Society of Critical Care Anesthesiologists
SOCCA

24th Annual Meeting and Critical Care Update

October 13-14, 2011 • Hilton Chicago • Chicago, Illinois

Presented prior to ANESTHESIOLOGY 2011

Syllabus

American Society of Anesthesiologists

This CME meeting is jointly sponsored by the American Society of Anesthesiologists (ASA)

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Society of Critical Care Anesthesiologists would like to thank the following supporters of the SOCCA 24th Annual Meeting:

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Program Information

Target Audience

The SOCCA 24th Annual Meeting and Critical Care Update is designed for anesthesiologists in the clinical and laboratory setting who desire to improve development of anesthesiology teaching methods by engaging in an inter-change of ideas as represented in this meeting.

Needs Assessment

Topics for this meeting were derived from 2010 meeting evaluations and previous annual meetings. Suggested topics were discussed and developed by educators who attended previous Annual and Board meetings and by other authorities in the field of Anesthesiology.

Faculty Disclosure

The Society of Critical Care Anesthesiologists adheres to ACCME Essential Areas, Stand-ards, and Policies regarding industry support of continuing medical education. Disclosures of faculty and commercial relationships will be made known at the activity. Speakers are required to openly disclose any limitations of data and/or any discussion of any off-label, experimental, or investigational uses of drugs or devices in their presentations.

Participation in the SOCCA 24th Annual Meeting

Attendance shall be open to all health prac-titioners, provided that they have registered for the meeting. CME credit will only be offered to M.D.s, D.O.s or equivalent. A completed Physician Verification of Attendance form must be turned in to SOCCA at the conclusion of the meeting. The form will be available on-site.

Educational Format

CME activities include the following formats: plenary sessions, lectures, moderated poster discussions, and skill-set workshops.

Accreditation Statement and Credit Designation

This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education through the joint sponsorship of the American Society of Anesthesiologists and the Society of Critical Care Anesthesiologists. The American Society of Anesthesiologists is accredited by the ACCME to provide continuing medical education for physicians.

SOCCA Annual Meeting and Critical Care Update (Friday)

The American Society of Anesthesiologists designates this live activity for a maximum of *8.0 AMA PRA Category 1 Credit(s)*™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

Pre-Meeting Workshop "Perioperative Ultrasound Workshop" (Thursday)

The American Society of Anesthesiologists designates this live activity for a maximum of *4.0 AMA PRA Category 1 Credit(s)*™. Physicians should only claim credit commen-surate with the extent of their participation in the activity.

Resolution of Conflicts of Interest

In accordance with the ACCME Standards for Commercial Support of CME, the American Society of Anesthesiologists and the Society of Critical Care Anesthesiologists will implement mechanisms, prior to the planning and implementation of this CME activity, to identify and resolve conflicts of interest for all individuals in a position to control content of this CME activity.

Disclaimer

The information provided at this CME activity is for continuing education purposes only and is not meant to substitute for the independent medical/clinical judgment of a health care provider relative to diagnostic and treatment options of a specific patient's medical condition.

Commercial Support Acknowledgement

This CME activity is supported by educational grants. A complete list of supporters will be published in the program syllabus.

Meeting Learning Objectives

Upon completion of this learning activity participants should be able to:

- Describe emerging concepts on the role of the microcirculation and mitochondrial dysfunction in the pathophysiology of sepsis and ARDS.
- Discuss the outcomes that are important to survivors of critical illness.
- Review the application of novel therapies in the management of severe sepsis and septic shock.
- Analyze controversies in the design, conduct and interpretation of clinical trials in critical care.
- Apply relevant lessons learned from the military experience in the delivery of critical care services to civilian disaster manage-ment scenarios.
- Explain how generational differences in learning and values may affect medical education and individual expectations and performance in the workplace.
- Discuss how regional and institutional variations in intensive care practice influence the evolution and progress of delivery of critical care.
- Review emerging applications for ultrasound technology in the evaluation and management of patients in the intensive care unit.
- Appraise the use of medical simulation in critical care education and potential applications in competency assessment of experienced providers.

Awards

Lifetime Achievement Award

Attendees of the SOCCA 24th Annual Meeting will honor Stanley H. Rosenbaum, M.D. as this year's Lifetime Achievement Award recipient. This award recognizes Dr. Rosenbaum distinguished service and outstanding contributions to critical care medicine.

Young Investigator Award

This award is presented annually to the individual whose research exemplifies the Society's mission to educate anesthesiologists in the care of critically ill patients and to foster the knowledge and practice of critical care medicine by anesthesiologists. The recipient of the Young Investigator Award will make an oral presentation of their work at the SOCCA Annual Meeting. SOCCA is proud to announce the 2011 Young Investigator Award recipient as Daniel S. Rubin, M.D. for his paper entitled *"The Frank-Starling Relationship is Absent in Patients with Pulmonary Hypertension: A 3-Dimensional Transesophageal Euchocardiographics Study in Patients Undergoing Cardiac Surgery"*

SOCCA Breakfast Panel at ANESTHESIOLOGY 2011

"Hemodynamic Monitoring and Management in 2010"

Sunday, October 16, 2011, 7:00 - 8:15 a.m.

Hyatt McCormick Place – Regency A

Objectives: Upon completion of this learning activity, participants should be able to: 1. Review and critically assess recent literature on the clinical value of hemodynamic monitoring; 2. Identify gaps between literature findings, hemodynamic theory, and clinical practice; 3. Explore alternate theories and strategies to reconcile hemodynamic theory with current literature; 4. Develop a clinical approach to hemodynamic management of critically ill patients.

Reconciling Traditional Hemodynamic Theory with Current Literature

Avery Tung, M.D.
University of Chicago
Chicago, Illinois

In Defense of Traditional Hemodynamic Monitoring: CVP, PAC, CO, DO2

Jeffery Vender, M.D.
Evanston Northwestern Healthcare
Chicago, Illinois

The Widening Gap Between Hemodynamic Theory, Literature and Practice

Vivek K. Moitra, M.D.
College of Physicians and Surgeons
New York, New York

Program Committee and Faculty Disclosures

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Meeting Schedule

Thursday, October 13, 2011

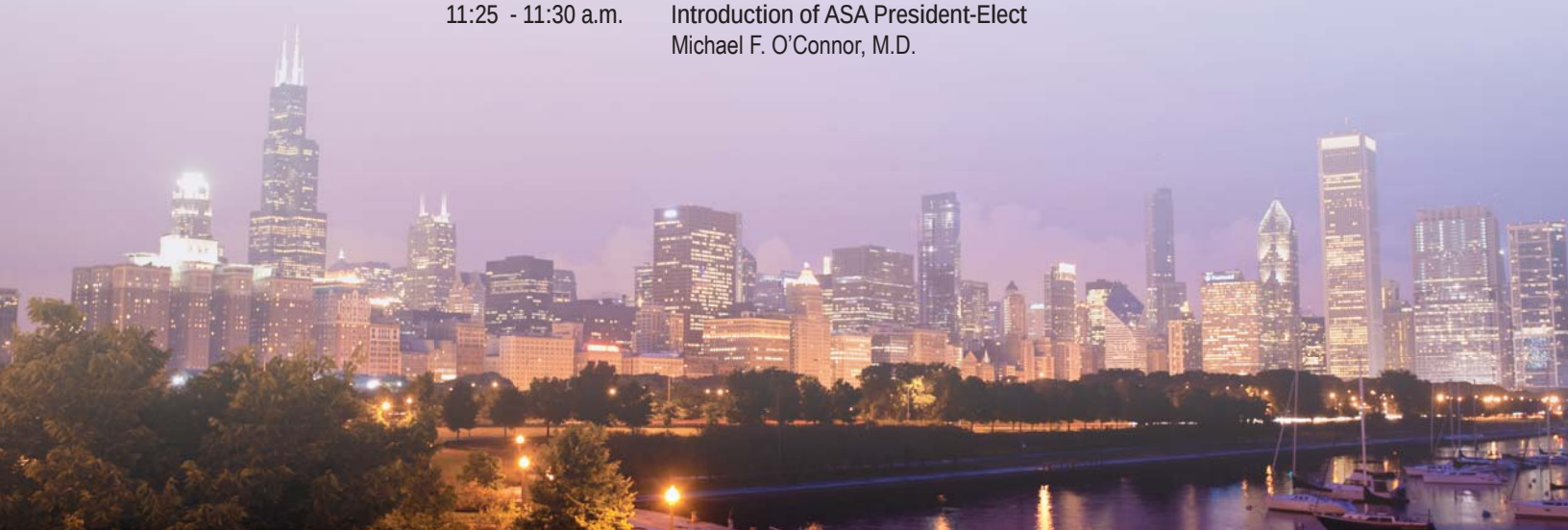
11:00 a.m. - 3:00 p.m.	Registration for the Perioperative Ultrasound Workshop
1:00 - 5:00 p.m.	Perioperative Ultrasound Workshop

Friday, October 14, 2011

6:30 a.m. - 5:30 p.m.	Registration
7:00 - 7:25 a.m.	Continental Breakfast – Exhibits Open
7:25 - 7:30 a.m.	Welcome and Introduction Vivek K. Moitra, M.D., Ronald Pauldine, M.D.

SESSION I - Multiple Organ Dysfunction Syndrome 2011 (Challenging Conventional Wisdom)

7:30 - 7:40 a.m.	Introduction/Overview of Session Vivek K. Moitra, M.D.
7:45 - 8:15 a.m.	Pathophysiology of Sepsis and ARDS: Have We Finally Gotten it Right? Clifford S. Deutschman, M.D.
8:15 - 8:45 a.m.	Long-term Outcomes After MODS/Chronic Critical Illness Hannah Wunsch, M.D., M.Sc.
8:45 - 9:15 a.m.	Nitroglycerin and Lactate Guided Resuscitation in Sepsis Jan Bakker, M.D., Ph.D.
9:15 - 9:45 a.m.	Break and Exhibits
9:45 - 10:30 a.m.	PRO: ICU Trials Show Progress Carlee A. Clark, M.D. CON: ICU Trials Are Equivocal Joseph S. Meltzer, M.D.
10:30 - 11:00 a.m.	Rethinking MODS and Concluding Remarks (Maybe The Disease Isn't All We Believed It To Be) Clifford S. Deutschman, M.D.
11:00 - 11:25 a.m.	Young Investigator Award and Presentation *"The Frank-Starling Relationship is Absent in Patients with Pulmonary Hypertension: A 3-Dimensional Transesophageal Euchocardiographics Study in Patients Undergoing Cardiac Surgery"* Recipient: Daniel S. Rubin, M.D. Presenter: Brenda G. Fahy, M.D.
11:25 - 11:30 a.m.	Introduction of ASA President-Elect Michael F. O'Connor, M.D.



Meeting Schedule

11:30 - 11:50 a.m.	ASA President-Elect Address Jerry Cohen, M.D.
11:50 a.m. - 1:00 p.m.	Lunch and Lifetime Achievement Award Presentation "An Unfocused Path" Recipient: Stanley H. Rosenbaum, M.D.

SESSION II - Lessons Learned from Military Critical Care

1:00 - 1:45 p.m.	Rethinking Civilian Critical Care 2011 Todd E. Carter, M.D.
1:45 - 2:25 p.m.	Moderated Poster Session
2:25 - 2:40 p.m.	Break and Exhibits
2:40 - 3:00 p.m.	SOCCA-FAER- Hospira Physician Scientist Award Lecture *"Cerebrovascular Autoregulation After Pediatric Cardiac Arrest"* Jennifer K. Lee-Summers, M.D.

SESSION III: Education and Technology

3:00 - 3:45 p.m.	PRO: My Generation is Better (What Has Worked Well in Medical Education) Douglas B. Coursin, M.D.
	CON: My Generation Rocks (Does Generation Y Learn Differently?) Aaron M. Joffe, D.O.
3:45 - 5:15 p.m.	Learning From Diversity: How Do We Teach, Learn, and Get Better if Everybody Does It Differently Avery Tung, M.D.
	Ultrasonography – Replacing Our Stethoscope! How Do We Get It Done Michael H. Wall, M.D., FCCM
	Role of Simulation/Learning Skills for Rare Events Steven J. Lisco, M.D.
5:15 - 6:00 p.m.	SOCCA Annual Business Meeting
5:15 - 6:00 p.m.	SOCCA Resident Session
6:00 - 7:45 p.m.	Welcome Reception

SESSION I - Multiple Organ Dysfunction Syndrome 2011 (Challenging Conventional Wisdom)

Pathophysiology of Sepsis and ARDS: Have We Finally Gotten it Right?
Clifford S. Deutschman, M.D.

Long-term Outcomes After MODS/Chronic Critical Illness
Hannah Wunsch, M.D., M.Sc.

Nitroglycerin and Lactate Guided Resuscitation in Sepsis
Jan Bakker, M.D., Ph.D.

PRO: ICU Trials Show Progress and CON: ICU Trials Are Equivocal
Carlee A. Clark, M.D. and Joseph S. Meltzer, M.D.

Rethinking MODS and Concluding Remarks (Maybe The Disease Isn't All We Believed It To Be)
Clifford S. Deutschman, M.D.

Pathophysiology of Sepsis and ARDS: Have We Finally Gotten it Right?

Clifford S. Deutschman, M.D.

Treating Sepsis and ARDS; What do YOU think ? And does the evidence support your practice ?

In this initial session, we will begin with your ideas and thoughts. For a number of approaches to sepsis and lung injury, we will use an interactive device to see how those in the audience interpret the results of recent trials.

The questions –

1. Are PA catheters useful in managing sepsis/critical illness ?
2. Do small tidal volumes, PEEP, recruitment maneuvers, fluid restriction, open lung ventilation, limited inspiratory pressure, or beta-agonist administration improve outcome in ALI/ARDS ?
3. Should vasopressin be administered to patients with septic shock ?
4. Does initiation of early goal-directed therapy effect recovery from sepsis ?
5. Should septic/critically ill patients receive glucocorticoids ?
6. Is administration of activated protein C to patients with severe sepsis justified ? Is it cost-effective ?
7. Should insulin be administered to keep the blood glucose level of septic patients between 80-110 ? Below 150 ? Is this practice safe ?

Each audience member will be asked to express his/her opinion and to detail his/her current practice. Once we have tabulated the results, we will look at the data and see what the literature supports.

Specific studies to be discussed:

1. Sandham et al, *New Engl J Med* 348:, 2003
2. Yu et al, *Crit Care Med* 31:2734 –2741, 2003
3. ARDSNet Investigators, *N Engl J Med*. 2000 May 4;342(18):1301-8.
4. Brower et al, *Crit Care Med*. 2003 Nov;31(11):2592-7
5. Brower et al, *N Engl J Med*. 2004 Jul 22;351(4):327-36.
6. Weidemann et al *N Engl J Med.* 2006 Jun 15;354(24):2564-75
7. Russell et al, *New Engl J Med* 358, 2008
8. Rivers et al, *New Engl J Med* 354, 2001
9. Annane et al, *JAMA.* 2002;288:862-871.
10. Sprung et al, *New Engl J Med* 358:111-124, 2008
11. Bernard et al, *New Engl J Med* 344:699-709, 2001
12. Van Den Berghe et al, *New Engl J Med* 345, 2001
13. The NICE SUGAR Study Investigators, *New Engl J Med* 360: 1283-97, 2009

Long-term Outcomes After MODS/Chronic Critical Illness

Hannah Wunsch, M.D., M.Sc.

- Overall long-term survival after critical illness is poor
  - But not so different from hospitalized patients
  - Much worse for mechanically ventilated

- What is chronic critical illness?
  - Variable definitions
    - Mechanical ventilation, mechanical ventilation for more than a few days, length of stay in the ICU, need for tracheostomy, ?inability to be discharged home

  Growing population, however it is defined
  - Predicted growth in need for mechanical ventilation and demand for intensive care

- Survival is poor
  - Recent cohort study by Cox et al [*CCM* 2009] of 126 patients who received either tracheostomy placement or 21+ days of mechanical ventilation
    - 56% survival at 1 year
    - Poor prognostication by clinicians and inappropriate expectations by families
    - Most surrogates expected patients to survive (93%), as well as to have no major functional limitations (71%); at one year 9% were alive with independent function

- Increasing use of other care facilities (sub-acute nursing, skilled care, long-term acute care facilities) for care of critically ill patients after initial stabilization
  - Are we doing the right thing for patients by discharging patients to these facilities?
    - Poor outcomes associated with discharge to LTACs, but may just be the patient mix [Kahn et al *JAMA* 2010]

- How much organ dysfunction occurs?
  - Majority data are on overall "function" rather than specific organ dysfunction
  - ARDS cohort followed by Margaret Herridge demonstrates surprisingly little pulmonary dysfunction
    - But still with profound physical disability
  - Interaction between organ dysfunction and disability remains unclear

  Quality of life after intensive care
  - Difficult to study due to the problem of quantifying quality of life prior to the illness [Wunsch and Angus, *Critical Care* 2010
  - Post-traumatic stress disorder, depression, delirium, physical weakness
    - "Post-Intensive Care Syndrome" [SCCM term]
    - Worsening dementia [Iwashyna et al *JAMA* 2011
    - Depression not so clear-cut
  - Will be improvement in this area of research as ability to link data from different healthcare domains improves

  Potential interventions to improve quality of life
  - Better end-of-life planning
    - Palliative care acts in California and New York
  - ICU diaries
  - Improvements in drug reconciliation
  - Early physical therapy and rehabilitation

Nitroglycerin and Lactate Guided Resuscitation in Sepsis

Jan Bakker, M.D., Ph.D.

The first time lactate was demonstrated in human blood it was taken from patients that died of septic shock [1]. Since then increased levels have been associated with morbidity and mortality in about any disease state [2]. In addition a decrease in lactate levels and decreased duration of increased levels during treatment is also associated with improved outcome in critically ill and septic shock patients. Although a 10% decrease is associated with a significant lower mortality when compared to less decreases it remains unclear what the most adequate end point should be [5]. Observational studies have shown that a small decrease (10%) in the first six hours of treatment can discriminate survivors from non-survivors [6]. When we used a much higher clearance of lactate (20% per two hours for the first 8 hours of treatment) together with a normal central venous oxygen saturation ($ScvO_2$) as a goal of treatment in a randomized study this was associated with a significant decrease in mortality although ultimately the clearance of lactate was ±5% per hour in both groups [7].

In critically ill patients increased lactate levels as a result of impaired tissue oxygenation remains the most important reason to intervene with hemodynamics. In many experimental and some clinical studies the presence of a critical level of global/regional oxygen delivery (DO_2) has been identified [8,9]. At DO_2 levels lower than this critical level, oxygen consumption is dependent on DO_2 (supply dependency). Both in experimental and clinical conditions this phenomenon is associated with increased blood lactate levels in many disease states [9,10-14]. Moreover, in experimental conditions reversal of this supply dependency state is associated with normalization of blood lactate levels to baseline values [15]. In clinical conditions, improvement in oxygen delivery in patients with increased lactate is associated with increased oxygen consumption [12]. In addition the supply dependent oxygen consumption phenomenon seems to be apparent in the early phase of critical illness and to resolve following adequate resuscitation associated with a normalization of lactate levels [10]. Although other causes of increased lactate production exist [16,17] it remains unclear whether these causes require specific hemodynamic interventions. When using lactate as a marker of inadequate tissue oxygenation initial treatment should be focused on improving tissue oxygenation. The tissues regulate the immediate delivery of oxygen to meet their oxygen demand by changing blood flow as hemoglobin level or arterial oxygen saturation cannot be increased rapidly and significantly. As blood flow can increase by more then 100% [17] as an adaptation to decreasing hemoglobin levels, flow adaptation is a very important mechanism. Therefore the initial treatment of patients with increased lactate levels targets improving tissue blood flow. This should first be accomplished by optimizing cardiac preload by fluid resuscitation that can effectively increase oxygen delivery and oxygen consumption [18]. When blood flow is still not optimal, this could be further increased by the use of inotropic agents [12]. Regional and microcirculatory blood flow can be optimized by use of inotropic agents and vasodilators [18,19,20,21,22]. Although the efficiency of improving tissue oxygenation by use of blood transfusion is unclear, it can optimize microcirculatory perfusion by increasing the number of perfused capillaries [23]. In addition an adequate perfusion pressure should accompany these interventions. Although the optimal perfusion pressure is not well defined, in general a mean arterial pressure above 65 mm Hg seems adequate in most patients and is thus recommended in international guidelines [24]. Norepinephrine has been shown to improve microcirculatory oxygenation, even in the early phase of septic shock [25] and seems to be superior to dopamine [26].

An important question when optimizing tissue oxygen delivery to meet metabolic demands is: “when is delivery adequate?” When tissues need more oxygen and delivery cannot be increased, the oxygen reserve present in the circulation is used. As in normal circumstances only 25% of the amount of oxygen is used for consumption a significant amount of oxygen returns unused to the right heart. In a condition where this reserve is used, the venous oxygen saturation will decrease. Clinically the oxygen saturation in the vena cava superior is frequently used and has been incorporated in treatment schedules that have resulted in improved outcome in critically ill patients [27]. Although the use of the vena cave superior ($ScvO_2$) has some limitations, it’s trending seems to reflect the true mixed venous compartment (SvO_2) adequately [28]. Therefore general guidelines suggest maintaining $ScvO_2$ above 70% [24,29].

When global oxygen delivery and oxygen demand have been optimized, inadequate regional/microcirculatory perfusion could persist. This abnormality could be treated by the use of inotropes [18] and vasodilators [21]. In recent studies we have shown that impaired peripheral perfusion was associated with limited lactate clearance [30,31] and therefore this condition could serve as a surrogate marker to optimize lactate clearance. Peripheral perfusion in septic shock can be optimized by improving perfusion pressure and global blood flow [25], by targeting coagulation abnormalities [32,33] and with the use of vasodilators [22]. Although the use of a vasodilator may be counterintuitive, the effects on actual microcirculatory perfusion pressure make it physiologically sound to use vasodilators even in the case of normal/low blood pressure [34]. Arterial hypotension will not decrease but rather increase the entry pressure of the microcirculation where increased venous pressure in the presence of arterial hypotension (arteriolar vasodilation) will have profound effect on microcirculatory perfusion pressure (figure). In these cases decreasing venous pressure by use of nitroglycerine will not jeopardize microcirculatory perfusion but rather enhance perfusion of the microcirculation. In a recent animal model we have shown the importance of decreasing venous pressures to optimize microcirculatory perfusion even in the presence of hypotension [35].

Conclusion

Lactate is a key metabolite in humans and increased lactate levels are associated with significant morbidity and mortality in critically ill patients. As inadequate tissue oxygenation/perfusion is an important and significant cause of increased lactate levels, targeting optimal tissue oxygenation/perfusion is an important goal in the first hours of treatment. Optimizing cardiac output and regional/microcirculatory flow by improving preload, use of inotropes, optimizing hemoglobin levels and arterial oxygen saturation can improve the delivery of oxygen to the tissues. The use of vasodilators in these cases has a solid physiological basis although the clinical use may be counterintuitive and clinical studies are needed to prove safety and efficacy of this use. The use of venous oxygen saturation and significant decreases in lactate levels as the goal of the initial treatment of patients with increased lactate levels could optimize the changes of survival of patients.

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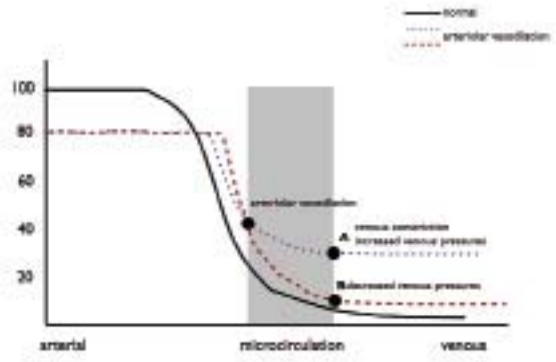
Legend to the figure

Effect of arterial vasodilation and increased venous pressure on microcirculatory perfusion pressure.

Arterial hypotension (arteriolar vasodilation) causes an increase in the entry pressure of the microcirculation. Increased venous pressure as sometimes present in shock states severely compromises perfusion pressure of the microcirculation (point A). Using a vasodilator with main effects on veneus vessels will hardly have any effect on the arterial entry pressure of the microcirculation but will greatly increase microcirculatory perfusion pressure (point B).

Legenda: Uninterrupted line: normal situation
Dotted line: arterial hypotension with increased venous pressure
Interrupted line: arterial hypotension with decreased venous pressure



PRO: ICU Trials Show Progress
CON: ICU Trials Are Equivocal

Carlee A. Clark, M.D. and Joseph S. Meltzer, M.D.

The contemporary practice of critical care medicine incorporates multidisciplinary teams, technology and the practice of evidence-based medicine. In order to practice evidence based medicine, there needs to be overwhelming evidence that a specific medicine, procedure, treatment or lack there of will reduce a patient's morbidity or mortality. Overwhelming evidence is difficult to come by, and over the last decade several ICU trials have indeed led to a change in practice in the hopes of changing patient outcomes. However, not all data can be extrapolated to all patient populations, repeat studies sometimes contradict earlier findings and often physicians fail to follow published guidelines regardless of the evidence. From blood transfusions and blood glucose management to procedural based checklists, recent studies have challenged critical care physicians to weigh the evidence and potentially change their practice.

Blood Transfusions

Historically, an optimal hemoglobin level in the acutely ill patient was believed to be 10gm/dL. It was thought to improve oxygen carrying capacity and therefore improve oxygen delivery to injured, infected or inflamed tissues in critically ill patients. The Transfusion Requirements in Critically Ill trial (TRICC) from 1999 changed the way that most physicians practice transfusion medicine. Soon after 7 was the new 10, and across the world physicians were restricting transfusions to critically ill patients.

It is clear that we should be restricting blood transfusions for our younger, less severely unwell patients. What is not so clear is what we should do for our average patient. Patients in the ICU are older, sicker and more complex than at any other time in history. There is compelling data that preoperative anemia predisposes to increased mortality. The TRICC trial found that mortality was higher in the younger patients (age<55 years) and those with APACHE II scores <20 when blood was transfused in a liberal fashion. Patients with ischemic heart disease as a baseline comorbidity had a trend towards better outcome with a liberal transfusion strategy. Additionally, patients with ischemic heart disease may have been under-represented in the TRICC trial (physicians and family members declining enrollment) and some have questioned the possible interaction between ischemic heart disease and the hemoglobin level. Admittedly, all of these subgroups (the young, the low APACHE II and the CAD) were underpowered however the findings are thought provoking in a time when our patients are increasingly more critically ill, not less. Finally, as our knowledge of and practices of blood banking improve, notably in relation to storage times and leukodepletion strategies, blood may not be as bad as we once thought and now think.

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Blood Glucose Management

Hyperglycemia, whether associated with uncontrolled diabetes or stress, increases morbidity and mortality in acutely ill patients. The appropriate therapeutic goal for hyperglycemia has been the subject of many investigative trials over the last decade with curious and influential

findings. In 2001, Van Den Berghe et al. showed that critically ill surgical patients managed with a strategy of tight blood glucose control (blood glucose 80-110 mg/dL) had significantly reduced rates of in-hospital mortality and ICU mortality. Tight glycemic control also resulted in fewer days on the ventilator, less acute kidney injury and a reduction in rates of sepsis. Following the release of this study, surgical critical care patients throughout the United States were immediately kept under tight blood glucose management even though it was only a single center trial. However, medical intensivists were left to wonder if the data was applicable to their patients. Blood glucose management has continued to be a hot topic for research, however, subsequent studies have failed to show mortality benefits, and many trials have shown tighter glucose control increases morbidity and mortality. In 2006, Van Den Berghe repeated her study in the medical ICU population. An overall reduction in mortality was not shown, but a decrease in morbidity was. Patients spent less time in the ICU and hospital, were weaned from the ventilator faster and had less episodes of acute kidney injury. Patients who were on intensive insulin therapy for greater than three days did have decreased mortality. We know that hyperglycemia is harmful to patients, but hypoglycemia may be just as harmful. Van De Berghe's 2006 study showed an incidence of hypoglycemia in the treatment group and adjusted cohort of 18.7% and 25.1% respectively. The NICE Sugar study published in 2009 failed to show benefit for tight blood glucose, and actually showed a higher mortality rate in the treatment group. Blood glucose research over the last ten years has failed to give us a specific range in which to keep our patients, but it has led to a better understanding of the dangers of both hyperglycemia and hypoglycemia in different critically ill patient populations.

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Checklists

Many physicians think of medicine as an art, rather than a science. Art allows the use of both skill and creativity. The practice of science relies on application of knowledge and meticulousness. The practice of medicine may be both an art and a science, but data has shown over the last 10 years that creativity in medicine may lead to worse patient outcomes. Checklists have entered into medicine in multiple arenas: the operating room, procedural rooms, ventilator management and blood and medication administration. Checklists result in the simplification of a process or procedure. Evidence based medicine has been used to create standardized checklists that serve as reminders to physicians and ways to empower nurses and respiratory therapists. Offensive to some for their removal of independent thought, checklists have been shown to significantly alter a patient's healthcare experience. Peter Pronovost has shown that by taking what we consider to be good medicine and putting it in a checklist format, the number of blood stream infections associated with central line placement can be almost eliminated. Checklists created to aid in weaning patients off of the ventilator have resulted in earlier extubations and improved patient outcomes. The institution of checklists into the critical care arena has improved the quality of medicine being practiced.

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Practice Patterns

Admission to an intensive care unit brings with it a mortality rate between 15-30%. Intensive care research is dedicated to finding therapies or changes in therapies that can reduce patient mortality. Very few trials have been overwhelmingly successful, but there are a few. Low tidal volume ventilation has been the only intervention

shown to reduce mortality in patients with Acute Respiratory Distress Syndrome. Early goal directed therapy has reduced sepsis related mortality. Standardization of central line placement and use of checklists has reduced mortality related to central catheter related blood stream infections. Additionally, as presented here, blood transfusion and checklist have compelling data to support practice patterns in the ICU but our decisions have not followed. Regardless of the data, many physicians fail to adhere to evidence and guidelines.

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Rethinking MODS and Concluding Remarks (Maybe The Disease Isn't All We Believed It To Be)

Clifford S. Deutschman, M.D.

Sepsis is a syndrome of disordered inflammation. It has long been assumed that the key pathologic event in sepsis is excessive inflammation. This response, in turn, provokes the multiple organ dysfunction syndrome (MODS). Therefore, virtually all approaches to therapy have been directed towards limiting an uncontrolled inflammatory response. And virtually all these approaches have failed. For reasons that remain unclear, the response provoked by these failures has been to search for additional, unsuspected pro-inflammatory pathways or to conduct trials on alternative anti-inflammatory agents. Logic might suggest that our initial hypothesis was incorrect and lead us to search for another explanation for MODS. In the second part of this lecture, we will consider some possible alternatives.

Awards

Young Investigator Award
"The Frank-Starling Relationship is Absent in Patients with Pulmonary Hypertension: A 3-Dimensional Transesophageal Euchocardiographics Study in Patients Undergoing Cardiac Surgery"
Recipient: Daniel S. Rubin, M.D.
Presenter: Brenda G. Fahy, M.D.

Lifetime Achievement Award
"An Unfocused Path"
Recipient: Stanley H. Rosenbaum, M.D.

SOCCA-FAER- Hospira Physician Scientist Award Lecture
"Cerebrovascular Autoregulation After Pediatric Cardiac Arrest"
Jennifer K. Lee-Summers, M.D.

The Frank-Starling Relationship is Absent in Patients with Pulmonary Hypertension: A 3-Dimensional Transesophageal Euchocardiographics Study in Patients Undergoing Cardiac Surgery

Recipient: Daniel S. Rubin, M.D.

Introduction: Pulse pressure variation is frequently used to predict the change in cardiac output with intravascular volume administration.1 Recent studies suggest that the effectiveness of pulse pressure variation is diminished or absent when pulmonary hypertension is present.2 We hypothesized that this diminished predictive power was due to an absent Frank Starling relationship in patients with pulmonary hypertension. To test our hypothesis, we correlated real time 3 dimensional transesophageal echocardiographic (RT3DE) assessments of right ventricular volume and function with central venous pressure (CVP) measurements in patients with and without pulmonary hypertension.

Methods: Patients undergoing cardiac surgery were prospectively enrolled after informed consent and IRB approval. CVP measurements, pulmonary artery pressures, and RT3DE assessments of right ventricular volume and function were then obtained after anesthetic induction and before incision. Using the Philips iE33 system and a matrix array transducer (X3-1) in the four chamber mid-esophageal view, dynamic RT3DE images of the right ventricle were obtained throughout the entire cardiac cycle. Image loops were analyzed offline by two independent, blinded investigators and 3D assessments of right ventricular end-diastolic (RVEDV) and end-systolic (RVESV) volumes were performed. Linear regression was then used to correlate CVP values with RVEDV, RVESV, and stroke volume.

Results: 21 patients completed the study. 13 patients underwent valve repair or replacement, 4 underwent combined CABG and valve surgery, 1 underwent CABG only, and 3 received a LVAD. 8 of 21 patients had pulmonary hypertension, defined as a mean pulmonary artery pressure > 25 mmHg. Right ventricular volumes were significantly larger in the group with pulmonary hypertension (189.9±42.2mL vs 130.1±36.0mL , $p<0.05$ for RVEDV, 133.6±40.9mL vs 76.4±25.1mL, $p<0.05$ for RVESV). CVP correlated strongly with RVEDV ($r=0.68$. $p<0.02$), RVESV ($r=0.67$, $p<0.02$), and RVSV ($r=0.56$, $p<0.05$) in patients with normal pulmonary artery pressures. No correlation between CVP and RVEDV, RVESV or RVSV was observed in patients with pulmonary hypertension

Discussion: We found that CVP correlated strongly with right ventricular volume and function only in patients with normal pulmonary artery pressures. Our data indicate that the Frank Starling relationship is only present in patients with normal pulmonary artery pressure, and suggest that CVP is a poor measure of intravascular volume in patients with pulmonary hypertension. Assessment for pulmonary hypertension may be warranted prior to use of either pulse pressure variation or CVP as a guide to hemodynamic management. Further work is needed to better understand the relationship between right ventricular volume, CVP, and pulse pressure variation in the presence of pulmonary hypertension.

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An Unfocused Path

Recipient: Stanley H. Rosenbaum, M.D.

Notes:

SOCCA-FAER- Hospira Physician Scientist Award Lecture

Cerebrovascular Autoregulation After Pediatric Cardiac Arrest

Jennifer K. Lee-Summers, M.D.

Outline:

1. Cerebrovascular autoregulation and cerebral vasoreactivity are the physiologic mechanisms that maintain relatively constant cerebral blood flow across changes in blood pressure.

2. Previous assumptions about cerebral autoregulation involve lesions clearly associated with intracranial hypertension, such as mass lesions with traumatic brain injuries and intracranial hemorrhages.

3. My research focuses on cerebral autoregulation after pediatric hypoxic brain injuries, specifically hypoxic-asphyxic pediatric cardiac arrest and neonatal hypoxic-ischemic encephalopathy.

4. Description of a neonatal swine model of hypoxic-ischemic brain injury/ cardiac arrest and therapeutic hypothermia.

5. Preliminary data suggests that therapeutic hypothermia may decrease the lower limit of autoregulation.

6. Autoregulatory function may change as time progresses during recovery from cardiac arrest.

7. Description of a neonatal swine model of hypoxic-ischemic brain injury/ cardiac arrest and recovery.

8. Introduction of novel autoregulation indices that are derived from near infrared spectroscopy (NIRS). These indices may potentially be used clinically to monitor blood pressure autoregulation in real time and identify individual patients' optimal blood pressure goals that support cerebral autoregulation.

9. Preliminary data of autoregulation monitoring with the NIRS-derived autoregulation indices in pediatric patients recovering from cardiac arrest and in neonatal patients with hypoxic-ischemic encephalopathy.

SESSION II - Lessons Learned from Military Critical Care

Rethinking Civilian Critical Care 2011
Todd E. Carter, M.D.

Rethinking Civilian Critical Care 2011

Todd E. Carter, M.D.

A Brief Overview of Recent Developments in Deployed Medical Care with an Emphasis on Critical Care Delivery Systems

The evolution of the model for deployed medical care in the US military has been driven by the changing nature of the US military mission in the post Cold War era. The Cold War model of care relied on relatively large facilities to provide definitive care. Patients remained in the facility until they could be returned to duty or were stable enough for evacuation. By necessity, such facilities required extensive resources to set up and operate with considerable time required to become fully operational. Concerns for deployed medical care shifted from the extensive use of these larger medical facilities to smaller rapidly deployable assets to meet the demand of short notice or evolving contingency operations in remote areas. Forward, easily transported facilities with an ability to perform life and limb saving procedures (damage control) were developed. Such facilities have limited space and holding capacity for patients and this in turn demanded the timely evacuation of patients often with the need for ongoing critical care interventions. The existing patient transport system had no organic critical care capability. If a critically ill patient required movement, ad hoc teams had to be assembled to meet the mission. This left the referring facility short on resources as it often was burdened with providing personnel for the transport. In response to these needs, CCATT was developed. Critical care air transport teams usually operate as a separate team augmenting aeromedical evacuation teams on USAF cargo aircraft and recently teams have been designated to perform a similar function on US Army rotary wing aircraft. In the USAF, aircraft are not dedicated for aeromedical evacuation specifically. They are configured by the air crew at the time they are needed. This adds considerable flexibility to the system since almost any airframe can be utilized as an aeromedical platform. The three member teams are composed of a physician, critical care nurse, and respiratory therapist. Physicians have either completed formal fellowship training in critical care medicine or demonstrated considerable experience in critical care medicine. The concept of operations calls for the capability to care for up to 3 critically ill or injured patients simultaneously or up to 6 patients of lower acuity. Teams carry all necessary equipment including three sets of gear consisting of a transport ventilator, physiologic monitor, multi-channel infusion device, and suction. A point-of-care blood analyzer is also part of the standard equipment and allows measurement of blood pH, pO2, pCO2, hemoglobin, serum sodium, serum potassium, and glucose. A cardioverter-defibrillator is carried as well. Equipment undergoes rigorous testing to ensure compatibility with aircraft systems, durability, and operational characteristics in extreme environments. Other support equipment includes supplies for performing endotracheal intubation, emergency surgical airway, tube thoracostomy, placement of intravascular devices, wound care, and other disposable items frequently encountered in the ICU such as nasogastric tubes, urinary catheters, and suction catheters. Pharmacy supplies include an extensive formulary with medication selections available from the majority of agent classes frequently encountered in critical care medicine as well as intravenous fluids. During the mid-1990s the model was employed and validated during a number military exercises and humanitarian missions. Later CCATT was involved in the evacuation of victims from the US Embassy bombings in Kenya and the attack on the USS Cole. The model for care for the current operations in Afghanistan and Iraq calls for early evacuation of “stabilizing” but not necessarily “stable” patients from the theater of operations to definitive medical treatment outside the theater. This often means that patients are transported within hours of damage control surgery while still requiring interventions such as mechanical ventilation, ongoing fluid resuscitation, and pharmacologic support of blood pressure. The challenge of providing care in the air is defined by a number of issues encountered in the aeromedical environment. Patients and crew are subject to a number of physiologic stresses of flight. The most clinically relevant for patient physiology relate to exposure to the hypobaric environment. Although the aircraft cabin is pressurized, cabin pressure of most military transport aircraft is approximately 8000 feet. While it is possible to achieve cabin altitudes close to sea level, this requires flight at lower altitudes resulting in increased fuel consumption and likelihood of turbulence. Exposure to altitude results in lower partial pressure of oxygen and expansion of gas present in closed spaces. Clinical consequences include hypoxemia, tension pneumothorax in the setting of unrecognized simple pneumothorax, expansion of trapped bowel gas leading to increased ostomy output or increased intra-abdominal pressure with potential for respiratory embarrassment, significant alterations in intracranial pressure in the setting of pneumocephalus, increased endotracheal tube cuff pressure, and sinus squeeze. Other significant stressors include forces related to acceleration leading to hemodynamic instability secondary to transient fluid shifts, autonomic responses, and increased intracranial pressure. Decreased humidity leads to increased insensible fluid losses and the potential for thickening of airway secretions and mucous plugging. Vibration can be particularly uncomfortable for patients with orthopedic injuries. Noise greatly diminishes the value of physical examination in flight and mandates strict visual vigilance in scanning physiologic monitors as the familiar audible alarms cannot be heard. Further, noise can induce hearing damage and is a significant barrier to communication and coordination between crew members. The ambient lighting on military aircraft varies with the airframe and nature of the mission. In some settings transport may take place under dark conditions. Temperature control can be problematic on many transport aircraft complicating thermal regulation of critically ill patients. The highly modular and transportable quality of the system makes it attractive for wider application. Based on the CCATT concept, sub-specialized flight teams have been developed for burn care and support of patients with severe lung injury. CCATT operates within a highly evolved Joint Theater Trauma System. The system represents a robust model of regionalized trauma and critical care management.

A Brief Overview of the Role of the ICU in Disaster Management

The Joint Commission requires hospitals to have written disaster management plans in place. However, the focus of local planning is often at the level of the first responder and emergency department. It is evident that the nature and magnitude of the specific disaster or mass casualty event will determine the resources needed to meet the patient demand. General categories of events include terrorist attack,

epidemic disease, and natural disasters. Terrorist events including the use of unconventional attacks including chemical, nuclear or biological weapons are a frequent focus for planners but conventional explosions with blast injury have been more common. Some events allow for a degree of preparation such as hurricanes where weather prediction frequently gives lead time for evacuation and initiation of contingency operations. Disease outbreaks usually evolve over days to weeks. However, other events such as earthquakes and terrorist attacks occur without warning. In general, healthcare facilities may see the greatest number of patients in the first hours after an event but these will likely not be the sickest patients. They may however cause crowding, slow triage and compromise care to higher acuity patients arriving later. The concept of Emergency Mass Critical Care addresses issues with triage of patients and triage of supplies and equipment and provision of essential critical care interventions when capacity in overwhelmed. Many local plans assume that hospital infrastructure remains intact to handle the influx of those needing care. As seen in natural disasters with extensive flooding, this is not always the case. Published data from a variety of mass casualty events suggest that approximately 16% of survivors utilize critical care resources. From an organizational perspective, disaster response is initiated at the local and state level. The federal government becomes involved in response only after declaration of a state of disaster by the governor. Hospital disaster plans frequently employ implementation of an Incident Command System to define command and control and communication within the facility including backup communications. Specifics of such plans usually address issues involving strategies for providing the manpower, material, and physical space necessary to care for the expanded patient population. In addition, personal protective equipment for providers and security for personnel and the facility must be taken into account. Considerations for the ICU include recall and scheduling of appropriate staff with several caveats. There may not be enough critical care staff employed to meet the demand. Communication failure and difficulties with transportation may interfere with notification of staff and their ability to get to the treatment facility. Some staff may be adversely affected by the nature of the event including injury and illness and therefore unable to report. It is readily apparent that hospital inventory or equipment including standard ICU devices such as mechanical ventilators, physiologic monitors and infusion pumps as well as consumable supplies and medications may be inadequate to meet demand. Plans for ICUs may include resource sharing and access to regional or national strategic stockpiles but timely delivery may again be hampered by communication and transportation problems. If hospital infrastructure remains intact, plans for expansion of ICU space often include use of alternative care areas within the hospital to provide critical care. Other strategies may include transfer of patients with more chronic conditions out of the ICU or transfer of patients out of areas pre-designated for expansion of ICU services to other facilities. Coordination of activities between local and state agencies as well as non-governmental and private sector assets is a key focus of local disaster planning. At the federal level the Federal Emergency Management Agency operates as part of the Department of Homeland Defense. The National Response Framework (NRF) determines policy and defines principles, roles and structures that promote preparedness, mitigation and organize a national response to a disaster event. The National Incident Management System (NIMS) works within NRF in providing templates to manage critical incidents that are employed at all levels of government, non-governmental organizations and within the private sector to promote a coordinated response. In addition to other assets, FEMA has the ability to deploy Disaster Medical Assistance Teams (DMAT).

Potential Disaster Scenarios to Consider

Scenarios may exist where the infrastructure remains intact but facilities are overwhelmed with victims.

In some cases infrastructure is destroyed or extensively damaged.

Contamination of personnel or equipment may be observed in with the use of chemical or nuclear weapons. In this situation, it may difficult to impossible to operate in the contaminated environment and all efforts will be complicated by time consuming decontamination processes.

Possible Application of the Military Model to the Civilian Sector

The CCATT concept was developed to meet the need for providing seamless critical care in the transport environment but has the ability to provide care in a highly portable manner in many settings. While a number of aspects of the CCATT model and transportable treatment facilities including the modular design, relatively small logistic footprint, and rapid deployment are extremely attractive in addressing the medical response to disasters, the resources required are significant and beyond what is considered practical for many individual civilian centers or health care systems. It is often assumed that if a severe disaster event occurs military assets can be brought to assist easily. This however is an inaccurate assumption. Federal legislation including the Posse Comitatus Act and the Stafford Act require significant political action to request and activate Department of Defense assets. The National Guard is an exception to this and can be requested by the State Governor. Increasingly capability has been built into Army and Air Guard units to assist with homeland defense issues and CCATT assets have been assigned to selected Air Guard units. While individual units can be activated and have participated in disaster relief operations, the overwhelming majority of the response capability comes from the civilian sector. However, examination of full scale operations in the current model of deployed medical care suggests a number of aspects of military operations that could have broad application within civilian disaster response and serve as “lessons learned” in assisting implementation of effective strategies and avoiding pitfalls.

Lessons Learned from the Field (Specific examples will be presented)

Have a “plan B” and “C” and ….

> Flexibility is required in dealing with rapidly evolving problems in a dynamic environment. Frequently, events will not unfold as anticipated.

Practice, practice, practice

> It is necessary to exercise how disaster plans will be implemented, what backup systems are available and the specifics of treating unfamiliar or infrequently encountered conditions. Focusing on problem areas from past critical events is helpful.
>
> Checklists and protocols are beneficial, especially in planning for treatment of uncommonly encountered conditions.

Just because you are in an austere environment disaster does not mean that fundamentals of good critical care practice go out the window.

> It will be necessary to provide critical care in a portable manner where care will occur outside of the classically defined ICU environment.

Be aware of issues of interoperability of equipment and other supplies.

If involved in multinational contingencies, beware of significant variations in medical practice between teams operating from different countries and implications for continued care.

Be aware of unintended consequences.

Key References

1. Beninati W, Meyer MT, Carter TE. The critical care air transport program. Crit Care Med. 2008;36(7 Suppl):S370-6.

2. Corcoran SP, Niven AS, Reese JM. Critical care management of major disasters: A practical guide to disaster preparation in the intensive care unit. J Intensive Care Med. 2011.

3. Dara SI, Farmer JC. Preparedness lessons from modern disasters and wars. Crit Care Clin. 2009;25(1):47-65, vii.

4. Farmer JC, Carlton PK,Jr. Providing critical care during a disaster: The interface between disaster response agencies and hospitals. Crit Care Med. 2006;34(3 Suppl):S56-9.

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6. Grissom TE, Farmer JC. The provision of sophisticated critical care beyond the hospital: Lessons from physiology and military experiences that apply to civil disaster medical response. Crit Care Med. 2005;33(1 Suppl):S13-21.

SESSION III: Education and Technology

PRO: My Generation is Better (What Has Worked Well in Medical Education)
Douglas B. Coursin, M.D.

CON: My Generation Rocks (Does Generation Y Learn Differently?)
Aaron M. Joffe, D.O.

Learning From Diversity: How Do We Teach, Learn, and Get Better if Everybody Does It Differently
Avery Tung, M.D.

Ultrasonography – Replacing Our Stethoscope! How Do We Get It Done
Michael H. Wall, M.D., FCCM

Role of Simulation/Learning Skills for Rare Events
Steven J. Lisco, M.D.

PRO: My Generation is Better (What Has Worked Well in Medical Education)

Douglas B. Coursin, M.D.

"There is no crying in baseball". Jimmy Dugan, *A League of Their Own*

"*Nobody said life would be fair*". Anonymous

The world of adult education continues to be dynamic as is the arena of benchmarking of medical education through NBME assessments, ACGME competencies and evolving milestones and ABMS Board certification and maintenance of certification. In this debate a facile, able and insightful younger intensivist who has incredible verbal skills and neuroplasticity will educate the audience about newer, although, frequently not validated methods to teach and learn. He will represent the Gen Y or Millennial generation approach to education.

An older man who is the ghost of intensivists past will represent the baby boomer generation and present the other half of the discussion. He will be recognized by his gray beard, loss of hair, and stooped demeanor, all acquired and precipitated by too many nights of ICU call. He will attempt to provide some insights and words of caution about abandoning some of the teaching elements that have been in place since ancient Greece and handed down generationally through Osler, Hurst and others.

Historically, the basis of clinical medical education was founded on several principles:

1. Read, read, and then read some more
2. See, manage and participate in the care of all the patients you can
    a. Apply the classic concept of "see one, do one, teach one"
    b. Learn from your mistakes
3. Widespread application of the Socratic method of bedside education or "pimping"
4. Participation in high stakes written, and occasionally, oral examinations through graduate medical education and the primary certification process

The explosive growth of Internet content and ease of access, availability of powerful portable electronic communication devices, social net-working, and virtual education through various simulation vehicles has lead to a tipping point in how individuals learn (or at least think they learn) and what they learn. Is Wikipedia, for example, the definitive answer? Is Up-to-Date the final word? What do we really need to know in the 21st century? Can we turn our learning and reservoir of knowledge over to "Watson" and allow Big Blue to be our intellectual database, collator of information, and decision maker, while we joyfully and somewhat mindlessly tweet away, peruse YouTube and podcasts, and examine the greater meaning of the cosmos through *Survivor*, *Dancing with the Stars* or *American Idol*?

From the geriatric intensivist's perspective there are several key issues to how we learn and need to continue to learn throughout our careers. First and foremost, we need to learn that medicine centers around two principles: knowledge, its reliable acquisition and proper application, and ownership. The ownership piece relates to how we relate to our patients and our jobs. We need to own them. To own them we must recognize and take responsibility. Part of that responsibility is in learning and maintaining our knowledge base and its application. The key to learning is to identify how we as individuals learn, how we obtain the educational resources that meet our needs, and how we retain, critique, re-examine and apply knowledge.

This talk will draw on some basic literature, life experience, comic relief, and potentially cynical observations.

Annotated References:

1. http://www.auahq.org/AUASummer2011Newsletter.pdf This newsletter contains a summary of a pro-con discussion between two well-regarded program directors, Bob Gaiser of Penn and Manny Pardo at UCSF. At the AUA annual meeting in May, 2011, they debated issues in learning and education related to newer methodologies.

2. Wendling AL, et al. Virtual humans versus standardized patients: which lead residents to more correct diagnoses? Acad Med 2011;86(3):384-8.

3. Deladisma AM, et al. Do medical students respond empathetically to a virtual patient? Am J Surg 2007;193:756-60. Guess what, they do, but not as genuinely or as empathetically as they would with a real person or patient.

4. Triola M,, et al. A randomized trial of teaching clinical skills using virtual and live standardized patients. J Gen Intern Med 2006;21:424-9.

5. Berkenstadt H, et al. Incorporating simulation-based objective structured clinical examination into the Israeli National Board Examination in Anesthesiology. Anesth Analg 2006;102:853-8.

6. Cook DA, et al. Technology-enhanced simulation for health professions education: a systematic review and meta-analysis. JAMA 2011;306:978-88.

7. Cook DA, et al. Instructional design variations in internet-based learning for health professions education: a systematic review and meta-analysis. Acad Med 2010;85:909-22.

Conclusions:

"In comparison with no intervention, technology-enhanced simulation training in health professions education is consistently associated with large effects for outcomes of knowledge, skills, and behaviors and moderate effects for patient-related outcomes".

Is that like saying, in comparison of drug x to drug y, drug x is non-inferior to drug y?

8. Cook DA, et al. Internet-based learning in the health professions: a meta-analysis. JAMA 2008;300:1181-96.

Conclusions:
"Internet-based learning is associated with large positive effects compared with no intervention. In contrast, effects compared with non-Internet instructional methods are heterogeneous and generally small, suggesting effectiveness similar to traditional methods. Future research should directly compare different Internet-based interventions".

9. Srinivasan M, et al. "Teaching as a Competency": Competencies for Medical Educators. Acad Med 2011 Aug 24. [Epub ahead of print]

"Most medical faculty receive little or no training about how to be effective teachers, even when they assume major educational leadership roles. To identify the competencies required of an effective teacher in medical education, the authors developed a comprehensive conceptual model -"Teaching as a Competency" model. Four core values grounded this framework: learner engagement, learner-centeredness, adaptability, and self-reflection. The authors identified six core competencies, based on the ACGME competencies framework. They also included four specialized competencies for educators with additional programmatic roles: program design/implementation, evaluation/scholarship, leadership, and mentorship. The Teaching as a Competency framework promotes a culture of effective teaching and learning.

10. Mann KV. Thinking about learning: implications for principle-based professional education. J Contin Educ Health Prof 2002;22:69-76.

"The understanding of teaching and learning in medical education has increased to improve medical education at all levels. Selected approaches to understanding learning provide a basis for eliciting principles that may inform and guide educational practice. *In this article, these approaches are discussed from two perspectives: the cognitive and the environmental. The cognitive perspective includes activation of prior knowledge, elaboration of new learning, learning in context, transfer of learning, and organization of knowledge. The environmental perspective includes the dynamic interaction of learners with their environment, observational learning, incentives and rewards in the environment, goal setting and self-monitoring, self-efficacy, and situated learning. Implications are presented for facilitation of effective learning and support of the learning environment throughout the continuum of medical education.*

Wenk M, et al. Simulation-based medical education is no better than problem-based discussions and induces misjudgment in self-assessment. Adv Health Sci Educ Theory Pract 2009;14:159-71.

"Simulation-based teaching (SBT) is increasingly used in medical education. As an alternative to other teaching methods there is a lack of evidence concerning its efficacy. The aim of this study was to evaluate the potency of SBT in anesthesia in comparison to problem-based discussion (PBD) with students in a randomized controlled setting. The current study demonstrates that both PBD and SBT lead to comparable short-term outcomes in theoretical knowledge and clinical skills. However, undesirably, SBT students overrated their anticipated clinical abilities and knowledge improvement".

Chumley-Jones HS, Dobbie A, Alford CL. Web-based learning: sound educational method or hype? A review of the evaluation literature. Acad Med 2002;77(10 Suppl):S86-93.

West CP, Shanafelt TD, Kolars JC. Quality of Life, Burnout, Educational Debt, and Medical Knowledge Among Internal Medicine Residents. JAMA 2011;306:952-60.

"Residents' burnout, exhaustion and debt affect their medical learning. Burnout and educational debt are associated with lower scores among residents taking the Internal Medicine In-Training Examination (IM-ITE). And some of the lower-scoring students are unable to catch up with their peers by the end of residency, according to a new study".

Greater educational debt was associated with the presence of at least one symptom of burnout. Residents reporting debt greater than $200,000 had mean IM-ITE scores 5.0 points (99% CI, 4.4 to 5.6; *P*<0.001) lower than those with no debt. As a point of comparison, these differences were as large as the increases normally seen as residents progress from their first to second postgraduate year (4.1 points; 99% CI, 3.9 to 4.3) and their second to third postgraduate year (2.6 points; 99% CI, 2.4 to 2.8).

Decreased quality of life and increased frequency of burnout symptoms were associated with lower IM-ITE scores.

Burnout was less common among international medical graduates than among U.S. medical graduates. This effect persisted after adjusting for debt. Researchers suggested that international medical graduates in the U.S. may be more resilient because they've already successfully completed a complex and highly competitive selection process for U.S. residency positions.

The study authors also noted that all members of the study cohort began training after duty hour limits went into effect in 2003, so burnout remains an issue despite these regulations. *I am shocked I tell you shocked, I thought duty hours were the solution to all problems: Safer care, fewer errors, better education, less burnout, and happier docs. Say it ain't so, Joe*

CON: My Generation Rocks (Does Generation Y Learn Differently?)

Aaron M. Joffe, D.O.

"*The problems that exist in the world today cannot be solved by the level of thinking that created them.*" Albert Einstein

"The effective, moving, vitalizing work of the world is done between the ages of twenty-five and forty…chloroform is recommended at sixty." Sir William Osler

The term *generation* is defined variably as 1) individuals born and living about the same time, 2) the average period between birth of parents and their children (approximately 30 years), or, 3) a group of individuals, most of whom are the same approximate age, having similar ideas, problems, attitudes, etc. Several monikers are notable in the 20th century. Those born from 1925–1945, most notably during the Great Depression (1929–1939) or World War II (1939–1945) are called the silent generation. A person who was born after World War II and who grew up during the 1960s and 1970s is referred to as a baby boomer. Generation X generally includes people born in the 1960s through the late '70s, while Generation Y (also called the Millennial Generation, Generation Next, Net Generation, or Echo Boomers) describes the demographic cohort following Generation X. A member of the post World War II baby boom will present the world of medical education through the eyes of a learned sage, regarding his students as apprentices. In response, a younger, better-quaffed former apprentice of the sage will explain why the pedagogy of the "sage on the stage" is an antiquated model of instruction.

The foundation of modern medical education has its origins in the apprenticeship model. Youth seeking medical training in the 17th and 18th centuries were "at an early age indentured to some reputable practitioner, to whom his service was successively menial, pharmaceutical, and professional; he ran his master's errands, washed the bottles, mixed the drugs, spread the plasters, and finally, as the stipulated term drew toward its close, actually took part in the daily practice of his preceptor,—bleeding his patients, pulling their teeth, and obeying a hurried summons in the night." The formation of formal medical schools followed. After accepting the Physician-in-Chief position in 1889 at the new Johns Hopkins Hospital, William Osler was instrumental in founding the Johns Hopkins University School of Medicine in 1893 subsequently started the first medical residency training program. William Halstead, also at Hopkins, soon started the first surgical residency program. With this system, trainees made up the majority of a hospital's total medical staff. The residency system was pyramidal in structure with many interns (at the bottom), fewer assistant residents (in the middle) and a single chief resident (at the top). Originally the chief occupied the position for several years. The residency was a full-time, sleep-in system whereby staff physicians lived in the Administration Building of the Hospital. As established, the residency was open-ended, and long tenure was the rule. Doctors spent as long as seven or eight years as residents, during which time they led a restricted, almost monastic life (sounds awesome!). Much was expected of the trainees as they essentially ran the medical care of the hospital. One attending physicians, William Halstead (considered a father or modern surgical technique), was noted for his seemingly inexhaustible work ethic. He expected the same of his residents. Only years later did it become clear that the tremendous productivity displayed during his lifetime is partly attributed to a lifelong addiction to cocaine. Such draconian conditions and unreasonable expectations placed upon trainees remained for many years. It is upon this shaky foundation that modern medical education training systems were based.

This talk will focus on how the new generation learns best. In truth, all humans learn in exactly the same way (don't tell Dr. Coursin I say so). The neurobiology of learning has been there since time immemorial, but it is only in recent years that scientists and educators have attempted to integrate these concepts into traditional educational systems to improve the efficiency and individuality of the learning process.

The historical system in which the sage was raised:

1. Read, read, and then read some more
2. See, manage and participate in the care of all the patients you can
    a. Apply the classic concept of "see one, do one, teach one"
    b. Learn from your mistakes
3. Widespread application of the Socratic method of bedside education or "pimping"
4. Participation in high stakes written, and occasionally, oral examinations through graduate medical education and the primary certification process will be expanded to include several other concepts. Concessions will be made by the younger, genuflect presenter, that all is not bad with the older system provided tweaks are made. As with the sage, the former apprentice will also draw on some basic literature, life experience, and comic relief. There is no doubt that cynical observations will be made.

Annotated References:

1. Friedlander MJ, Andrews L, Armstrong EG, Aschenbrenner C, Kass JS, Ogden P, Schwartzstein R, Viggiano TR. What can medical education learn from the neurobiology of learning? Acad Med. 2011 Apr;86(4):415-20.

   This article briefly explains the molecular and cellular basis for learning and list implications for medical teaching and curricular development. Individually, specific elements of learning are discussed: Repetition, Reward and reinforcement, Visualization, Active engagement, Stress, Fatigue, Multitasking, Individual learning styles, Active involvement, and Revisiting information/ concepts through multimedia.

2. Wesch M. A vision of students today.http://mediatedcultures.net/mediatedculture.htm (accessed August 23, 2011)

   An interesting web site by Dr. Michael Wesch, an Assistant Professor of Cultural Anthropology and Digital Ethnography at Kansas State University. Various areas of old and new pedagogy in education are found.

3. Pasquale SJ, Pugnaire MP. Preparing medical students to teach. Acad Med. 2002 Nov;77(11):1175-6.

A week-long elective, Physician as Teacher, was designed to encompass core educational information such as needs assessment of learners, establishing goals and objectives, teaching methods, and evaluation and feedback. This core information was then applied and enriched during an end-of-course teaching presentation. Students reported that the end-of-course teaching presentation was a rich source of their learning, and an important vehicle for helping them apply and synthesize the new knowledge. Seventy-one percent of those students "strongly agreed" and 29% "agreed" that the course provided useful knowledge and skills. Seventy-nine percent "strongly agreed" and 21% "agreed" that their teaching would be better because of the course.

Learning From Diversity: How Do We Teach, Learn, and Get Better if Everybody Does It Differently

Avery Tung, M.D.

Notes:

Ultrasonography – Replacing Our Stethoscope! How Do We Get It Done

Michael H. Wall, M.D., FCCM

Notes:

Critical Care Ultrasound: Applications and Training

Michael H Wall, MD, FCCM
Professor of Anesthesiology and Cardiothoracic Surgery
Washington University

Outline

- History of CCUS
- Applications
- Training
- Certification?

Emergency and CCUS

- 1991-Am Col Emerg Phys offered 1st course
- 1991-ACEP and Soc Academic EM
  - Position papers published
- 1994-(SAEM) "Model Curriculum for physician training in emergency US"
- 2001-(ACEP) "Emergency US Guidelines"
  - Scope of practice, indications
  - Credentialing, QA and documentation

What is EUS or CCUS?

- Clearly defined condition in which US improves patient care
- Focused limited examination
- Characterized by 1 or 2 easily recognizable findings
- Easily learned
- Quickly performed
- Direct decision making
- Performed at the bedside

www.acep.org
Kendall et al CCM 2007 S126

‘ACCP/SRLF Statement on Competence in CCUS”

- Mayo et al 2009;135, 1050

- General CCUS (GCCUS)
  - Pleural
  - Lung
  - Abdominal
  - Vascular-access
  - Vascular-DVT
- Echocardiography
  - Basic
  - Advanced

Focused Assessment with Sonography for Trauma (FAST)

- 1970- (Goldberg) US could detect fluid in cadavers
- 1971-(Kristensen) 1st US dx of splenic injury
- 1976-(Asher) US to describe and grade splenic injury
- 1988- (Mayron) 1st paper by EM
- 1990s-FAST part of ATLS

FAST-views

- Subxiphoid
  - Heart/liver
- RUQ
  - Liver/kidney/Morrison's pouch/thoracic
- LUQ
  - Spleen/kidney/fluid/thoracic
- Suprapubic
  - Pouch of Douglas

Korner RadioGraphics 2008;28,1

FAST-uses

- Best in HD unstable blunt trauma patients
- Effective at finding intra-abdominal fluid that requires immediate surgery
  - Probability of death increases 1% every 3 min
- Exclude injury to heart pericardium
- Not good for excluding injuries to:
  - Bladder
  - Bowel
  - Mesentery
- Not good for solid organ injuries w/o free fluid

Korner RadioGraphics 2008;28,1

Vascular Access

- 2001-AHRQ recommends 2D US guided CVC
- 2002-NICE (UK)
  - Natl Institute for Clinical Excellence
  - 2D is preferred method
- 2 meta-analysis, one PRCT
  - Decreased failure rate
  - Decreased number of attempts
  - Decreased complications

Kumar Best Pract Res Clin Anesth 2009;23,299

Accuracy of US performed by CC MDs for the diagnosis of DVT

- Kory Chest 2011;139, 538

- Intensivist performed compression US vs
  - Fellows <2yrs experience
- Formal vascular study
- (n=128)
  - Sensitivity 86%
  - Specificity 96%
  - Accuracy 95%
  - Faster (by 13 hours)

Emergency US of the Chest

- Reissig 2011 CCM 39,839 (Excellent review)

- US useful for;
  - Life-threatening thoracic pain
    - (esophageal rupture, ACS, PE, PTX, Aortic dissection)
  - PE
  - PTX
  - Pneumonia
  - Pleural fluid
  - Lung contusion
  - Pulm edema, ALI, ARDS

Echocardiography in Intensive Care

- World Interactive Network Focused on CCUS (WINFOCUS)
- Basic (Emergency Echo)
- Level 1
- Level 2 (Advanced)
  - Equates to level II competence as described by American College of Cardiology Statement of Competence
- Level 3

Price et al CV Ultrasound 2008; 49
Quinones Circ 2003;107, 1068
Kaplan Chest 2009;135,529

Basic (Emergency Echo)

- FEEL&FATE in ACLS and ATLS
- Major causes of arrest and shock
- TTE only

Price et al CV Ultrasound 2008; 49

Level 1

- Acquire all standard views
- Normal vs abnormal
- Diagnose common abnormalities
- Seek expert advice
- Analogous with interpretation of x-rays, ECG
- Training
  - During CCM fellowship
  - Course work plus experience plus on-line learning

Price et al CV Ultrasound 2008; 49

Level 2

- Acquire all standard views (TTE and TEE)
- Diagnose almost all abnormalities
- Perform US-guided invasive procedures
- Teach
  - Emergency and Level 1
- Training
  - During CCM fellowship, or after.
  - Course work plus experience plus on-line learning
- Certification
  - Pass exam

Price et al CV Ultrasound 2008; 49

Level 3

- Acquire all standard views (TTE and TEE)
- Perform US-guided invasive procedures
- Perform research in Echo
- Teach
  - All levels
- Training
  - Additional training beyond CCM
- Certification
  - Pass exam

Price et al CV Ultrasound 2008; 49

Focused TTE

- Cowie Anesth Int Care 2010;38,823
- Excellent review
- 5 standard views
  - Parasternal long axis
  - Parasternal short axis
  - Apical 4 chamber
  - Apical 2 chamber
  - Subxiphoid
- Evaluate
  - Valve disease
  - Hemodynamic instability
  - Ventricular function
  - Dyspnea
  - Hypoxia
  - Intravascular volume status

Focused Echo Eval in Life Support (FEEL)

- During 10 sec ALS-conformed interruption of CPR
- Views
  - Subcostal
  - Parasternal
  - Apical
- Cardiac motion?
- LV function
- RV dilation
- Pericardial fluid
- Hypovolemia
- +/- pneumothorax

Breitkreutz CCM 2007;35, S150
Breitkreutz Resuscitation 2010;81,1527

FEEL: A prospective trial

- 100 cardiac arrest and 104 shock state
  - Pre-hospital resuscitation
- 96% Diagnostic images obtained
- Cardiac motion detected in;
  - 35% of pts with ECG of asystole
  - 58% of PTS with PEA
- 78% of cases FEEL altered therapy

Breitkreutz Resuscitation 2010;81,1527

Focused Cardiac US Study (FOCUS)
Focused CC US Study (FOCCUS)

- Assess;
  - LV RV fxn
  - Pericardial space
  - Volume status
  - Guide invasive procedures
  - +/- Lung pathology
  - +/- Abdominal fluid

Manasia JCTVA 2005;19,155
Labovitz J Am Soc Echo 2010;23,1225

Focused Rapid Echo Exam (FREE)

- 53 Trauma ICU pts
  - 80% obtained an EF
  - 56% had moderate to severe LV dysfunction
  - 25% had RV dysfunction
  - 80% had respiratory variation in IVC
  - 54%-FREE changed therapy
- (FREE is same as FOCUS)

Ferada J Trauma 2011;70,56

Training

- Numerous studies have shown that focused echo can be learned quickly
  - Internal medicine residents
    - 20 hours training, 20 exams
  - Intensivists
    - 6 hours training
  - ICU residents
    - 8 hour training

DeCarva Eur J Echo 3003;4,141
Manasia JCTVA 2005;19,155
Vignon Int Care Med 2007;33,1795

"Basic CC Echo: Validation of a Curriculum…"

- Vignon CCM 2011;39,636

- Residents
  - 4 hour didactics
  - 2 hr interactive clinical cases
  - 6 hours hands on
- Accurate dx
  - LV fxn
  - Dilated LV and RV
  - Dilated IVC
  - Tamponade

Training GCCUS

- Should be part of a CCM Fellowship
  - Pleural/Lung
  - Abdominal
    - FAST??
    - Limited abdominal US
      - Bladder, kidneys
  - Vascular-access/DVT
    - 5 to 12 hours training adequate

Kory Chest 2011;139, 538

Training GCCUS(2)

- Annual meetings
  - ACCP
  - SCCM
  - SCA
  - ASE
  - ASA
  - SOCCA!

Training-CC Echo

- Basic TEE
  - As part of core residency
- Level 1
  - As part of CCM fellowship
  - Web-based
    - www.anesthesia-analgesia.com (echo rounds)
    - www.e-echocardiography.com
    - www.jcardioanesthesia.com
    - www.scahq.org
    - www.sccm.org
    - www.icuimaging.ca
    - www.chestnet.org
    - HTTP://pie.med.utoronto.ca/TEE

Training CC Echo(2)

- Annual meetings
  - SCA/ASA course (2d course, 4x/yr)
    - iTEE (Introduction to TEE for Noncardiac surgery
    - Aka "Focused Basic TEE"
  - ACCP
  - SCCM
  - SCA
  - ASE
  - ASA
  - SOCCA!

Accreditation, Certification, Competency

- Accreditation
  - Goal-enhance patient safety and quality of care
  - Practice issues (equipment calibration, maintenance, universal precautions, adherence to guidelines etc)
- Certification
  - "Acknowledgement by a medical specialty board of successful completion of requirements for recognition as a specialist"
- Competent
  - "Capable; fit or sufficient; adequate"
- *"Practices are accredited, individuals are certified"*

Certification

- CC Echo?
  - Maybe, NBE considering it
- GCCUS?

- Or should CCM be like OB/Gyn and declare that CCSU is part of the training in CCM and just be done with it?

Conclusion

- ACC/AHA
- "the era of the ultrasound-assisted physical examination has arrived"

Quinones Circ 2003;107, 1068

Role of Simulation/Learning Skills for Rare Events

Steven J. Lisco, M.D.

Notes:

Poster Presentations

(Note: Bold name represents poster presenter)

Poster 1 — Trends in In-Hospital Major Morbidity and Mortality After Total Joint Arthroplasty: USA 1998-2008
Meghan A. Kirksey, M.D., Ph.D.[1]; L. Poultsides, M.D.[2]; Y. L. Chiu, Ph.D.[3]; Y. Ma, Ph.D.[2]; S. G. Memtsoudis, M.D., Ph.D.[2]
New York Presbyterian Hospital - Weill Cornell, Hospital for Special Surger[1]; Hospital for Special Surgery[2]; Weill Cornell Medical College of Cornell University[3]

Poster 2 — Preoperative Statin Administration Does Not Protect Against Early Postoperative Acute Lung Injury: A Retrospective Cohort Study.
Amandeep Singh, M.B.B.S.; Katie A. Stockler, R.N.; Ericka J. Slivinski, R.N; Robin L. Olsen, R.N.; Anas Alsara, M.D.; Daryl J. Kor, M.D.
Mayo Clinic

Poster 3 — Tissue Oxygenation in Response to Intraoperative Homologous Blood Transfusion in Complex Spine Surgery
Jens M. Walz, M.D.[1]; Stavros G. Memtsoudis, M.D., Ph.D.[2]; Michael Urban, M.D., Ph.D.[2]; Bruce A. Barton, Ph.D.[3]; Babs R. Soller, Ph.D.[4]; Stephen O. Heard, M.D.[1]
University of Massachusetts Memorial Healthcare[1]; Hospital for Special Surgery, NYC[2]; University of Massachusetts Medical School[3]; Reflectance Medical, Inc.[4]

Poster 4 — Epidemiology and Risk Factors for Perioperative Mortality After Total Hip and Knee Arthroplasty
Stavros G. Memtsoudis, M.D., Ph.D.[1]; Matthias Pumberger, M.D.[1]; Anna Maria Bombardieri, M.D.[1]; Ya Lin, MS[2]; Peter Gerner, M.D.[3]
Hospital for Special Surgery[1]; Weill Medical Cornell[2]; Paracelsus Medical University[3]

Poster 5 — The Role of Endothelial Health in Prevention of ICU Brain Dysfunction
Christopher G. Hughes, M.D.; Alessandro Morandi, M.D.; Jennifer Thompson, MPH; Timothy Girard, M.D., MSCI; E. W. Ely, M.D., MPH; Pratik Pandharipande, M.D., MSCI
Vanderbilt University School of Medicine

Poster 6 — Etomidate and Adrenal Function in Cardiac Surgery: A Retrospective Cohort Study
Chad E. Wagner, M.D.; Julian S. Bick, M.D.; Christine R. Parker, Ph.D.; Daniel Johnson, Ph.D.; Rashid Ahmad, M.D.; Mias Pretorius, M.D.
Vanderbilt University

Poster 7 — Prevalence and Risk Factors of Delirium in the Cardiovascular Intensive Care Unit
Chad E. Wagner, M.D.; John McPherson, M.D.; David D. Hall, M.D.; Daniel Johnson, Ph.D.; Wesley Ely, M.D.; Pratik Pandharipande, M.D.
Vanderbilt University

Poster 8 — Serial Monitoring of Cardiac Function and Filling in 13 Patients During Therapeutic Hypothermia Following Cardiac Arrest: Performance Characteristics of the ClariTEE™ Probe
Chad E. Wagner, M.D.[1]; Julian S. Bick, M.D.[1]; Jacob Schaff, M.D.[2]; John McPherson, M.D.[1]
Vanderbilt University Medical Center[1]; Colombia[2]

Poster 9 — Ten Year Trends in Specialist Billing for Critical Care Services in the United States (1998-2007)
Adam S. Evans, M.D., MBA; Joanne Brady, M.Sc., Robert N. Sladen, M.D.; Hannah Wunsch, M.D., M.Sc.
NY Presbyterian Hospital-Columbia

Poster 10 — Gegenhalten Phenomena in the Surgical Intensive Care Unit after Orthotopic Liver Transplant
Insung Chung, M.D.; Vivek Moitra, M.D.
Columbia University

Poster 11 — Prediction of Acute Lung Injury (ALI) in Elderly Patients Within the First 48 Hours of ICU Admission
Alexander F. Bautista, M.D.; Ozan Akca, M.D.; Rainer Lenhardt, M.D.; Michael Heine, M.D.; Mattthew Kuestner, M.D.
University of Louisville, Department of Anesthesiology and Perioperative Medicine

Poster 12 — Can We Predict Mortality in Elderly Ventilated ICU Patients Within the First 48-Hour of Admission?
Alexander F. Bautista, M.D.; Ozan Akca, M.D.; Rainer Lenhardt, M.D.; Michael Heine, M.D.; Ed Mascha, Ph.D.
University of Louisville, Department of Anesthesiology and Perioperative Medicine

Poster 13 Ethical Case Presentation; Failed Lung Transplant x2
Richard B. Silverman, M.D.; Sean Quinn, M.D.
University of Miami

Poster 14 Arterial Monitoring in Post Transplant Patient Using Antegrade Radial Artery Stump Pressures Assessed With Ultrasound in a Patient With Anasarca
Richard B. Silverman, M.D.; Bruce Saltzman, M.D.
University of Miami

Poster 15 *Young Investigator Award*
The Frank-Starling Relationship is Absent in Patients with Pulmonary Hypertension: A 3 Dimensional Transesophageal Echocardiographic Study in Patients Undergoing Cardiac Surgery
Daniel S. Rubin, M.D.; Avery Tung, M.D.
Department of Anesthesia and Critical Care, University of Chicago Medical Center

Poster 16 What Starling Curve? Right Ventricular Dysfunction Abolishes the Frank-Starling Relationship as Assessed by 3-Dimensional Echocardiography and CVP in Patients Undergoing Cardiac Surgery
Daniel S. Rubin, M.D.; Avery Tung, M.D.
Department of Anesthesia and Critical Care, University of Chicago Medical Center

Poster 17 Real Time Determination of Respiratory System Resistance (Rrs) During Pressure Support Ventilation (PSV) Using the Expiratory Time Constant (TE)*
Nawar N. Al-Rawas, M.D.[1]; Michael J. Banner, Ph.D.[1]; Neil Euliano, Ph.D.[2]; Jeff Brown, RRT[1]; Daniel Martin, Ph.D.[1]; Andrea Gabrielli, M.D.[1]
University of Florida[1]; Convergent Engineering[2]

Poster 18 Real Time Calculation of Respiratory System Compliance (Crs) and Plateau Pressure (Pplt) During Pressure Support Ventilation (PSV) *
Nawar N. Al-Rawas, M.D.[1]; Michael J. Banner, Ph.D.[1]; Neil Euliano, Ph.D.[2]; Michael W. Stahl, M.S.[2]; Daniel Martin, Ph.D.[1]; Andrea Gabrielli, M.D.[1]
University of Florida[1]; Convergent Engineering[2]

Poster 19 Predictors of Postoperative Acute Lung Injury in a Low-Incidence Surgical Population
Michael J. Stentz, M.S.; Pauline K. Park, M.D.; James M. Blum, M.D.
University of Michigan Health System

Poster 20 Temperature and pH are Important Considerations When Attempting to Predict PaO2 from SaO2
William B. Beam, M.D.; Gregory A. Wilson, RRT; Michael Malinchoc, B.S.; Ognjen Gajic, M.D.; Guangxi Li, M.D.; Daryl J. Kor, M.D.
Department of Anesthesia, Division of Critical Care, M.E.T.R.I.C., Mayo Clinic, Rochester, Minnesota

Poster 21 Determination of Brain Death on Veno-Arterial Extracorporeal Membrane Oxygenation in Adults
Bobby Das, M.D.; Adam Evans, M.D.; Lloyd Meeks, M.D.; Gebhard Wagener, M.D.; Sumeet Goswami, M.D.
Columbia New York Presbyterian Hospital

Poster 22 Efficacy and Risk of Anticoagulation for Atrial Fibrillation in Patients Admitted to the Intensive Care Unit Following Noncardiac Surgery
Paul Gunn, M.D.[1]; Anas Alsara, M.D.[1]; Persida Drotar, M.D.[2]; Benjamin Dreesman, Ph.D.[1]; Amandeep Singh, M.B.B.S.[1]; Daryl Kor, M.D.[1]
Mayo Clinic[1]; University of Arizona[2]

Poster 23 The Contribution of Continuous Transesophageal Echocardiography to the Postoperative Management of Hemodynamically Unstable Cardiac Surgery Patients
William T. Costello, M.D.; Frederic T. Billings, IV, M.D.; Julian Bick, M.D.; Chad Wagner, M.D.
Vanderbilt University Medical Center

Poster 24 Comparative Effectiveness of Centrally versus Peripherally Transduced Venous Pressure Monitoring in the Perioperative Period in Spine Surgery Patients
Anna Maria Bombardieri, M.D.; James Beckman, M.D.; Pamela Shaw, B.S.; Federico Girardi, M.D.; Yan Ma, Ph.D.; Stavros Memtsoudis, M.D., Ph.D., FCCP
Hospital for Special Surgery

Poster 25 Physicians' Compliance with Patient Advance Directives: A Survey of the Fear of Legal Liability
Christopher M. Burkle, M.D.; Mark T. Keegan, M.D.; Deepi G. Goyal, M.D.; Paul S. Mueller, M.D.
Mayo Clinic

Poster 26 Application of Neurally Adjusted Ventilatory Assist (NAVA)
Stuart M. Lowson, M.B.B.S; Daniel Rowley, RRT-NOS; Clark Linda, RRT; Witte Jurgen, M.D.; Caruso Frank, RRT
University of Virginia Health System

Poster 27 The Effect on PA Catheter Directed Intraoperative Management on Post Operative Kidney Injury
Eric K. Cannon, M.D.; Daryl J. Kor, M.D.; Liang H. Tan, M.B.B.S.; Arun Subramanian, M.B.B.S.
Department of Anesthesiology, Mayo Clinic College of Medicine

Poster 28 Septic Shock and Multi-Organ Failure with Elevated Hematocrit From Capillary Leak
Crisanjali R. Rajaratnam, M.D.; Peter Roffey, M.D.; Mariana Mogos, M.D.; Duraiyah Thangathurai, M.D.
University of Southern California, Keck School of Medicine

Poster 29 An Uncommon Presentation of Supraventricular Tachycardia in the ICU Refractory to Conventional Therapy
Crisanjali R. Rajaratnam, M.D.; Mariana Mogos, M.D.; Peter Roffey, M.D.; Duraiyah Thangathurai, M.D.
University of Southern California, Keck School of Medicine

Poster 30 Severe Chest and Back Pain and Bilateral Massive Adrenal Swelling in Polycythemia Vera: A Postsurgical Scene
Ana B Fernandez[1]; Azahara Sancho De Avila[2]; Nayra Gomez[3]; Milagros Fuentes[2]
Department of Anesthesiology, Intensive Care and Pain Treatment, Ntra Sra de Candelaria University Hospital, Santa Cruz de Tenerife, Canary Islands, Spain[1]; Candelaria University Hospital, Santa Cruz de Tenerife, Canary Islands, Spain[2]; Department of Radiology, Ntra Sra de Candelaria University Hospital, Santa Cruz de Tenerife, Canary Islands, Spain[3]

Poster 31 Developing a Stepwise Approach to Endotracheal Intubation
Oliver Applegarth, M.D., M.Ed., FRCPC; Edward Allcock, B.M., FRCA; Donald E.G. Griesdale, M.D., MPH, FRCPC; Adam Peets, M.D., M.Sc., FRCPC; Mark Vu, M.D., FRCPC
University of British Columbia

Poster 32 Goal Directed Fluid Management During Complex Spinal Surgery Using the Flo-Trac System
Michael K. Urban, M.D., Ph.D.; Stavros Memstoudis, M.D.; Federico Girardi, M.D.; Dorothy Marcello, B.A.
Department of Anesthesiology, Hospital for Special Surgery

Poster 33 Beta Blockade and Amiodarone Prevention of Atrial Fibrillation Following Cardiac Surgery
Margaret J. Fernandez, Ph.D.[1,2]; Willam T. Peruzzi, M.D.[1]
Jackson Memorial Hospital[1]; University of Miami, Miller School of Medicine[2]

Poster 34 A Comparison of Rescue Airway Devices placed by EMS Providers in a Human Patient Simulation Model
Christopher J. Voscopoulos, M.D.; Tobias Barker, M.D.; Charles Pozner, M.D.; Todd Listwa, M.D.; Richard Zane, M.D.; Jill Antoine, M.D.
Emory University School of Medicine and Brigham and Women's Hospital

Poster 35 My Pregnant Patient NEEDS a Lung Volume Reduction Surgery...What?? Really
Sheela S. Pai, M.D.; Jessica Luke, D.O.
Temple University School of Medicine

Poster 36 Omega-3 Fatty Acid Supplementation, Body Mass Index, and Risk of Acute Kidney Injury Following Cardiac Surgery
Rajesh Ramakrishna, M.B.B.S.; Patricia Hendricks, R.N.; Frederic T. Billings, M.D., M.Sc.
Vanderbilt University

Poster 37 The Surgical Apgar Score as a Predictor of Admission to ICU After Intra-Abdominal Surgical Procedures
Julia Sobol, M.D., MPH[1]; Nanshi Sha, M.Sc.[2]; Guohua Li, M.D., Dr.P.H.[3]; Hannah Wunsch, M.D., M.Sc.[3]
Department of Anesthesiology[1]; Departments of Anesthesiology and Biostatistics[2]; Departments of Anesthesiology and Epidemiology[3]; Columbia University

Trends in In-Hospital Major Morbidity and Mortality After Total Joint Arthroplasty: USA 1998-2008

Meghan A. Kirksey, M.D., Ph.D.[1]; L. Poultsides, M.D.[2]; Y. L. Chiu, Ph.D.[3]; Y. Ma, Ph.D.[2]; S. G. Memtsoudis, M.D., Ph.D.[2]
New York Presbyterian Hospital - Weill Cornell, Hospital for Special Surgery[1]; Hospital for Special Surgery[2]; Weill Cornell Medical College of Cornell University[3]

Background: Total hip and total knee arthroplasties are increasingly common surgical procedures in the United States. This work serves to elucidate recent trends in demographics and perioperative morbidity and mortality with these procedures.

Methods: Data from the National Impatient Sample for each year between 1998 and 2008 were gathered for primary total hip arthroplasties (THAs) and total knee arthroplasties (TKAs). Trends in patient age, comorbidity burden, and length of hospital stay were analysed. Trends in mortality and frequency of life-threatening perioperative complications were also examined. Complications and mortality are calculated per 1000 patient days to account for changes in length of hospital stay over the time period examined.

Results: An estimated 2,290,751 and 4,439,784 admissions for THA and TKA were recorded in the US between 1998 and 2008. The average age of patients decreased by 2-3 years. The average length of stay decreased by approximately 1 day over the time interval studied, accompanied by a decrease of routine discharges to the patients home in favor of discharges to long and short term care facilities. There was a trend of increasing comorbidity burden as measured by the Deyo comorbidity index (P<0.0001). An increasing incidence of life-threatening peri-operative events including thromboembolism, sepsis, non-myocardial infarction cardiac complications, and pneumonia (P<0.0001) was recorded. Recent trends towards declining rates of myocardial infarction after TKA (P 0.013) and stable rates after THA were seen. The incidence of in-hospital shock/cardiac arrest and mortality declined over time after both TKA and THA (P<0.0001).

Conclusion: Between 1998 and 2008 trends show increasing in-hospital life-threatening complications after THA and TKA, but declining in-hospital shock/cardiac arrest and mortality. The former observation may be the result of increasing rates of patient comorbidities, while the latter suggests that improvements in perioperative care have decreased the incidence of catastrophic outcomes.

Preoperative Statin Administration Does Not Protect Against Early Postoperative Acute Lung Injury: A Retrospective Cohort Study.

Amandeep Singh, M.B.B.S.; Katie A. Stockler, R.N.; Ericka J. Slivinski, R.N; Robin L. Olsen, R.N.; Anas Alsara, M.D.; Daryl J. Kor, M.D.
Mayo Clinic

Introduction: Acute lung injury (ALI) is a devastating postoperative complication with an estimated mortality exceeding 45% in certain surgical populations. The pathogenesis of ALI is believed largely mediated by activation of the inflammatory cascade. Statins have been shown to possess important anti-inflammatory and immunomodulatory effects. The objective of this study was to determine if preoperative statin therapy is associated with a reduced frequency of postoperative ALI among patients undergoing elective high-risk thoracic and aortic vascular surgery.

Methods: Following IRB approval, we performed a retrospective cohort study evaluating of the association between preoperative statin therapy and early postoperative ALI (within 5 postoperative days). The study population included consecutive consenting patients undergoing elective high-risk thoracic (esophageal and lung resection surgery) and aortic vascular surgery. Data on baseline characteristics including demographic variables, comorbidities, and medications were recorded. The presence of statin therapy at the time of hospital admission was determined for all study participants. The primary outcome variable was early postoperative ALI. American-European Consensus Conference criteria were used to define ALI. The association between preoperative statin administration and postoperative ALI was first assessed with univariate analysis. To control for statin indication bias and other confounding factors, a multivariate logistic regression analysis was performed. Statin propensity was added as a covariate in this multivariate model.

Results: Out of 1845 surgical patients, 722 were receiving preoperative statin therapy. A total of 120 patients developed early postoperative ALI. The frequency of ALI among those who were receiving statin therapy versus those who were not was 7.2% vs. 6.1% (OR = 1.20, 95% CI = 0.83 – 1.75; p = 0.33). After adjusting for the propensity to receive statin therapy, as well as other pertinent confounding variables, no significant relationship between statins and ALI was noted (OR = 0.98, 95% CI = 0.61 – 1.56; p = 0.93).

Conclusion: In patients undergoing high-risk thoracic and aortic vascular surgery, preoperative statin therapy is not associated with a reduction in early postoperative ALI. Our results temper the enthusiasm for statin therapy as a potential therapeutic option in patients with or at-risk for postoperative ALI.

Tissue Oxygenation in Response to Intraoperative Homologous Blood Transfusion in Complex Spine Surgery

Jens M. Walz, M.D.[1]; Stavros G. Memtsoudis, M.D., Ph.D.[2]; Michael Urban, M.D., Ph.D.[2]; Bruce A. Barton, Ph.D.[3]; Babs R. Soller, Ph.D.[4]; Stephen O. Heard, M.D.[1]

University of Massachusetts Memorial Healthcare[1]; Hospital for Special Surgery, NYC[2]; University of Massachusetts Medical School[3]; Reflectance Medical, Inc.[4]

Background: Recent data suggest that transfusion of homologous packed red blood cells (PRBC) in the perioperative setting have limited efficacy in improving oxygen delivery to tissues1. Tissue oxygen saturation (as a proxy for microvascular blood flow) determined by Near Infrared Spectroscopy has been validated in animal models as well as healthy human volunteers2, and has been used in a variety of clinical settings3. We sought to determine the impact of homologous blood transfusion on tissue oxygenation in patients undergoing complex spine surgery.

Methods: After Institutional Review Board approval and written informed consent, we performed a prospective, observational clinical trial in 7 patients undergoing complex spine surgery in a single specialty hospital. Patients were monitored with standard ASA-monitors; in addition, invasive parameters by means of pulse contour analysis as well as NIRS-determined noninvasive skeletal muscle oxygen saturation (SmO2) were continually measured. HCT levels were obtained in regular intervals as determined by the treating physicians. The SmO2 response to transfusion was then measured. To determine the relationship between HCT and SmO2 values, Spearman's correlation was performed.

Results: Anterior/posterior spine surgery was performed in four females and three males, age range from 39 to 64 years. Transfusions in all 7 patients resulted in transient increases in SmO2, which did not appear to depend on HCT level (Figure 1). In addition, there was an insignificant negative correlation between SmO2 and HCT values (rho=-0.1185, p=0.63).

Discussion: The transient improvement in SmO2 after transfusion may have been related to a storage injury to the PRBC resulting in an impaired ability to unload O2 to the tissues. Alternatively, red cell deformability may have been reduced thereby altering capillary bed perfusion patterns (e.g. shunting). This is supported by the fact that we were unable to demonstrate a sustained improvement in SmO2 in response to transfusion or a positive correlation between SmO2 and HCT-values. To investigate the relationship between these two variables more closely, non-invasive continuous HCT measurement by means of NIRS technology will be added to the protocol for the remainder of this ongoing clinical pilot study (target enrollment n=40).

References:

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2. Soller BR, Yang Y, Soyemi OO, et al. Noninvasively determined muscle oxygen saturation is an early indicator of central hypovolemia in humans. J Appl Physiol 2008; 104:475-481.
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Figure 1: Representative data from one patient undergoing complex spine surgery. SmO2 (blue line) response to transfusion (red line) over time. Note the transient upstroke in SmO2 following infusion of PRBC. HCT denoted as black dots.

Epidemiology and Risk Factors for Perioperative Mortality After Total Hip and Knee Arthroplasty

Stavros G. Memtsoudis, M.D., Ph.D.[1]; Matthias Pumberger, M.D.[1]; Anna Maria Bombardieri, M.D.[1]; Ya Lin, MS[2]; Peter Gerner, M.D.[3]
Hospital for Special Surgery[1]; Weill Medical Cornell[2]; Paracelsus Medical University[3]

Background and Objectives: Although total knee and hip arthroplasties (TKA, THA) are considered to be relatively safe, perioperative mortality remains of major concern among health care providers and their patients. Therefore, we attempted to elucidate factors surrounding this outcome and identify risk factors for perioperative mortality after TKA and THA.

Methods: Nationwide Inpatient Sample data from 1998-2008 were analyzed and characteristics of admissions with perioperative mortality compared to those that survived their hospitalization. The timing of death was computed and risk factors for such outcome were determined.

Results: An estimated total of 4,414,836 TKA and 2,276,386 THA procedures were performed in the United States between 1998 and 2008. The average mortality rate for TKA was 0.13% and for THA 0.29%, respectively. Independent risk factors for in-hospital mortality were advanced age, male gender, ethnic minority background, emergency admission as well as a number of comorbidities and complications. Furthermore, we demonstrated that the timing of death occurred earlier after TKA when compared to THA, with 50% of fatalities occurring by day 4 versus day 6 of hospitalization, respectively.

Conclusion: This study provides nationally representative information on risk factors for and timing of perioperative mortality after TKA and THA. These data can be used to assess risk for this event and to develop targeted intervention to decrease such risk.

The Role of Endothelial Health in Prevention of ICU Brain Dysfunction

Christopher G. Hughes, M.D.; Alessandro Morandi, M.D.; Jennifer Thompson, MPH; Timothy Girard, M.D., MSCI; E. W. Ely, M.D., MPH; Pratik Pandharipande, M.D., MSCI
Vanderbilt University School of Medicine

Introduction: Delirium is highly prevalent in ICU patients and is associated with higher mortality and cost.1-3 Each individual day of delirium contributes to increased long-term cognitive impairment and mortality.4;5 The blood brain barrier (BBB) is an endothelial structure protecting the brain; its function is altered by inflammatory mediators, leading to oxidative stress and neuronal damage.6;7 Critical illness increases patient risk for endothelial dysfunction, likely increasing BBB permeability and brain dysfunction.8;9 Thus, endothelial health may serve as a prognostic tool for risk stratification for acute brain dysfunction and provide further insight into the mechanisms of critical illness delirium. The validated Endo_PAT device is a noninvasive bedside instrument that permits endothelial function evaluation via peripheral artery tonometry, with measured reactive hyperemia index (RHI) < 1.67 correlating to endothelial dysfunction.10;11 Our objective was to evaluate the effects of endothelial function on brain dysfunction in critically ill patients.

Methods: Following IRB approval, we enrolled adult medical or surgical ICU patients in shock and/or respiratory failure. Endothelial function was assessed via RHI upon study enrollment. Brain dysfunction was assessed daily using the Confusion Assessment Method for the ICU.1 Linear regression was used to assess the association between endothelial function and brain dysfunction defined as days alive and free of coma and delirium over the first 14 days, adjusting for age, APACHE II, sepsis, preexisting cognitive dysfunction, ICU type, and statin use. The same model was used to study the association between endothelial function and delirium duration in survivors, our secondary outcome.

Results: Our study population had a median age of 57 years, median APACHE II score of 26, and 30% of were admitted with sepsis. Endothelial function was measured in 134 patients, and median RHI was 1.5 (IQR 1.3-1.8). Median length of ICU stay was 4.8 days, and median duration of brain dysfunction was 3 days. Better endothelial function was associated with greater days alive and free of coma and delirium, such that a patient with a RHI of 1.81 (75th percentile, reflecting better endothelial function) vs. 1.32 (25th percentile, reflecting worse endothelial function) had 0.83 more days free of brain dysfunction ($p=0.02$, Figure 1). Better endothelial function was also predictive of decreased duration of delirium in survivors ($p=0.05$).

Conclusion: These data support the association between endothelial health and acute brain dysfunction and highlight the need for subsequent investigations to examine endothelial function modulation as a means to improve cognitive outcomes of ICU patients.

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Etomidate and Adrenal Function in Cardiac Surgery: A Retrospective Cohort Study

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Introduction: Etomidate is an imidazole derivative used commonly to facilitate intubation in cardiac surgery patients. There is no controversy that a single bolus injection of etomidate can inhibit adrenal steroidogenesis. Two recent meta-analysis of sepsis patients found a strong association between etomidate use and adrenal insufficiency (AI) but no association with mortality.A prospective cohort evaluating 120 cardiac surgery patients concluded that the use of etomidate may increase vasopressor requirements with no difference in mortality. Our aim was to retrospectively assess risk factors associated with AI in postoperative cardiac surgery patients and investigate the effect of AI on clinical outcomes.

Methods: We conducted a retrospective review of 329 postoperative cardiac surgery patients in whom a cortisol level and/or corticotrophin (ACTH) stimulation test were obtained from Jan 2007 to Dec 2009. Standard protocol in our CVICU is to order a cortisol level and/or ACTH test on any post-operative patient on norepinephrine ≥15 mcg/min. Patients were excluded if the cortisol level was drawn >72 hours after surgery (N=51), surgery other than CABG or valve surgery (N=8), and preoperative steroid or immunosuppressant treatment (N=12). AI was defined as a cortisol level < 6 mcg/dL or a rise in cortisol level ≤ 9 mcg/dL after administration of 250 mcg cosyntropin.

Results: AI occurred in 112/258 (43.4%) and etomidate was used in 149/258 (57.7%) of patients. Patients who received etomidate were significantly younger (P=0.002) and less likely to undergo off-pump surgery (P=0.02) compared to non-recipients. There were no significant differences in baseline ejection fraction, use of ACE inhibitors, type of surgery or duration of cardiopulmonary bypass between etomidate recipients and non-recipients. Patients who developed AI tended to be more likely males with a history of hypertension and CHF (Table). Etomidate use was associated with a significant increased risk of AI (53.7% vs 29.4% in non-recipients, P<0.001). In multivariate logistic regression, etomidate use (odds ratio 3.05, 95% CI 1.75-5.30, P<0.001) was the only independent predictor of AI. Adding other potential confounders did not change the association of etomidate use with AI. Vasopressor use, ICU length of stay, hospital length of stay, and mortality were not significantly different between patients who developed AI and those who did not, however, mechanical ventilation was significantly greater in the AI group (91.4±19.3 vs 72.7±12.2 hours; P= 0.02). Post operatively, stress dose steroids were started in 28/146 (19.2%) with no AI and 52/112 (46.4%) with AI. (P < 0.001).

Conclusion: In this retrospective cardiac surgery cohort etomidate use was the only independent predictor of postoperative AI. In addition, AI was associated with longer mechanical ventilation times. One may consider prophylactic stress dose steroid coverage in patients who receive etomidate in the perioperative period. A prospective, randomized study is needed to compare safety of other induction agents as compared to etomidate.

Prevalence and Risk Factors of Delirium in the Cardiovascular Intensive Care Unit

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Introduction: Delirium is the most common manifestation of acute brain dysfunction in critically ill patients and is associated with poor clinical outcomes, including a longer hospital length of stay, increased risk of long-term cognitive impairment, and up to a threefold increase in six-month mortality. The goal of the present study was to prospectively study the prevalence and risk factors associated with the development of delirium in the Cardiovascular Intensive Care Unit (CVICU), measured using a validated delirium monitoring instrument.

Methods: We enrolled adults patients admitted to the cardiovascular ICU with an expected length of stay > 24 hours. Patients were excluded if they had significant baseline neurologic diseases that would confound the evaluation of delirium, an inability to understand English, significant hearing loss, or if expected survival was < 24 hours. Patients were evaluated daily for delirium using the validated Confusion Assessment Method for the ICU (CAM-ICU). Demographic, laboratory and ICU data were collected daily to study the risk factors of delirium.

Results: Two-hundred consecutive patients from the CVICU were enrolled into the study; 96 patients (48%) were admitted to the cardiology service and 104 patients (52%) were admitted to the cardiac surgical service. Demographic data and baseline characteristics are presented in Table 1. The overall prevalence of delirium was 26% in the total CVICU population; 29% of the cardiology patients and 24% of the cardiac surgical patients developed delirium. When patients developed delirium, the duration was 0.5 (+ 1.1) days. There was an increased risk of delirium in patients with a prior history of statin use. Similarly daily statin use was a risk factor for delirium on the next day. Exposure to dexmedetomidine or benzodiazepines in the first 24 hours of hospital admission and use of restraints was also a risk factor for delirium.

Conclusion: This prospective observational study demonstrates that a significant proportion of cardiology and cardiac surgical patients in the CVICU develop delirium. Patients treated with statins, dexmedetomidine, benzodiazepines, and physical restraints had increased rates of delirium. Statin use may be a surrogate for other co-morbidities that predispose patients to delirium; dexmedetomidine is our standard of care for patients experiencing delirium, hence this may be an association and not a cause of delirium.

Serial Monitoring of Cardiac Function and Filling in 13 Patients During Therapeutic Hypothermia Following Cardiac Arrest: Performance Characteristics of the ClariTEE™ Probe

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Aim: The clinical utility of invasive pressure monitoring in the setting of positive pressure ventilation and induced hypothermia following cardiac arrest is of questionable value. The introduction of a miniaturized disposable transesophageal echocardiography probe enables "at will" serial assessment of cardiac function and filling for up to 72 hours. This investigation examines the performance characteristics and echocardiographic information obtained from of a miniaturized disposable transesophageal echocardiography probe in patients undergoing therapeutic hypothermia following out of hospital cardiac arrest.

Methods: Therapeutic hypothermia was induced in 13 patients after resuscitation from out of hospital cardiac arrest. The ClariTEE™ (ImaCor, Uniondale, NY) probe was placed in all patients and assessment of cardiac function and filling was conducted "at will" by an intensivist certified in advanced perioperative transesophageal echocardiography. A retrospective analysis of the echocardiographic data obtained from the ClariTEE probe was completed.

Results: A total of 40 imaging sessions were performed. The success rate for obtaining the mid esophageal four chamber and transgastric mid papillary short axis views were 92.5% and 100% respectively. Endocardial boarder definition was adequate in 90% of imaging sessions to measure left ventricular end diastolic and systolic areas enabling calculation of fractional area of change. Assessment of right ventricular function was possible in 93% of imaging sessions. 12 imaging sessions provided information that changed hemodynamic management in the setting of ambiguous invasive pressure monitoring measurements. Regional wall motion abnormalities were observed during 16 imaging sessions. Table 1. lists the specific echocardiographic observations that occurred during imaging sessions.

Conclusions: Serial monitoring of cardiac function and filling with the ClariTEE™ probe including the qualitative assessment of right ventricular function, measurement of left ventricular end systolic, and diastolic area is possible in most patients during induced hypothermia following cardiac arrest. The authors conclude that the assessment of cardiac function and filling with ClariTEE™ probe reduces the ambiguity of hemodynamic assessment compared solely to invasive pressure monitoring and improves hemodynamic management.

Ten Year Trends in Specialist Billing for Critical Care Services in the United States (1998-2007)

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Introduction: In 2005, the American Society of Anesthesiology task force on Future Paradigms for Anesthesia Practice recommended that anesthesiologists diversify their practice in order to ensure a future leadership position in medicine, with a recommendation to consider expanding practice in critical care(1). We sought to determine the percentage of critical care currently provided by anesthesiologists, and to identify trends in specialist reimbursement over time.

Methods: We conducted a study of Medicare data from 2007 using the 5% sample from the Standard Analytic Carrier File that includes de-identified data for a random 5% sample of Medicare beneficiaries greater than 64 years of age. The data included all individual critical care bills for each hospitalization (billing codes 99291 and 99292), as well as information on the primary specialty of the individual provider. The primary outcome of interest was the proportion of total dollars billed by each specialty for critical care services. We compared the data from 2007 to previously published data from 1998(2).

Findings: For a 5% sample of Medicare beneficiaries in 2007, providers billed almost $26 million for critical care services. Broken down by specialty, anesthesiologists accounted for only 1.9% of billing, and intensivists for 7.9% (Table 1). Internal medicine and pulmonary medicine combined accounted for almost half of critical care billing (25.8% and 22.7% respectively), and emergency medicine for another fifth (21.1%). Compared with 1998, the percentage of billing in 2007 by intensivists had doubled (from 4.3% to 7.9%) and by emergency medicine physicians had tripled (from 7.0% to 21.1%).

Conclusion: Anesthesiologists provide only a small proportion of critical care services compared with other specialties. Billing for critical care services by emergency medicine physicians has increased the most in the past ten years. Given the growing need for critical care providers, there is a significant opportunity for anesthesiologists to increase provision of critical care services as part of their practice.

Table 1. Distribution of Medicare Billing for Critical Care Services in 1998 and 2007

Specialty	1998 Percent of Dollars	2007 Percent of Dollars
Anesthesiology	NA	1.9%
Intensivists	4.4%	7.9%
Internal Medicine	31.7%	25.8%
Pulmonary Medicine	20.0%	22.7%
Cardiology	10.9%	4.2%
Emergency Medicine	6.5%	21.1%
Family Practice	5.7%	4.5%
General Surgery	2.7%	2.8%
General Practice	2.7%	1.0%
Nephrology	8.7%	2.2%
Total (10 Specialties)	91.0%	93.9%

Source: 100% Heatlhcare Financing Administration Part B (1998)2, Carrier File, 5% LDS with Part A and B coverage, (2007)
Based on Provider Payment Amount
NA = not available

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Gegenhalten Phenomena in the Surgical Intensive Care Unit after Orthotopic Liver Transplant

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A 59 yo female with a past medical history significant for end stage liver disease with a MELD score of 33 secondary to primary biliary cirrhosis presented with jaundice, pruritis, encephalopathy, esophageal varices and ascites. Her medical history was also significant for recent treatment of depression with escitalopram following the death of her son 3 months ago from osteosarcoma. The patient is status post deceased donor orthotopic liver transplant. Soon after extubation on POD#0, the patient becomes increasingly hypervigilent and paranoid. Statements range from “I know why you are here. I am competent and I know the five stages of death” to “ You are trying to take my vena cava and I won’t let you.” The patient is evaluated by the liver transplant psychiatrist, who has been following the patient before her surgery. The psychiatrist diagnoses her with new onset psychosis with paranoid delusions. The psychiatrist recommends 3mg of IV haloperi every 4-6 hours as first line treatment. Despite receiving two doses of 3mgs of IV haloperidol, the patient’s psychiatric disturbances remain unchanged.

On POD#1, the patient is found to be in a catatonic state and not responding to any verbal or physical stimuli or commands. She is also exhibiting the gegenhalten phenomena, which is an involuntary resistance to passive movement of the extremities. Throughout this time, the patients vital signs are unchanged and stable with no new lab abnormalities. A creatine phosphokinase was sent and the patient was given 1 mg of IV lorazepam. Approximately 30 minutes after IV lorazepam, the patient becomes verbal and interactive with medical staff, with no recollection of being in a catatonic state. However, the patient continues to have paranoid delusions but is more amenable to taking her oral medications and a regular diet. Over the next few days, the patient has gradual resolution of her paranoid delusions and is discharged from the intensive care unit on POD#4 and discharged from the hospital on POD#9.

Treatment of delirium and psychiatric disorders in the intensive care unit is a complex and often difficult clinical problem. These range of disorders are particularly hard to interpret in liver transplant patients, who often have hepatic encephalopathy preoperatively in addition to several other medical comorbidities. Predisposing factors related to depression, anxiety, and the stress of being a transplant candidate are intermingled with the organic factors of a stay in the intensive care unit such as sleep deprivation, functional immobility, physical restraints and disruption of circadian rhythms. These factors are then compounded with drug-induced psychiatric reactions from exposure to inhalational anesthetic agents, narcotics, calcineurin inhibitors, corticosteroids, and polypharmacy.

Though the use of benzodiazepines in the intensive care unit has been shown to increase delirium, the treatment of catatonia in a post liver transplant patient with lorazepam was effective with immediate results.

Prediction of Acute Lung Injury (ALI) in Elderly Patients Within the First 48 Hours of ICU Admission

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Background: With more than 200,000 cases being diagnosed yearly, ALI is one of the major problems in the ICU. If we can predict the patients at-risk to develop ALI, we can try to prevent and improve patient outcomes. In this retrospective analysis, we aimed to predict developing ALI before its diagnosis utilizing a set of a priori determined factors.

Methods: After IRB approval, we reviewed the charts of 790 elderly (age >64 years) patients admitted to the ICU, to search for the patients who developed ALI within the first 48 hours of mechanical ventilation. Further assessment was done in mechanically ventilated patients (n=296). An a priori determined set of factors were assessed for their independent contribution to ALI. Data were analyzed by SPSS-IBM 19.0 software and multivariate stepwise logistic regression analysis was performed.

Results: Patients who developed ALI (n=152) were slightly but not significantly older (77±7 vs. 75±7 years). Factors considered for multivariate regression analysis were history of diabetes, admission diagnosis of stroke, male gender, albumin level in the first 48 h, GCS, and SOFA scores at admission. Within these factors, albumin level (OR 0.67 [CI 0.45=0.99]), GCS (OR 1.45 [CI 1.21-1.74]), and SOFA (OR 2.10 [CI 1.62-2.73]) scores at admission appeared to be the only independent factors to contribute to ALI within the first 48 h of admission. ROC curve for admission SOFA score was prepared (Figure), and AUC was found as 0.731, and a score cut-off of 4.5 with 80% sensitivity and 51% specificity.

Conclusion: Within the factors tested, we found that the coma status (GCS) and organ failures at admission (SOFA) as well as albumin levels independently contributed to ALI. Early recognition using the aforementioned non-modifiable factors will enable susceptible patients to undergo established ALI/ARDS preventive strategies thereby preventing morbidity and mortality.

Can We Predict Mortality in Elderly Ventilated ICU Patients Within the First 48-Hour of Admission?

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Background: The paucity of financial health resources and increasing cost of health care play an important role in the acute care of critically ill patients. As such, acute care should be focused and initiated promptly. Undoubtedly, as the population grows older, elderly patients account for a vast majority of ICU admissions in the United States. Age and mechanical ventilation are determinants perceived to be highly associated with outcomes in the critically ill. Hence, we aimed to establish scoring systems using background, physiologic and clinical parameters to predict mortality in elderly mechanically ventilated patients within the first 48 hours of ICU care.

Methods: In a retrospective review of our ICU database from 2005-2010, elderly patients (age >64 years) who needed to be mechanically ventilated for more than 48 hours, were assessed. We recorded baseline characteristics upon admission. Severity of illness was assessed daily using APACHE III, GCS, PaO2/FiO2, and SOFA. Independent contribution of baseline characteristics, admission severity status, and progressing severity were assessed with multivariate logistic regression analysis.

Results: Analysis included 296 elderly mechanically ventilated patients. Mortality was about 37% in the elderly population studied (age 75±7years). Patients were mechanically ventilated for 10±9 days, and duration of ICU stay was 13±10 days. Independent risk parameters, which predicted mortality within the first 48 hours of admission were baseline cardiac risk factors, admission time GCS score, APACHE III score, SOFA score, and progression of SOFA score (48h).

Conclusion: The present results suggested that baseline cardiac risk factors, GCS overall severity status, and worsening of severity within the first 48 hours of admission predicted mortality in elderly mechanically ventilated patients. Assessment of severity status early on using the cut-off values suggested may guide focused acute care to start immediately. Additionally, such approach would help both care teams and patients' significant others to be informed about severity very early, and plan care accordingly.

Ethical Case Presentation; Failed Lung Transplant x2

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Introduction: A 29 year old Hispanic female with a past medical history of scleroderma, pulmonary hypertension, right sided heart failure and end stage lung disease was admitted for orthotopic bilateral lung transplant. The patient had been on the lung transplant list for over three years. At the time of admission she had severe limitation of activities because of ascites secondary to her right heart failure and shortness of breath.

On the day of admission she underwent bilateral lung transplant. Intra-operatively she developed severe coagulopathy and respiratory failure requiring extracorporeal membrane oxygenation support. Over the next three days she was re-explored but continued to bleed with less and less chance of separation of ECMO.

Eleven days later another donor became available and the patient was re-transplanted. Patient rapidly developed primary graft failure and again required ECMO. With the need for ECMO is was necessary to anti-coagulate which progressed again into difficult cycle of bleeding/ need for ECMO/need for anticoagulation. The patient underwent several further chest explorations. The patient's renal and hepatic functions subsequently failed. The lungs were frankly opacified on x-ray and membranous bleeding was encountered globally.

A family meeting was called. The parents who held durable power of attorney refused any method of withdrawal. An ethics consult was called.

Issue: In the face of two failed lung transplants and no hope of further transplant is it ethical to withdraw ECMO?

Results: The ethics committee met with the doctors involved. They asked if the patient had a mental status; she could respond to simple commands. They asked, could her pathology be reversed, could another lung transplant be possible and could someone live on an ECMO device?
It was the opinion of the CVT surgeons and CV-ICU team that the answers were no.

The ethics committee wrote a consult. They felt that every avenue of treatment was explored by the primary team. They continued that the ECMO was futile and the ICU/surgeon was permitted to discontinue it. The matter was referred to the hospital board and attorney but no decision was provided.

Resolution: The care team decided to continue. It was thought that with the massive dysfunction already observed the patient would succumb and that discontinuing artificial circulation; even if it was a futile effort would put the family through even greater duress.

On the 31st day, the patient was unresponsive. Pupils were dilated. An EEG and transcranial Doppler exam was performed; a neurology attending examined the patient and declared brain death. While awaiting family, the patient went into complete asystole, at that time the family agreed to disconnect support.

Discussion: It is clear we have an impressive armamentarium of devices and therapies but how do we guide and control their usage? Frequently families will cling to heroic measures and implore that faith will supply a cure. Perhaps a counter argument is that a higher power does not need our feeble machines. This leaves the physician to ponder, is it divine design that we are able to artificially continue a life or do we interfere with a greater heavenly plan? As we develop newer and greater therapies holding out hope for the ill it is essential that we develop rational guidelines in advance of our technologies.

Arterial Monitoring in Post Transplant Patient Using Antegrade Radial Artery Stump Pressures Assessed With Ultrasound in a Patient With Anasarca

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Objective: The feasibility of antegrade radial artery catheters has been demonstrated (1). We demonstrate its use as an alternative to standard retrograde radial artery canulation in a patient with diminished options of intra arterial monitoriing. There for we used a radial arterial stump pressure after coroberating ulnar the artery was intact palmar arch provided perfusion by ultrasound.

Case Description: The patient was status post small and large intestinal transplant seconday to Crohn's disease. Her post transplant course was complicated by rejection, rounds of immunosuppression, hemodynamic instability renal failure, and multiple procedures culminating in the explantation of the graft. Despite anasarca and need for vasopressors we planned on \abdominal wall closer and G-tube insertion. However with the myriad of previous lines, local infections and thrombosed arteries obtaining a viable access for arterial monitoring for the operating room team became daunting.

Ultrasound exam revealed radial artery 7.5 mm from skin, with distal diameter 1.9 mm. However, since the proximal diameter was 0.9mm, conventional retrograde cannulation with a 22g catheter was unsuccessful. ("in but could not thread" due to diminished calibre) We were able to cannulate from the narrower proximal to the wider distal segment of the radial artery in antegrade direction with good blood return and waveform.

Ultrasound of normal antegrade canulation of radial artery in this patient catheter showing complete obstruction of the radial artery by the catheter and eliminating the possibility of obtaining retrograde flow around the catheter. Thus, if there is no antegrade flow there can be no obtainable pulse wave or sample retrieval.

It is quite possible in common practice to insert a radial line in the distal artery directed to stenosed proximal segment. This can result in no radial artery perfusion because the catheter is blocking the flow. In this case we were able to canulate a 0.9 mm vessel with a 22g catheter which has a 0.9mm external diameter and in deed we were blocking radial artery antegrade flow. The ability to feel a pulse and the ultrasound confirmation of palmer flow insured viability of the thumb. By placing a short catheter antegrade into the radial artery it is possible to obtain an arterial blood pressure tracing and draw blood samples without compromising the blood flow to the hand. Ultrasound confirmation using a GE LOGIQ E Ultrasound with the 12L-RS at 8MHz was obtained by standing beside the patient lateral and cephalad to the hand, the radial artery is visualized in the short axis view. The radial artery is then canulated antegrade under direct ultrasonic guidance and the catheter threaded. After the procedure the ultrasound integrity of the ulnar pulse and palmer arch were assesed again as viable conduits to digital perfusion. The patient was able to proceed to the O.R. with intra-arterial monitoring despite pressers and few available sites.

Conclusions: Ultrasound guided antegrade placement of radial artery catheters may be a useful alternative to other arterial cannulations in a patient who has a blocked radial artery but good circulation to the thumb through the palmer arcade.

Young Investigator Award

The Frank-Starling Relationship is Absent in Patients with Pulmonary Hypertension: A 3 Dimensional Transesophageal Echocardiographic Study in Patients Undergoing Cardiac Surgery

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Introduction: Pulse pressure variation is frequently used to predict the change in cardiac output with intravascular volume administration.1 Recent studies suggest that the effectiveness of pulse pressure variation is diminished or absent when pulmonary hypertension is present.2 We hypothesized that this diminished predictive power was due to an absent Frank Starling relationship in patients with pulmonary hypertension. To test our hypothesis, we correlated real time 3 dimensional transesophageal echocardiographic (RT3DE) assessments of right ventricular volume and function with central venous pressure (CVP) measurements in patients with and without pulmonary hypertension.

Methods: Patients undergoing cardiac surgery were prospectively enrolled after informed consent and IRB approval. CVP measurements, pulmonary artery pressures, and RT3DE assessments of right ventricular volume and function were then obtained after anesthetic induction and before incision. Using the Philips iE33 system and a matrix array transducer (X3-1) in the four chamber mid-esophageal view, dynamic RT3DE images of the right ventricle were obtained throughout the entire cardiac cycle. Image loops were analyzed offline by two independent, blinded investigators and 3D assessments of right ventricular end-diastolic (RVEDV) and end-systolic (RVESV) volumes were performed. Linear regression was then used to correlate CVP values with RVEDV, RVESV, and stroke volume.

Results: 21 patients completed the study. 13 patients underwent valve repair or replacement, 4 underwent combined CABG and valve surgery, 1 underwent CABG only, and 3 received a LVAD. 8 of 21 patients had pulmonary hypertension, defined as a mean pulmonary artery pressure > 25 mmHg. Right ventricular volumes were significantly larger in the group with pulmonary hypertension (189.9±42.2mL vs 130.1±36.0mL , $p<0.05$ for RVEDV, 133.6±40.9mL vs 76.4±25.1mL, $p<0.05$ for RVESV). CVP correlated strongly with RVEDV ($r=0.68$. $p<0.02$), RVESV ($r=0.67$, $p<0.02$), and RVSV ($r=0.56$, $p<0.05$) in patients with normal pulmonary artery pressures. No correlation between CVP and RVEDV, RVESV or RVSV was observed in patients with pulmonary hypertension

Discussion: We found that CVP correlated strongly with right ventricular volume and function only in patients with normal pulmonary artery pressures. Our data indicate that the Frank Starling relationship is only present in patients with normal pulmonary artery pressure, and suggest that CVP is a poor measure of intravascular volume in patients with pulmonary hypertension. Assessment for pulmonary hypertension may be warranted prior to use of either pulse pressure variation or CVP as a guide to hemodynamic management. Further work is needed to better understand the relationship between right ventricular volume, CVP, and pulse pressure variation in the presence of pulmonary hypertension.

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What Starling Curve? Right Ventricular Dysfunction Abolishes the Frank-Starling Relationship as Assessed by 3-Dimensional Echocardiography and CVP in Patients Undergoing Cardiac Surgery

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Introduction: Central venous pressure (CVP) is commonly used to guide perioperative fluid therapy and is a component of evidence-based resuscitation protocols.1 A recent meta-analysis suggests that the relationship between CVP and intravascular volume is poor.1 We hypothesized that changes in right ventricular (RV) function may partly explain the absence of a Starling relationship between CVP and intravascular volume. To test our hypothesis we correlated real time 3-D transesophageal echocardiography (RT3DTEE) assessments of RV function and volume with CVP measurements in patients undergoing cardiac surgery.

Methods: Patients undergoing cardiac surgery were prospectively enrolled after informed consent and IRB approval. CVP measurement and RT3DTEE imaging of the right ventricle were obtained after induction of anesthesia and prior to surgical incision. Using the Philips iE33 system and a matrix aray transducer (X3-1), RT3DTEE full volume loops of the RV were obtained over seven heart beats with the mid esophageal four chamber view. Images were analyzed off-line using Tom-Tec software by two blinded and independent operators. 3D analysis generated RV volumes at end-diastole (RVEDV) and end-systole (RVESV) and overall stroke volume (SV). Linear regression was then used to correlate CVP values with RVEDV, RVESV, and SV.

Results: 21 patients completed the study. 13 underwent valve repair or replacement, 4 underwent combined CABG and valve surgery, 1 underwent CABG only, and 3 received a left ventricular assist device . 10 patients had reduced RV function (RV ejection fraction < 40%). In these patients, right ventricular volumes were significantly larger than in patients with normal RV function (173.0±40.0mL vs 131.1±46.1mL $p<0.05$ for RVEDV, and 126.4±37.6mL vs 71.6±28.7mL $p<0.05$ for RVESV). CVP correlated strongly with RVEDV ($r=0.70$ $p<0.02$), RVESV ($r=0.70$, $p<0.02$)and SV($r=0.65$ $p<0.05$) in patients with normal RV function only. No correlation between CVP and RV volumes or function were observed in patients with reduced RV function.

Conclusions: We found that CVP correlated strongly with RVEDV, RVESV and SV only in patients with normal RV function. Our data support using CVP to guide fluid therapy only in patients with normal RV function, and suggest that CVP may be an inaccurate measure of intravascular volume in patients with RV dysfunction. RV functional assessment may be warranted in patients suspected of having RV dysfunction prior to implementing CVP-based protocols for hemodynamic resuscitation. Further work is needed to better understand the relationship between CVP and right ventricular volume and function .

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Real Time Determination of Respiratory System Resistance (Rrs) During Pressure Support Ventilation (PSV) Using the Expiratory Time Constant (TE)*

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Knowledge of Rrs, and respiratory system compliance, is helpful for determining appropriate ventilator settings of inspiratory flow rate and time to promote improved filling of lung compartments with long inspiratory time constants, especially patients with chronic obstructive pulmonary disease, and exhalation time in similar types of patients with long TE to minimize the development of intrinsic positive end expiratory pressure. Traditionally, an End Inspiratory Pause (EIP) is applied immediately following an intermittent mandatory ventilation (IMV) with a known tidal volume (VT) in order to determine inspiratory plateau pressure (Pplt), needed for the calculation of Rrs. However, patient-ventilator breathing dyssynchrony often occurs when an EIP is applied to spontaneously breathing patients as during PSV, precluding accurate measurement of Pplt, and, thus Rrs. We hypothesize that Rrs can be continuously and accurately determined during PSV using TE, obviating the need to apply an EIP.

In an IRB approved study, 10 patients (age 48 ± 18, wt 81±17 kg, 8 males 2 females) with heterogeneous causes of respiratory failure and breathing spontaneously with PSV (range 5 – 20 cm H2O) were recruited. Applying the same VT as during PSV, IMV with EIP of 0.5 sec was applied in the same patients to determine Pplt and then calculate Rrs by using the standard equation (Rrs = [Peak inflation pressure – Pplt] ÷ peak inspiratory flow rate). During PSV, Rrs was also obtained by determining TE from expiratory volume and flow waveforms and using an equation (Rrs = [Airway pressure – positive end expiratory pressure] ÷ [(Volume / TE) + inspiratory flow rate]). Data were analyzed using t-Test, regression analysis, and Bland-Altman plots; alpha was set at 0.05 for statistical significance.

For the IMV with EIP method, Rrs was 9.47 ± 2.15 cm H2O/L/sec and for the TE method, Rrs was 9.26 ± 2.42 cm H2O/L/sec (no significant differences). The relationship for Rrs for both methods was $r = 0.99$ and $r2 = 0.98$ ($p < 0.05$). Bland-Altman plots showed bias of 0.2 and precision of 0.8.

Rrs may be continuously determined during PSV by using the TE method from passive deflation of the lungs without the need for IMV with EIP. This novel method allows for real time monitoring of Rrs and continuous assessments of the effects of therapeutic interventions on Rrs (for example, before and after effects of bronchodilator therapy) during PSV without the need to change ventilator modes.

Real Time Calculation of Respiratory System Compliance (Crs) and Plateau Pressure (Pplt) During Pressure Support Ventilation (PSV) *

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Introduction: Real time Pplt allows understanding of pulmonary compliance and therapeutic effects of patients with respiratory failure. Measurement of Pplt requires a change in ventilator mode to intermittent mandatory ventilation (IMV) with an end inspiratory pause (EIP). Patient-ventilator breathing dyssynchrony during EIP predisposes to measuring errors of Pplt. One weaning mode is PSV to assist spontaneous breathing. Knowledge of Pplt during PSV would provide continuous monitoring of Crs precluding the need to change ventilator modes. In a preliminary study we demonstrated a mathematical relationship between the expiratory time constant (τE) and the equation of motion of the respiratory system allowing estimate of Pplt without using IMV with EIP. We hypothesized that real time Pplt may be accurately and continuously estimated using the τE from passive deflation of the lungs during PSV.

Methods: Twenty-four adults (age 56.1 ± 16.6 yrs; 10 males; weight 79.9 ± 28.8 kg) with heterogeneous causes of respiratory failure and breathing spontaneously with PSV were recruited in an IRB approved study. PSV ranged between 5 and 20 cm H2O. Applying the same tidal volume, PSV and IMV with EIP were compared in the same patients. During PSV, Pplt and Crs were obtained by integrating the τE from the expiratory volume and flow waveforms. During IMV and EIP, Pplt was obtained from viewing pressure plateau of the airway pressure waveform at EIP. Data were analyzed using regression and Bland-Altman analysis; alpha was set at .05.

Results: During PSV, Pplt and Crs from the τE method were 19.65 ± 6.6 cm H2O and 0.051 ±0.0124 ml / cm H2O, respectively. During IMV with EIP, Pplt and Crs were 20.84 ± 7.17 cm H2O and 0.046 ± 0.011 ml / cm H2O, respectively (no significant differences in all measurements). Comparing both measuring methods, the relationships between Pplt and Crs were $r2 = 0.98$ and $r2 = 0.92$, respectively ($p < 0.05$)). Bland-Altman plots for Pplt and Crs showed bias at 1.17 and - 0.0035, respectively and precision at ± 1 and ± 0.0031, respectively.

Conclusions: Pplt and Crs may be continuously determined during PSV using the τE from passive deflation of the lungs without the need for IMV with EIP. These data allow real time monitoring of pulmonary mechanics, a dynamic means of continuously assessing the risks of lung overdistension, and evaluation of therapeutic treatment strategies during PSV without the need to change ventilator modes.
* Patent pending

Predictors of Postoperative Acute Lung Injury in a Low-Incidence Surgical Population

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Background: Acute Lung Injury (ALI) is a devastating condition with an estimated mortality between 30 and 40 percent. There are data suggesting risk factors for postoperative ALI development in high risk populations, but few data are available in lower incidence populations. Using propensity-matched analysis and a combination of clinical and research datasets, we determined the incidence and risk factors for the development of ALI in this unstudied population.

Methods: We conducted a review of all adult non-cardiothoracic, non-transplant procedures performed between January 1, 2005 and July 1, 2009 using an anesthesia information system. This dataset was merged with an ALI registry and an institutional death registry. Preoperative variables were subjected to multivariate analysis. Propensity matching was then used to control for preoperative risk. Further multivariate analysis was used determine the impact of intraoperative management on the development of ALI.

Results: 53,910 separate patient admissions were identified and 102 (0.2%) of these patients developed ALI. Preoperative risk factors for ALI development after multivariate analysis included ASA physical status 3-5 (OR 19.95, CI 9.12-43.64), emergent surgery (OR 6.42, CI 4.18-9.84), vascular or trauma surgery (OR 3.46, CI 2.24-5.34), renal failure (OR 1.7, CI 1.07-2.71), and number of anesthetics during the admission (OR 1.17, CI 1.04-1.30). This predictive model was well fit, with a Hosmer-Lemeshow Goodness of Fit statistic of 0.879 and a Reciever Operating Characteristic Area Under the Curve (ROC-AUC) of 0.903 (Figure 1).

After matching, intraoperative risk factors included number of ten-minute epochs with peak inspiratory pressure ≥ 30cm H2O (OR 1.06, CI 1.02-1.10) and packed red cell transfusion (OR 5.53, CI 2.54-12.01). While there was a statistical association with tidal volume (OR 0.766, CI 0.62-0.95), this was deemed to have little clinical significance (9.2 vs 9.1 cc/kg). This model was also well fit, with Hosmer-Lemeshow Goodness of Fit = 0.872.

Conclusion: ALI is a rare condition postoperatively in the non-cardiothoracic, non-transplant population and is exceptionally uncommon in low ASA status patients undergoing scheduled surgery. Analysis after propensity matching suggests that ALI development is associated with peak inspiratory pressures ≥ 30 cm H2O and transfusion.

Temperature and pH are Important Considerations When Attempting to Predict PaO2 from SaO2

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Introduction: As a measure of oxygenation, the PaO2/FiO2 (P/F) ratio is used to define acute lung injury (ALI) and acute respiratory distress syndrome (ARDS). It is also employed in multiple severity of illness predictive scoring systems. The SpO2/FiO2 ratio has been proposed as a surrogate to the P/F ratio (1-5) but have not adequately explored the influence of factors known to impact the relationship between SpO2 and PaO2 such as temperature and pH. This study tests the hypothesis that inclusion of temperature and pH will improve the relationship between SaO2 and PaO2 in mechanically ventilated ICU patients.

Methods: After IRB approval, we reviewed data from all adult, intubated patients admitted to an ICU with an arterial line in situ (2006-2009) at a single academic center. We extracted all arterial blood gas (ABG) results with a temperature recorded at ABG acquisition time. To ensure an accurate measure of oxygen saturation and identical acquisition time as PaO2, SaO2 rather than SpO2 was utilized. Due to the non-linear relationship between SaO2 and PaO2 at extreme values, samples were restricted to the range of 75% to 92%. Data was restricted to venous pH collected 6 hours from ABG collection. For participants with more than one qualifying ABG, only the first was included. Patients were included in the database only once. We evaluated the extent of model fit with SaO2, SaO2 + temperature, SaO2 + pH, and SaO2 + temperature + pH for estimating PaO2 using linear regression models. Model fit was evaluated with R2 value with single predictor and adjusted R2 value with multiple covariates.

Results: 5,045 ABGs with a temperature recorded at the time of sample acquisition and a corresponding venous pH measurement within 6 hours of ABG acquisition were obtained. 3,613 samples remained after eliminating multiple entries for individual patients. Restricting samples to those with 75% ≤ SaO2 ≥ 92%, left 409 ABGs and comprised the data set used for analysis. Four influential outliers with PaO2 > 110 with associated SaO2 ≤ 92% were removed. See Table 1 and figure 1 for results.

Discussion: SaO2 had suboptimal predictive accuracy when attempting to determine PaO2. Predictive accuracy improved when temperature and pH were included. Best fit was noted when including all three variables. These results suggest that when attempting to estimate PaO2 from SpO2, improved predictive accuracy is seen if both temperature and venous pH are considered.

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Determination of Brain Death on Veno-Arterial Extracorporeal Membrane Oxygenation in Adults

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Introduction: Veno-Arterial Extracorporeal Membrane Oxygenation (VA ECMO) is increasingly being used as a rescue therapy for refractory circulatory collapse [1, 2]. However neurologic damage and brain death are serious complications associated with ECMO [3]. Brain death exams and apnea testing in patients on ECMO can be technically challenging. We describe the successful determination of brain death in three adult patients on VA ECMO.

Case Report: Case #1 - A 55 year-old woman suffered cardiac arrest immediately after tricuspid valve repair; VA ECMO was initiated. After more than 24 hours she was comatose with iso-electric electroencephalogram (EEG) and absence of brainstem reflexes confirmed by two neurologists 6 hours apart. For apnea testing, the patient was taken off the ventilator and the lungs were insufflated with O2. The ECMO circuit flow was maintained at previous levels and sweep gas flow was lowered to 0.5 l/m with an FiO2=100%. The paCO2 increased to 67.5 with a paO2 =136. After 10 minutes of apnea without any respiratory effort. The patient was declared brain dead and taken to the operating room for organ harvesting.

Case #2 – A 78 year old man suffered cardiac arrest after emergent cardiac catheterization and stent placement complicated by coronary artery perforation. VA ECMO was placed percutaneously. After more than 24 hours the patient was comatose and had absent cranial nerve reflexes. Apnea testing was performed, as described in the previous case report. Prior to apnea testing the ABG was 7.26/41/177 and after 3 minutes ABG was 7.13/60/84 with no respiratory efforts. The patient was declared brain dead and removed from life support. Organs could not be donated.

Case #3 – A 64 year old woman suffered an out of hospital cardiac arrest, was resuscitated but then progressed to hemodynamic collapse and was percutaneously placed on VA ECMO. After more than 24 hours the patient was comatose and had absent cranial nerve reflexes and an isoelectric EEG. The patient was deemed too unstable for apnea testing, therefore transcranial doppler exam was performed, which revealed diastolic reversal of flow on 2 exams, 6 hours apart. The patient underwent organ donation after declaration of brain death.

All patients underwent therapeutic cooling to 33o C for 24 hours followed by rewarming to 37o C.

Discussion: With increasing use of VA ECMO as a rescue therapy for refractory circulatory collapse, we may see some patients with severe neurological injury and brain death. However, diagnosing brain death on VA ECMO can be technically challenging and has not been reported. Tests other than apnea testing (i.e. cerebral angiography) are often not feasible for logistical reasons. To confirm the diagnoses of brain death, we successfully performed apnea test in two patients and used transcranial doppler in the third patient. Brain dead donors on ECMO could potentially increase the organ availability for transplantation.

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Efficacy and Risk of Anticoagulation for Atrial Fibrillation in Patients Admitted to the Intensive Care Unit Following Noncardiac Surgery

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Background: Atrial fibrillation following major noncardiac surgery is a common occurrence with significant associated morbidity and substantial resource utilization. Although the benefit of therapeutic anticoagulation for stroke prevention is well established in the general medical population, the decision to anticoagulate postoperative patients is complicated by a lack of evidence regarding its efficacy as well as increased concerns regarding bleeding complications. The objective of this study was to evaluate the efficacy and risks of therapeutic anticoagulation in postoperative intensive care unit (ICU) patients with persistent atrial fibrillation.

Methods: Following IRB approval, we performed a single-center retrospective cohort study. The evaluable study population included all patients admitted to a surgical ICU following major noncardiac surgery from 1/1/2004 to 12/31/2009. Additional inclusion criteria included age ≥ 18 years and postoperative atrial fibrillation of at least 48 hours duration. Patients were excluded if contraindications to anticoagulation were present. Data on baseline characteristics including demographic variables, comorbidities, and medications were recorded. The presence of therapeutic anticoagulation and antiplatelet therapy was determined for all study participants. The primary outcome variable was the frequency of cerebrovascular accidents (CVA) after the onset of atrial fibrillation. A co-primary outcome was major bleeding complications in the 28 days following the onset of atrial fibrillation (or hospital discharge if prior to 28 days). The association of therapeutic anticoagulation with both stroke and major bleeding events was assessed with the Chi-square test for independence.

Results: A total of 2,031 patients met the initial inclusion criteria of age > 18 years, admission to a surgical intensive care unit following major non-cardiac surgery and presence of postoperative atrial fibrillation. 1,162 patients were excluded due to a duration of atrial fibrillation < 48 hours. An additional 222 were excluded due to a contraindication to anticoagulation. The remaining 647 study participants were included in the statistical analyses. A total of 419 patients (65%) received therapeutic anticoagulation, 194 (30%) in combination with anti-platelet therapy. A total of 8 patients had the primary outcome of CVA. The frequency of CVA among those receiving therapeutic anticoagulation versus those who were not was 1.2 % vs. 1.3 % (OR = 0.91, 95% CI = 0.21 – 3.9; p = 0.90). Seventy-three patients (11%) experienced a major bleeding complication. The frequency of major bleeding among those anticoagulated versus those who were not was 10.5% vs. 12.7% (OR = 0.81, 95% CI = 0.49 – 1.33; p = 0.40).

Conclusion: In this study, therapeutic anticoagulation in postoperative patients with atrial fibrillation lasting greater than 48 hours was not associated with a reduced risk of CVA. Similarly, the frequency of major bleeding complications was not significantly different between the two groups. Our results suggest that in patients with persistent atrial fibrillation following major noncardiac surgery, the efficacy of anticoagulation for stroke prevention is questionable.

The Contribution of Continuous Transesophageal Echocardiography to the Postoperative Management of Hemodynamically Unstable Cardiac Surgery Patients

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Introduction: Clinicians use systemic blood pressure (BP), central venous pressure, urine output, and pulmonary artery pressures as surrogate markers for cardiovascular function and to manage critically ill patients with hemodynamic instability, despite the well-recognized risks and limitations of these monitors. Slender flexible disposable transesophageal echocardiography (TEE) probes approved for 72 hours of continuous use have recently become available and provide direct assessment of cardiac function. (ImaCor, Uniondale, NY). We hypothesized that continuous TEE contributes to the postoperative management of hemodynamically unstable cardiovascular surgical patients.

Methods: We placed TEE probes in consecutive post-cardiac surgery patients with gross hemodynamic instability in a university hospital cardiovascular ICU. Gross instability was defined as persistent systolic BP <100 mmHg, cardiac index <2.2 l/min/m2, SvO2 < 60 %, suspected pericardial effusion with tamponade, base deficit > 8 mEq/L, or lactate >5 mg/dL despite persistent inotropic, vasopressor, and/or volume resuscitation. We performed a monoplane TEE imaging session every 2-3 hours for the initial 6 hours and as needed until hemodynamically stable, extubated, or for 72 hours. We sought to obtain both the mid esophageal four chamber (ME4C) and transgastric short axis (TGSAX) views to assess left and right ventricular function, intravascular volume status, response to fluid resuscitation, and pericardial effusion with or without tamponade. Study endpoints included the ability to obtain the ME4C and TGSAX views, left ventricular end diastolic area (LVEDA), and LV fractional area of change (FAC). In addition, we compared fluid balance between subjects judged to likely benefit from a fluid bolus (defined as XXXXan increase in LVEDA with no decrease in FAC during passive leg raise) to those judged unlikely to benefit, and the echocardiographer recorded whether information obtained during imaging sessions influenced the hemodynamic management of each subject.

Results: Five hundred twelve video loops were recorded in twenty-one patients. Five (23.8%) subjects required reoperation, average ICU length of stay was 8.8+6.9 (mean, st. dev.) among survivors, and 30-day mortality was 14%. Both the ME4C and TGSAX views were obtained in 19 (90.5%) subjects, and at least one view in 20 (95.2%). Mean LVEDA among all subjects and all exams was 17.1+6.3 cm2, and LV fractional area of change 48.7+16.6 %. TEE data directed hemodynamic patient management decisions in 17XX (81.0 %) of subjects. Eleven (52%) subjects were deemed likely to benefit from fluid bolus. Findings revealed intravascular hypovolemia in 11 (52%) subjects and right ventricular failure in 10 (XX%) subjects. Although these findings did not consistently align with data obtained from intravascular monitors, subjects diagnosed as likely to benefit from fluid bolus had a XXX1370.3 + XX1508.0 ml net fluid balance over the ensuing 6-hours compared to XXX31.3 + XX310.7 mL among those determined not likely to benefit from fluid bolus (P=0.0137).

Findings revealed right ventricular dysfunction in 10 (48%) subjects. In addition, TEE data aided intra-aortic balloon pump and ECMO weaning in one patient over the 72-hour study period. In two INTRODUCTION

Clinicians use systemic blood pressure, central venous pressure, urine output, and pulmonary artery pressures as indirect measures of cardiac function and to manage critically ill patients with hemodynamic instability, despite the well-recognized risks and limitations of these monitors. Slender flexible disposable transesophageal echocardiography (TEE) probes approved for 72 hours of continuous use have recently become available and provide direct assessment of cardiac function (ImaCor, Uniondale, NY). We tested the hypothesis that continuous TEE contributes to the postoperative management of hemodynamically unstable cardiac surgery patients.

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patient management decisions in 17 (81.0 %) subjects. Eleven (52%) subjects were deemed likely to benefit from intravenous fluid bolus, , although this finding did not consistently align with data obtained from intravascular monitors. Subjects diagnosed as likely to benefit from fluid bolus had a 1370 + 1508 ml net fluid balance over the ensuing 6-hours compared to 31 + 310 mL among subjects determined not likely to benefit from fluid bolus (P=0.013)(Figure). TEE revealed right ventricular dysfunction in 10 (48%) subjects. In addition, continuous TEE aided intra-aortic balloon pump and ECMO weaning in one patient over 72 hours. In two of five emergent reoperations, TEE guided the decision to return to the operating room.

Discussion: Continuous TEE contributes to the postoperative management of cardiac surgery patients with hemodynamic instability. In conjunction with other hemodynamic monitors, bedside TEE may improve patient management and reduce hemodynamic instability. Future randomized, controlled studies are needed to determine if TEE reduces hemodynamic instability or improves patient outcomes in postoperative cardiac surgery patients.

Comparative Effectiveness of Centrally versus Peripherally Transduced Venous Pressure Monitoring in the Perioperative Period in Spine Surgery Patients

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Background: The placement of a central venous line for the measurement of central venous pressures (CVP) is frequently employed during spine surgery. However, its placement is associated with potential complications, patient discomfort and considerable cost. Studies have suggested that peripherally transduced venous pressures (PVP) correlate well with centrally derived values. However, comprehensive data of comparative effectiveness of this technique in the perioperative setting, and those concerning patient satisfaction, safety and cost remain largely unstudied.

Therefore, we decided to conduct a study comparing centrally to peripherally transduced venous pressure monitoring during the intraoperative and postoperative period in patients undergoing spine surgery, taking into account comparative effectiveness, patients satisfaction and procedural cost. We hypothesize that PVP monitoring correlates well with CVP measurements in the perioperative period and is associated with lower cost, while not negatively affecting patient satisfaction, ease of use and initiation, and safety.

Methods: Thirty-five patients undergoing spine surgery participated in the study. CVP and PVP were collected simultaneously during surgery and postoperatively. Data pairs were analyzed using the Pearson correlation coefficient in both settings and Bland and Altman plots were created to evaluate the degree of agreement between the two modes of venous pressure monitoring. Associated variables, including the number of attempts for line placement, the ease of use, maintenance, and interpretation were recorded. Patient comfort, incidence of complications and cost were analyzed.

Results: CVP and PVP correlated well in the operating room (correlation coefficient = 0.650, $p<.0001$). Correlation was lower in the recovery room (correlation coefficient = 0.388, $p< 0.0001$). There was no difference in terms of number of attempts to place either catheter, maintenance, interpretation and use in respect to PVP and CVP monitoring in the operating room. In the recovery room, the nurses reported a higher level of difficulty in interpretation the PVP as compared to the CVP, but no difference in the ease of maintenance. Patient comfort was higher with a peripheral than a central catheter. There were no complication related to either central or peripheral catheter placement. The overall cost as calculated by material expenses and charges in Medicare reimbursement were approximately 15 times higher for CVP compared to PVP monitoring.

Conclusion: PVP and CVP correlate well and with an acceptable level of agreement in the prone position during surgery and postoperatively, although the correlation is higher in the intraoperative period. Given the advantages in cost and patient satisfaction, PVP represents a valid, cost effective and safe alternative to CVP monitoring.

Physicians' Compliance with Patient Advance Directives: A Survey of the Fear of Legal Liability

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Introduction: Despite presence of an advance directive (AD), physician practice may not reflect patient desires.(1-3) Threat of legal liability and pressure from family may influence physician compliance with a patient's AD.(2-3) Using previously court-litigated scenarios,(3)we aimed to assess the impact legal concerns and external factors play on compliance with ADs.

Methods: After IRB approval, Critical Care, Emergency, and Internal Medicine staff physicians were queried via electronic survey tool. For each of the following 3 scenarios, subjects were asked if they would follow the patient's prior AD (very likely, somewhat likely, unsure, somewhat unlikely, very unlikely) and their reasons for compliance or non-compliance.

Scenario 1: 62 yr old. History of hypertension and diabetes. Presents to Emergency Department (ED) in severe respiratory distress following massive CVA. Trial of non-invasive ventilation has failed. Intubation required. Paramedics provide AD signed by patient 5 yrs ago prior to knee surgery indicating that patient is "Do not resuscitate" (DNR) / "Do not intubate" (DNI).

Scenario 2: 65 yr old. History of well-controlled hypertension. Arrives at ED in ventricular fibrillation, apneic and requiring mask ventilation. Previously-signed AD states a wish to "pass away in peace."

Scenario 3: 68 yr old. History of hypertension, DM, ESRD on dialysis, and acute lymphocytic leukemia arrives at ED febrile, tachypneic and hypotensive. On ICU transfer he becomes asystolic. Hospital electronic charting system shows patient signed AD indicating "DNR/DNI" during recent visit with oncologist. Patient's wife demands you "disregard the AD and do everything you can to save my husband."

Results: 60 of 188 surveys completed (32% response rate). Fear of legal liability involving decisions to comply or not comply with an AD was considered "somewhat" or "very important" by 27%, 27%, and 40% of respondents for Scenarios 1, 2, and 3, respectively.

Scenario 1: 48 physicians very or somewhat likely to follow AD. Of 8 physicians (13%) who were somewhat/very unlikely to follow AD, 5 considered age of AD to be very important in their non-compliance, and 0 expressed concern for legal liability.

Scenario 2: 37 (62%) were somewhat/very unlikely to follow AD. Of those 37, 86% believed the fact that AD did not reflect acuity of patient's current condition to be somewhat/very important.

Scenario 3: 37 (62%) somewhat/very likely to follow AD, despite fact that half considered wishes of patient's wife to be important. 40% stated that fear of legal liability was important/somewhat important in their decision-making. 18 out of 60 would not follow the patient's AD. Of those 18, 86% considered demand by patient's wife to have significantly affected their decision.

Conclusion: Our findings suggest that, in contrast to previous investigations, fear of legal liability plays a relatively minor role in decision-making related to adherence to ADs. We hypothesize that, as all physicians were employees of a single tertiary referral institution, enterprise rather than individual liability may have influenced physician decisions.

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Application of Neurally Adjusted Ventilatory Assist (NAVA)

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Introduction: Neurally adjusted ventilatory assist (NAVA) is a mode of mechanical ventilation that permits triggering and variable pressure assist in response to diaphragmatic electrical activity (Edi). An Edi catheter is inserted via the nasal cavity down to the crus of the diaphragm. Electrodes, embedded in the catheter, record the Edi in μv and this electrical signal is transmitted to the ventilator to trigger a pressure breath. The level of assist is determined by the NAVA level that determines the pressure delivered per μv of Edi.

Methods: This study took place in the adult (predominantly surgical) intensive care units of an academic medical center and was approved by the institutional IRB. Fifty adult ICU patients on mechanical ventilation and having failed a 30 minute spontaneous breathing trial, were enrolled into a study of NAVA ventilation. The NAVA catheter was placed by one of the investigators, either an RRT or M.D.. The catheter was positioned to obtain the optimum diaphragmatic EMG (Edi) based on the ECG trace and the depth of insertion. If a low/no Edi was obtained the patient was placed on CPAP 5 cmH2O to determine whether the Edi was suppressed by the existing mode of ventilation. Once a stable Edi had been obtained the patient was placed on NAVA ventilation, the initial NAVA level being titrated to obtain an average TV of 5-6 ml/kg ideal body weight. The care of the patient was then left to the primary team. RRTs and RNs had received instruction in NAVA and support was available 24/7 . The decision to stop mechanical ventilation / NAVA was left to the primary team.

Results: The patient demographics and initial ventilator characteristics are shown in Table 1. In the majority of cases the catheter was inserted on the first attempt in 5 minutes and a satisfactory Edi was obtained. The larger the NAVA catheter, the easier the insertion. Based on a target TV of 5-6 ml/kg ideal BW, the mean initial NAVA level was 1.3 cmH2O/μv. In contrast to previous studies we did not detect a significant difference in respiratory rate or TVs between NAVA and conventional ventilation modes.

We noted 8 NAVA “failures”, however, 6 of these were due to patient factors (diaphragmatic paralysis x3, oversedation, severe agitation x2) and 2 were due to an inability to obtain a reliable Edi despite multiple repositioning attempts. . Interestingly, we noted 12 (24%) patients in whom the Edi was significantly suppressed by the conventional ventilator modes. In 5 patients the Edi was suppressed by both PSV and assist control modes, wheras in an additional 7 patients, the Edi was suppressed by assist control alone while a satisfactory Edi was obtained in PSV and NAVA. This observed suppression of diaphragmatic activity by low/moderate levels of assist in 24% of our study population is particularly interesting in light of the growing concern of ventilator induced diaphragmatic dysfunction.

Overall, 22 out of 50 trials of NAVA worked well and required no manipulation post-insertion. The most common problems we encountered were patient agitation at baseline, loss of Edi signal and staff resistance to a nasogastric tube being placed.

The Effect on PA Catheter Directed Intraoperative Management on Post Operative Kidney Injury

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Introduction: Development of acute kidney injury in the perioperative period is associated with increased postoperative morbidity and mortality.1 The incidence of AKI after major vascular surgery has been reported as high as 18% and it is an important risk factor for adverse long-term outcomes.2 The authors sought to evaluate the effect of Pulmonary Artery Catheter (PAC) guided intraoperative care on Acute Kidney Injury (AKI) in the perioperative period.

Method: Following IRB approval, a retrospective observational cohort study was performed of consecutive adult patients undergoing open aortic vascular surgery from January 2003 to May 2008 at a single tertiary care academic hospital. Patients with pre-existing end stage renal disease and age ≤ 18 years were excluded. The exposure of interest was the intraoperative use of PAC to guide hemodynamic resuscitation. The primary outcome was the development of postoperative AKI, defined as AKIN stage ≥ 1 within 3 postoperative days. Data were extracted on the following predictor variables: baseline demographics, preoperative data (cardiac and pulmonary comorbidities, GFR, ASA status) and intraoperative data (MAP, HR, CVP, CI, cumulative vasopressor dose, urine output (UO), diuretic dose, EBL and length of surgery). Univariate analysis was performed evaluating the association between PAC use and early postoperative AKI. To further evaluate the association of PAC use with early postoperative AKI and to control for confounding and PAC indication bias, additional variables with biological plausible associations with early postoperative AKI were included in a multivariate logistic regression model.

Results: 818 patients underwent open aortic surgery. A PAC was used in 596 (72.8%) patients. The PAC group differed significantly from the non-PAC group as follows: lower preoperative GFR, higher intraoperative furosemide doses, greater intraoperative UO, greater likelihood of systolic dysfunction and longer duration of surgery. AKI stage ≥ 1 developed in 318 (38.9%) patients. Univariate predictors of AKI were smoking, age, emergency surgery, preoperative GFR, preoperative systolic dysfunction, intraoperative diuretic use, length of surgery, EBL and PAC use. On multivariate analysis, only preoperative GFR, length of surgery, male gender and intraoperative diuretic use were significantly associated with postoperative AKI (table 1). After multivariate adjustment, use of a PAC was no longer associated with postoperative AKI.

Conclusion: In this large retrospective cohort study, PAC-directed hemodynamic management was not associated with a decreased incidence of postoperative AKI. These results do not support PAC-guided hemodynamic management as a means of improving renal outcomes following aortic surgery. Additional clinical studies are needed to identify intraoperative interventions that may decrease the incidence of AKI.

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Septic Shock and Multi-Organ Failure with Elevated Hematocrit From Capillary Leak

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Introduction: In the ICU setting, septic shock may present with severe hypotension and multi-organ failure. Patients experience shock and massive edema, often after a prodrome of weakness, fatigue, and myalgias. These patients are at risk for ischemic organ failure, rhabdomyolysis/compartment syndrome, and venous thromboembolism. Hemoconcentration, despite aggressive fluid resuscitation is ominous. This is likely due to capillary leak. We are presenting the management of a patient with critically high hematocrit in septic shock resistant to standard fluid therapy and vasopressors.

Case Presentation: A 60 year-old Caucasian female was transferred from a California area facility with a diagnosis of worsening urosepsis and respiratory distress. The patient had a known medical history significant for morbid obesity, coronary artery disease, hypertension, chronic obstructive pulmonary disease with sleep apnea, pulmonary hypertension, and insulin dependent diabetes mellitus. She presented to our facility in septic shock, and oliguric renal failure. At the outside hospital, she had been managed unsuccessfully with crystalloid, antibiotics, and norepinephrine for blood pressure support. Her presenting vitals were as follows: HR 126, BP 65/41, RR 22, Sp02 92% on 40%Fi02 non re-breather, Temp 38.4. Initial laboratory reports reveal Hb/Hct 16.5/55.2%, Na 140, K 5.0, Cl- 97, Hc02 27, BUN 66, Cr 4.2. A 8.5F right internal jugular introducer sheath with pulmonary artery catheter was placed with a right radial arterial line for hemodynamic monitoring. Our initial therapy was based on intravascular volume resuscitation with crystalloid solution and continuation of vasopressors for hemodynamic stability. Additional antibiotic coverage was implemented. In an attempt to increase the intravascular volume and minimize fluid leak, a modified fluid therapy was implemented which included infusion of colloid (albumin/hetastarch), crystalloid, mannitol, dopamine, and vasodilators such as nitroglycerin. Nitroglycerin was chosen to expand the intravascular volume by vasodilating the venous capacitance vessels, decrease the SVR, improve pulmonary hypertension, and maintain capillary perfusion. This regime resulted in remarkable improvement in her shock status evidenced by improvement in her renal function and hematocrit to baseline levels.

Discussion: An abnormally elevated hematocrit- as found in dehydration and sepsis, poses a number of concerns for the clinician. Patients with alarmingly elevated hematocrits are at risk of imminent pro-thrombotic states leading to CVA, MI, PE, and death if left untreated. Furthermore, patients who are admitted with a hematocrit of >44% coupled with failure to reduce hematocrit within 24 hours of admission are more likely to experience multi-organ failure. The shift of plasma from the intravascular space to the extravascular space secondary to the release of inflammatory mediators results in hemodynamic instability, global edema, and hemoconcentration. Despite its controversial use in the setting of hemodynamic instability, nitroglycerin, a potent vasodilator, enables aggressive volume resusitation, limits further leak into the interstitial space, and restore microcirculatory function- a key function in the recovery of sepsis.

An Uncommon Presentation of Supraventricular Tachycardia in the ICU Refractory to Conventional Therapy

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Introduction: Supraventricular tachycardia (SVT) is an uncommon arrhythmia seen in the ICU patient population. The etiology of SVT is multifactorial, but may include intrinsic cardiac disease, electrolyte imbalance, excessive sympathetic activity, post cardiac, and systemic syndromes such as sepsis and ARDS. In addition to treating the underlying cause, current treatment of SVT includes use of beta-blockers, calcium channel blockers, amiodarone and cardioversion. We are reporting a case in which the above measures failed to respond to the above measures, and ultimately responded to intravenous procainamide therapy.

Case Report: A 60 year-old female was admitted to the ICU with ongoing shock secondary to sepsis from pyelonephritis. Her co-morbidities included morbid obesity, coronary artery disease, hypertension, COPD, pulmonary hypertension, and IDDM. She also had a history of OSA syndrome on 6L home oxygen. On admission, the patient was hypotensive with HR 126 and BP 69/41. Appropriate intravascular lines were placed for volume resuscitation and continuous hemodynamic monitoring. She was resuscitated with fluid and norepinephrine. The patient initially responded to standard fluid administration and vasopressor support, however, later developed narrow complex supraventricular tachycardia with HR > 250 beats per minute coupled with hypotension manifested by BP 80-90/45-60. Electrolytes were checked and replaced as needed. The patient was initially given Adenosine 6mg IV x3 without any response. We then gave Esmolol 20mg IV bolus with initiation of Esmolol infusion, again without any response. She was given a trial of Metoprolol 5mg IV x3 without effect. We attempted biphasic cardioversion at 300 joules, which showed a transient recovery and immediate reversion to SVT. A diltiazem infusion was started and the patient was again cardioverted. This resulted in recovery from SVT for 60 minutes. Amiodarone bolus 150mg IV and Amiodarone infusion was implemented with cardioversion- again resulting in transient recovery. A bolus dose of Procainamide 100mg IV was started. The patient reverted to sustained normal sinus rhythm. We discontinued the Amiodarone infusion and started a Procainamide infusion at 2mg/min until her sepsis and hemodynamic status improved. This provided sustained resolution of the tachyarrhythmia.

Discussion: Procainamide is a Type 1a antiarrhythmic agent useful in the treatment of both supraventricular and ventricular arrhythmias. Procainamide blocks open Na+ channels and to some degree outward K+ channels to prolong the cardiac action potential. This results in slowed conduction and a decreased rate of rise in the action potential. Our patient likely had what is known as AV reciprocating tachycardia- a subtype of SVT where accessory pathways exist between the atrial and ventricular myocardium. It is important to note that AV nodal blocking agents such as adenosine may not be effective if antero/retrograde conduction takes place over two separate accessory pathways. Despite this, the use of procainamide has fallen out of favor in the last two decades primarily owing to the development of new antiarrhythmics. However, procainamide remains procainamide remains therapeutically useful in refractory aberrant pathway arrhythmias.

Severe Chest and Back Pain and Bilateral Massive Adrenal Swelling in Polycythemia Vera: A Postsurgical Scene

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Introduction: The complex adrenal gland microvascular system predisposes the gland to be vulnerable either to hemorrhagic necrosis in the setting of profuse bleeding associated with severe stress, sepsis, hypotension and/or long term anticoagulation or to microvascular ischemia and subsequent hemorrhagic infarction in the setting of thrombotic conditions.

Bilateral adrenal haemorrhage (BAS) in complete absence of bleeding and with a completely normal coagulation profile in a patient with Polycythemia vera (PV) and severe chest pain, are very unlikely to coexist, having been published just one case in a medical context in the most recent literature(1), described by Gelfand et al in 1992, and non in an postoperative one. It is therefore interesting to present the case of severe chest and back pain associated with bilateral adrenal swelling in a patient with polycythemia vera undergoing esophagectomy.

Methods: N/A
A 70-year-old male patient with a prior medical history of PV, without treatment at present, scheduled for thoracic laparoscopic esophagectomy due to a IV grade distal adenocarcinoma. Two years earlier he had completed 12 cycles of chemotherapy and in the last year radiation therapy. At the time of admission the platelet count was 560 x 109/l, hematocrit 0.52, red cell 5.7x 10/l, and white blood cell count 17 x 10/l. In the sixth and ninth day respectively, subsequent to the esofaguectomy, surgery is performed due to lower esophageal suture dehiscence and thoracic apex collection drainage is performed under videotoracoscopy, receiving broad-spectrum antibiotics treatment. A few hours after the second reoperation, the patient develops great intensity chest and back pain that does not yield with medical treatment. Sequentially he presents, hyponatremia, occasional vomiting and hemodynamic lability. Bilateral CT scanning of chest and abdomen, demonstrated high-attenuating homogeneous adrenal masses (value around 60 HU), which did not enhance with intravenous contrast media. This CT scan image was interpreted as being diagnostic of massive BAS as the result of microvascular trombosis ischemia and secondary inflammatory swelling, as Michiels et al had described in their work (2). An ACTH stimulation test confirmed adrenal insufficiency and preemptive steroid therapy was started and was discharged on oral hydrocortisone.

Discussion: Essential thrombocythemia and thrombocythemia associated to PV with platelet counts between 400 and 1000 x 109/l are serious microvascular thrombotic conditions with high risk of platelet-mediated inflammation at the complex peripheral endarterial microvasculature (erythromelalgia), at the brain (atypical aunts), and at the coronary circulation (angina or infarction).
Our patient had this condition and was also subject of severe stress due to a complicated postoperative, developing BAS. Therefore as Michiels et al, we can say that BAS on CT scan as a cause of chest and back pain cannot be explained by hemorrhage alone, so it should more likely be interpreted as a consequence of microvascular ischemic thrombosis and associated inflammatory swelling (3).

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Developing a Stepwise Approach to Endotracheal Intubation

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Purpose: Little is known about how to properly teach complex technical tasks in medicine. We propose a unique pathway to the creation of an educational program to teach complex tasks, using intubation as an example. In part 1 we have attempted to create an exhaustive checklist of all the important steps in intubation, as decided upon through expert consensus via a modified Delphi technique. In part 2 we attempted to establish validity of the checklist.

Methods: Part 1 - we asked 30 airway experts from across Canada to tell us what steps represent the key features of intubation. They were asked to be exhaustive. We then carried out a modified Delphi technique with these experts until we came up with an endotracheal intubation “checklist”. We suggest that this list represents consensus on the “ideal” steps of intubation. In Part 2 a patient simulator was set up to mimic an operating room, equipped with all standard airway equipment. We recruited a total of 30 participants from 6 different levels of airway training and expertise (medical student, junior non-anesthesia resident, junior anesthesia resident, senior non-anesthesia resident, senior anesthesia resident and staff anesthesiologist). The participants, without knowing the contents of the “checklist”, were filmed intubating a healthy patient with an easy airway while verbalizing all steps. Drug selection and delivery was not a factor in our process. The films were analyzed by airway experts not involved in the Delphi process. The experts graded the films using the intubation “checklist” created in part 1, and the final values achieved were correlated to the level of airway experience. Inter-rater reliability was established using an inter-class correlation co-efficient and variation between study groups was assessed using the t-test with a bonferroni correction for multiple comparisons.

Results: Our expert panel returned to us a 54 point intubation checklist divided into three areas, namely preparation, evaluation and intubation. The modified Delphi process proved to be an effective tool allowing experts to reach consensus on the nuances of complex tasks such as intubation. 30 particants with vaying levels of intubation training were filmed and evaluated by three airway experts using the resulting checklist. Inter-rater reliability was found to be 0.85. There was a statistically significant difference between the number of items achieved by anesthesia residents and staff when compared to other groups ($p<0.001$)(see figure 1).

Conclusion: A modified Delphi technique can be used to solicit expert opinion on complex tasks in anesthesia practice. The resulting checklist for complex tasks such as intubation does show validity. We now plan on creating an intubation course based around our checklist. We hope to show that learners who use our expertdriven checklist will achieve proficiency in intubation more efficiently than those who use other programs.

Goal Directed Fluid Management During Complex Spinal Surgery Using the Flo-Trac System

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During operative procedures with large blood losses the anesthesiologist is presented with the task of managing a patient's fluids (crystalloid, colloid, blood) to insure adequate end organ perfusion and oxygenation. Static monitors of intravascular volume have been shown to be poor predictors of patient's fluid requirements. The Vigileo FloTrac system (Edwards Lifescience) permits continuous cardiac output and respiratory stroke volume variation (SVV) which predicts fluid responsiveness.

In 15 patients undergoing multiple level posterior spinal instrumentation we assessed the ability of the FloTrac to predict fluid responsiveness. Baseline measurements of HR, BP, CVP, CI, SVV, ABG, central venous 02 saturation (CV0%), and Hb were taken in the prone position. At an increase in SVV>15% all of the hemodynamic parameters were repeated and fluids and/or blood (Hb<8) was infused until the SVV returned to baseline.

The mean SVV increased from 10 to 18% at the same time that the CI decreased from 2.7 to 2.3, which was associated with a greater than 10% loss of estimated total body blood volume. The mean CVP tracked with the SVV, 9.6mmHg at baseline to 7.1 during the blood loss and back up to 10.1 with a return of the SVV to 10. The other hemodynamic parameters did not track as closely to the changes in SVV. CV0% changes were inconsistent and at times presented as a delayed decrease, after a return to baseline SVV.

The FloTrac system is a simple monitoring device to assess blood loss/ fluid responsiveness during posterior spinal fusions.

Beta Blockade and Amiodarone Prevention of Atrial Fibrillation Following Cardiac Surgery

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Introduction: Post-operative atrial fibrillation (POAF) is the most common complication following cardiothoracic surgery and can have considerable impact on hospital costs and length of stay. POAF is prevalent during the second to third post-operative days with an incidence of 15-50% in patients undergoing coronary artery bypass grafting and valve procedures1. There are several risk factors including gender, hypertension, valvular disease, atrial enlargement, perioperative heart failure, chronic obstructive pulmonary disease and withdrawal of beta-blocker therapy peri-operatively. Beta-blockers have shown the best evidence for preventing atrial fibrillation1,2 and have been shown to decrease the incidence of atrial fibrillation by 50% postoperatively. Prophylactic use of amiodarone has also been studied in the post-operative setting. Studies have shown a reduction in length of stay and complications associated with atrial fibrillation with subsequent reductions in hospital costs.

Methods: At Jackson Memorial Hospital, postoperative amiodarone prophylaxis guidelines for adult patients requiring cardiac surgery were implemented in 2010. A quality management focused retrospective chart review was conducted between April 2010 to June 2010 to evaluate the incidence of atrial fibrillation and impact on length of stay. Patient demographics, type of cardiac surgery, amiodarone dosage regimen, use of pre-operative and post-operative beta blockers, atrial pacing, ICU length of stay and overall hospital length of stay were evaluated.

Results: There were a total of 59 adult cardiac surgery patients that received amiodarone for prevention of atrial fibrillation. Seventy five percent of patients did not develop atrial fibrillation with amiodarone prophylaxis and 25% of the patients did develop atrial fibrillation. Fifty-three percent of patients undergoing valvular surgery had the highest incidence of developing atrial fibrillation; whereas those with coronary artery bypass graft surgery an incidence of 27%. Patients undergoing a single vessel CABG procedure and those with only an aortic valve replacement showed no significant development of atrial fibrillation. Proper preoperative use of beta blockers occurred in only 71% of patients and compliance with the entire amiodarone dosing protocol occurred in only 86% of patients. . Thirty-three percent of patients that developed atrial fibrillation postoperatively did not receive beta-blockers in the preoperative period. Postoperative use of beta blockers occurred in 86% of patients. There was a 13% incidence of atrial fibrillation in patients that were atrially paced. In patients where peri-operative beta blockade and proper amiodarone protocol compliance were instituted or maintained, hospital stay was reduced by 2 days and ICU length of stay was reduced by 1 day.

Conclusions: Adherence to beta-blocker protocols is not uniformly maintained and may contribute to increased medical costs. Amiodarone prophylaxis may not be needed in single vessel CABG procedures or in single valve aortic valve surgery during the postoperative period.

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A Comparison of Rescue Airway Devices placed by EMS Providers in a Human Patient Simulation Model

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Objective: To compare the time required for correct insertion of three blindly inserted advanced airway devices and skill retention by emergency medical technician (EMS) providers with no prior advanced airway experience.

Methods: This was a prospective study of 43 emergency medical technicians with minimal or no experience in the insertion of advanced airways. Each participant was trained in the use of the Esophageal-Tracheal-Combitube® (ETC) (Kendall-Sheridan Corporation), King LT® (KLT) (King Systems Corporation), and Laryngeal Mask Airway® (LMA North America) utilizing custom slides and information directly from each manufacturer. This was followed by supervised practice employing a human patient simulator until each participant correctly placed each device 3 times. The time it took each participant to place each device correctly and ventilate the human patient simulator was then assessed. The order in which the devices were tested was randomly chosen for each participant. The primary outcome measures were the success rate of proper insertion for each device as well as the time interval from initiation of mouth insertion to initiation of chest rise, signifying proper placement. At three months, the providers were reassessed under exact conditions without any intervening training or practice.

Results: At the day of teaching, the time required to place an ETC, LMA and KLT were 32.7± 12.3, 19.2±6.2, 20.1±6.6 seconds respectively. Using paired T tests for comparison; LMA and KLT were significantly faster than ETC $p<0.0001$. At 3 months, pair-wise comparisons of the three devices showed the ETC took significantly longer to place than the KLT and LMA $p<0.0001$, and the LMA took significantly longer to place than the KLT $p=0.0034$(36.4±13.1 ETC, 24.8±12.4 LMA, 19.0±6.9 KLT). There was no statistical difference in the number of failures in placing any individual device.

Conclusions: Comparison of 3 rescue airway devices in a human patient simulator by formerly untrained EMS providers showed that it takes significantly longer to place an ETC compared to an LMA and KLT on both the day of teaching and 3 months later with no interim practice. At 3 months, it took significantly longer to place an LMA compared to the KLT.

My Pregnant Patient NEEDS a Lung Volume Reduction Surgery... What?? Really

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DS is a 36 year old female G2P1 at 25 weeks gestational age who was admitted to Temple University Hospital with shortness of breath and oxygen desaturation. Her medical history includes emphysema, pulmonary hypertension and asthma. She is currently on the lung transplant list. She was negative for alpha-1 antitrypsin disorder. Her home medications include ipratropium and albuterol nebulizer treatments, budesonide, prednisone, and azithromycin. She has no known drug allergies. She has no past surgical history. Social history includes a 25 pack-year history of smoking with current use at 1-2 cigarettes per day. She has a history of using marijuana and cocaine.

She was admitted to the ICU with an oxygen saturation of 94% on room air. Fetal monitoring was performed by the obstetrics team from the time of admission to the point of delivery by cesarean section. At the time of admission any oxygen saturation below 96% was proving to cause fetal distress. Six hours after admission she required intubation. Chest x-ray showed bilateral bullous changes, which accounted for 60% of the pleural cavities. The practice of permissive hypercapnia with a small degree of hypoxia was not an option for this patient because of fetal intolerance. Options other than conservative methods for treatment of this patient's emphysema needed to be explored. A multidisciplinary meeting was held with the presence of the critical care team, cardiothoracic surgery, maternal-fetal medicine, and anesthesiology. This discussion led to a conclusion with two options, which included extracorporeal membrane oxygenation or salvage lung volume reduction surgery. The decision was made to perform the right thoracotomy and right upper bullectomy. Bullectomy was performed only on the rightt side in order to decrease intraoperative duration given that the extent of disease was greater on the right.

The patient continued to require ventilator support to maintain adequate oxygen saturations as well as appropriate ventilation during the immediate post-operative course. Intubation and positive pressure ventilation of this patient increased the risk of pneumothorax given the extent of bullous disease. On post-operative day 4/ ICU day 11 the patient became bradycardic and eventually asystolic secondary to left sided tension pneumothorax formation. The cardiopulmonary arrest spanned a 9 minute time interval. A cesarean section was performed after fetal heart rate decelerations were noted. The patient developed another pneumothorax on ICU day 30 and a second left-sided chest tube was placed in response to the 30-40% left lower lung pneumothorax. She will undergo LVRS on the right lung in the near future.

This medically complicated case involving a patient and her fetus is a rare circumstance that required invasive measures to salvage lung function in order to treat the hypoxia that was a detriment to two patients.

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Omega-3 Fatty Acid Supplementation, Body Mass Index, and Risk of Acute Kidney Injury Following Cardiac Surgery

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Introduction: Acute kidney injury (AKI) complicates the postoperative course of up to 30% of cardiac surgery patients, and the diagnosis of AKI independently predicts a 5-fold increase in postoperative mortality. Identification of modifiable risk factors for AKI may enable physicians to reduce this devastating postoperative complication. We recently reported that intraoperative markers of oxidative stress predict postoperative AKI. Patient body mass index (BMI) directly correlates with markers of oxidative stress while fish oil supplements have been reported to reduce oxidative stress. We conducted the following study to test the hypothesis that preoperative fish oil supplement use or BMI are associated with AKI following cardiac surgery.

Methods: We prospectively collected perioperative data from all cardiac surgery patients at a university hospital from November 1, 2009 – March 15, 2011. We assessed predictors of oxidative stress including history of diabetes, BMI, use of statins, use of fish oil, baseline renal function, type of surgery, and baseline demographics. We defined AKI using AKI Network consensus criteria for AKI diagnosis (stage 1 AKI = 0.3 mg/dl rise in serum creatinine within 48 hours of surgery). Patients on chronic renal replacement therapy at baseline or who died prior to 48 hours postop were excluded. We compared fish oil use and BMI between patients who did and did not develop stage I AKI. We adjusted for the effects of AKI risk factors using logistic regression and also tested for interaction between fish oil use and BMI with AKI.

Results: Twelve hundred thirty three non-end stage renal disease patients underwent cardiac surgery during the study period, and 283 (23.0%) developed AKI. AKI subjects were older, more likely to be diabetic, had elevated baseline creatinine and BMI, and had a higher likelihood of receiving surgery with the assistance of cardiopulmonary bypass. One hundred forty-one subjects (11.6%) were taking fish oil prior to surgery, and the incidence of AKI was 23.1% in fish oil users and 22.9% in non-users (P=0.96). BMI was 29.5 kg/m2 in patients who developed AKI and 27.9 kg/m2 in patients who did not (P<0.001). After adjusting for the effects of age, gender, BMI, history of diabetes, baseline creatinine, preoperative statin use, use of cardiopulmonary bypass, mitral valve surgery, and the interaction of fish oil use with BMI, the use of fish oil was not associated with risk of AKI (P=0.37). BMI also did not modify the effect of fish oil use on AKI (P=0.39). Age, BMI, history of diabetes, baseline creatinine, and use of cardiopulmonary bypass, however, were highly associated with the development of AKI. For 5 kg/m2 increases in BMI (i.e, normal to overweight BMI classification transition or overweight to obese transition), the odds of AKI were increased by 22.1%. Statin use, another modifier of oxidative stress, was also not associated with AKI reduction in this cohort.

Conclusion: Fish oil use, despite potential effects on perioperative oxidative stress, was not associated with AKI following cardiac surgery. BMI, an established predictor of oxidative stress, independently predicted postoperative AKI. Future studies are needed to determine how BMI may influence the risk of post cardiac surgery AKI

The Surgical Apgar Score as a Predictor of Admission to ICU After Intra-Abdominal Surgical Procedures

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Background: Current practices of postoperative triage to intensive care units (ICUs) are highly inconsistent. Objective, evidence-based criteria for ICU admission after surgery may facilitate resource allocation and ultimately improve postoperative outcomes. The Surgical Apgar Score (SAS) is a scoring system developed for easy calculation, incorporating three intraoperative variables to predict those patients at highest risk of postoperative complications and death. We hypthesized that a patient's SAS is a strong predictor of admission to ICU at the end of surgery.

Methods: Retrospective cohort study of patients undergoing intra-abdominal surgical procedures at Columbia University Medical Center from January 2003 through January 2010. We calculated the SAS using data from the intra-operative electronic medical records, and extracted information on patient characteristics and location after surgery using chart review. We determined the ability of the SAS to predict admission to ICU after surgery. We compared the predictive value of the SAS to other potential predictors, such as the American Society of Anesthesiologists' (ASA) physical status classification system and patient age.

Results: Of 8,535 patients who had intra-abdominal surgical procedures, 5,953 (69.7%) had an SAS of 7-10 (low risk), 2,391 (28.0%) 4-6, and 191 (2.2%) 0-3 (high risk) (see Table 1). There was minimal correlation between the SAS and assigned ASA score (R2= -0.18). Overall, 12.7% of patients were admitted to the ICU after surgery. Of patients with an SAS of 7-10, 6.1% were admitted to the ICU directly from the operating room, for SAS 4-6, 26.4%, and for SAS 0-3 45.5%. The SAS had better predictive value for admission to ICU (Receiver Operating Characteristic area under the curve (AUC) = 0.76) than ASA alone (AUC = 0.70), and ASA and age combined (AUC = 0.72). Combination of all three factors provided the best predictive value (AUC=0.82).

Conclusions: The SAS is a good predictor of admission to ICU after intra-abdominal surgery and may have a role in aiding in clinical decision-making regarding appropriate patient triage at the end of surgery.

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