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AANA Mid-Year Assembly



IANA'S SPRING CONFERENCE

April 23, 2016
Springfield, Illinois



Calendar Update 2015-16

April 2-6, 2016

AANA Mid-Year Assembly

*Renissance Washington DC, Downtown Hotel
Washington, D.C.*

April 23, 2016

IANA Spring Conference

*Hilton Springfield
Springfield, IL*

Registration Opening Soon

September 9-13, 2016

AANA Annual Congress

Washington, D.C.

October 1-2, 2016

IANA Fall Conference

*Northwestern Memorial Hospital
Chicago, IL*

Fall 2016

AANA Fall Assembly - Leadership Academy

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LETTER FROM THE EDITOR

Happy Holidays from the IANA staff, board of directors, and the editorial members of the Journal. We are excited to bring you the second edition of our Journal, including a well-researched paper on goal directed fluid therapy, one CRNAs perspective on providing anesthesia with Doctors Without Borders, and several legislative updates.

As we consider the myriad influences that shape our practice: from state law, to insurance conditions of participation, down to hospital bylaws and policies, it is important to remember to be a part of the conversation at every level of the process. Your help is needed with the IANA on the state level, but it is

also needed right at home where you work to influence practice and policies on the local level. I had the privilege of attending a very informative practice management session by the Center for Advanced Practice Providers (CAP2) and held right here in Chicago. I received a wealth of information regarding practice patterns for all Advanced Practice Providers (APNs and PAs) throughout the state and the all over the country. The struggles you may face regarding scope of practice, credentialing and privileging, peer review, ongoing evaluation, quality management, and professional development are not unique. Consider using the resources available to you through these independent consulting groups. Your hospital may already be a member; there are 74 CAP2 participating hospitals in Illinois.

The AANA has also launched the interactive discussion forum called AANACONNECT. Discussions are organized by topic, with areas for students and active practitioners. A sign in is required, so this is a safe and collaborative way to discuss practice issues, billing, standards of care... just about anything. You can find it at www.connect.aana.com

Stay connected, and stay informed. We want to hear from you at the Journal of the IANA. Do not hesitate to contact any of the staff with submissions or comments.

Sincerely,

Jennifer Greenwood, CRNA, PhD

Your Illinois Association on Nurse Anesthetists JOURNAL OF THE IANA STAFF

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LETTERS TO THE EDITOR

We want to hear from you! Please submit any comments, questions or letters to the editor at:

ianajournal@gmail.com

We are also looking for photo submissions for our future covers! Please submit high quality pictures of Illinois CRNAs or students in action.

As required by section 6033(e) of the Internal Revenue Code, we are required to inform you that \$58.13 (or 25%) of your state membership dues are allocated toward expenses incurred by the Illinois Association of Nurse Anesthetists for state lobbying activities. This amount is not deductible for federal income tax purposes. All IANA members are also members of the AANA.

IANA Lobbyist Report



By Roger H. Bickel
IANA Lobbyist & Legislative
Counsel Law firm of Freeborn &
Peters LLP

ILLINOIS GENERAL ASSEMBLY SESSION UPDATE

Greetings from our State Capitol to all of our CRNA's, students and a special recognition to those among our association membership deployed to active duty in our Armed Forces – thank you for your service. The Illinois General Assembly convened its scheduled five-month Spring Session in mid-January and as widely reported, failed to pass a Fiscal Year 2016 State Budget by the May 31st constitutional deadline. As a result, from early June to present, the Legislature has remained in a rare Overtime Session as an impasse on the budget between the parties continues.

WHAT YOU NEED TO KNOW

The debate for the Legislature presently confines itself to the Fiscal Year 2016 State Budget, business reforms impacting our economy, spending levels and potential new revenue sources. While there have been interim funding proposals approved relating to authority for the State to expend federal funds, and court orders directing payment of select public wages and vendors, none of the actual legislation in summer Overtime Session have related specifically to “CRNA scope of practice” issues.

What were the major developments from 2015 Spring Session that a CRNA must know about?

“ANESTHESIA ASSISTANTS LICENSURE” SOUGHT BY ANESTHESIOLOGISTS BUT FAILED

This Spring Session witnessed introduction of yet another challenging measure directed squarely at CRNA's – this year the Illinois Society of Anesthesiologists sought to pass a law creating the new licensure of Anesthesiologist Assistants and declaring by legislation, that “the practice of anesthesiology is the practice of medicine (only)”. House Bill 3205, the Anesthesiologist Assistant Practice Act was introduced on February 25th and after an intense

lobbying effort by your IANA leadership team, failed to be called or advance out of House Committee. To quote the Illinois Society of Anesthesiologists, “ISA has introduced HB 3205 which establishes the legal practice of AAs in Illinois. With passage of this bill, Illinois will allow AAs from Illinois working in other states to return to their homes.”

IANA Past President Andy Griffin noted: “The bill fails to recognize that there is no shortage of CRNA's to provide anesthesia care in Illinois, among other fallacies”. However, the proponents of this legislation are far from done with pushing this 2015 failed legislation – rather they fully intend to seek passage again in 2016 unless defeated.

CRNA Scope of Practice Developments

FULL PRACTICE AUTHORITY FOR ADVANCED PRACTICE NURSES INTRODUCED NEGOTIATIONS CONCLUDE WITH MODEST APN CHANGES

Earlier this Spring, House Bill 421 (Feigenholtz/Steans) was introduced seeking full practice authority for APN's – IANA supported this measure and fully expects to continue discussions advancing like measures in 2016. Following a series of negotiations among legislators and stakeholders, an interim compromise for 2015 was enacted. Below is a summary of the changes made in the 185 page new law:

- For CRNA's, it makes no changes to the provision of anesthesia services.
- Makes no changes to the law requiring delegation of prescriptive authority by a physician, but allows APNs (other than CRNAs) to prescribe at a hospital affiliate such as an urgent care center if credentialed by the medical staff to do so. Under a written collaborative agreement, an APN can only prescribe medications if the collaborating physician delegates authority to do so. Additional limitations exist on an APN's ability to prescribe Schedule II controlled substances, including specific identification of the controlled substances prescribed and a prohibition on any delivery method other than oral, topical or transdermal application. These same restrictions will apply at the hospital affiliate.

...Continued on page 3

*Why you should get involved in your IANA
Government Relations Committee...*

YOU KNOW WHAT IS GOING ON UNDERNEATH THIS DOME?



Every year, there are literally thousands of new legislative proposals introduced by the General Assembly, many which directly impact CRNAs. Let's briefly look at the 99th General Assembly strictly by the numbers.

Number of Senate Bills Introduced 2175
Number of House Bills Introduced 4293
Number of Senate Resolutions Filed 973
Number of House Resolutions Filed 762
Number of bills referencing “sedation” 18
Number of bills referencing “anesthetist” 29
Number of bills referencing “anesthesia” 39
Number of bills referencing “pain” 97
Number of bills and amendments referencing “nurse” 805

JOIN OUR EFFORTS:

Do you care about potential IL licensure of AAs? IANA Members are encouraged to contact our President Elect, Kent Fair, CRNA, at ianapresidentelect@gmail.com to help our association educate your local legislators on our priorities and challenges. Also remember that your PAC donations are essential to supporting Members of the General Assembly that have stood with CRNAs in our effort to promote better patient care, safety, and healthcare access. Contact ILCRNPAC Chair Christine Salvator, CRNA, MSN, APN at ilcrnpac@gmail.com with questions.

2015-2016 IANA ELECTION RESULTS

CONGRATULATIONS TO:

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CRNA, DNP

SECRETARY



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Lobbyist's Report (Continued from page 2)

- Maintains current law requiring APNs to have a collaborative agreement with a physician if they are practicing outside of a hospital, hospital affiliate, or ASTC. In hospitals, hospital affiliates, and ASTCs, APNs continue to be credentialed by the medical staff.
- Eliminates specified content in the collaborative agreement and allows the physician and the APN to more broadly determine their collaborative practice within the specialty area of the APN and the physician.
- Eliminates contractual barriers that might prevent APNs from participating in Medicaid.
- Allows for a 90-day transition period when, for any reason, a physician discontinues a collaborative agreement with an APN, provided the APN seeks any needed collaboration at a local hospital and refers patients who require services beyond the training and experience of the APN to a physician or other health care professional.
- Deletes references in approximately 28 different acts where APNs and physician assistants are allowed to perform various functions, only if they are specifically mentioned in the collaborative agreement or the supervisory agreement with physician assistants. Most written collaborative agreements do not enumerate the particular patient services, but collaborating physicians routinely allow such services to be performed by the APN even though enumeration is required by the law.

HB 421 as amended has been signed into law as Public Act 99-0173 and was effective immediately.



Pictured here are Immediate Past President Andrew Griffin, CRNA, PhD, APN, and Representative Dwight Kay (R), Illinois 112th District, in the House Chambers in Springfield. Andrew and the IANA were formally recognized on the floor of both the house and the senate in May.

From the President's Desk



Kent Fair, CRNA
Marion Healthcare Ambulatory Surgery Center

As our board starts a new year for the Illinois Association of Nurse Anesthetists, 2015-2016, I want to take this opportunity to provide a brief update on your association's recent activities and plans for the future. Our Fall Conference, held in the Chicago area, was very successful. I feel it was one of our better meetings, and the information delivered to the members was very insightful and pertinent. Our spring meeting will again be held in Springfield and we will be presenting some new legislative briefings and update on ethical practice issues. We have just confirmed that our 2016 Fall Conference will be moved to downtown Chicago at Northwestern Memorial Hospital. In the past, this venue has proven to be exciting and informative for our members and their families as one of our most attended meetings. Everyone should make plans to come to Chicago and enjoy the City of Big Shoulders.

On the legislative front, as many of you may know, the General Assembly has continued to meet in Springfield for Overtime Session, to hopefully achieve the goal of approving a Fiscal Year 2016 State budget. Because of this ongoing activity in our Capitol, we have continually monitored developments with any legislation that may affect CRNAs in the state. We just recently reviewed the Dental Practice Act Sunset bill which had received some language changes, which were determined to not adversely affect CRNAs. Roger Bickel, our IANA legislative counsel / lobbyist, and myself have also met with some of our key legislators to address both our proactive IANA legislative agenda as well as the association's steadfast opposition to hostile scope of practice legislation. This includes the recently introduced Anesthesia Assistant licensure bill. These discussions will continue into spring and will include our continued examination of national developments and perspectives relating to greater practice autonomy. I, together with our IANA board, will continue to keep you informed on those discussions as they relate to the upcoming 2016 Spring Session.

2016 Lobby Day: We are planning an organized IANA Lobby Day in early March with details to be communicated through our Members Only portal and email. The date selected (based on Session schedule) will be given to you in plenty of time so that everyone who wishes to attend can arrange their schedules well in advance.

Work has already begun on the sunset of the Nurse Practice Act (NPA) which expires in 2018. A new NPA will be drafted and updated for consideration and approval by lawmakers in the spring of 2017. We have formed a task force of IANA members familiar with key practice issues. We have been asked to formulate language for our portion of the NPA, and incorporate our recommendations into the parallel work underway with the recently formed Illinois Coalition of Nursing Organizations - of which IANA is an active member. IANA Executive Director Micah Roderick has met with the Coalition and we will continue to be very involved in the collaborative language drafting process for all of nursing. The task force will be meeting in November and then report their initial recommendations to the other participating nursing groups in December. A timeline has been established, with the objective that all desired language proposals will be prepared by the mid-2016.

We have also been working to examine the work and recommendations of our association Radiation Task Force. Specifically, we are exploring the impact current scope of practice restrictions within the Act impose upon access to health care. The IANA board, along with association legislative counsel Roger Bickel will be actively deliberating on the implications of access to health care issues this Session.

Please note that we have active association Facebook and Twitter accounts. Please check our web site at www.ilcrna.com for quick links and access to association information, legislative updates, and practice updates. Thank you for your support, and I look forward to serving you and the IANA in the critical coming legislative year. Please do not hesitate to contact me should you have any questions or concerns. You can email me directly at ianapresident@gmail.com.

Sincerely,
Kent Fair
President IANA

Looking Ahead

IANA & THE UPCOMING REGULATORY SUNSET PROCESS OF THE NURSE PRACTICE ACT

Every ten years, all professional acts are set for review by the General Assembly as mandated by the Illinois Regulatory Sunset Act (5 ILCS 80). **For the Nurse Practice Act, that review will be undertaken in 2017 coinciding with the Act's current expiration date of December 31, 2017.** The Governor's Office of Management and Budget is required to study the performance of each regulatory agency and Act scheduled for termination and make recommendations of changes or continuation.

Why are we talking now about a law that will not technically expire until 2018? Because 2016 will be the kick off of a comprehensive effort to solicit your input and recommendations on possible changes to the Nurse Practice Act that will be sought formally during the Spring of 2017. The Illinois Coalition of Nursing Organizations will be spearheading the sunset review process with open summits to be scheduled statewide in 2016 for solicitation of feedback and suggestions for improving upon the Illinois Nurse Practice Act.

Traditionally, the sunset reviews result in the most far reaching amendments to our professional regulation and scope of practice – IANA, a key member of the Illinois Coalition of Nursing Organizations, will look forward to playing a critical and active role in that process going forward.

Sunset Review Process:

- Workgroups are to provide recommended changes with rationale in common language.
- Recommendations will come back to ICNO for review and prioritization.
- ICNO leadership will then meet with the Illinois Board of Nursing and IDFPR to discuss recommendations and transform recommendations into legal language.
- January 2017 - bill will be introduced.

Look for further details and announcements regarding this very important process on your IANA website Homepage.

IANA Advocacy: Your IANA Board and Government Relations Committee are presently tracking more than 50 separate additional measures in Overtime Session on your behalf. Please check our Members Only Portal for details.

State Rep. Mike Zalewski Honored as Legislator of the Year



Joseph Grazaitis, SRNA, Past IANA President Bernadette Roche, IANA Executive Director Micah Roderick, present State Representative Mike Zalewski of Riverside (center) with the "IANA Legislator of the Year Award" in the Capitol.

Representative Zalewski, who Chairs the House Health Care and Licenses Committee, was the unanimous board selection for the association honor based upon his steadfast support for preservation of CRNA's scope of practice over the past two years.

Milikin University

MESSAGE FROM THE DIRECTOR

Rhonda Gee, CRNA

Eleven students graduated in December 2014. All passed the National Certification Examination, and are gainfully employed as nurse anesthetists. Not surprisingly, they are very happy with the career they have chosen.

In April of this year, our program celebrated the 50th anniversary of the beginning of the nurse anesthesia program at Decatur Memorial Hospital (DMH). The celebration was a two night event. On Friday evening, a cocktail-type gathering occurred at the DMH café. The primary event was held the following night at the Decatur Club where the dinner, complete with program occurred. Our first student (and therefore, graduate) was in attendance. As expected, there was much "catching up" and many stories remembered and shared. It was a very nice and enjoyable celebration. The celebration also launched the Program's Alumni Association with officer's being chosen. Officers elected were: Betty Horton (president); Diane Ritter (vice-president); Anita Burton (treasurer); and Valerie Vancil (secretary). Liaisons between the association and the program are Kathryn Mentzer (faculty) and Sarah Brumleve (student). An annual dinner is planned and graduates will be contacted with details regarding the Alumni Association's activities.

As summer is closing, the senior nurse anesthesia students are busy with comprehensive exams and clinical experiences. I am sure they have a countdown to the day of their graduation. Most students have completed their MSN Project; those who have not completed their projects are expected to do so within the upcoming months. Our IANA school representative, Paul Pritts, RNAI, will be presenting his project at the fall meeting of the IANA. He studied personality and anesthesia students. His presentation is very interesting. Clinical experiences are continuing at both DMH and our clinical affiliations. We are so fortunate to have such fabulous and strong support from our clinical institutions.

The Junior RNAIs, our first DNP class, began in the clinical arena in June following preparatory lectures and simulations. They are working diligently at applying the didactic information they obtained from their courses into clinical practice. Our first-year students are heavily engaged in didactic coursework and we are excited to have them in our program.

Our Admission Committee is busy reviewing applicant files and preparing for interviews for selection of the next class beginning in January. Always a busy and exciting time around here!

Impact of Legislation on Scope of Practice Among Nurse Anesthetists



Full Abstract
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Certified Registered Nurse Anesthetists (CRNAs) are vital in delivering anesthesia services. Despite rigorous training and proven quality outcome metrics, their scope of practice (SOP) is often limited. We investigated the impact of locale and absence of physician supervision, on a national sample of CRNAs (N=1202).

CRNAs practicing in rural locations had higher SOP scores; those in states opting-out of physician supervision had higher SOP scores. CRNAs who experienced a change in practice following opt-out legislation had the highest SOP of all groups (all $P < 0.001$). Restrictions in excess of state laws negatively impacted SOP.

*Jennifer E. Greenwood, CRNA, PhD, is the chief nurse anesthetist at Northwestern Lake Forest Hospital, Lake Forest, Illinois. The research findings for this article are taken from a dissertation written while a PhD candidate at Virginia Commonwealth University. greenwoodagain@yahoo.com

Chuck Biddle, CRNA, PhD, is a professor and director of research at Virginia Commonwealth University.
*corresponding author

Funding Sources: Doctoral Research Grant awarded to Jennifer Greenwood by the AANA Foundation to support this research.

Greenwood, J. & Biddle, C. 2015. Impact of Legislation on Scope of Practice Among Nurse Anesthetists. *Journal of Nurse Practitioners*, 11(5): 498.

Anesthesia Away From Home

Elizandra Pierre, CRNA, MS

Six months after starting my first job as a Nurse Anesthetist, I was on my way to Haiti for one of the largest disaster relief efforts of my lifetime. As I was flying in a Black Hawk helicopter from a military base in the Dominican Republic to Haiti, the reality of my situation kicked in. I was green, barely out of school, and somehow thought I would be an asset to this relief effort. What was I thinking?! The answer to that question is that I was not. I was asked, along with a CRNA colleague and RN, by an anesthesiologist, if I would like to join him at a clinic about thirty miles outside of Port au Prince. I immediately said yes, but I did not need to think about the implications. I had been watching the earthquake footage for days and could no longer sit by and watch this disaster from the comforts of my living room. We arrived to Croix de Bouquets, Haiti two days after our departure from the United States, landed in a bean field behind the clinic, and immediately started working.

I am sure many of you remember the scenes of the destruction and ruin of the city of Port au Prince, but it was worse once you were on the ground. I do not believe anything in my life experiences could have prepared me for what we witnessed as medical providers during this crisis. The Toussaint L'Ouverture Int'l airport was shut down and field tents were set up on the tarmac as operating rooms. It was absolutely surreal. We were fortunate to be able to work out of proper operating rooms at the clinic; we had ample drugs and supplies that had been left there by previous surgical teams. The surgical procedures performed were mostly for the treatment of orthopedic trauma, limb amputation and wound care. Every day people were arriving and departing from the clinic, nurses, anesthesia providers, surgeons, surgical technicians, and general practitioners. It was chaos, at times organized, but most of the time not. There have been a multitude of essays written after the earthquake assessing the relief efforts, and there is no doubt the international community could have done a better job to help this ravaged country. However, I know our little group from Charlotte, NC did as much as we could, with our resources, and with all the care and compassion that we had. By the end we were mentally, emotionally, and physically exhausted, while frustrated that we could not do more and utterly heartbroken by what we had just experienced.

Five years later I was once again en route to a foreign land to provide anesthesia services. This time I would be 7,500 miles and eight time zones away from home. My destination: Aweil, South Sudan. It is a small city located in the Northwestern part of the country that borders the Republic of Sudan. I applied to work with Doctors Without Borders, was accepted, and granted my first assignment. I would be practicing in a maternity/pediatric hospital providing

anesthesia care alongside a group of expatriates and national staff. I was greeted with a Halothane draw over vaporizer and enough ketamine to sedate a small country. MSF (Doctors Without Borders) had been present at this hospital for many years and it was quite a well-oiled machine, considering the geography. I had a fantastic South Sudanese anesthetist that worked days with me, but after 5pm and on weekends I was the sole anesthesia provider. I worked very closely with an American OB/GYN from Oregon that had over 30 years of experience and together we performed surgical procedures for complications that he had only read about in textbooks, and that have not been seen for decades in the US. I provided mostly spinal anesthesia for cesarean sections, hysterectomies, and to assist with forceps deliveries. The number of intrauterine fetal deaths (IUFD) was astounding and tragic. South Sudan has the highest maternal mortality rate in the world with one in seven women dying during pregnancy or childbirth. Major causes of death are obstructed labor, hemorrhage, infections, and lack of access to healthcare facilities. Most mothers only arrive at the hospital when their condition has worsened and become too complicated for traditional practitioners. By then, it is often too late.

The pediatric cases were comprised of burn injuries, abscesses from an assortment of reptiles (snakes and lizards) and some minor orthopedic procedures. We also had a few conflict injuries from bomb blasts and gunfire. The burns were scald burns from water or from fires that were used for cooking. This was my life for six weeks. I lived amongst about 25 expats from all over the world, Canada, Brazil, Australia, Nigeria, France, and Germany. We slept in tukuls (thatched roof huts) and used latrines; soon this all became normal. We ate all of our meals together, played volleyball, and wished for rain (I had arrived in the midst of the hot season with daily temperatures up to 115°F and evenings cooling off to the 90's). Although there was sadness and hardship during my time in South Sudan, I shared a lot of laughter and joyful moments with my national and expat colleagues. They hold a special place in my heart and I am forever indebted for this experience that I was granted.

Volunteer work has been and will continue to be a part of my clinical career as a CRNA. I am lucky to work for a great company that allotted me six weeks leave of absence this past spring to go on assignment with MSF. I have returned to Double Harvest (the clinic in Haiti) just about every year since the earthquake with an ENT/general surgery team for a week at a time. Thankfully, it is a much more stable and controlled environment now, something that I definitely prefer. Contrary to my experiences, I am neither an adrenaline junkie nor a thrill seeker, but believe that as nurse anesthetists we possess a skill set that is essential and desperately needed in this modern world of conflict and frequent natural disasters.

Goal-Directed Fluid Therapy: A Literature Review

Andrew Chase-Ziolek, RN, BSN, MS
Lake Forest Hospital, Lake Forest, IL

ABSTRACT

Goal-Directed Fluid Therapies (GDFTs) are a promising class of perioperative fluid management therapies. This article explains the basic algorithms used in GDFT, reviews the physiologic parameters responsive to fluid management, describes the measurement techniques currently being studied to improve outcomes in high-risk patients, and discusses the effect of GDFT on patient outcomes.

INTRODUCTION

Goal-Directed Fluid Therapies (GDFTs) are a class of perioperative fluid management therapies that use data from physiologic monitors in conjunction with fluid administration to optimize a particular physiologic parameter, usually cardiac output or tissue oxygenation. GDFTs can roughly be divided into two categories: therapies that measure tissue oxygenation directly and those that optimize cardiac output in order to optimize tissue perfusion. To some extent, these techniques are broadly used throughout anesthesia. There has been recent interest, however, in systematically applying these techniques to reduce morbidity and mortality in high risk patients.

GDFT is a subset of a broader project known as Goal Directed Therapy (GDT), which in addition to fluids use inotropes and vasoconstrictors. This article will primarily discuss GDFT, and will explain the basic algorithms used in GDFT, review the physiologic parameters responsive to fluid management, describe the measurement techniques currently being studied to improve outcomes in high-risk patients, and discuss the effect of GDFT on patient outcomes.

Most algorithms for GDFT involve assessing fluid responsiveness (measured in a variety of ways), and then giving fluid until fluid responsiveness ceases or a preset endpoint is met. Fluid responsiveness is measured by one of the measurement techniques which will be discussed below. Many algorithms include specific guidance for addressing position changes and surgical events. In contrast to GDFT algorithms, the algorithms for GDT are inherently more complicated due to the complex interaction of fluid volume, inotropes and vasopressors. As a result, they tend to involve measuring a larger number of discrete physiologic parameters (e.g. monitoring cardiac index for inotropes and systemic vascular resistance for vasopressors.)

OPTIMIZING TISSUE OXYGENATION

The demands of surgery increase the metabolic requirements of some tissue groups, especially at the surgical site, while anesthesia results in a decrease in the metabolic requirements of others most notably cerebral metabolic O_2 demands. Tissue perfusion refers to the flow of blood to a particular tissue group, while tissue oxygenation refers to oxygen tension at the level of a specific tissue of interest. This is dependent on the balance of tissue oxygen delivery (DO_2) and tissue oxygen consumption (VO_2). DO_2 is the product of both blood flow and oxygen carrying capacity (CaO_2), and the major determinants of CaO_2 are oxygen saturation (SpO_2) and hemoglobin concentration. Hypoxia and anemia have both been indicted in surgical site infection¹ and low tissue oxygen saturation (StO_2) has been found to strongly predict surgical site infection.² Consequently, increasing DO_2 has been found to improve surgical outcomes.³ Optimizing both tissue perfusion and blood oxygen carrying capacity results in the maximal delivery of metabolic substrates (glucose, O_2 , proteins and free fatty acids) and removal of metabolic wastes (CO_2 , K^+ , lactate), which in theory optimizes accelerates wound healing and reduces the risk for infection.⁴

Tissue perfusion can be measured indirectly at the tissue level by several techniques. Splanchnic perfusion is compromised early in hypovolemic states, so measuring gastric pH may be a good indicator of hypovolemia and global or splanchnic hypoperfusion.⁵ However, because this is the result of a compensatory mechanism, it may not be specific if the tissue of concern is not fed by the splanchnic circulation. Newer brain oxygenation monitors and other tissue monitors display oxygenation by measuring differential light absorption, but they are primarily useful for very specific surgical cases. SvO_2 has also been used as a measure of tissue oxygenation, however it may not be accurate in patients with derangements of oxygen extraction and is a global rather than local indicator of hypoxia.⁶ Near-Infrared Spectroscopy has also been trialed for GDFT, but the results diverge from other measures of tissue oxygenation, and may face issues with extracerebral contamination.⁷

OPTIMIZING CARDIAC OUTPUT

Tissue perfusion to a particular tissue group is dependent on cardiac output and local tissue resistance. These resistances are largely mediated by the sympathetic nervous system and the concentration of local metabolic factors. In surgery the presence of

tourniquets will also significantly increase local tissue resistance. Furthermore, hypothermia increases peripheral vascular resistance and redistributes blood flow centrally. Blood flow to these tissues can be modeled as . Because it is difficult to directly modify local tissue resistance, the clinician is left with three modifiable variables which can be used to optimize tissue perfusion. SVR and HR are most easily controlled by sympathomimetic agents, although volume status can also impact HR via the Bainbridge reflex and the tachycardic response to hypovolemia. SV is significantly dependent on volume status.

The Frank-Starling curve describes the optimal SV in response to preload. The myocardial myofibrils have an ideal tension for optimal contraction, but the relationship of preload to SV is non-linear. Both under and overload reduce SV due to the limited maximal contraction of the myofibrils and reduced stroke power with myofibril overextension, respectively. Volume status (along with venous tone) are the significant contributors to preload, and thus SV.

One advantage of using fluid to optimize physiologic parameters is that modifying volume status, largely modulated by the Renin-Angiotensin-Aldosterone system, has a longer-term effect than most commonly used pharmacologic agents, and can thus extend the effect of optimized tissue perfusion out into the postoperative time period. In addition, the surgical context maximizes the likelihood of relative hypovolemia due to patient fasting and surgical blood loss. Finally, using technologies that measure stroke volume to guide fluid resuscitation may reduce the risk of both hypo and hypervolemia in patients at risk for volume-related complications (e.g. congestive heart failure and renal failure).

If tissue perfusion is not directly measured, optimizing cardiac output can improve tissue perfusion throughout the body. Cardiac output is negatively affected by anesthetic gasses, some sedative-hypnotics, and sympatholytics. As we know, heart rate, mean arterial pressure, central venous pressure, and pulmonary wedge pressures can be insensitive and misleading in the assessment of circulating blood volume.^{8,9} Stroke Volume Variation (SVV) has been shown to have a high sensitivity and specificity compared with conventional indicators of volume status, at least in the context of mechanically ventilated patients with normal cardiac rhythms.^{10,11} SVV is normalized to body surface area as the Stroke Volume Index. Typically this value is derived from an arterial pulse waveform. However, similar data may be extracted from a pulse plethysmograph, and this data also correlates well to volume status.^{12,13,14} Alternately, Esophageal Doppler (ED) can be used to directly measure stroke volume,¹⁵ although there are concerns regarding the accuracy of ED measurements in critically ill adults.¹⁶ Finally, some studies have used

thermodilution or dilution of lithium chloride to measure cardiac output, and many have used CVP as an indicator of volume status in spite of its potential insensitivity to volume responsiveness.¹⁷

Recently bioreactance technology has been studied, which uses variation in transthoracic bioimpedance across chest electrodes to determine hemodynamic parameters including CO, SV and SVV. One study compared such a device to esophageal Doppler, and found no significant difference in patient outcomes.¹⁸

THE EFFECT OF GDFT ON MORTALITY AND GENERAL MORBIDITY

Table 1 summarizes the results of recent meta-analyses and systemic reviews on GDFT and GDT that analyzed both morbidity and mortality. Although they all show either an improvement in morbidity, mortality, or both, the results are not consistent.

Table 1: Systemic Reviews and Meta-analyses of the Effect of GDFT on Morbidity and Mortality

Study	Type	Effect on Mortality	Effect on Morbidity
Ripollés-melchor et al. 2015 ¹⁹	Systematic Review and Meta-analysis	Reduction in all-cause mortality (RR 0.64)	Not significant
Arulkumaran et al. 2014 ²⁰	Meta-analysis	Not significant	Decrease in total cardiovascular complications
Trissoon and Gold 2013 ²¹	Systematic Review	Not significant	Decrease in length of hospital stay, decrease in postoperative
Aya et al. 2013 ²²	Systematic Review and Meta-analysis	Not significant	Reduction in total cardiovascular complications
Cecconi et al. 2013 ²³	Systematic Review and Meta-analysis	Reduction of mortality only with high-risk patients	Reduction in complication rates (OR 0.45)
Hamilton et al. 2011 ²⁴	Systematic Review and Meta-analysis	Reduction in all-cause mortality	Reduction in rate of complications

In addition to study protocol heterogeneity – GDFT describes a broad range of algorithms and technologies – some of this variability may be due patient age and health status. Several studies have found that the benefits of GDFT increase with age.²⁵ Cecconi et al.’s 2013 meta-analysis found GDFT beneficial to all patients, but a subgroup analysis found that the mortality benefit from GDFT was limited to patients at extremely high risk of death (baseline risk > 20%), although the level of risk reduction was quite significant (OR=0.27). Several studies focusing specifically on high-risk patients have found significant reductions in both morbidity and mortality.²⁶

Another potential confounder is that GDFT may reduce mortality in the long term but not the short term. Rhodes and colleagues conducted a small (N=107) 15-year follow-up for patients who had undergone major surgery and received GDFT. 20% of those receiving GDFT were alive vs. 8% of the controls. Median survival was increased by 3 years in patients receiving GDFT.²⁷ Finally, Poeze and colleagues compared the effect size of mortality reduction due to

GDFT to trial design, and found that the reduction in mortality was not an artifact of trial quality, and found a 25% mortality reduction in high-risk patients undergoing surgery.²⁸ However, subgroup analyses found that this effect did not persist in patients with pre-existing sepsis or organ failure.

THE EFFECT OF GDFT ON SPECIFIC MORBIDITIES AND SURGICAL OUTCOMES

A few studies have examined the effect of GDFT on specific morbidities associated with surgery. For example, a 2011 meta-analysis showed that GDFT reduced surgical site infections by 60%.²⁹ GDFT has also been shown to reduce PONV³⁰ and be protective against acute renal injury.³¹

GI surgery in particular has often been singled out for GDFT due to the sensitivity of the splanchnic circulation to hypovolemia. Several studies have found that esophageal Doppler-guided GDFT reduced length of stay, hastened return of gut function, and reduced overall morbidity.^{32,33} On the other hand, Brandstrup et al. found no significant difference between colloid GDFT using ED and zero-balance colloid protocol.³⁴ A meta-analysis by Giglio et al. found a decrease in both major and minor GI complications associated with GDFT.³⁵ Similarly, a systematic review by Abbas and Hill found a reduction in complications and more rapid return of GI function in patients receiving GDFT,³⁶ while one by Bundgaard-Nielsen found a reduction in PONV and post-operative ileus.³⁷

Another area where GDFT may reduce morbidity is in thoracic and cardiac surgery. Zhang et al. studied GDFT in thoracoscopic surgery, finding an increased PaO₂/FiO₂ ratio at the end of one-lung ventilation and reduced time to extubation and nausea, but no difference in length of stay.³⁸ Haas et al., concerned that GDFT would liberalize fluid therapy and thus lead to pulmonary edema, found no clinically significant changes (but did not utilize a control group).³⁹ Several small studies have examined the use of GDFT in cardiac surgery, and have consistently found lower catecholamine demand and shorter hospital length-of-stay.^{40,41}

FLUID SELECTION FOR GDFT

Two early pig studies concluded that colloids but not crystalloid GDFT increased microcirculatory blood flow in the small intestine and intestinal tissue oxygen tension after abdominal surgery.^{42,43} This has been confirmed by two studies examining GDFT in open gastro-intestinal surgery⁴⁴ and laparoscopic cytoreductive surgery for ovarian cancer,⁴⁵ but was not confirmed by a subsequent trial in colorectal surgery.⁴⁶ Some researchers have included hemoglobin optimization using blood transfusion as part of their protocol with good results,⁴⁷ although this is not part of all protocols.

The small number of studies, their heterogeneity and the uncertain implications of trials in animal models make it difficult to draw any firm conclusions. As of yet, there is no compelling data to suggest one form of fluid over another for GDFT, and fluid selection should be based primarily on patient and surgical factors.

RISK VS. REWARD

The majority of GDFT studies have utilized invasive hemodynamic monitoring. Typically this is only an arterial line, but some studies have used central lines, pulmonary catheters, and EDs. The risks of pulmonary lines are well documented,⁴⁸ and they are rarely used outside of cardiac surgery. Although the safety profile of arterial lines is quite good, there is a risk for infection, pseudoaneurysm, and hematoma with subsequent compartment syndrome. Finally, any device introduced into the esophagus introduces the risk of trauma, including esophageal tears and perforation.

The greatest risk with any monitor is the misuse of data. As always, algorithms cannot be followed blindly, and anesthesia providers should use common sense and clinical judgement when following them. Finally, it must be understood that monitors are fallible, and that when the clinical picture and monitor data disagree, caution is required.

Tissue oxygenation may also be improved with blood transfusion, which increases both volume status and CaO₂. The risks of blood transfusion are well known, including anaphylaxis, transfusion-related acute lung injury, infection, coagulopathy and hypothermia. In critically ill patients, these risks may be worth the benefits of improved tissue oxygenation.

ADOPTION INTO CLINICAL PRACTICE

Srinivasa et al. surveyed anesthesia providers in the UK, the United States, Australia and New Zealand regarding their clinical practice and opinions on GDT. They found that the most common impediment to GDFT was lack of availability or familiarity with monitoring equipment.⁴⁹ However, given the widespread availability of pulse-oximetry with plethysmography, some variants of GDFT should be accessible to almost all anesthesia providers.

GDFT is a promising new class of anesthetic techniques. There is strong evidence that GDFT improves outcomes, particularly in high risk patients undergoing major surgery. The evidence is more mixed for low risk patients. The relative risk of volume overload, invasive hemodynamic monitoring and transfusion must be measured against the potential benefits of decreased mortality, wound infection, and renal and GI injury. As of yet, there is no single agreed upon algorithm for GDFT, but the basic principle – optimize tissue perfusion and CaO₂ with fluids using measurable indicators of fluid responsiveness – can be implemented by most anesthesia providers, with or without invasive monitoring.

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