N E W S L E T T E R

Society of Critical Care Anesthesiologists SOCCA

INTERCHANGE

SOCIETY OF CRITICAL CARE ANESTHESIOLOGISTS

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President's Message

Welcome to SOCCA!

Michael F. O'Connor, M.D., F.C.C.M.

On October 14, 2011, over 240 people attended the 24th Annual Meeting of SOCCA. Details of the meeting and its program can be found in the article by Drs. Moitra and Pauldine in this issue of the newsletter. On behalf of our members, I thank **Laureen Hill M.D.**, **Vivek Moitra M.D.** and **Ron Pauldine M.D.** for assembling such a thought-provoking and stimulating program. We should also thank **Michael Wall M.D**. and **DannyTalmor M.D.** for organizing a fabulous workshop on critical care ultrasound the afternoon before our meeting. They are in the process of finding a way to train and certify or credential members of our subspecialty in this increasingly important component of our practice.

The Fellowship Breakfast meeting was chaired this year by **Benjamin Kohl M.D**. and covered a wide range of topics of great importance to those who train the members of our specialty from the United States. SOCCA's newly founded Fellowship Training Committee met subsequently at the **Association of Anesthesia Subspecialty Program Directors (AASPD)**, where its charter was reviewed and a host of issues, including a common application, a match, and fellow training in ultrasound were discussed. Fellowship directors: please come to the SOCCA Annual Meeting, and also to the AASPD, which is destined to become *the* forum for issues related to anesthesia critical care medicine fellowship training. The next AASPD meeting is November 2-4, 2012 in San Francisco.

We are a volunteer society. Everything we accomplish is a consequence of the efforts of our members. Please contact myself or Brenda Fahy if you would like to participate in any of our society's activities. Our membership remains strong, thanks to the efforts of our Membership Committee, chaired by **Sam Galvagno D.O.** Board member **Christine A. Doyle M.D.** continues to manage our website, which is also home to the online versions of the *Interchange*. My understanding is that a complete redesign of our website is under way and will go live sometime in the next several months. Our thanks go to our new team of **Jean Charchaflieh M.D., Dr.P.H.** and **Lisa Weavind M.D.** for their continued production of our outstanding newsletter.

"We are a volunteer society. Everything we accomplish is a consequence of the efforts of our members. Please contact myself or Brenda Fahy if you would like to participate in any of our society's activities."

Our society is active on a variety of fronts. Board member **Miguel Cobas M.D.** is leading our efforts to develop Maintenance of Certification in Anesthesiology-Subspecialty tools in collaboration with the ASA, with our initial focus being on the mandatory simulation component. Other elements of MOCA-subs, including practice improvement and question writing, will loom onto our radar through the course of this year. The FDA has had an interest in obtaining advice about sedation and its management. Secretary **Avery Tung M.D**, and members **Pratik Panhairpande M.D.** and **Aaron Joffe D.O.**, generated a detailed response to the FDA, which was in turn incorporated into the ASA's response. We don't yet know how this process will unfold or what opportunities we will have to shape it in the near future. **Michael Murray M.D.** continues in his role as the editor of the critical care section of our journal *Anesthesia & Analgesia.*

Our 25th Annual Meeting will be in Washington D.C. on October 11-12, 2012. Mark your calendars. We anticipate that our ultrasound workshop will expand to fill the entire day prior to our meeting. Members are also welcome to attend the Board of Directors meeting, one of which will happen at the SCCM, and the other the day before the Annual Meeting. It is a terrific window into all of the business of our small but incredibly dynamic society. Finally, on behalf of the Board and the membership, I want to thank **Chris Dionne** from our central office for her hard work for our society.

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E-mail

You may e-mail inquiries to SOCCA at:
General inquiries:
SOCCA@asahq.org
Meeting information:
SOCCAmeetings@asahq.org
Membership information:
SOCCAmembership@asahq.org

Web Page

You may visit the SOCCA website at:
www.SOCCA.org

Membership

Membership in SOCCA is open to all anesthesiologists and residents in approved anesthesiology programs. Membership applications may be obtained by contacting SOCCA at (847) 825-5586 or through the SOCCA website at **www.SOCCA.org/shop/index.php**.

SOCCA Dues

Dues are $150 for active members; $100 for affiliate members and $20 for residents/fellows. Dues may be paid online at **www.SOCCA.org/shop/index.php** by credit card or by mailing payment to the SOCCA office at 520 N. Northwest Highway, Park Ridge, IL 60068.

Remember, payment of your dues allows you to enjoy the full privileges of SOCCA membership.

EDITORIAL NOTES

Editorial Policy

The opinions presented are those of the authors only, not of SOCCA. Drug dosages, accuracy and completeness of content are not guaranteed by SOCCA.

A Note from the Editor to SOCCA Members:

If you would like to contribute a review for a Fellowship Program at your institution in a future issue of the SOCCA Interchange, please contact Chris Dionne at **c.dionne@asahq.org**.

The SOCCA Interchange is published by the Society of Critical Care Anesthesiologists, 520 N. Northwest Highway, Park Ridge, IL 60068-2573; (847) 825-5586.

Challenging the Status Quo: 24th SOCCA Annual Meeting

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The 24th Annual Meeting of the Society of Critical Care Anesthesiologists was held Friday, October 14 at the Hilton Chicago. The meeting was preceded by the inaugural presentation of the SOCCA Perioperative Ultrasound Workshop on Thursday, October 13. Led by Michael Wall, M.D. and featuring expert faculty Matthias Merkel, M.D., Ph.D., Chad Wagner, M.D., Daniel Talmor, M.D., M.P.H., Benjamin Kohl, M.D., Charl de Wet, M.D., Michael Woo, M.D. and Thomas Comfere, M.D., the workshop offered instruction and hands-on experience in ultrasound evaluation of cardiac function, valvular heart disease, the pleural space and vascular access procedures. This sold-out session was greeted with enthusiasm by the 42 registered participants and will be offered as a pre-meeting workshop next year.

The Annual Meeting kicked off with a provocative introduction from program co-chair Vivek Moitra, M.D., who set the tone for a curriculum that promised to challenge conventional wisdom and explore new ideas in critical care, ranging from our understanding of sepsis to how we educate and train our residents and fellows. Focusing on the clinical approach to sepsis, ARDS and multiple organ failure, Clifford Deutschman, M.D. elicited responses from the audience questioning how practitioners apply the data that form the basis for current sepsis management guidelines. Hannah Wunsch, M.D., M.Sc. then provided a thoughtful perspective on long-term outcomes following chronic critical illness. Noting that there is no uniform definition for chronic critical illness, Dr. Wunsch presented data suggesting that long-term survival is poor and there is fertile ground for further research on the needs of patient and families following intensive care with a focus to improve quality of life. Jan Bakker, M.D., Ph.D. presented a progressive session on the use of nitroglycerin in lactate-guided resuscitation in sepsis. Following a detailed discussion of the physiologic basis for the technique, Dr. Bakker presented an algorithm to address microcirculatory blood flow with nitroglycerin noting that while counterintuitive, modulation of venous pressure to improve tissue perfusion may be beneficial even in the setting of low systemic blood pressure. During the next session, Carlee Clark, M.D. and Joseph Meltzer, M.D. participated in a spirited debate on the progress of clinical trials in intensive care. Examining common but complex issues, including blood transfusions, glucose control, checklists and implementation of evidence by critical care professionals, they reminded the audience that many factors contribute to the difficulty in implementation of clinical trial data into everyday practice. Dr. Deutschman returned to the podium to offer an alternative viewpoint that our slow progress in sepsis research and treatment may be caused by asking the wrong questions based on the wrong fundamental assumptions. He presented preliminary data that supported the concept that disordered function of specific neural pathways and endocrine dysfunction may be important in the progression of physiologic insults to multiple-organ dysfunction syndrome.

This year there were 37 poster presentations of a wide variety of topics. Daniel S. Rubin, M.D., from the University of Chicago, was the recipient of the Young Investigator Award for his abstract "The Frank-Starling Relationship Is Absent in Patients with Pulmonary Hypertension: A 3-Dimensional Transesophageal Echocardiographic Study in Patients Undergoing Cardiac Surgery." Dr. Rubin's oral presentation was delivered by his mentor for the project, Dr. Avery Tung. The next segment of the program featured an address by American Society of Anesthesiologists President-Elect Jerry Cohen, M.D. Following an introduction by SOCCA president Michael O'Connor, M.D., Dr. Cohen discussed several of the political challenges facing the ASA in the future, including changing payment models for anesthesia services and the concept of the "perioperative surgical home" as a mechanism to address coordination of care and enhance value in the acute care setting. He noted that such an endeavor is a natural fit for critical care anesthesiologists.

During lunch, the attendees acknowledged the recipient of the Lifetime Achievement Award, Stanley H. Rosenbaum, M.D. Dr. Rosenbaum was introduced by longtime mentee and friend Lee A. Fleisher, M.D. Dr. Rosenbaum offered an entertaining and interesting overview of his career in critical care, titled "An Unfocused Path."

Following the lunch break, program co-chair Ronald Pauldine, M.D. presented a session on the application of lessons learned from military medical models for deployed critical care to assist civilian centers to meet the required surge capacity for disasters or mass casualty events. Past SOCCA-FAER-Hospira Physician Scientist Award Winner Jennifer K. Lee-Summers, M.D., from Johns Hopkins University, presented the results of her basic research on cerebrovascular autoregulation after pediatric cardiac arrest. Dr. Lee described a neonatal swine model of hypoxic-ischemic brain injury and presented clinical data based on near infrared spectroscopy, suggesting alterations in the lower limit for cerebral autoregulation following hypoxic-ischemic arrest in the setting of therapeutic hypothermia. Such findings could have important implications for blood pressure management in post-arrest patients.

The final session of the meeting focused on a wide range of topics in the areas of education and technology. In an entertaining and humorous debate, Professor Douglas Cousin, M.D. and his former resident trainee Aaron Joffe, M.D. explored generational differences in learning and the learning process. Dr. Coursin, representing the Baby Boomer generation, entered the room dressed as Methuselah to respond to Dr Joffe's views on "Generation Y." Avery Tung, M.D. explored variability in critical care practice, and Michael Wall, M.D. followed him with an overview of ultrasonography in critical care medicine. Dr. Wall's overview of the history, application, training and certification process for ultrasound served as a summary for the participants in the Thursday ultrasound workshop and an introduction for those who were unable to attend. The final presentation was delivered by Steve Lisco, M.D., who focused on the use of simulation in a competency-based curriculum to address learning and assessing technical skills and teamwork in the critical care environment. The education program was followed by the SOCCA Annual Business Meeting. The day's activities concluded with an opportunity for all participants and faculty to socialize at the Welcome Reception. Next year's meeting will again precede the ASA annual meeting (ANESTHESIOLOGY 2012) in Washington, D.C., with an expanded ultrasound workshop planned for October 11, 2012, and the SOCCA Annual Meeting scheduled for October 12, 2012. Washington, D.C. is beautiful and especially vibrant in the fall. We hope to see you there.

SOCCA Affiliation with *Anesthesia and Analgesia*

Call for Articles Dealing with Critical Care, Trauma and Resuscitation

Michael J. Murray, M.D., Ph.D.

In 1996, I was present at a meeting with Dr. Doug Coursin and Dr. Mike Todd; Dr. Coursin representing the organization as it was then known, "The American Society of Critical Care Anesthesiologists," and Dr. Todd as the Editor-in-Chief of the journal *Anesthesiology*. Through a not-too-lengthy process, *Anesthesiology* agreed to have an affiliation with ASCCA, a win-win for both organizations. Not many societies had affiliated with *Anesthesiology*, and for the ASCCA, our logo was on *Anesthesiology's* masthead, and Dr. Todd agreed to publish our annual meeting abstracts. Over the next decade, both entities grew and both entities changed. The most obvious change for our society is the name change, but as is evident to anyone who goes to the annual meeting, the growth in the number of members and the quality of the science has been outstanding.

Anesthesiology changed as well, deciding that maintaining affiliations with anesthesia subspecialty groups was not part of its mission. Fortunately, however, the journal *Anesthesia & Analgesia*, which has had in the past several affiliations with other subspecialty groups, welcomed SOCCA.

I have been selected to represent SOCCA as the Section Editor for Critical Care, Trauma, and Resuscitation (the latter an acknowledgement of our international focus) for the past 18 months.

The editorial board has noted a decreasing number of CCM articles being submitted to the journal. Overall, our acceptance rate is the same as for the other sections, but because the absolute number of articles being submitted is low, the other editors are concerned that the lack of novel, innovative CCM articles will impede *A&A's* goal to improve its value to anesthesiologists.

I have met with the SOCCA Board to discuss the issue more than once and with individuals at the annual meetings of the IARS and the ASA to encourage submission of articles dealing with critical care medicine (or trauma anesthesiology or resuscitation) to *A&A*. We have discussed the irony that as the organization has grown, many intensivists find they have less time for academic pursuits. Many of us think we are caught in the middle as we feel pressured to maintain academic productivity and to maintain coverage in the intensive care unit 24/7.

However, we know the "triple-threat" anesthesiologist-intensivist still exists. The journal and I encourage you to submit original scientific articles or review articles to *A&A*, as it is "our" journal. If you have any interest in, or thoughts of, writing a review article or of submitting a manuscript describing the results of a study, please contact me: murray.**michael@mayo.edu**. I can tell you in advance that the process is very simple: 1) What is the hypothesis? 2) Have you done a power analysis to identify how many patients you will need to study to satisfy the null hypothesis? 3) Is the article of interest? (we joke at the editorial board that if we had a penny for every article dealing with how to avoid the venous irritation associated with propofol, we would all be wealthy). 4) Has a medical writer/editor reviewed the manuscript? You may have outstanding command of the English language and you may have written many articles in the past, but what I find most often is that individuals are so familiar with the material that they cannot see the deficiencies in the way it is presented. Having a medical writer edit the manuscript so that anyone could understand the information increases the chances of the manuscript being accepted a thousand-fold.

I look forward to this new chapter in the life of SOCCA and to our relation with *Anesthesia and Analgesia*, and I hope that we as a group will be able to make significant contributions to how critical care medicine is provided in the United States and internationally.

House Activities at ANESTHESIOLOGY 2011

Daniel L. Brown, M.D., Ph.D., F.C.C.M.
Alternate Delegate

Mark E. Nunnally, M.D., F.C.C.M.
Delegate

The ASA House of Delegates met on Sunday, October 16, and Wednesday, October 19, completing the governance cycle for the year. The House must consider all reports submitted to it or to the Board of Directors in the last governance year. The sheer mass of these reports was large: 1,519 pages, if printed. Fortunately, only a few items were controversial.

The ASA is growing as an organization, a result of the Organizational Improvement Initiative and expansion into several major projects, most notably the Anesthesia Quality Institute and Education Department, both at ASA headquarters. The consequences of this expansion color the internal political environment. Bylaws and administrative procedures have undergone extensive review. Growth continues, including new hires, the mission and financials are scrutinized, and staff leadership has been realigned. This progress takes place against the backdrop of a slow economy, scope-of-practice conflicts and looming regulatory changes at the national level.

Of particular interest to SOCCA are changes within the ASA regarding the care of subspecialties. Subspecialty administration fees are an ongoing concern. This year, a New York delegate put forward a report calling on the ASA President to appoint a committee "to define and report to this House of Delegates what type of relationship with the anesthesia subspecialty organizations would best get us to our mission statement of 'Advancing the Practice and Securing the Future' and how any change in the current relationship might affect the health of the ASA and the subspecialty societies." As SOCCA faces incremental increases in its management fees over the next three years, the passage of this measure, along with conciliatory language from executive leadership, suggests there is room for discussion.

The House approved the Committee on Standards, Guidelines and Practice Parameters' long-disputed Practice Guidelines for Central Venous Access. The parameter is published online in the "Members Only" section of the ASA website at: **http://www.asahq.org/For-Members/Clinical-Information/Practice-Parameters-Request-for-Comments.aspx.** Ultrasound use and full-body drapes were among the provisions that generated spirited testimony. A performance measure assessing the delivery of a basic sign-out when transferring care from the procedure room to the intensive care unit was also approved. The ASA's Committee on Critical Care Medicine submitted revisions to the "Statement of Principles: Critical Care and Trauma Medical Services," a standing document up for five-year review. The new report, approved by the Board of Directors in August with minor revision, was approved by the House.

Deep sedation training was probably the single most controversial topic this year, and that debate was carried to the floor of the House at the Wednesday session. At issue is the proposal to initiate a deep sedation training program for non-anesthesia providers. It is easy to see the controversy here, as sedation is so deeply rooted in anesthesia care. Paraphrasing both sides, there were passionate petitions not to cede this practice and its safety to those not appropriately trained and, opposing this view, to insert our expertise into something that is already happening and expected to grow. Ultimately, this measure will be debated for some time, and it was referred back to a committee for rethinking and rewording.

To extend the organizational improvements that began several years ago, the position of chief executive officer will be shifted from the ASA President to the chief staff officer. As a growing organization, there will be an ongoing need to keep governance nimble, yet responsive to its membership.

Certain to be a fixture of ASA advocacy, the concept of a "surgical home," akin to the "medical home," enjoyed a lot of discussion and promotion during this year's House sessions and related activities. Bearing some resemblance to the concept of "perioperative physician," the surgical home offers a way to present the value of comprehensive anesthesia services to public and policymakers. Critical care physicians should be prepared to demonstrate their role in the surgical home.

For elected offices, there was only one contested election. Jane C. K. Fitch defeated Robert E. Johnstone to become the next first vice president, putting her in line for the ASA presidency in 2013. Both candidates ran admirably positive campaigns and have a worthy record of service to the Society.

Other elected officers for the ASA in 2012 are:

- President: Jerry A. Cohen, M.D.
- President-Elect: John M. Zerwas, M.D.
- Vice President for Professional Affairs: Norman A. Cohen, M.D.
- Vice President for Scientific Affairs: Arnold J. Berry, M.D.
- Treasurer: James Grant, M.D.
- Assistant Treasurer: Mary Dale Peterson, M.D.
- Secretary: Arthur M. Boudreaux, M.D.
- Assistant Secretary: Linda J. Mason, M.D.
- Speaker: J.P. Abenstein, M.D.
- Vice Speaker: Steven L. Sween, M.D.

It was another interesting year in ASA governance. Your delegate and alternate delegate are happy to serve the Society and hear any concerns you might have. We encourage you to get involved in the ASA political process with testimony or volunteer efforts.

2011 Fellowship Director's Breakfast Symposium Summary

Benjamin A. Kohl, M.D.
Chief, Division of Critical Care
Department of Anesthesiology and Critical Care
Perelman School of Medicine
University of Pennsylvania

This year's annual Fellowship Director's Breakfast Symposium was attended by more than 25 program directors (PDs) and was filled with the lively discussions we have all come to enjoy. We started promptly at 7 a.m. on Saturday, October 15 in the Joliet Room of the Chicago Hilton.

Over the last two years, PDs from SOCCA have made clear their interest in learning more about critical care ultrasound. As a result, SOCCA held its first annual critical care ultrasound workshop at the Annual Meeting, which received rave reviews. Furthermore, PDs are seeing an enormous surge in interest for ultrasound by potential applicants and, as a result, have asked for guidance on how to begin integrating such training within their existing paradigm. As a result, Dr. Anne-Sophie Beraud was invited to speak this year to address these concerns. Dr. Beraud is an Instructor in the Department of Medicine, Division of Cardiology at Stanford University and has a specific interest in the development of critical care ultrasound (so called, "focused" ultrasound). She has created one of the best-developed and defined curricula for such training and was happy to join us to share her thoughts. The title of her talk was "How to Implement an Ultrasound Training Program in Your Fellowship Program."

One of the key aspects Dr. Beraud emphasized was the need to collaborate with others very early on in the process. Seek out members not only from within your own department, but specifically in cardiology and emergency medicine and let them know what you are trying to do. Understanding up front that the goal is not to usurp another's service line but rather learn from them and develop a focused niche will help make allies of them rather than obstructionists. There are five key points to consider that Dr. Beraud spent the remainder of her time discussing: 1) Identifying the team, 2) Establishing a curriculum, 3) Obtaining the right equipment, 4) Training and 5) Billing.

While the initial team members may be few, it is necessary to identify three distinct groups: the core team, the instructor and the trainees. The core team includes you and your partners in critical care who will be primarily responsible for the organizational and training aspects of the program. These are the individuals who should gain experience (consider sending them to the next SOCCA ultrasound workshop!) and share the newly acquired knowledge with the broader group of trainees. The instructor should serve as an expert in ultrasound/echocardiography and should be available not only as an instructor but as the primary overseer for issues pertaining to quality and standards in ultrasonography and should be experienced with a focused exam. This individual need not be an intensivist but should be comfortable interacting with the ICU environment and leadership. The third group is the trainees- faculty, fellows, residents and others. Initial resources should go into training faculty who can then join the core team once they are competent. This "team" structure helps to ensure uniform training with adequate oversight.

Establishing the curriculum is usually pretty straightforward and may vary depending on the institution and local resources. Most programs will want to, at the very least, have a cardiac component (TTE +/- TEE). Other areas of interest include training in FAST, pleural, abdominal and vascular ultrasound. While SOCCA continues working on developing standards for ultrasound in our specialty, there are a number of consensus statements published that can be used for guidance both for suggested curriculum and training requirements (*J Am Soc Echocardiog*. 2010; 23(12):1225-30. *Int Care Med*. 2011; 37(7):1077-83). Regardless of the specifics, emphasis should be placed on a limited, focused exam rather than a more comprehensive evaluation.

Acquiring the necessary equipment is obviously essential and, again, will depend on departmental and institutional resources. Certain features to consider include image storage, portability, storage of devices and image quality. Regardless of what is chosen, there must be easy access to the device (or else it will not be used). The ability to store images is very helpful not only to allow for comparison, but for training purposes, documentation (if necessary) and improving collaboration with others by sharing images of particular interest. While Dr. Beraud did not feel that a simulator was essential, she did emphasize that it can be very useful in the early stages of training (helping to describe the concept of ultrasound) as well as a potential mechanism to test proficiency.

"There are five key points to consider that Dr. Beraud spent the remainder of her time discussing: 1) Identifying the team, 2) Establishing a curriculum, 3) Obtaining the right equipment, 4) Training and 5) Billing."

Setting up the training requires a time commitment and an understanding of the individual goals for each trainee. There must be designated time for fellows to obtain the necessary didactics. Initially, all examinations by fellows should be supervised. There should also be a review process in place whereby the fellow receives frequent and constructive feedback on his or her examinations. The review process should include (if possible) information from other imaging modalities to compare with and a more comprehensive examination if one was performed. It is important early on to clearly define objectives for the fellow, including number of supervised exams, number of exams during fellowship, etc. Dr. Beraud requires fellows to perform at least 50 focused transthoracic examinations during the year and to pass a final test.

Currently, few (if any) are billing for focused ultrasound examinations in the ICU. While most consider this tool as an extension of the clinical evaluation, there is no reason why in the future, once standards and guidelines are better established, we could not revisit this issue.

Dr. Beraud's website can be found at: **https://www.stanford.edu/group/ccm_echocardio/cgi-bin/mediawiki/index.php/Main_Page**.

Neal Cohen, M.D., Chair of the Anesthesiology RRC, then gave an update on issues related to ACGME. There are currently 48 ACGME-accredited ACCM fellowship programs (compared with 49 last year) and 125 filled positions (compared with 95 last year). Everyone was encouraged by the rise in fellow numbers and felt this was a promising and hopeful trend. There were 10 site visits this past year, resulting in eight full accreditations (cycles of three, four or five years) and two accreditations with warning (cycle of ≤ two years). Most citations addressed concerns with the adequacy of the evaluation process (both program of fellows and fellows of program), ill-defined goals and objectives, and scholarly activity. Dr. Cohen alerted us to a new fellow survey that was being rolled out by the ACGME and that specifics will be coming out shortly.

Currently, the IM-RRC restricts the role of any non-ABIM certified faculty in supervising trainees in Medical ICUs: "*The RRC-IM does not approve of, or accept non-ACGME trained internists or non-ABIM certified physicians serving as teaching attending or attendings-of-record on inpatients internal medicine services including the medical critical care units. This includes cross-coverage by other attendings for the attending-of-record on nights, weekends and holidays."* Dr. Cohen confirmed that active discussions and attempts to either reverse or clarify this rule are under way (particularly for academic programs with medical-surgical ICUs).

A new criteria for residency/fellowship eligibility is being rolled out (likely to start July 2015) that broadens the prerequisite for entry into ACGME-accredited programs to completion of a Royal College of Physicians and Surgeons of Canada (RCPSC)-accredited residency program within Canada.

Finally, Dr. Cohen reminded us of the upcoming change in the ACGME accreditation system. Cycle lengths will be variable (i.e., longer for stronger programs), and there will be greater emphasis placed on patient safety and quality. Annual program updates will be required, and there will likely be unannounced site visits. The proposed start date for this system will likely be 2015.

Douglas Coursin, M.D., Vice-President of the ABA, followed with a brief update of relevant issues from the ABA. Of greatest interest was the ongoing dialog to establish a five-year combined Anesthesia-IM training pathway that would lead to board eligibility in both specialties. The five-year program would likely resemble the following: Year 1-Medicine, Year 2-Anesthesia, Years 3,4,5-Integrated Anesthesia/Medicine with three- to six-month blocks of each. As critical care continues to move beyond the concrete walls of the ICU and we are called on to provide patient support in other venues, a broader educational background will almost certainly be of benefit.

Robert N. Sladen, M.D., F.C.C.M., President of the Association of Anesthesiology Subspecialty Program Directors (AASPD), reviewed with us the history, goals and mission of the AASPD. Importantly, he urged all PDs to join us at the annual meeting in Denver on November 4, 2011. The program will be of great interest to all and encourages/facilitates interactions with other subspecialty PDs as well as core PDs and chairs. SOCCA will be having its own PD committee meeting followed by a general break-out session for all ACCM PDs. Everyone is encouraged and welcome to attend. Please contact Nicole Bradle (N.Bradle@asahq.org) if you have any questions.

In the remaining time, there was general discussion on items that have been discussed for some time without resolution. Of greatest interest was use of the National Resident Matching Program (NRMP) for our subspecialty. After a fair amount of discussion, there was near unanimous support to move forward with this option. In an effort to hear the greatest number of voices, we will discuss this at great length at the upcoming AASPD meeting, after which a decision will be made. Of note, most agreed that if we choose to participate in the NRMP, we should do so *without* use of the Electronic Residency Application Service (ERASÒ).

The meeting was adjourned promptly at 9 a.m. Please feel free to send any individual comments, questions or suggestions to Ben Kohl, M.D. **Benjamin.Kohl@uphs.upenn.edu**. However, if there are general discussion issues, questions for the group or important topics of interest to all, please use the listserv that was graciously set up by Steven Deem, M.D. Email for the listserv is: **accmprogramdirectors@u.washington.edu**. Use of this listserv throughout the year should facilitate discussion and allow greater and more rapid dissemination of information.

Encouraging Investigative Careers: Opportunities for SOCCA

Denham S. Ward, M.D., Ph.D.
President, Foundation for Anesthesia Education and Research

As this issue of *Interchange* lands on your desk, I begin my fifth month as FAER's new president. I am honored to assume this role following 15 years of outstanding leadership by Alan D. Sessler, M.D. I am also honored to write what I hope will become a regular and useful column in the *Interchange*. I thank SOCCA President Michael F. O'Connor, M.D. and newsletter editor Jean Charchaflieh, M.D. for giving me this opportunity.

One of my foremost goals during FAER's leadership transition and beyond is to continue the partnership between FAER and SOCCA. We have a strong history of collaboration, and it must live on. Programs such as the jointly funded SOCCA-FAER-Hospira mentored research training grant have allowed us to achieve each of our missions efficiently and effectively. The grant allows junior faculty to obtain funding to spend the majority of their time pursuing clinical or laboratory investigations, and it prepares them for a successful application to the NIH for a K award.

In this column, I will share with you how SOCCA members can benefit from existing FAER programs and share some of FAER's future plans, asking for your thoughts on how FAER can better serve SOCCA and critical care anesthesiologists. Your participation in our programs and feedback on our plans are pivotal to improving research and educational opportunities in anesthesiology.

It is crucial for better patient care in the future that the investigative careers of anesthesiologists and critical care physicians be encouraged. To accomplish this, students, residents and fellows need to be introduced to the rewards of investigation as a significant element of their careers.

How SOCCA Members Can Benefit From Existing FAER Programs

As you probably know, FAER has several programs that provide research opportunities to aspiring anesthesiologists. Here, I will focus on two programs from which SOCCA members could particularly benefit.

Medical students experience research through our Medical Student Anesthesia Research Fellowship (MSARF) program. MSARF serves both students and anesthesiology departments by matching students with a host program and mentor for a summer research project. Through MSARF, students interested in investigative anesthesiology have the opportunity to conduct research at a different school, meet other physician investigators and potentially start a mentor relationship.

FAER is currently accepting applications from host departments for 2012. I encourage SOCCA members actively conducting clinical or basic science investigations to apply to host a FAER MSARF participant. Introducing students to the excitement of research and mentoring them on careers in anesthesiology is rewarding. Many, if not most, of these students advance to residency training in our specialty. You can find more information and apply online at **faer.org/programs/students/host.html.**

Anesthesiology residents can experience investigative careers through FAER's Research Fellowship Grant. This program is designed as a one-year research fellowship in conjunction with either a fifth year of residency or a second research year after a clinical fellowship year. The latter opportunity should be of great interest to SOCCA members. This fellowship, with a $75,000 one-year funding level, allows 20 percent clinical activity and at least 80 percent protected research time.

With an application deadline of February 15, a first-year CCM fellow could write her grant application as a clinical fellow, obtaining funding for her second research year. Alternatively, a resident could write an application during his CA-3 year and obtain funding for a research year prior to beginning his CCM fellowship. The 20 percent clinical time requirement would still allow the recipient to work as an anesthesiology attending during this year.

How FAER Can Support SOCCA Through Future Programs and Opportunities

Anesthesiology - and all of medicine - is entering into some uncertain waters, but just as the lighthouse is the symbol for SOCCA, the need to provide a beacon of encouragement for clinical investigation and research is the vital role for FAER. As FAER moves forward, we are developing new programs and initiatives, creating even more opportunities for anesthesiologists to conduct research leading to discovery and innovation.

This will, of course, require significant resources. FAER appreciates the funding SOCCA and its members contribute. We also appreciate your participation in our programs and your feedback on our plans. I welcome your thoughts on how FAER can better serve SOCCA and critical care anesthesiologists, and ideas on how we can continue to fulfill our mission. You can contact me at **DenhamWard@faer.org**. It is through partnerships such as this one that we will be able to ensure the vitality of the specialty in the future.

PRO: Should Amiodarone Be Used for Prevention of Atrial Fibrillation in Cardiac Surgery Patients?

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Postoperative atrial fibrillation (POAF) following cardiac surgery occurs in 30-60 percent of patients and usually occurs within the first four postoperative days.[1] Though usually self-limited, POAF is associated with longer postoperative mechanical ventilation, ventricular arrhythmias, a three-fold increase in perioperative stroke, increased hospital length of stay, more readmissions and higher overall costs.[1,2]

It is unclear why cardiac surgery patients are at a significantly higher risk for POAF than non-cardiac surgery patients with cardiac disease. Changes in atrial refractoriness and reentry may be due to surgical manipulation, myocardial "stunning" after bypass, inflammation, etc.[1] Patients with POAF may also have a pre-existing electro physical predisposition. Age remains the strongest predictor for POAF. Other risk factors include male sex, history of hypertension, obesity, valvular surgery and beta blocker withdrawal.[1,2]

Many pharmacologic strategies have been proposed to prevent POAF in cardiac surgery. Beta-blockers received the strongest recommendation by the American College of Chest Physicians (ACCP) and are the most popular choice.[3,4] Amiodarone also received a positive recommendation by the ACCP, but is far less utilized than beta-blockers.[1] One survey found that 20 percent of cardiac surgeons routinely use amiodarone for POAF prophylaxis.[3] Surgeons who did not use amiodarone believed there was a high risk of complications and lack of efficacy. However, the literature demonstrates contrary to these perceptions.

There is evidence that amiodarone reduces POAF post-cardiac surgery. Although many studies on this subject are small and use various dosing protocols, a meta-analysis by Aasbo et al. found amiodarone had a risk reduction of 0.64 (95 percent CI 0.55-0.75) versus placebo.[5] This reduction remained significant in both studies regardless of dose, PO or I.V. route, or preoperative or immediately postoperative administration.

More convincing is the randomized controlled trial by Mitchell et al.[6] Six-hundred patients undergoing CABG and/or valve replacement received oral amiodarone (10mg/kg/day) versus placebo, beginning six days prior to surgery and up to six days postoperatively. Amiodarone was shown to reduce POAF from 29.5 percent to 16.1 percent ($P<0.001$), as well as significantly reduce ventricular tachycardia. While patients on amiodarone required pacing more due to bradycardia (5.7 percent versus 2 percent), adverse events were not otherwise different.

Amiodarone may have a role as a first line POAF prophylactic agent, not just an alternative for patients who cannot tolerate beta-blockers.[4] Solomon et al. found amiodarone is as effective as beta blockers in preventing POAF and with no difference in adverse events.[7] More so, the combination of beta-blockers and amiodarone may provide better prophylaxis than beta blockers alone and does not cause more bradycardia.[8] In a study by Zebis et al., 85 percent of all patients enrolled were taking beta-blockers preoperatively and perioperatively and still received additional benefit from adding amiodarone.[9]

The 2011 American College of Cardiology Foundation (ACCF) and American Heart Association (AHA) updated guidelines for atrial fibrillation management state that amiodarone is an appropriate prophylactic therapy for patients at high risk for POAF.[2] It is precisely the old, hypertensive, and valvular surgery patients that may have the most to gain from amiodarone, especially when used in combination with beta-blockers. Patients with low ejection fraction should also be considered for amiodarone prophylaxis because of the additional benefit of reducing postoperative ventricular arrhythmias.[6]

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CON: Should Amiodarone Be Used for Prevention of Atrial Fibrillation in Cardiac Surgery Patients?

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The incidence of postoperative atrial fibrillation (POAF) after cardiac surgery has been reported to be as high as 60 percent.[1] Despite the fact that about 90 percent of patients that develop POAF at six weeks will revert to normal sinus rhythm, POAF is associated with increased morbidity and mortality, prolonged hospital stay and increased costs.[2] Onset of PAOF may be facilitated by atrial trauma, stretch and ischemia, epicardial inflammation, hypoxia, acidosis, electrolyte disturbances as well as sympathetic discharge accompanied in the postoperative period. Predictive risk factors include age, male gender, valvular surgery, history of hypertension, withdrawal of beta-blockers and obesity.[3] The primary aim in patients who develop new onset POAF is conversion to normal sinus rhythm. Prevention of POAF has been shown to be effective. Based on the current literature, beta-blockers, atrial pacing and amiodarone are the recommended first-line treatment in prevention of POAF. To be effective, atrial pacing would need to be bi-atrial and continued for 72 hours postoperatively.[4,5]

Pharmacology and kinetics of amiodarone have some unique characteristics. Its steady state partition coefficient relative to plasma in myocardium, adipose tissue, liver and pulmonary tissue is estimated to be 100 to above 1,000. This pharmacokinetic characteristic requires a loading dose at the initiation of treatment, delay in achievement of full antiarrhythmic effects and protracted period of elimination of the drug after discontinuation. The elimination half-life after long use has been estimated to be between eight and 107 days.[6] Amiodarone increases the concentration of several medications, including class I antiarrhthmics, digoxin and warfarin. Reported complications of amiodarone for long-term therapy have been observed to some extent even with short-term treatment. With limited data in prospective trials regarding POAF therapy, overall reported incidence of complications with amiodarone therapy are listed: infiltrates on chest radiography and reduced DLCO (5-15 percent), hypo- and hyperthyroidism (3-4 percent), bradycardia and atrioventricular block (3-5 percent), hepatitis and cirrhosis (<3 percent), corneal microdeposits (>90 percent), CNS manifestations including ataxia, paresthesias, sleep disturbances, impaired memory, tremor (4-5 percent), optic neuritis (<1 percent).[7]

In RCTs in which preoperative as well as postoperative amiodarone use was compared to placebo, amiodorone therapy was associated with a significant reduction of POAF regardless of the route of administration (i.e., po/iv).[8]

However, there is a paucity of research comparing amiodorone and beta-blockers. Studies to date have been small, precluding the ability to draw conclusions whether the two treatments were equally effective in reducing the incidence of postoperative atrial fibrillation.[9]

In regard to rates of serious complications, there are no significant differences reported between beta-blockers or amiodarone.[9]

Even among beta-blockers the question of best choice in prevention of POAF remains unanswered. In a retrospective study, carvedilol was more effective than metoprolol and atenolol in reducing postoperative atrial fibrillation. This interesting finding would need to be confirmed in a prospective trial.[10]

Based on the current ACCP (American College of Chest Physicians) and CCS (Canadian Cardiovascular Society) guidelines for POAF prophylaxis supported by the results from two separate meta- analysis, beta-blockers remain the dominant therapy for prevention of POAF in cardiac surgery patients. Strong recommendation is placed on continuation of beta-blockers in postoperative patients already receiving beta-blockers preoperatively. The data are less compelling in patients not being treated with beta-blockers preoperatively. Patients who cannot take beta-blockers would qualify for the use of amiodarone. As pointed out earlier, pharmacokinetics, drug interactions and unclear incidence of potentially serious side effects limit its use in prophylaxis of POAF.

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Fellowship Review: Critical Care Fellowship at the Medical University of South Carolina

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Fellowship Review:

The critical care fellowship within the Department of Anesthesiology at the Medical University of South Carolina can, perhaps, be best described as an expanding opportunity within a unique and beautiful community. This program is designed to provide a well-rounded educational experience while developing fellows into full-time, dedicated intensivists capable of the various clinical, educational, administrative and research responsibilities that occur in the "real world" of critical care medicine. Clinically, fellows rotate within the medical/surgical ICU, surgical/trauma ICU, neurosurgical ICU, and cardiothoracic ICU. These rotations provide fellows the opportunity to become experienced in the postoperative management of patients undergoing complicated gastrointestinal surgeries, trauma, transplants (liver, heart, kidney and pancreas), major vascular, neurosurgical, cardiac and thoracic surgeries. Fellows are also given the opportunity to select from a large variety throughout the MUSC hospital.

Fellows are fully integrated into teaching and patient care teams as they coordinate daily multidisciplinary working and teaching rounds, daily resident lectures, fellow's conferences and monthly morbidity and mortality rounds. In addition to these clinical, educational and administrative experiences, fellows are given the opportunity to hone their skills in developing research projects and evaluating scientific papers. Fellows are expected to participate in research studies and various quality improvement projects during their fellowship year, and it is expected that each fellow will be able to successfully complete at least one project with an accompanying presentation and publication.

The hospital at MUSC is located within the heart of Charleston, a bustling city set along the Charleston Harbor at the confluence of the Ashley and Cooper rivers as they flow into the Atlantic Ocean. In addition to its many historic sites, Charleston is also home to a number of world-class restaurants and a vibrant nightlife. The weather is pleasant throughout much of the year, with easily accessible beaches and a number of outdoor activities just minutes away from the central city.

Overall, the critical care fellowship at MUSC provides a unique opportunity driven by excellence in education, research and clinical support set within the beautiful Charleston community. Education remains the key experience for the fellow and is thoroughly interwoven throughout the clinical, administrative and research requirements for all our critical care fellows. For more information, contact the program director, Larry Field, M.D., at his email address: **field@musc.edu**.

Fellowship Review: University of Washington Medical Center

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Our anesthesiology critical care fellows rotate through a broad mix of ICUs within the UW system, resulting in a rich multidisciplinary experience in a schedule that is shared with fellows from pulmonary and surgical critical care. The Critical Care Division of the Anesthesiology Department includes 14 faculty members who are trained in critical care medicine, all of whom participate in the education of critical care fellows.

Rotations

Fellows split their time between three clinical sites within Seattle, though they spend the majority of their time at Harborview Medical Center (HMC) and the University of Washington Medical Center (UWMC).

HMC is the hospital for King County, and it is also the only level I trauma center in a five-state region (Washington, Wyoming, Alaska, Montana and Idaho, or "WWAMI"). The hospital is owned by the county, but managed by the University of Washington. Fellows take "home call" when they rotate on the three services at Harborview:

- The **Neurocritical Care Service** is directed by the Department of Anesthesiology, and provides care for neurology patients, neurosurgical trauma patients with isolated spine and head injuries, and for patients with a variety of neurovascular problems such as subarachnoid hemorrhage. Fellows work with house staff from anesthesiology, emergency medicine and neurosurgery, and faculty from anesthesiology and pulmonary critical care.
- Fellows also rotate on the **Trauma/Surgical ICU service**. This service manages a large volume of trauma patients from throughout the region, in addition to general, vascular and thoracic surgical patients in a "closed" ICU model. Residents on the service come from anesthesiology and surgery, and critical care faculty are from anesthesiology, pulmonary critical care, and trauma surgery. Unlike other rotations, call on this service is in-house, averaging about four to five calls per month.
- Finally, the busy **Harborview MICU service** cares for critical care patients with medical problems from the surrounding area and WWAMI region. Residents on this service are from internal medicine, and faculty members are from pulmonary critical care.

The UWMC offers fellows several ICU services as well, all of which are "home call":

- The **Medical ICU service** cares for a variety of patients, including post-operative liver transplant and long-term lung transplant patients, as well as more "routine" medically ill patients. The fellow guides a team of house staff composed of interns and internal medicine R2s with oversight by faculty from pulmonary and critical care. The fellow takes the calls for outside transfers from throughout the Pacific Northwest and is responsible for triaging transfers.
- **The Surgical ICU service** cares for postoperative surgical patients from general surgery, neurosurgery, ENT, urology, plastics, orthopedics, and some obstetrics patients requiring ICU stays. The fellow oversees a group of house staff from anesthesiology, surgery and emergency medicine. Critical care faculty members on this service are from general surgery, anesthesiology and pulmonary critical care.
- **The Cardiothoracic ICU service** cares for postoperative cardiac surgery, thoracic surgery, and vascular surgery patients. This ICU provides postoperative care, and some preoperative care, for patients having valvular surgery, bypass grafting, heart transplantation, lung transplantation, ventricular assist device placement, aortic surgery and complex thoracic surgery. The fellow supervises a team comprising general surgery residents, acute care nurse practitioners and physician assistants. The faculty members on this service are dual-trained in either cardiothoracic anesthesiology and critical care, or cardiothoracic surgery and critical care.
- Additionally, fellows rotate at UWMC on the **Seattle Cancer Care Alliance service**. Fellows work one-on-one with a pulmonary critical care attending in a co-management role with the hematology/oncology teams. Patients on this service are a mix of bone marrow transplant and solid organ malignancy patients requiring ICU care. This service provides a great opportunity to work with a unique patient population and provides an opportunity to become facile with bronchoscopy as a tool for the evaluation of immunocompromised patients.

The third site is the Veterans Affairs Puget Sound Health Care Center, where fellows rotate through the **Surgical ICU service**. This service cares for a variety of postoperative patients, including post-cardiac surgery patients. This service is directed by the Anesthesiology Department. Residents on this service are from anesthesiology and surgery, whereas faculty members are predominantly from

anesthesiology and surgery.

In addition to nine months of core ICU rotations, a wide range of electives are available, including rotations in radiology, cardiology/echocardiography, nephrology, infectious disease and independent study.

Education

A wide array of structured educational opportunities exists in addition to ongoing clinical education. The Anesthesiology Critical Care Division holds a quarterly journal club meeting for faculty, fellows and combined program trainees. Fellows also take part in the Pulmonary Division's weekly Chest Conference, a CPC-type format where fellows present teaching cases for attendings to discuss. This conference is followed by a didactic session each week. Each rotation also has specific didactics, and a weekly multidisciplinary critical care journal club takes place at both Harborview and UWMC. An extensive array of research-based journal clubs and conferences are available through the fellowship.

Research Opportunities

The University of Washington provides a vibrant environment for interdisciplinary biomedical research. The Anesthesiology, Medicine and Surgery departments all offer opportunities for research in basic science and clinical aspects of critical care and related fields. Collaboration between departments is common, and provides for a rich intellectual atmosphere. The University of Washington School of Medicine ranked sixth among U.S. medical schools in receiving NIH funding in 2005, with grants totaling more than $300 million.

Harborview Medical Center and the University of Washington have an illustrious history of leadership in research in critical care medicine. The Critical Care Division of the Department of Anesthesiology and Pain Medicine is actively involved in outcomes-based research at Harborview Medical Center, providing opportunities for critical care fellows to gain exposure to clinical research. Several opportunities exist for trainees interested in more in-depth research training with the intent to pursue an academic career. The department offers a two-year research fellowship in basic science or clinical research for trainees interested in focused research training that is funded by an NIH training grant. Another mechanism for research training is present in the form of research "faculty-fellowships" that combine clinical work with basic science or clinical research training and are which are in turn funded by clinical revenue.

PRO: The Physical Exam Is Still an Indispensible Tool in Critical Care

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With the advent of readily available imaging modalities and advanced physiological data, time-honored skills in physical examination have eroded and are not typically emphasized in ICU. Although clinical signs in critically ill patients are imperfect, the physical exam still has utility in the ICU and should not be abandoned in favor of other technologies.

The physical examination has a long track record in helping clinicians formulate a differential diagnosis. Kalantri showed that for ruling out pleural effusions, asymmetric chest expansion and dullness to percussion could predict pleural effusions with a likelihood of 8.57 (95 percent CI, 54.-13.4)[1]. In another review by Diaz-Guzman and Budev, while it was recognized that clinical acumen is less accurate than ultrasonography, it may be as accurate as standard chest radiography in certain conditions.[2] For example, asymmetrical tactile fremitus has been shown to have a sensitivity of 82 percent, specificity of 86 percent, and a negative predictive value of 95 percent for detecting pleural effusions.[1,2] Surely, the exceptionally low cost of performing a pulmonary examination justifies its performance.

Clinical signs may provide early clues about life-threatening conditions in the ICU. Jugular venous distension has been reviewed in patients with heart failure, and when accurately assessed has correlated highly (81% percent) with pulmonary capillary wedge pressures greater than 18 mm Hg.[3] Simple bedside clinical examinations using capillary refill, pulse pressure, skin temperature, jugular venous pressure and lung examination have been shown to be useful in predicting different shock states with an accuracy greater than 70 percent.[4] Patients with a third heart sound and elevated jugular venous pressure have been shown to have a relative risk of 1.32 (95 percent CI, 1.08,1.62, $p<0.01$) for developing heart failure, as found in a multivariate analysis of the SOLVD trial.[5]

Numerous tests can be quickly and easily performed to detect clinically important signs. Kalantri et al. studied the ability to detect levels of anemia in a blinded, controlled trial of 390 consecutive patients, 208 of whom were hospitalized.[6] In this trial, the presence of severe tongue pallor yielded a likelihood ratio of 9.87 (95 percent CI, 2.81, 34.6) for detecting a hemoglobin level less than 7 g/dL. Simple palpation of the distal lower extremities — the "Marik" sign — although not studied formally, is widely used as a general indicator for end-organ perfusion.[7] In trauma patients, auscultation of the chest, palpation and determination of the respiratory rate has been shown to have a negative predictive value of 99 percent in patients with chest injuries, even obviating the requirement for a chest radiograph when all three signs are negative.[8] Finally, omission of a neurological examination in an ICU admitting neurosurgical or stroke patients would be considered malpractice; the physical exam in such instances is indispensible for detecting early signs of vasospasm, increased intracranial pressure or bleeding.

In the ICU, the physical exam is more than another means for obtaining objective data. As others have suggested, even a focused physical exam may be used as a vehicle to promote core values and to practice the humanistic aspects of medicine.[9] No ultrasound machine, lab test or monitoring device can ever take the place of an opportunity to connect with a patient (although ultrasound does represent a new opportunity in critical care to spend more time at the patient's bedside). Competency, as with other skills in critical care, can only be achieved with continuous exposure, and the physical exam can be used to supplement, confirm or — in cases where care is rendered in austere environments, humanitarian missions, or disasters — provide invaluable physiologic information about patients.

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CON: The Physical Examination Should Take a Backseat to Newer Technologies in the ICU

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The physical exam has always been considered a cornerstone of medicine. However, as we move well into the 21st century, we find that, in practice, we are depending more and more on other modalities to guide our assessment in the ICU. So the question becomes not "has physical exam taken a backseat to technology" but "*should* it take a backseat?"

With the recent explosion of technological advancements over the past decades, it is not only easier, but safer and more logical to rely less on the physical exam. The patients and disease processes that we face today are so different from the past that physical exam should perhaps be regarded as a supplement rather than the gold standard. For example, it is estimated that almost 35 percent of Americans are obese.[1] With this rising epidemic, it is not uncommon to encounter critically ill patients with BMIs of over 40 or 50. The large amount of soft tissue makes the usual "inspection, auscultation, palpation, and percussion" extremely difficult to perform and even more so unreliable. In addition, this problem is compounded by the increasing severity of illness in the ICU. Our patients today are much sicker and live with much less reserve compared to those just 20 years ago.

Since many patients are difficult to examine because of their size, subtle changes in physiology are often missed by the physical exam. More importantly, by relying on an unreliable diagnostic technique, we can potentially miss early signs of infection or organ dysfunction. The simple act of listening to lung sounds is difficult, even in the best of conditions, since the relatively low frequency of these sounds (112 Hz) is far from the optimal frequency for which the human ear can detect them.[2] Even measurement of blood pressure has been shown to be inaccurate since the Korotkoff sounds are extremely low frequency sounds (25-50 Hz) that are heard right above the lower limit for human hearing (16 Hz).[3] Moreover, in many cases, physical signs that suggest worsening clinical condition do not present themselves until late in the disease process. Given the high prevalence of multi-organ damage in the critically ill patient, early detection of major events such as sepsis and acute kidney injury becomes extremely crucial in lowering morbidity and mortality. For instance, heart sounds have been found to have extremely poor sensitivity and specificity for detecting elevations in left ventricular diastolic pressure in patients with heart failure.[4] Heart sounds, in general, have been shown to have high interobserver variation, and even when an advanced stethoscope is used, correlation with actual echocardiographic findings is poor.[5]

Modalities such as ultrasound and minimally invasive hemodynamic monitors have made diagnosis and monitoring easy, convenient and reliable without much risk to the patient.[6] Bedside echocardiography can provide volume status, ejection fraction and presence/absence of pericardial effusion much faster and more reliably than chest auscultation.[7] Ultrasound can detect pneumothorax, lung consolidation and pleural effusions with a sensitivity and specificity of 93 percent as well as determine its etiology based on fluid appearance.[8] It can even be used for anatomical airway assessment, endotracheal tube visualization and diaphragmatic movement when assessing respiratory mechanics. In addition, minimally invasive monitoring has the ability to provide continuous data on cardiac physiology.[9] Since the physiology of the ICU patient is constantly changing, it is much more useful to have a technique that can detect changes more accurately and at a pace faster than physical examination. Finally, given the severity of illness in most tertiary care centers, it has become routine to draw daily laboratories on most patients. Although this practice may not be goal directed, it provides information on subtle changes in hemoglobin, white blood count, coagulation and other labs that make early detection of disease processes much more reliable.

"Modalities such as ultrasound and minimally invasive hemodynamic monitors have made diagnosis and monitoring easy, convenient and reliable without much risk to the patient."

We are taught from the first year of medical school that the physical exam is a staple of

medical practice. However, as we move into a new age of medicine, we must change, as our patients have changed, and adapt to these new conditions. With the advent of faster, safer and more reliable technology, why depend on subjective measures such as the physical exam to guide our practice? Just because history has considered it a crucial part of medicine, does not mean we should still place an equal amount of weight on it today. Therefore, although we should not abandon the practice of physical examination, we must admit that newer medical advancements have perhaps dramatically lessened its importance.

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Literature Review: Should Etomidate Be Used in Critically Ill Patients?

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Article:

Albert SG, Ariyan S, Rather A. The effect of etomidate on adrenal function in critical illness: a systematic review. *Intensive Care Medicine*. 2011; 37:901-910.

Etomidate is an unusual induction agent; it is basically an inhibitor of steroid synthesis that happens to cause hypnosis. It can cause adrenal suppression at 1/20th the plasma concentrations needed to produce hypnosis.[1] After Ledingham and Watt's report in 1983 on the increased mortality associated with etomidate infusions,[2] etomidate has been used almost exclusively as an anesthetic induction agent. It is particularly popular in emergency department intubations and for intubations is critically ill patients given its remarkably stable hemodynamic profile.[3] In the last decade, however, the use of even a single bolus of etomidate in critically ill patients has become controversial because of the possible effect of etomidate-induced adrenal suppression on mortality. In the absence of robust data, there is no shortage of opinions regarding whether or not etomidate should be used in critically ill patients. Since none of the studies in the field are anywhere near definitive, I shall briefly discuss a recent systematic review addressing the question, before attempting to place the available data in perspective.

Albert et al. electronically searched multiple databases between 1983 and June 2010 for articles dealing with etomidate, adrenal insufficiency/glucocorticoid use in intensive care or critically ill patients.[4] They found 263 articles, of which 19 met their inclusion criteria (trials that evaluated either adrenal insufficiency and/or mortality). Trial quality was graded as high (large randomized controlled trials [RCT]), moderate (RCTs with post hoc analysis of etomidate effect) or low (retrospective and observational studies). The primary end point was 28-day mortality, and a secondary end point was rate of adrenal insufficiency (AI) as defined by study authors (most commonly a ΔCortisol<9µg/dl after a 250µg dose of cosyntropin). A meta-analysis was then performed, with the authors giving more weight to larger studies and also performing heterogeneity analysis (the more heterogeneous the studies comprising the meta-analysis the poorer the strength of its conclusions).

The authors found an increased risk ratio (RR) for AI with etomidate (RR 1.64, p<0.0001). They also found that etomidate was associated with an increased relative risk for mortality (RR 1.19, p<0.0001). When subgroups were re-analyzed to divide the patients on the basis of having sepsis or otherwise, the patients with sepsis remained at a higher relative risk of mortality with etomidate (RR 1.22, p<0.0001), but this risk did not persist in patients without sepsis (RR 1.15, p=0.10). The use of etomidate was also associated with longer ICU stays, longer time on the ventilator and overall increased length of stay. The authors concluded that there was strong evidence that etomidate caused AI, and weak evidence that etomidate may be associated with worse outcomes.

The paper by Albert et al. is far from definitive. Any meta-analysis is only as good as the quality of the studies that it includes, and the data in this field are not extremely strong. The included studies are also very heterogeneous, a fact that the authors acknowledge as a weakness. Some of the studies (such as CORTICUS) did not randomize patients to a specific induction agent, and it is therefore likely that the sicker patients were induced with etomidate, biasing the results. In addition, another slightly older meta-analysis examining the influence of etomidate on outcome showed evidence of transient adrenal suppression but no difference in outcome.[5]

So where does this study leave us? A recent editorial on the etomidate debate points out that although passionate opinions exist on both sides, they must be tempered by the fact that the only thing clear on this topic is clinical equipoise – a condition of genuine uncertainty about which option is better.[6]

Having acknowledged the above statement, I will now proceed to outline why, in my opinion, etomidate should not be used in critically ill patients. My argument will involve four salient points:

1. A single bolus of etomidate causes transient adrenocortical suppression. This point is fairly non-controversial, although the duration of this suppression is less clear. The available data indicate that adrenocortical suppression can be as brief as 8 hours,[5] as long as 72 hours[7] or anywhere in between.[8-9]
2. The key question is whether etomidate-mediated adrenocortical suppression is clinically relevant. The controversy surrounding etomidate centers on this question. I would argue that, as mentioned above, we do not have the data to decide one way or another. However, I am not sure that we will ever have robust data that truly answers the question. Examining the effect of a single, one-time intervention such as etomidate in a disease process as complex as

sepsis is extraordinarily difficult. Such a study would need to be enormous to be sufficiently powered to detect mortality differences (one estimate of the sample size necessary to detect a 3 percent difference in outcomes is 7,600 patients).[5] Moreover, the study would need to include a treatment protocol after intubation – otherwise variances in post-intubation care may significantly impact outcomes. It will likely be a long time until such a definitive study can be undertaken.

3. Is etomidate indispensible? Interestingly enough, all the data that demonstrate etomidate's superior hemodynamic profile originate in the operating room on healthy volunteers or in patients undergoing elective surgery – a very different situation from the ICU or ED population. A few studies exist that are relevant here. Jabre et al. conducted a prospective, randomized single-blinded study comparing etomidate and ketamine in the pre-hospital, ED and ICU settings.[10] Tekwani et al. performed a prospective, randomized double-blind study comparing etomidate and midazolam for ED intubations.[11] Neither of those studies demonstrates that etomidate had superior hemodynamics compared to either ketamine or midazolam. It is interesting to note that etomidate was associated with non-statistically significant increases in mortality in both studies, making it quite possible that these studies were underpowered to detect a clinically important impact on mortality due to etomidate. Given this data, I believe that the burden of proof falls on the proponents of etomidate to show that etomidate is a superior (or at least non-inferior) alternative to other induction agents in critical care patients. There are also those who believe that routinely giving steroids to patients who have received etomidate is beneficial and obviates the problem of adrenal insufficiency.[7] However, recent evidence appears to suggest that steroids should be not routinely administered following etomidate.[12, 13] Another practical point is also germane to this discussion. Most studies examining induction agents do not look at combinations of drugs and the use of boluses of vasopressor medications to defend the blood pressure. However, in practice, we often use combinations of drugs (e.g., midazolam and fentanyl), each drug being used at sub-induction doses, together with a paralytic agent (rocuronium or succinylcholine). In addition, it is not unusual to use some pressor agent (such as phenylephrine) to prevent hypotension. A judicious combination of induction agents, muscle relaxants and pressors completely nullifies any theoretical advantages of etomidate, in my opinion. Moreover, having trained in a country where etomidate was simply unavailable, I am not particularly sympathetic to arguments that etomidate is essential for the safe care of our patients.
4. There is an important caveat to the above discussion, however. My arguments primarily apply to situations where emergency intubations are carried out by experts (anesthesiologists, at our institution) who are comfortable with tailoring drugs to the individual patient, even under emergent conditions. I completely understand the rationale for the use of etomidate in the field, where simplicity is at a premium, and available expertise more limited. The emergency room falls somewhere between the above situations; however, in my opinion, the barriers to embracing alternatives to etomidate in the ER are primarily systems issues rather than medical ones.

To summarize the discussion, etomidate is a drug with an important side effect (i.e., adrenal suppression). The impact of etomidate-induced adrenal insufficiency on outcomes is very cloudy and is likely to remain so in the foreseeable future. However, given the lack of proof of superiority of etomidate over other induction agents, and the ability of anesthesiologists to tailor medications to individual patients, the decision to stay away from etomidate in the critically ill patient population should not be a particularly difficult one.

As an aside, the work by Douglas Raines and his group on carboetomidate[14] (an analogue of etomidate without the adrenal suppressive effects) may, if it comes to fruition, make the entire debate irrelevant.

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PRO: Early Tracheostomy

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Tracheostomy has been portrayed as early as 3600 B.C. on ancient Egyptian artifacts, and even Alexander the Great purportedly performed a crude version of the technique on one of his dying soldiers.[1,2] The procedure has become more widespread during the modern era; for example, it was used extensively for the diphtheria and polio pandemics in the late 19th and early 20th centuries, respectively.[3] In addition to its more frequent use, its indications have evolved over the years from being used purely for upper airway obstructions to having a multitude of indications, including treatment of subglottic stenosis, respiratory failure from paralysis, chronic obstructive pulmonary disease and extensive airway secretions. Its potential clinical advantages today include reduced laryngeal damage, a more rapid wean from the ventilator, less airway resistance, decreased work of breathing, earlier mobilization, improved patient comfort (including improved communication and transition to oral feeding), shorter hospital and ICU lengths of stay, and lower risk of ventilator-associated pneumonia. When Ciaglia et al. described their new bedside percutaneous technique in 1985,[4] the debate over both the timing of the tracheostomy and its benefits over prolonged translaryngeal intubation came to the forefront of airway management.

Using the literature as a guide to the debate, an early tracheostomy is typically defined as one that is performed less than eight days after admission to the ICU. In a prospective, randomized trial by Rumbak et al. in 2004, early tracheostomy was associated with significantly less mortality as well as more ventilator-free days, ICU-free days and lower pneumonia rates.[5] The study design was adequate, and it was performed on a severely ill ICU population, but it unfortunately had poor generalizability and a poorly defined prediction model. Furthermore, the mortality results have not been validated in any other recent studies. Other comparable prospective, randomized trials looking at surgical ICU patients, trauma patients, burn patients and the severely head injured have yielded inconsistent results.[6-10] Significant limitations included differences in inclusion criteria, insufficient power, poor randomization and various biases. Despite the inconsistencies, several important trends have emerged and include reduced ICU and hospital lengths of stay, as well as more ventilator-free days. Griffiths et al., in a 2005 meta-analysis, also found shorter times for mechanical ventilation and a decreased ICU length of stay, although they were not able to show a difference in more important outcomes such as mortality or risk of pneumonia.[11] More recently, in a multi-center, randomized controlled trial of 600 patients in 12 Italian ICUs, Terragni et al. investigated the effects of early tracheostomy on rates of ventilator-associated pneumonia.[12] They did not find a statistically significant difference, but there was a strong trend toward improved pneumonia rates; similarly, they showed improved ventilator-free and ICU-free days in the early group. This study was limited by poor generalizability and insufficient power, since there was a much lower incidence of pneumonia than predicted.

Overall, early tracheostomy can aide in the transition of patients off of the ventilator, out of the ICU and perhaps out of the hospital sooner, but does this necessarily improve overall costs? Perhaps the institution's costs are lowered, but the time spent at the long-term care facilities and the overall costs may be comparable. Further large-scale studies are needed to assess the financial impacts and resource utilization of early tracheostomy on the health care system as a whole.

> "Instead of asking if all patients would benefit from an early tracheostomy, a better question would be asking which patients would benefit most. "

Instead of asking if all patients would benefit from an early tracheostomy, a better question would be asking which patients would benefit most. Our clinical decision to perform a tracheostomy is one limited by our inability to accurately predict which patients will require prolonged ventilation, placing these patients at undue risk without benefit. One of many prediction models available incorporates an ARDS prediction score that was developed by Heffner et al.[13] It proposes a simple modified algorithm for choosing those ICU patients that may benefit from early tracheostomy. Patients with upper airway obstruction, severe head injury or neuromuscular compromise (such as

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myasthenia gravis, Guillain-Barre, etc.), high cervical spinal cord injury, burns (especially those with facial, airway and neck involvement or significant active infection) and patients with severe ARDS are included.[14] Other prediction models can be found in the multitude of studies performed in the past five to 10 years, using combinations of parameters such as P_aO_2/P_AO_2 ratio, P_aO_2/FiO2 ratio, PEEP, chest radiographic findings, APACHE III, SOFA, clinical pulmonary infection and lung injury scores. Their generalizability is lacking, unfortunately, and have varying degrees of validation and success.

It has been shown that early tracheostomy can provide reductions in ventilator days and overall length of stay in both the ICU and hospital. Although there are insufficient data to support its effect on other important patient outcomes, including mortality and ventilator-associated pneumonia, its potentially positive effects on institutional throughput and resource utilization should stimulate further large-scale investigations. It is fair to say that current prediction models are insufficient at best; however, utilization of the algorithm mentioned above, in conjunction with astute clinical judgment and the patient's wishes, continues to be the most prudent approach.

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CON: Early Tracheostomy

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For over 30 years a debate has been waged in medical and surgical literature over the controversy of tracheostomy timing. Despite the acclaimed benefits of earlier liberation from ventilatory support, shorter hospital lengths of stay, decreased morbidity, mortality and overall health care costs, few high-quality trials have even attempted to address the debate. Whereas the advocates of early tracheostomy continue to advocate using these well-intentioned arguments, when one closely examines the available evidence, it is clear that inappropriate generalizations, under-powered studies with heterogeneous populations, and varying definitions of just what constitutes "early" versus "late" plague the argument for early tracheostomy.

In the era of evidence-based practice, even the best randomized controlled trials offer only mixed support for early tracheostomy. The oft-quoted trials by Rumbak et al., Rodriguez et al. and Blot et al. each defined early tracheostomy differently (two, seven and four days respectively), having inconsistent results with respect to mortality and pneumonia, while suggesting improved ventilator weaning and reduced lengths of stay.[1-3] However, on close examination each trial is critically flawed: statistical bias favoring early tracheostomy, limited population that underwent tracheostomy very early after admission without clear inclusion criteria, or lack of study power altogether. In the more recent trial by Terragni et al., patients without evidence of pneumonia were randomized to tracheostomy at seven or 14 days, and investigators failed to demonstrate any significant difference in rates of pneumonia, hospital length of stay, one-year mortality or need for long-term care facility.[4]

Due to the limited number of large, well-designed trials evaluating tracheostomy timing, several meta-analyses have attempted to shed light on the controversy. Griffiths et al. and Dunham and Ransom both failed to show significant difference in pneumonia or mortality with early versus late tracheostomy, while suggesting earlier ventilator weaning and reduced lengths of stay.[5-6] These analyses were hampered by the wide variation in included trials' design and timing of early tracheostomy. The recent meta-analysis by Durbin et al. included five prospective trials performing tracheostomy within five days of admission and did not show any difference in mortality, associated pneumonia or duration of mechanical ventilation.[7]

Despite our best efforts to find clarity in the currently available evidence for tracheostomy timing, the truth remains to be seen. Perhaps the only way to truly understand the potential benefits of this treatment strategy is to attempt to identify the subset of patients who may benefit from early tracheostomy from this heterogeneous ICU patient population. On the other hand, with recent advancement in the treatment of ICU delirium, ventilator weaning and reduced sedation strategies, and conservative volume resuscitation practices, perhaps the future question will not be the timing of tracheostomy, but whether to perform a tracheostomy at all.

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Multiple Choice Question: Early Tracheostomy:

Following a motor vehicle collision, a previously healthy 20-year-old male is admitted to the trauma ICU intubated for hemodynamic support, ongoing resuscitation and ventilator support. His injuries include a closed head injury with a GCS 10T, bilateral pulmonary contusions with 3 fractured ribs on the right, a left humerus fracture and a non-operable spleen laceration. His current ventilator setting are FiO2 .6/RR18/TV 550/PEEP 8 to maintain a P:F ratio > 200, 02 sat 92%.

Literature supports that early tracheostomy (< 7 days) will:

A: Improve early liberation from the ventilator
B: Avoid VAP
C: Decrease ICU and hospital length of stay
D: Decrease his mortality
E: None of the above

Answer: E

Literature Review: Respiratory Variability at the Time of a Spontaneous Breathing Trial Connotes Successful Liberation From the Ventilator

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Article:

Bien M-Y, Lin YS, Shih C-H, Yang Y-L, Lin H-W, Bai K-J, Wang J-H, Kou YR. Comparisons of predictive performance of breathing pattern variability measured during T-piece, automatic tube compensation, and pressure support ventilation for weaning intensive care unit patients from mechanical ventilation. *Crit Care Med.* 2011; 39:2253-2262.

It is difficult to review a good paper[1] when it is already paired with a good editorial[2] in the same issue of the journal. Bien, et al., have produced a seminal study regarding the success or failure of certain patients undergoing liberation (i.e., "weaning") from mechanical ventilation, based on subtle differences in the "randomness" of their breathing while on t-piece trials. Branson and Hess[2] do it justice in the same issue of *Critical Care Medicine* and it is they who pointed out the fascinating theoretical study co-authored by physicist-physician Ed Ingenito (Suki, et al.,[4]) that I will comment on later.

Briefly, the paper of Bien, et al. is remarkable because it shows that our standard methods of choosing which patients to extubate may be obsolete. There is a degree of physiological variation in the frequency, depth, peak flow and beat-to-beat RSBI of breathing that appears to correlate more closely with successful extubation (liberation) than the standard parameters. In their paper, the authors deal primarily with [rate (sec^{-1}) or T_{TOT} (sec), PIF (L/min), V_T (L), and BB-RSBI (breaths/min/L)]. These variables have been used for some time, but their absolute values, not the degree of embedded variation within them, have been the benchmarks for deciding when to extubate. This paper is revolutionary in that it says that the degree and type of variation, not the absolute value, of each parameter is important.

Bien, et al. studied 68 consecutive patients who were eligible for weaning according to standard criteria (Table 1). Once deemed eligible, they underwent a spontaneous breathing trial within one hour. The spontaneous breathing trial consisted of three tests, separated by 10 minutes, and conducted in random order for each patient. These three tests were a) t-piece spontaneous breathing; b) 100 percent automatic tube compensation[4] (ATC) plus 5 cm PEEP; or c) 5 cm pressure support plus 5 cm. After these trials were conducted, they were followed to see which would successfully (n = 45) be extubated, or which would fail (n = 23). Table 1 shows the criteria by which they were rescued from an unsuccessful attempt at liberation. They then retrospectively analyzed the breathing pattern variability of both groups and compared them.

Their main result was counterintuitive: They found that the patients who successfully extubated had **significantly** *more* random or *more* variable breathing patterns than those who failed, according to their statistical criteria of variability. And surprisingly, they found the absolute values of the **standard respiratory parameters** (see above) **did not distinguish** between the successful and failed groups. They also found that the use of the t-piece was the only weaning method that was sensitive enough to allow analysis of the variability of breathing. If instead either Automatic Tube Compensation[3] (ATC) plus 5 cm PEEP was used, or 5 cm pressure support plus 5 cm PEEP was used, then the breathing pattern variability was obscured, making analysis impossible.

How does one quantify randomness? To do so, Bien, et al. had to resort to a branch of contemporary applied mathematics called *time series analysis* (used in analysis of equities prices, temperatures, physiological variables, etc., over time), and to a more recent science known as *chaos theory*, a hybrid discipline combining mathematics, statistics and physics, with applications in many fields, including economics, biology and geology.

Chaos theory was pioneered around the turn of the last century by the French physicist, philosopher and mathematician Jules Henri Poincaré (1854-1912) of the University of Paris (Figure 1). It began as an adventitious byproduct of his research on the classical three-body (also known as the n-body) problem in particle dynamics.

Figure 1: Jules Henri Poincaré (1854-1912)

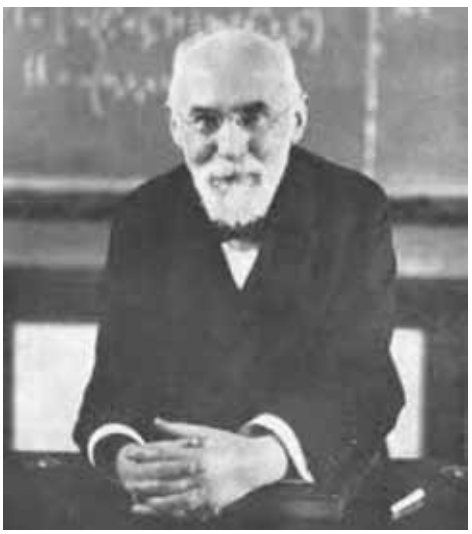

Table 1. Criteria for Airway Management in Bien, et al.*

Criteria for weaning from the ventilator		Criteria for interrupting trial and reconnecting	Criteria for noninvasive ventilation or reintubation
Clinical assessments	**Objective assessments**	Tachypnea	Severe cardiopulmonary distress immediately after extubation
Resolution of acute disease	Adequate oxygenation	Hypoxemia	Try noninvasive ventilation for slower onset distress
Adequate cough	Afebrile	Tachycardia or Bradycardia	Reintubate if noninvasive support not effective in 30 minutes.
	Stable CV status	Hypertension or Hypotension	
	Stable acid- base and electrolyte status	Significant dysrhythmias	
	No respiratory acidosis	Agitation	
	Mentating	Diaphoresis	
	Spontaneously breathing	Anxiety	

*Modified from Bien, et al.[1]

Poincaré was at the time a young professor whose interests were differential equations and dynamical systems. He entered a mathematical contest proposed by Karl Weierstrass (1815-1897) of the University of Berlin and Magnus Gösta Mittag-Leffler (1846-1927), Professor at the University of Stockholm and founder of the prestigious journal *Acta Mathematica.* The contest was devised as part of the festivities surrounding the 60th birthday (January 21, 1899) of King Oscar II of Sweden and Norway, great patron of the arts and sciences in Scandinavia.[5]

Weierstrass's contest problem was as follows: *"Given a system of arbitrarily many mass points that attract each other according to Newton's laws, assuming that no two points ever collide, give the coordinates of the individual points for all time as the sum of a uniformly convergent series whose terms are made up of known functions."*

Poincaré found no exact solution to the dynamical problem, but his response (itself a thesis) allowed him to deal with the differential equations involved with a generality and elegance not yet seen. The jury evaluated Poincaré's thesis and awarded him the prize medal and the Kr 2,500 prize. The value of his thesis was that certain stabilities of certain orbits were recognized. Moreover, in it, he recognized the hallmark of chaotic systems, i.e., their extreme sensitivity to initial conditions. The thesis is felt by historians of mathematics to be one of the founding documents of modern chaos theory.

So Poincaré, interested in recurrence in dynamical systems, and, in line with his tendency to visualize concepts in geometric terms rather than perform laborious textual proofs, then invented the so-called "Poincaré plots" to assess and visualize the repetitiveness, or variability, or lack of them, in dynamical systems.

A *Poincaré plot* is very easy to describe. If one measures consecutive R-R intervals, stock prices, or breath-breath intervals, and records them, they might be as follows:

$(x_1, x_2, x_3, x_4, x_5, x_6, \ldots, x_n)$.

This is a simple series of the values of the variables. But the crucial next step is to pair up the values in an overlapping manner, making them into a series of ordered pairs, as follows:

$(x_1, x_2), (x_2, x_3), (x_3, x_4), (x_4, x_5), (x_5, x_6), \ldots, (x_{n-1}, x_n)$.

And then plot them on *x-y* axes. Such a plot is a *Poincaré plot.* One first plots (x_1, x_2), then plots (x_2, x_3), then (x_3, x_4), and so on. This is illustrated in Figure 2.

If all the intervals are exactly alike, say, if the respirations are perfectly regular, then the plot will be a point at (1, 1), or at a constant (c, c). If each interval is nearly the same, but over time the intervals range very slowly over a set of values, then the plot will be nearly perfectly linear and follow the line $x = y$. If each interval is markedly different from the one immediately preceding it and the one following it, then the points will stray from the line $x = y$ to an extent determined by their beat-to-beat variability, as shown in Figure 2.

As a part of their analysis Bien, et al. applied the concept of *Poincaré plots* to the problem of respiratory variation in patients who were weaning from mechanical ventilation.

They found (Figure 2 of Bien, et al.[1]) that the derived quantities CV (the coefficient of variation, equal to the mean divided by the SD of each variable), as well as SD_2 and SD_1, were predictive of success following extubation. The mean values, per se, of the variables [rate (sec^{-1}) or T_{TOT} (sec), PIF(L/min), V_T(L), and BB-RSBI (breaths/min/L)], surprisingly, did not predict successful liberation from the ventilator.

The paper's main findings have some interesting applications. First, the indices measured and derived in Bien, et al. could be done in real time, given suitable software upgrades. So that raises the idea that it may someday be possible to have the coefficient of variation, (CV) of the common respiratory

variables, as well as SD_2 and SD_1 , displayed in real time for bedside decision-making.

But more fascinating in terms of potential applications is found in a 1998 *Nature* Scientific Correspondence[4] paper pointed out by Branson and Hess[2] in their editorial. Suki et al.[4] derive a novel computer model of respiratory variation, then apply it to a mathematical model of a lung. They find that it might serve to prevent alveolar closure, thereby improving arterial oxygenation. In other words, by adding "noise" or statistical variation to a ventilator's program, it may be a more therapeutic means of providing controlled ventilation than our current "fixed" ventilation schemes.

Suki, et al. suggest that such variation could be programmed into ventilators providing controlled ventilation to patients. In such a way, the potential of exploiting respiratory ventilation as therapy is quite possible. Meantime, Bien et al. seem to have elegantly pointed out the great value of subtle respiratory variation in making better-informed decisions about extubation.

Figure 2: Poincaré plots.

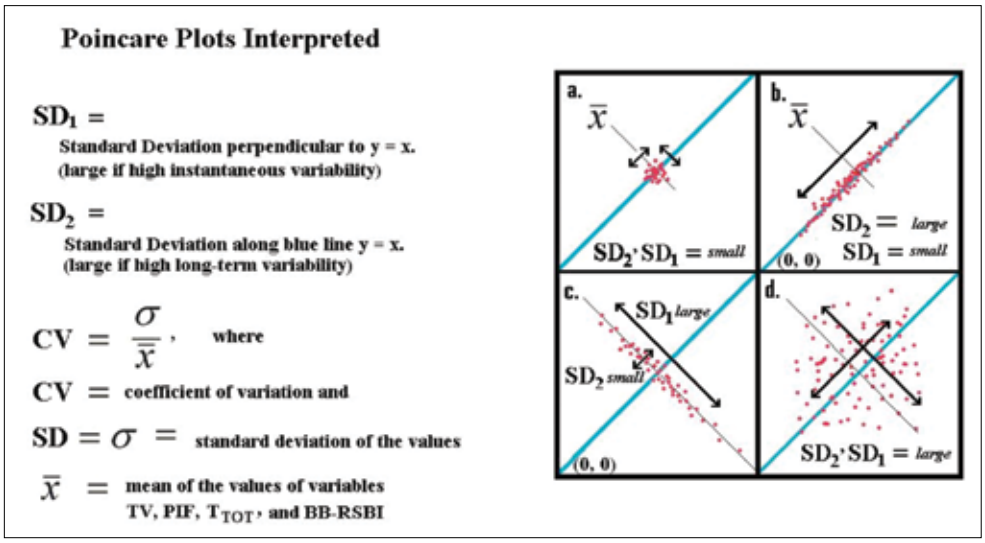

Figure 2 shows four Poincare plots [panels a), b), c) and d)] and illustrates the ways in which these graphical devices illuminate the variability in respiratory patterns or other time-series data. First, in panel a), the points are all concentrated at (1,1) or a constant (k, k). The tightly grouped pattern reflects a constant respiratory rate, for example, varying neither beat-to beat nor over longer intervals. Panel b) shows the same mean value, but the points vary long term along the line x = y. Such a spread is called a large SD2 value, and it means that the beat-to-beat variability is not great but there is longer-term variation. Panel c) shows a large SD_1 value, meaning great beat-to-beat variability but not much long-term variation. This might be seen in ventricular bigeminy, for example, as it shows the sensitivity of plotting ordered pairs in demonstrating short-term variability. Lastly, panel d) shows the case where both SD_1 and SD_2 are large. The physiological variables measured in this paper displayed this tendency most often: a concomitant short- and long-term variability. Bien et al. found that the coefficient of variation (CV), as well as SD_2 and SD_1, were the most informative indices. Surprisingly, the standard respiratory variables were not predictive of success or failure following extubation.

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3. Automatic Tube Compensation (ATC) is a complex proprietary (Drägerwerk, Lubeck, Germany) method of providing pressure support mechanical ventilation which supposedly compensates for the breathing circuit resistance and tube resistance, according to the patient's instantaneous respiratory flow rates. Its purpose is to relieve the work of breathing for the patient to the extent that it resembles the work of breathing after extubation. In other words, it tries to make the tube and circuit "invisible" to the patient.
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