THE AMERICAN ACADEMY
OF
CARDIOVASCULAR PERFUSION
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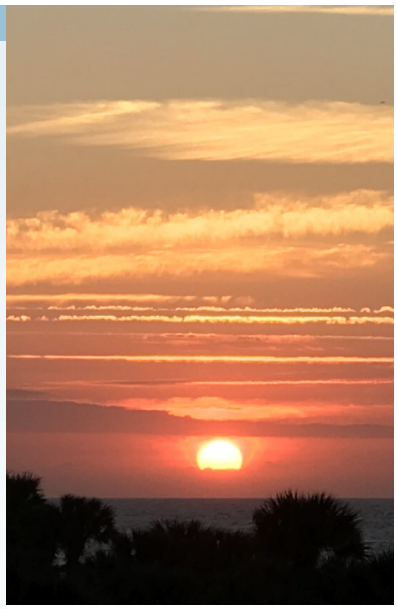
Spring 2019



The Academy Newsletter

2019 Annual Seminar

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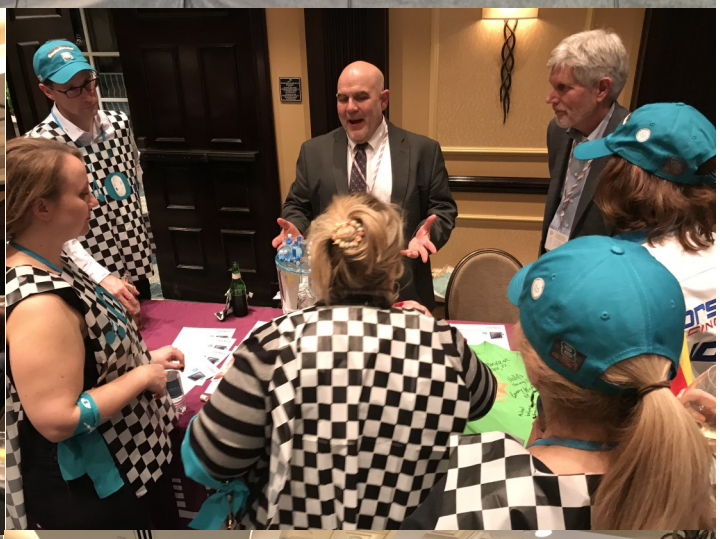
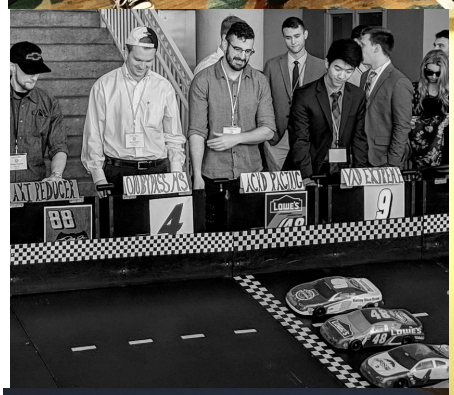
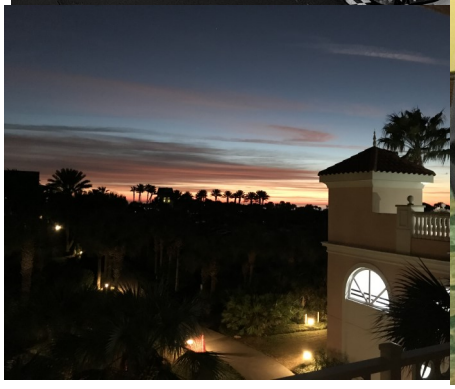
AMERICAN ACADEMY OF CARDIOVASCULAR PERFUSION





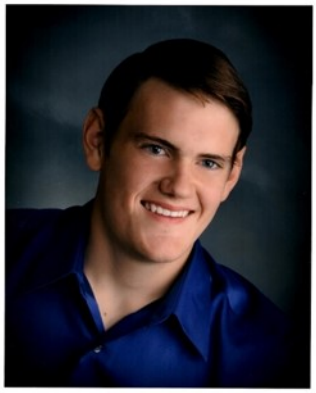


The Considerations for Splenectomized Patients Undergoing Cardiopulmonary Bypass Procedures

Brody Blackburn

University of Arizona

Tucson, AZ



Though it is possible to live productively without a spleen, there are related detriments that warrant special considerations when a splenectomized patient undergoes a procedure involving cardiopulmonary bypass. Despite there being limited studies associating adverse cardiopulmonary bypass effects with splenectomized patients, the objective of this review is to inform the perfusion community of spleen-related functions pertaining to blood filtration, blood component storage, and immunological contributions and how the absence of these functions can contribute to a multitude of complications when undergoing cardiopulmonary bypass procedures.

Being considered the largest lymphoid organ in the body, the spleen provides key contributions to a wide variety of physiological roles, including lymphatic and hemostatic functions. It is of crucial physiological importance for the body to have a means of monitoring the contents of blood that is being circulated systemically. Filtering capabilities can take credit for the removal and recycling of aged or abnormal erythrocytes, and can also work in conjunction with the selective process of destroying blood-borne pathogens to prevent subsequent infections. The storage capacity of the spleen can be directly linked with hemostatic operations in terms of the sequestration or release of erythrocytes and platelets. The red and white pulp regions of this organ provide the all-important interface between the innate and adaptive immune system to promote a rapid and effective immune response against invading microorganisms. Please refer to Figure 1 for a visual representation of the previously discussed anatomical features. The spleen is arguably a central contributor to clotting abilities and the implications of its absence, such as diminished

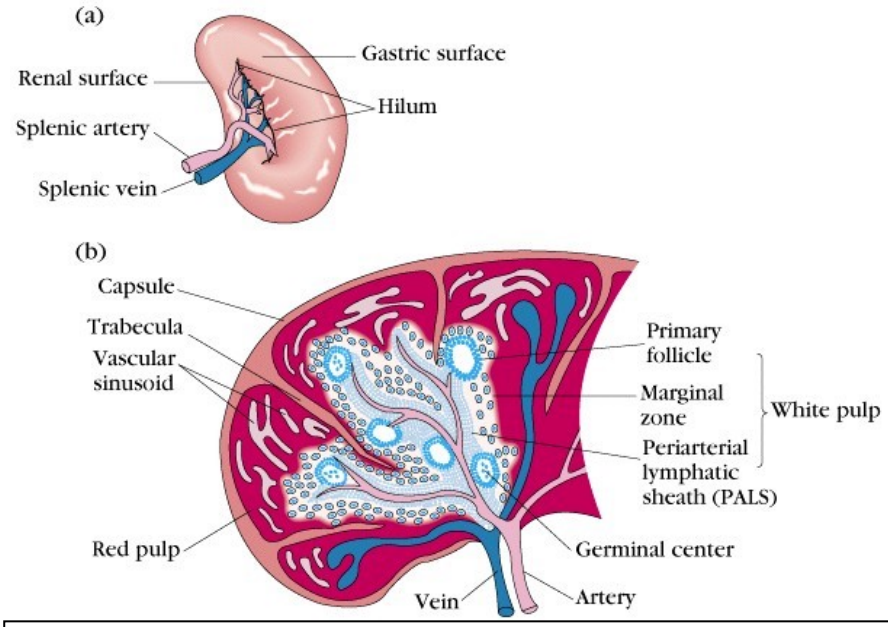


Figure 1: Cross section of spleen anatomy.
Retrieved from http://ranzcrpart1.wikia.com/wiki/Abdomen:Solid_viscus:Spleen

platelet regulation and immunosuppression, must be taken into special consideration for surgical procedures involving cardiopulmonary bypass. Events to be concerned with pertain to hypercoagulability, exaggerated inflammatory responses, compromised cerebral blood flow, peripheral edema, and acute kidney injury.

One rationale for removing the spleen is to alleviate, or reverse the deleterious effects of idiopathic thrombocytopenia purpura (ITP), which contributes to the autoimmune-mediated increase in platelet destruction by the splenic immune cells due to the ability of antibodies to recognize self-manufactured platelets. By removing the spleen and eliminating a means to destroy platelets, one can experience a shift in platelet numbers assuming the hematopoietic stem cells in the bone marrow are maintaining production of megakaryocytes and thrombocytes at a constant rate. Thrombocytosis, or increased platelet counts, can be observed in patients who previously have had a splenectomy [1]. It was suggested that patients with ITP, and thus low platelet counts, had a population of megakaryocytes that were less prone to apoptosis. In other words, megakaryocytic cells within ITP population experienced apoptosis less frequently than individuals without ITP who had normal platelet counts. These results suggest that the life span of the megakaryocytes are linked to the duration for which they continue to produce thrombocytes, and thus is reflective of a platelet production compensatory mechanism [2]. If an individual suffered from long term thrombocytopenia due to splenic platelet destruction, they may express megakaryocytes in greater numbers and with longer life spans for compensation, even after the spleen is removed. One may correlate this finding with the previous suggestion that splenectomized patients may exhibit thrombocytosis, or abnormally high platelet numbers. Realistically, any patient with thrombocytosis is more prone to stroke, myocardial infarction, pulmonary embolism, deep vein thrombosis, and even hepatic portal vein thrombosis due to the risk of hypercoagulability. Caution should arise when these patients must undergo any procedure that requires a reduction in hemostatic function.

Platelets and fibrinogen are known to adhere to the surfaces of determined biocompatible materials [3]. While on cardiopulmonary bypass, nearly all of the patient's blood will at some point come into contact with the interior surface of the perfusion circuit, and this circulation can continue for hours at a time. Also, it may be possible that non-smooth artificial surfaces, such as those in the corners of the venous reservoir, points of tubing connections, as well as areas of disturbed or insufficient flow within membrane oxygenators are likely surfaces for fibrinogen and platelets to accumulate and induce clot initiation. If a thrombus-like clot were to develop in the circuit and become dislodged from the point of formation and begin to circulate within the circuit such as that of an embolus, then this could cause grave harm to the patient if the clot where to be pumped up a major head vessel, potentially causing a stroke. For these reasons, the patient must be properly anticoagulated prior to cardiopulmonary bypass initiation.

Platelets can also be classified as modulators of immunological responses and exacerbators of inflammatory reactions. In multiple ways, the platelet can act extremely comparable to other immune cells in that it can express adhesive and immune receptors, secrete a multitude of cytokines and inflammatory mediators, and express specialized pattern recognition receptors that permit phagocytic-like activity via the endocytosis of serum components [4]. With this in mind, splenectomy-induced elevated platelet counts may contribute to an exaggerated inflammatory response, which could result in vasodilation, hypotension, compromised cerebral blood flow, hemolysis, and even edema due to increase capillary permeability. Hemolysis is often correlated to acute kidney injury when in over abundance. Red blood cell breakdown products such as hemoglobin and hemosiderin, an iron storage complex normally found within red blood cells, can induce cytotoxic effects on tubular cells within the nephron. Hemoglobin precipitate is also shown to cause obstruction in distal nephron regions [5].

Continued on Page 6

Continued from Page 5

Hemolysis-associated tubular injury can be another area of caution when an inflammatory response is provoked.

It is important to keep in mind that a splenectomized individual is ultimately immunosuppressed due to the absence of the single largest secondary lymphoid organ in the body. Though rare with proper immunological therapies, overwhelming post splenectomy infection (OPSI) is an example of the vulnerability a splenectomized patient may be to infection. Mild flu -like symptoms can quickly transform into lethal sepsis from encapsulated bacteria and other associated microbes [6]. Asplenic patients are most commonly susceptible to *Streptococcus pneumoniae*, but also *Haemophilus influenzae* and *Neisseria meningitidis* [7]. Any percutaneous procedure can subject a vulnerable splenectomized patient to sepsis, but this inclination stands even more so for individuals enduring a process as extensive as cardiopulmonary bypass. It is suggested that *Streptococcus pneumoniae* is responsible for nearly 80% of overwhelming post splenectomy infections, however, a host of other gram-positive and gram-negative bacteria contribute to severe infections of splenectomized patients. This can be related to the lack of antibody or macrophage bactericidal-mediated activity of pathogen clearance by the spleen. Aside from the actual microorganism themselves, the splenic macrophages also take part in the management and detoxification of bacteria-derived endotoxins as well [8].

Microorganisms display an impressive ability to adhere to a variety of surfaces, including synthetic or artificial surfaces of implantable medical devices. With the fusion of a few initial bacteria, they begin to secrete an exopolysaccharide matrix, or a basement layer composed of polysaccharides and other macromolecules such as DNA, lipids and other carbohydrates. This matrix provides the structural integrity and platform for biofilm formation as other bacteria cells begin to adhere to these surfaces and initiate colonization [9]. This tendency is all the more relevant in terms of valve replacements in immunosuppressed splenectomized patients that are absent of effective means of bacterial destruction. Though after an extensive review of publications with a lack of convincing studies, it may be warranted to speculate that an immunosuppressed splenectomized patient undergoing a cardiac valve procedure may be considerably more vulnerable to infective endocarditis.

In conclusion, the perfusion community may find it beneficial to acknowledge such risks associated with splenectomized patients. The reduced monitoring and adjustment of blood composition can lead to unregulated red blood cell and platelet counts, which in turn can affect coagulation. Splenectomy-induced thrombocytosis can cause a patient to be hypercoagulable, emphasizing the importance of proper heparin administration while on cardiopulmonary bypass. Platelets have a role in inflammatory responses due to immune cell-like attributes. Such responses are correlated with hypotension and hemolysis, which have been proved to increase chances of acute kidney injury with the accumulation of erythrocyte degradation products in the nephrons. Lastly, the weakened immunological protection can easily become overwhelmed when the body is subjected to microbial exposure. Considering splenectomized patients may be more susceptible to infection, a cardiopulmonary bypass procedure can become evermore taxing. This concept stands especially with the utilization of implantable medical devices and artificial valve replacements. Hematological factors such as blood composition and coagulation, as well as kidney protection and the risk of infection are all of crucial importance when considering the well-being of a patient undergoing an operation as extensive as cardiopulmonary bypass. Please refer to Figure 2 below for a comprehensive layout of the key issues relating to splenectomized patients described in this review and their associated effects.

Although there are few publications or clinical studies assessing these concerns, the vulnerabilities of splenectomized patients during and after medical operations should not be overlooked and warrant future investigation. Extra precautions such as proper anticoagulation, diuretics for kidney function, and prophylactic antibiotics for infection prevention should all be considered while striving to provide the best care possible for patients undergoing cardiopulmonary bypass procedures.

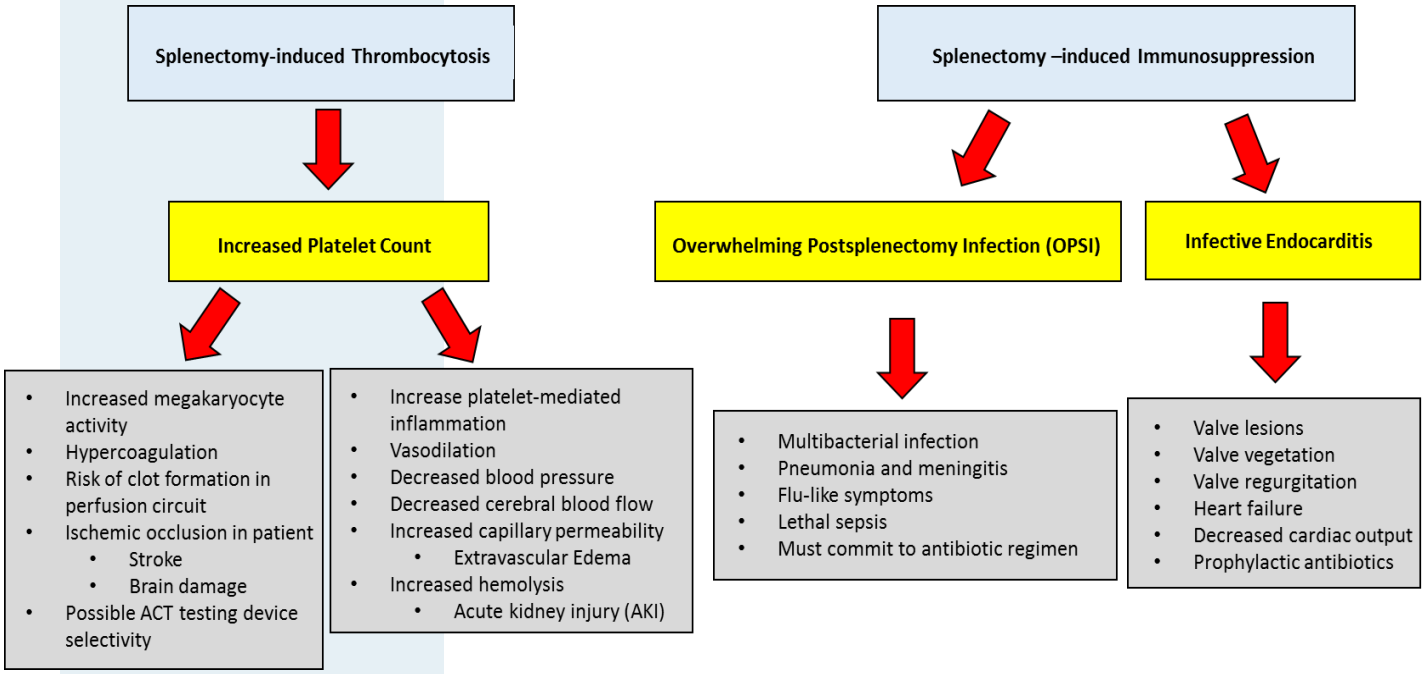


Figure 2: Systematic flowchart of two key issues effecting splenectomized patients; thrombocytosis and immunosuppression, and the negative outcomes and considerations associated with each diagnosis.

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Student Perfusionists Attending the Annual Seminar in Florida

Awards Committee Selects Winning Paper Presentations

Three students received **Lawrence Awards** for their paper presentations at the Annual Seminar in Florida.

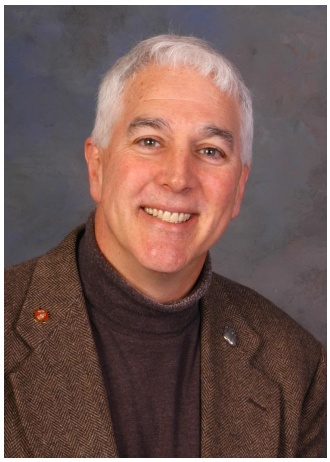
Alexandra Rezler - "Safety Relative To Staffing Requirements For The Cardiovascular Perfusionist"

Mitchell Katona - "Using A Quality Improvement Initiative To Reduce Acute Kidney Injury During On-Pump Coronary Artery Bypass Grafting "

Nathali Gomez - "Flolan Vs. Bivalirudin During Cardiopulmonary Bypass: Cost, Outcomes, Limitations"

The Lawrence Award is a $500 cash award for the best student papers presentations.

In addition, Al Stammers was awarded the **Best Paper of the Conference** - a $750 cash award funded by the journal *Perfusion* for his presentation entitled, "The Effect Of Various Blood Management Strategies On Intraoperative Red Blood Cell Transfusion In First Time Coronary Artery Bypass Graft Patients."



Welcome to New Members

The American Academy of Cardiovascular Perfusion would like to welcome the following individuals whom were voted into membership at the Closing Business Meeting of our annual meeting in Palm Coast, Florida.

Fellow Members
Bharat Datt
Larry Garrison
Ryan Piech

Members
Alexander, Alexis
Bassett, Gina
Dauch, William
Desjardins, Anthony
Gum, Alex
Kampert, Christa
Keller, Dan
Mabry-Elrod, Jessica
Markley, Douglas
Maunz, Olaf
Morris, Joseph
Potter, Edith
Radin, Heather
Slatter, Brent
Stephens, Rodney
Varso, Samantha
Vo, Anh
Win, Tun
Winters, Martha
Yana, Mesfin

Students
Al-Marhoun, Sarah (Rush)
Begum, Kali (MUSC)
Bender, Scott (VUMC)
Brandstetter, Jon (VUMC)
Burch, Lauren (MUSC)
Carey, Lauren (MUSC)
Carmody, Willow (MUSC)
Catricala, Joseph (NSUH)
Clark, Austin (Iowa)
Cooper, Baylie (Iowa)
Cossuto, Vincent (Quinnipiac)
Crews, Tyrone (MUSC)
Deaton, Alex (Midwestern)
Donizio, Jami (VUMC)
Dowlen, Najee (MUSC)
Dramer, Mary (VUMC)
Duarte, Mellissa (MUSC)
Dunaj, Sean (Rush)
Fluty, Ashley (THI)
Foster, Christian (THI)
Gayeski, Stephanie (Quinnipiac)
Gebrehindt, Samuel (Rush)
Gomez, Nathali (NSUH))
Hall, Courtney (VUMC)
Hall, Sagely (VUMC)
Hank, Alexandra (MUSC)
Harper, Tyler (Iowa)
Haulbrook, Alex (MUSC)
Haumschild, Timothy (Milwaukee)
Heyman, Matthew (VUMC)
Hickey, Alexandra (VUMC)
Higgins, Peyton (MUSC)
Hightower, Christopher (THI)
Hong, Justin (MUSC)
Korte, Jordan (THI)
Krause, Jacob (MUSC)
Kulesza, Agnes (Rush)
Kutateladze, Nikoloz (Rush)
Lamar, Benjamin (MUSC)
Landry, Emilianna (MUSC)
Lenihan, Joseph (MUSC)
Mackay, Ariana (Quinnipiac)
Mangine, Paul (Quinnipiac)
Mathew, Stephna (SUNY)
Maya, Liliana (THI)
Messarra, Branden (THI)
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Morgan, Taylor (THI)
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Pagel, Anthony (Quinnipiac)
Patel, Yogi (Rush)
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Pois, Blake (THI)
Poulos, Cassandra (Rush)
Povar, Natasha (NSUH)
Reitsma, Matthew (Rush)
Richards, Grant (MUSC)
Roos, Reid (Iowa)
Ruman, Alyssa (Milwaukee)
Saleem, Ifrah (SUNY)
Sanford, Sanquinetta (MUSC)
Satterlee, Taylor (Arizona)
Scheel, Colin (SUNY)
Shapiro, Matthew (MUSC)
Shore, Jake (Nebraska)
Stains, Kelly (THI)
Steht, Dustin (NSUH)
Stockwell, Chandler (UPMC)
Stover, Denesha (VUMC)
Texider, Leonard (Quinnipiac)
Urso, Alyssa (MUSC)
Van, Karen (SUNY)
Vespe, Michael (MUSC)
Walkowski, Christopher (MUSC)
Wallwork, Sarah (VUMC)
White, Noah (Iowa)
Wiscount, Brianna (MUSC)
Wisniewski, Andrea (MUSC)
Woodall, Elizabeth (Rush)
Zimmerman, Matthew (MUSC)

Safety Relative to Staffing Requirements for the Cardiovascular Perfusionist

The purpose of this study is to determine optimal staffing for a safe and quality Cardiopulmonary Bypass (CPB) run. The hypothesis of this study is "should there be two certified clinical perfusionists (CCP) totally dedicated to the operation of a mechanical circulating oxygenation system during CPB?". The goal is to recommend a standard for future staffing patterns in the perfusion field.

Other studies (cited in a future publication) asked the professionals what staffing pattern they are currently practicing. This is the first study that included inquiries from certified professionals for how they believe perfusionists SHOULD be practicing to provide the safest patient care.

The methods that were used in this study included a survey that was sent out via surveymonkey.com to 3,258 current CCP, and a comparative analysis performed on documented staffing standards in other high-stress career fields. Out of the 3,258 invitations sent out to perfusionists nationwide, there were 949 total responses, which is about a 29% response rate. The survey was designed with 40 questions pertaining to cardiovascular perfusion practices. According to Survey Gizmo, s good response rate for an external survey, on average, is 10-15%.

Alexandra Rezler

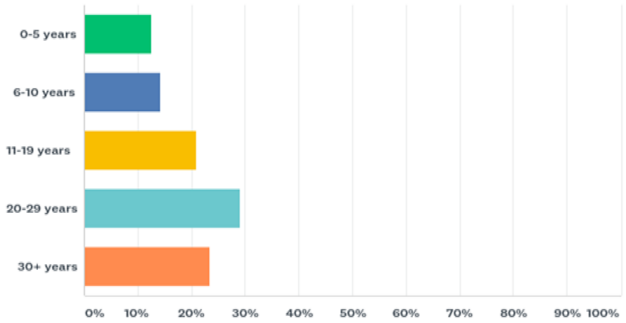
NSUH-LIUP School of Cardiovascular Perfusion

The full manuscript of this article has been submitted to the journal Perfusion for possible publication.

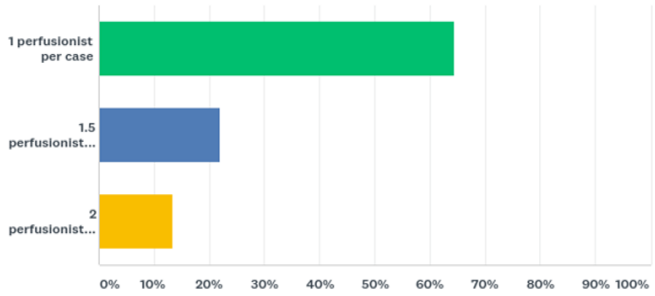
Some of the questions asked pertained to length of time as a practicing perfusionist, how many cases per year their particular institution conducts that require perfusion, the current staffing pattern at their institution, whether or not they have ever experienced a near miss and/or crisis while on CPB, and what they believe the safest staffing model would be. Of the participants, 64.5% answered that their institution current practices a one-perfusionist per case model, but when asked if two-person perfusion teams are safer than one-person perfusion teams, 67% agreed. Later in the survey, when asked "In the context of trying to provide the highest quality and safest patient care, what do you believe would be the best staffing model?", 81% of respondents answered that a staffing model over one-person would be the safest.

It is critical to define who is eligible to be considered for a two-person perfusion team, only certified perfusionists should be considered eligible. Adult cases are growing in acuity, complexity, re-operations, case numbers, and population size. It can prove beneficial to have a second certified perfusionist in the room to help make critical decisions and being able to catch unnoticed potential errors.

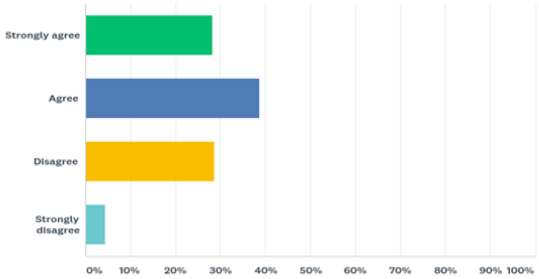
Q1 How long have you been a practicing perfusionist?



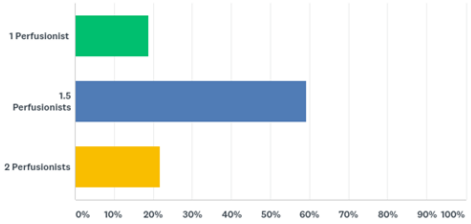
Q6 What is the current staffing pattern at your institution?



Q12 Two-man perfusion teams are safer than one-man perfusion teams



Q34 In the context of trying to provide the highest quality and safest patient care, what do you believe would be the best staffing model?



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The Council of The Academy Creates a New Awards/Manuscripts/Publications Committee

The Council's goal or focus of this committee is three-fold.

Awards: Review of presentations at current AACP meeting and naming awards for outstanding papers

Manuscripts: It is the purpose of this committee to review AACP presenters' manuscripts for both format and content as a helpful adjunct prior to submission to the *Perfusion* Journal. It is not the goal of this committee to review these manuscripts with the same level of detail that the journal editors will. It is meant to give additional guidance and address format, grammar, IRB approval and layout to assist and hopefully make the submission process easier with a higher rate of acceptance. The Academy will occasionally make content suggestions as well. The committee will not prevent submissions moving forward unless the submission format has not been followed.

Suggestions by the Council included developing a format template as an aide, as well as forming a session at the meeting. This session could be in a drop-in type format and/or sign up for time slots for assistance from the committee.

Publications: Council thought it might be a nice adjunct to our Website to recommend top journal articles from several pertinent journals for Academy Members on a quarterly basis. This could go out as a mass emailing or perhaps a tab with links on our website.

*Bragging Rights Belong to Team **On Bypass Motorsports***
Overall NASCAR Events Champions

On Bypass Motorsports

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Important Academy Dates

The ACADEMY ANNUAL MEETING DEADLINES

ABSTRACT DEADLINE	**October 15, 2019**
MEMBERSHIP DEADLINE	**December 5, 2019**
PRE-REGISTRATION	**January 9, 2020**
HOTEL REGISTRATION	**January 9, 2020**
2019 ANNUAL MEETING	**February 5-8, 2020**

Others Meetings

The 15th International Conference on Pediatric Mechanical Circulatory Support Systems & Pediatric Cardiopulmonary Perfusion
NewYork-Presbyterian/Columbia University Irving Medical Center
New York, NY
May 9-11, 2019
Contact: Jessica Mead
Email: jas2134@cumc.columbia.edu
Phone: 212-304-7817
https://collectedmed.com/index.php/article/article/course_preview/category/76/10504/205

18th European Congress on Extracorporeal Circulation Technology
Grand Hotel
Salerno, Italy
June 12– 14, 2019
Sponsored by the Foundation European Congress on Extracorporeal Circulation Technology (FECECT)
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2020 Annual Meeting

Reno, Nevada
February 5-8, 2020

Our Host Hotel
Grand Sierra Resort

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