfusionniste **doit** tenir compte de l'impact du priming sur le petit volume sanguin des patients pédiatriques
  - Sanguin ?
  - Cristalloïde ?

Mannitol : non recommandé

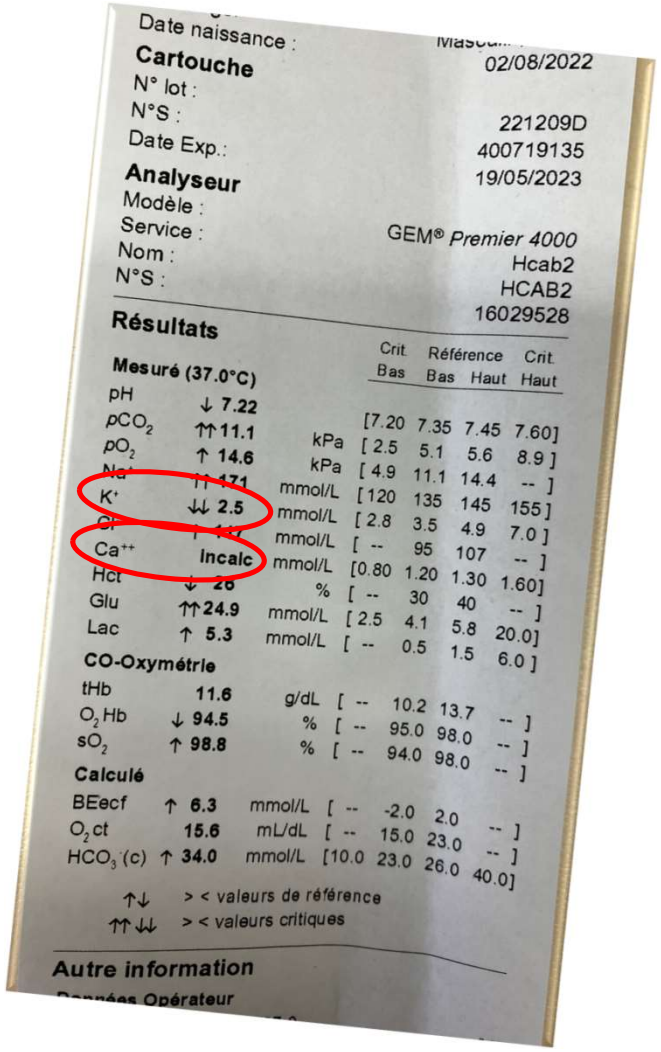
Bicarbonate : selon les habitudes (semble réduire l'incidence des IRA)

Ca^{2+} : supplémentation priming recommandée

Le priming

- Un gaz du sang du priming **doit** être réalisé avant la CEC

- L'ultrafiltration pré-CEC ou des CGR lavés **doivent** être utilisés



Date naissance : 02/08/2022

Cartouche
N° lot : 221209D
N°S : 400719135
Date Exp.: 19/05/2023

Analyseur
Modèle : GEM® *Premier 4000*
Service : Hcab2
Nom : HCAB2
N°S : 16029528

Résultats

			Crit. Bas	Référence Bas	Référence Haut	Crit. Haut
Mesuré (37.0°C)						
pH	↓ 7.22		[7.20	7.35	7.45	7.60]
pCO_2	↑↑ 11.1	kPa	[2.5	5.1	5.6	8.9]
pO_2	↑ 14.6	kPa	[4.9	11.1	14.4	--]
Na^+	↑↑ 171	mmol/L	[120	135	145	155]
K^+	↓↓ 2.5	mmol/L	[2.8	3.5	4.9	7.0]
Cl^-	↑ 127	mmol/L	[--	95	107	--]
Ca^{++}	Incalc	mmol/L	[0.80	1.20	1.30	1.60]
Hct	↓ 26	%	[--	30	40	--]
Glu	↑↑ 24.9	mmol/L	[2.5	4.1	5.8	20.0]
Lac	↑ 5.3	mmol/L	[--	0.5	1.5	6.0]
CO-Oxymétrie						
tHb	11.6	g/dL	[--	10.2	13.7	--]
O_2Hb	↓ 94.5	%	[--	95.0	98.0	--]
sO_2	↑ 98.8	%	[--	94.0	98.0	--]
Calculé						
BEecf	↑ 6.3	mmol/L	[--	-2.0	2.0	--]
O_2ct	15.6	mL/dL	[--	15.0	23.0	--]
$HCO_3^-(c)$	↑ 34.0	mmol/L	[10.0	23.0	26.0	40.0]

↑↓ > < valeurs de référence
↑↑ ↓↓ > < valeurs critiques

Autre information
Données Opérateur

Hématocrite cible

Hématocrite cible

Corrélation entre augmentation de la mortalité et transfusion de CGR

Mais

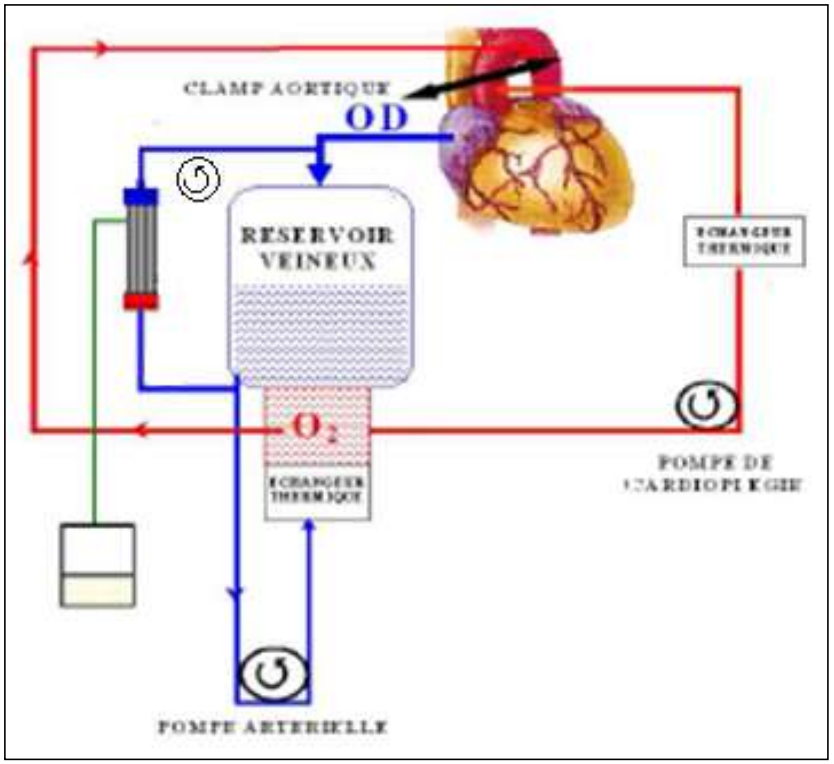
Une Hb basse en CEC est également délétère

<u>Moins d'atteinte rénale avec Hb élevée et débit de pompe élevé</u>

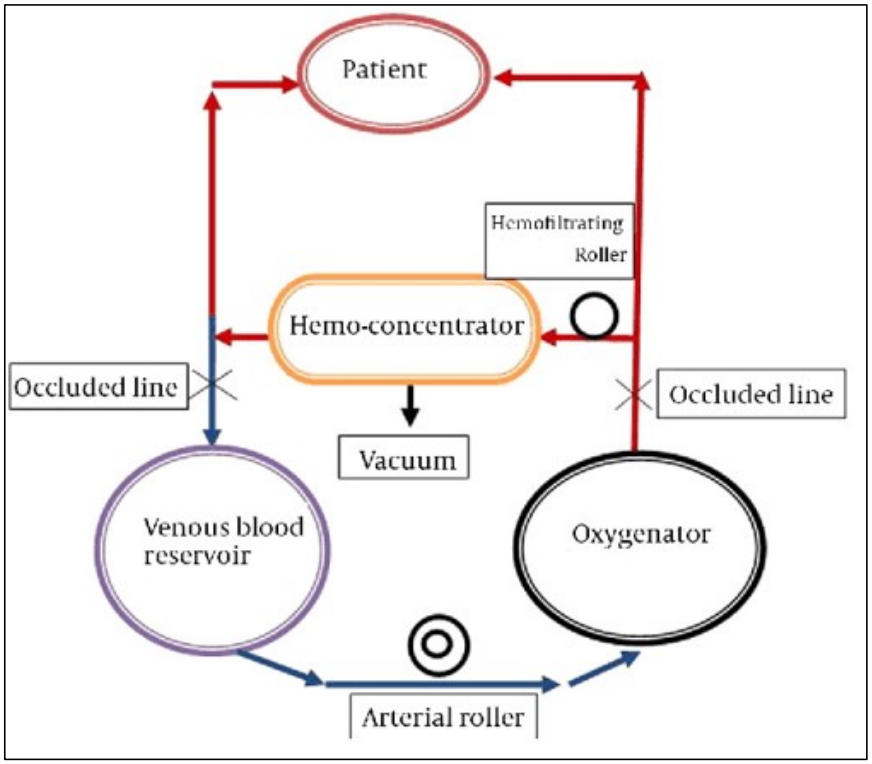
- L'HTC du priming **doit** être de 32 % minimum
- HTC fin de CEC : 43 % (pratiques actuelles de perfusion)

Ultrafiltration

Ultrafiltration



Ultrafiltration conventionnelle (CUF)
Compensation du volume filtré par transfusion (PFC et/ou CGR)



Ultrafiltration modifiée (MUF)
Compensation par le sang du réservoir

Ultrafiltration

L'ultrafiltration **doit** être utilisée pour optimiser :

- l'hémodynamique
- l'hématocrite (limite la transfusion de CGR)
- La réponse inflammatoire (réduire les cytokines)

<u>Pas de supériorité, sauf …</u>

MUF : Ultrafiltration modifiée
CUF : Ultrafiltration conventionnelle
ZBUF : Ultrafiltration avec balance à zéro

<u>MUF + CUF</u>
Semble meilleure
(Inflammation et Hb)

Anticoagulation et Surveillance objectif de PAM et GDP

Avant 6 mois : faible taux d'AT III = ↓ de l'efficacité de l'héparine

- Cible d'ACT ?
- Fréquence des ACT ?
- Héparine en continu ?

Le perfusionniste **doit** surveiller en continu :

L'oxymétrie cérébrale

gaz du sang

débit sanguin artériel
(après les shunts distaux)

GDP et objectif de PAM

Pression de perfusion **doit** être au-dessus de 60% de la PAM normale selon l'âge

	Nouveau né	3 – 6 ans
PAM normale	60 mmHg	75 mmHg
PAM minimum (60%)	35 mmHg	45 mmHg

PAM < 25mmHg : ↑ la lactatémie ↑ la mortalité

GDP et objectif de PAM

<u>Nouveau né</u> :

DO_2i de 360 $ml.min^{-1}.m^{-2}$

- ↑débit
- Transfusion
- Ultrafiltration

DO_2i adulte : 280 $ml.min^{-1}.m^{-2}$

Gestion de la température

Protection neurologique :

- Pas de supériorité de l'hypothermie sur la normothermie

Désavantage de l'hypothermie :

- Inhibe la cascade de la coagulation
- Augmente le saignement postopératoire
- Induit une résistance à l'insuline
- Interfère avec l'absorption d'O_2 et de glucose (cérébrale)
- Favorise le stress oxydatif
- Augmente les résistances vasculaires systémiques
- Augmente la viscosité du sang et affecte la microcirculation

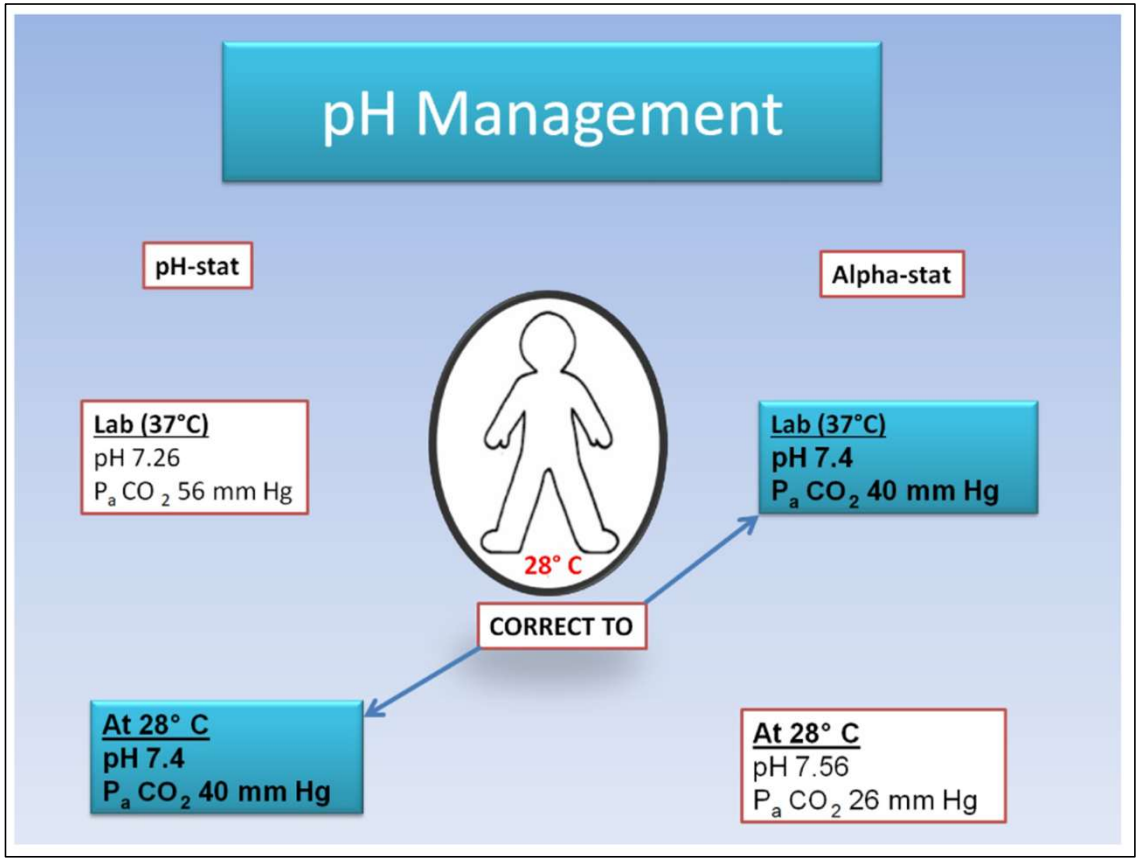
Gestion des gaz du sang

Alpha-stat :

- Interprétation des gaz du sang à 37°C
- Pas de correction à la température corporelle du patient

pH-stat :

- Interprétation des gaz du sang à la température du patient
- Apport en CO2 dans les gaz de CEC



Stratégie pH-stat **doit** être réalisée pendant l'hypothermie

L'utilisation de CO_2 supplémentaire **doit** être envisagée pour optimiser les gaz du sang

- Petits débits sanguins
- perfusion cérébrale sélective
- Hypothermie

Hypocapnie
=
↓ débit sanguin cérébral
+
↑ débit MAPCA

Pour conclure

Pas de recommandation française ni européenne

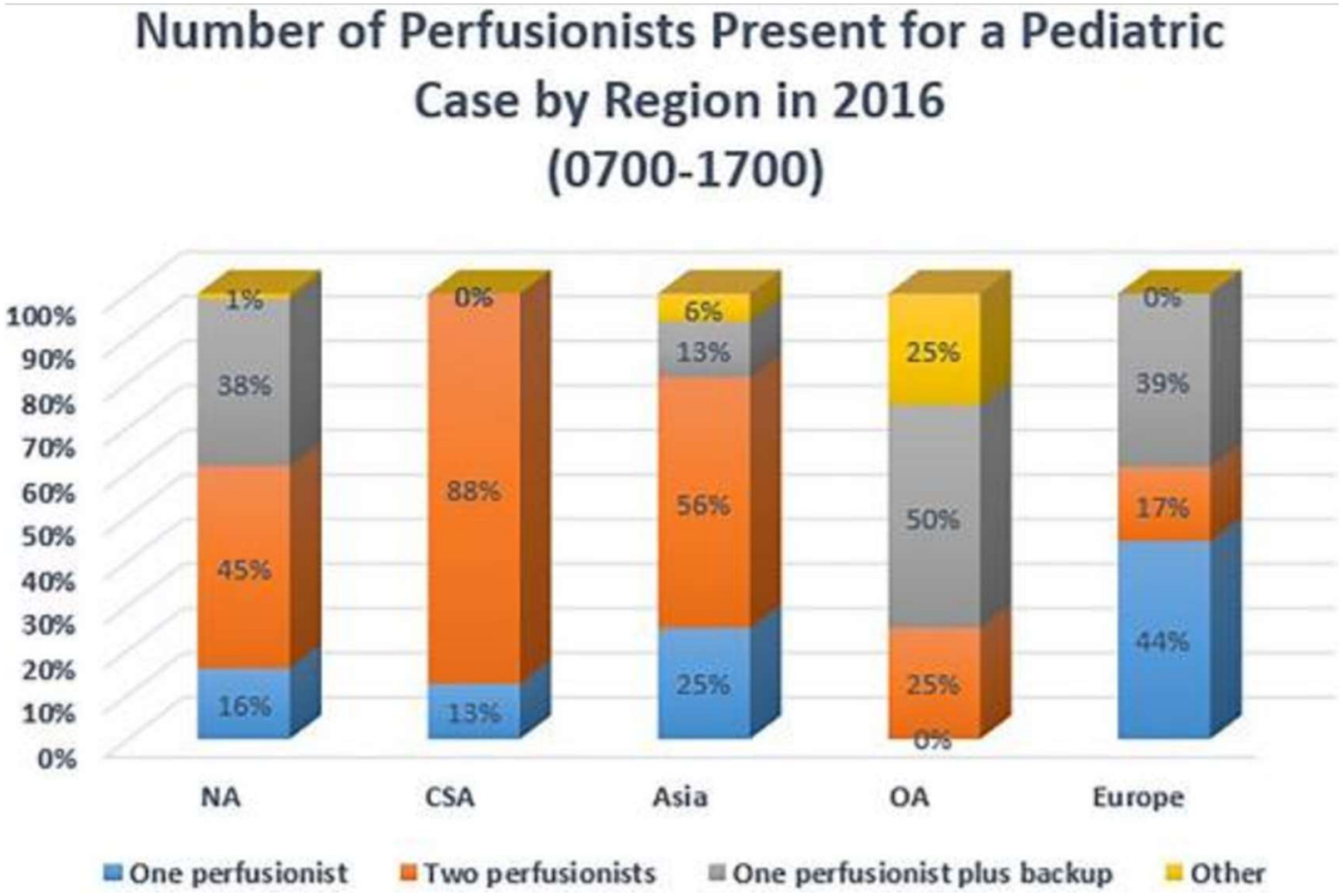
Quelle formation pour les perfusionnistes pédiatrique ?

Homogénéité des pratiques en France ? (gestion GDS en hypothermie)

Équipe dédiée à la CEC des congénitaux ?

Combien de perfusionniste présent pendant la CEC ?

Enquête mondiale sur les pratiques des perfusionnistes en 2016




NANTES 31.05 < 02.06 2023
JOURNÉES
FRANCOPHONES ET EUROPÉENNES
DE FORMATION
en CHIRURGIE THORACIQUE, CARDIO-VASCULAIRE,
STRUCTURELLE et ENDO-VASCULAIRE
SFCTCV

MERCI