N E W S L E T T E R

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President's Message

The Unacknowledged Transformation of Critical Care Medicine

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

The history of critical care is a narrative of increasing understanding of what care benefits our patients, delivered in a context that was stable, well understood, and substantially under local control. Now, our understanding of what care patients require is threatened by a variety of disruption in how that care is delivered. New restrictions on duty hours, the expansion of the critical care work force, and the widespread adaptation of the electronic medical record are transforming critical care medicine in important ways, most of which are completely unexamined.

As far as anyone can see into the future, there will be increasing demand for care provided by or supervised by intensivists. No matter how you slice the data, the difference between the supply of intensivists and the demand for their services is substantial, and growing. At academic centers, residents have historically extended the care generated by individual intensivists. Trainees allowed a single intensivist to supervise the care of a substantial number of patients around the clock. The benefit to the residents from this immersive and exhausting experience was incomparable; most trainees from that era describe their ICU rotation as the most intense, important, and formative experience of their residency.

Restrictions on duty hours have brought this era to a close, and have ushered in a new one of full-employment for physician extenders, such as nurse practitioners and Physician's Assistants. Resident duty-hours are now so restricted that housestaff generally no longer view themselves as the doctors for individual patients, and are absent frequently enough and long enough that they no longer generate continuity in the care of their patients. The physician extenders employed to fill the coverage gaps here also mostly view themselves as shift workers. Unsaid at many institutions: our residents (or attendings) cover nights and weekends for our extenders, whose hours are substantially better than the attending physicians. The number of handoffs has increased substantially. Sadly, the medical handoff literature is in its infancy (*Critical Care Medicine*. 2012;Vol 39:2540). There is no large body of science to help us deliver this distributed care effectively. Most organizations have not developed a robust plan for continuity in care, and are in essence winging it. In most circumstances, the intensivist is the only expert on the patient. Patients and families who remember the previous era are sensitive to this, and many now rightly regard themselves, and not the medical team, as the experts on the patient. This re-engineering of the care team may pose a threat to the outcomes and safety of our patients, the only question is how large?

Many experts are confident that the electronic medical record (EMR) provides practitioners with improved access to vital information about their patients, and defends continuity of care in the face of this workforce disruption. Practitioners who work with these systems have widely varied opinions; most are much less enthusiastic than the information technology enthusiasts interviewed in the media. In many institutions, the EMR is a repository of massive quantities of nice-to-have information that radically re-

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A Note from the Editor to SOCCA Members:

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

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President's Message

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duces the signal-to-noise ratio in the chart. Much of this information is inserted into the record to support billing. Most EMRs require a page to present information that required two lines of stick-graphics in a paper note. Perhaps worst of all, the discussion portion of most notes reads like a mad-lib compilation of cut-and-paste from other notes, and often is one. I would trade 90 percent of this data for five thoughtful new sentences about a patient every day. How about you? The EMR does not make this easy. If the regulators of our world were serious in their ambition to utilize the EMR to improve health care, they would shift all of their Pay-For-Performance efforts into incentivizing these systems to conform to health care, as opposed to being blind to the huge cost in dollars and efficiency that these systems have incurred. I feel like the guy in that old joke about the poorly cut suit, where at the end his friend says: 'Nice suit! But what's wrong with your arms and back?' Is your EMR a source of continuity? Or are your providers using paper sign-out sheets as their real charts and sources of continuity? Make no mistake – there are distinct advantages associated with the EMRs that are in widespread use, but in many instances, familiarity with the EMR breeds frustration and cynicism. Ironically, I am also certain that over time, the critical care community will devise ways to use the EMR to defend continuity.

In critical care medicine, our ideas about what care should be delivered are well established, and informed by a rich literature with which most of us are substantially familiar. How that care is being delivered has changed dramatically over the past couple of years, and will continue to do so over the next several years. This transformation has been largely unstudied, and there is effectively no understanding about how to deliver effective and safe care in the face of these changes. That our patients do so well is a tribute to the teams of providers – ICU nurses, pharmacists, physicians, and extenders – that generate this care. This is a dimension of medicine in general, and our specialty in specific, that is in desperate need of high quality scholarship.

Planning for the annual meeting by **Vivek Moitra, M.D.**, **Ron Pauldine, M.D.** and **Carlee Clark, M.D.** continues apace. This year's ultrasound and echocardiography workshop, organized by **Michael Wall, M.D.** and **Danny Talmor, M.D.**, will be an expanded, longer version of last year's workshop, with spaces for more attendees. Last year's offering was not only the highest quality training experience anywhere, it was also the best value for your dollar by far. Sign up early! **Miguel Cobas, M.D.** is convening our item writers (**Ludwig Lin, M.D., Michael Banks, M.D., Tuhin Roy, M.D., Ricardo Martinez-Ruiz, M.D., Thomas Higgins, M.D., J. David Roccaforte, M.D., Sasha Grek, M.D., Ed Bittner, M.D., Ron Pauldine, M.D., Todd Sarge, M.D., and Annette Rebel, M.D.**) for Maintenance Of Certification in Critical Care (MOC in CCM). They are going to receive formal training in question writing. In collaboration with **Randy Steadman, M.D.** and the ASA's Committee on Simulation, **Manny Pardo, M.D.**, **Elizabeth Sinz, M.D.** and **Miguel Cobas, M.D.** have created a program of simulation experiences that should fulfill the MOC in CCM Simulation requirement. Finally, several members, including **Avery Tung, M.D.** and **Pratik Pandharipande, M.D.** have agreed to represent SOCCA at an FDA meeting about sedation. We are indebted to them for their willingness to serve.

PRO/CON: Management of Vitamin D Insufficiency During Critical Illness

Background

The prevalence of low vitamin D status has increased dramatically in the general population in the United States and worldwide.[1] This is particularly concerning given that there is a growing recognition of the association between vitamin D insufficiency and increased risk of cardiovascular disease, diabetes, cancer, and pulmonary ailments.[2,3] Indeed, vitamin D supplementation appears to mitigate the incidence and adverse outcomes of these diseases and may reduce all-cause mortality.[4-6] While its pleotropic effects have received significant attention related to improved outcomes in various chronic diseases, the role of vitamin D in critical illness is less well understood.

Serum 25-Hydroxyvitamin D [25(OH)D] is the most abundant vitamin D metabolite and its relative stability in the systemic circulation makes it a good indicator of overall vitamin D contact from diet and sunlight exposure in the general population.[7] To date, there is no clear consensus on the optimal definitions of either vitamin D deficiency or vitamin D insufficiency.[8] Diverse cut points for 25(OH)D levels have been suggested, ranging from 16 to 48 ng/ml.[9,10] This uncertainty likely originates from the lack of standardized vitamin D assay methodologies and differences in the measured functional endpoints used by various investigators, which arise from the classic and non-classic effects of vitamin D.[7]

The classic function of vitamin D is the control of extracellular calcium metabolism by regulating absorption in epithelia involved in calcium transport.[11] Since low vitamin D status stimulates parathyroid hormone (PTH) secretion to increase intestinal calcium absorption and bone resorption to maintain calcium balance, it has been proposed that vitamin D sufficiency be described as the concentration of 25(OH)D which achieves maximal PTH suppression.[12] In this regard, vitamin D sufficiency is defined by 25(OH)D of >30 ng/mL. Based on studies on fracture prevention, most investigators have adopted the definition of vitamin D insufficiency as 25(OH)D concentration of <30 ng/mL and deficiency as <20 ng/mL.[13]

The non-classic functions of vitamin D include regulation of cell proliferation and differentiation, hormone secretion, and enhancement of immune function.[11] These effects take place on a cellular level and are directly dependent on 25(OH)D levels.[14] Indeed, cells of the neuromuscular, cardiovascular, endocrine, and immune system express the vitamin D receptor (VDR).[15] Furthermore, most of these cells express 25(OH)D-1-α-hydroxylase, the enzyme necessary to produce 1,25-Dihydroxyvitamin D [$1,25(OH)_2D$] for autocrine and paracrine use within the target cell itself.[16] $1,25(OH)_2D$ is the most biologically active vitamin D metabolite. The discovery of VDRs in activated immune cells has particularly stimulated research into the role of vitamin D in immune function. It is now recognized that vitamin D plays a critical role in the regulation of the innate and the adaptive immune systems.[17] $1,25(OH)_2D$ inhibits adaptive immunity by attenuating the proliferation and differentiation of T and B lymphocytes, which is thought to ameliorate the severity of inflammatory diseases.[18] In contrast to its inhibitory role in adaptive immunity, $1,25(OD)_2D$ is a potent activator of the innate immune system. Innate immunity represents the first line of defense against microbial invasion and constitutes both epithelial and mucosal cells, as well as polymorphonuclear leukocytes, monocytes, and macrophages. The central mechanism underlying microbial eradication is the activation of toll-like receptors in the host cell, which induces formation of potent antimicrobial peptides (e.g. cathelicidin).[19] 25(OH)D levels >30 ng/mL appear to be necessary for vitamin D to optimally exert its non-classical effects.[20]

PRO: We Should Aggressively Treat Low Vitamin D Levels in Critically Ill Patients

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A growing body of evidence suggests that 25(OH)D may influence the risk of mortality during critical illness. Though the significance of hypovitaminosis D in the intensive care unit (ICU) was described sporadically between 1987 and 2003, [21-23] interest in the association between 25(OH)D levels and mortality in critical illness did not resurface until 2009, when Lee et al. described a disproportionately high incidence of vitamin D insufficiency in this population.[24] Reports on the inverse relationship between vitamin D and severity of critical illness soon emerged,[25] which then lead to studies adequately powered to detect associations between 25(OH)D levels and mortality.

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In a prospective analysis of 112 patients hospitalized for community acquired pneumonia, Leow et al. observed that 25(OH)D levels <12 ng/mL upon admission was associated with a significantly higher risk of 30-day mortality when compared to similar patients with 25(OH) D levels ≥12 ng/mL (OR 13.5: 95% CI, 2.6 to 69.1).[26] Similarly, Annweiler et al. prospectively followed 399 elderly Caucasian patients after admission to an acute care geriatric unit.[27] A significant and independent association between 25(OH)D levels >20 ng/mL and lower short-term in-hospital mortality rate was observed (OR 0.65: 95% CI, 0.44 to 0.96). Venkatram et al. performed a retrospective analysis of 437 patients admitted to the medical ICU with 25(OH)D levels obtained within 24 hours of admission.[28] 25(OH)D level <20 ng/mL was independently associated with a higher risk of in-hospital mortality (OR 8.7: 95% CI, 1.03 to 72.8). Furthermore, Matthews et al. performed a prospective analysis on 258 consecutive patients admitted to the surgical ICU.[29] In this cohort, multivariate analysis demonstrated that 25(OH)D levels ≤26 ng/mL was independently associated with longer ICU length of stay (r = 0.194, p = 0.001), increased ICU-related costs (r = 0.194, p = 0.001), and a higher ICU-related mortality rate (r = 0.125, p = 0.023). Moreover, Braun et al. retroactively studied the relationship between vitamin D levels at initiation of care and mortality in a mixed ICU population.[30] Initial 25(OH)D levels were obtained within ±7 days of ICU admission in 1,325 eligible subjects. Adjusted multivariate analysis demonstrated that 25(OH)D ≤15 ng/mL was associated with significantly increased risk of in-hospital mortality (OR 1.77, 95% CI, 1.04 to 3.01) as well as mortality at 30days , 90 days, and 1-year follow-up.

The exact mechanism of *how* vitamin D influences mortality risk is not known and is an area of much needed scientific inquiry. However, a likely "biological" association between vitamin D status and survival from critical illness is hard to dispute in light of the current body of literature on this matter. Moreover, 25(OH) D levels are at least insufficient (in terms of optimizing the non-classical effects of vitamin D) in the majority of patients at initiation of ICU care and do not improve with supplement doses found in standard multivitamins, enteral formulations, and total parenteral nutrition.[23] Given a relatively broad therapeutic index (30-100 ng/mL), a very benign adverse event profile (hypercalcemia is the most common side effect), and the availability of oral as well as intravenous formulations, high-dose vitamin D supplementation can be safely initiated in the ICU setting to achieve 25(OH)D levels >30 ng/mL.[31] Published reports have demonstrated that single doses of oral cholecalciferol ranging between 50,000-300,000 IU can be administered safely to rapidly improve serum 25(OH)D levels. [32,33] With little to lose, and potentially much to gain, vitamin D status should be routinely monitored and aggressively corrected in critically ill patients.

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CON: We Should Not Aggressively Treat Low Vitamin D Levels in Critically Ill Patients

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While several reports indicate that the prevalence of vitamin D insufficiency has increased dramatically over the last decade, to suggest that it has reached epidemic proportions may not be accurate. Most researchers use 25-Hydroxyvitamin D [25(OH)D] levels of ≥30 ng/mL to define vitamin D sufficiency, despite a lack of consensus amongst clinicians regarding optimal thresholds.[8] After careful consideration of the quality, breadth, and reliability of available studies, the Institute of Medicine defined vitamin D adequacy in 2011 as serum 25(OH)D levels between 20-50 ng/mL,[34] based on an estimate that serum 25(OH)D levels of 20 ng/mL would protect 97.5 percent of the healthy population from skeletal disorders

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such as osteoporosis and osteomalacia and the possible risk of vitamin D toxicity at 25(OH)D levels >50 ng/mL. If the critical threshold for 25(OH)D is set at <20 ng/mL, estimates on the prevalence of hypovitaminosis D would be dramatically lower.

During times of critical illness, inflammatory responses can have a profound effect on measured micronutrient status. Duncan et al. recently demonstrated in a large cohort of hospitalized patients that there is a inverse association between C-reactive protein (CRP) and 25(OH)D levels ($r = -0.16$, $p<0.01$).[35] Even at slightly elevated CRP levels (5-10 mg/L), a significant decrease in measured 25(OH)D levels was evident. As CRP levels increased, the magnitude of its effect on 25(OH)D levels also increased, but the variability in the data invalidated the possibility of refining the association (i.e. build a correction factor). Moreover, Krishnan et al. have suggested that aggressive fluid therapy in the early stages of resuscitation plays a significant role in the perception of low vitamin D status in critically ill patients.[36] Using the immediate post-cardiopulmonary bypass state as a model for systemic inflammatory response in critical illness, they noted a dramatic 35 percent reduction in 25(OH)D level and 45% reduction in $1,25(OH)_2D$ level in the setting of a 3.5L positive fluid balance. As the fluid balance returned to baseline, so did 25(OH)D levels, while $1,25(OH)_2D$ levels actually surpassed baseline concentrations – most likely as a result of PTH stimulation from the transient 25(OH) D hemodilution. Furthermore, Venkatesh et al. recently demonstrated that 25(OH)D levels may vary significantly on an hour-to-hour basis in critically ill patients.[37] An observed mean within-patient hourly variation of 9.6 ng/mL was reported.

Theoretically, cathelicidins play an important protective role against pathogen-mediated disease states. [19,38] And while evidence suggests that 25(OH)D levels are positively associated with cathelicidin concentration during critical illness,[39] a direct association between cathelicidin levels and risk of infections, disease severity, or ICU mortality, has not been established. In addition, recent evidence suggests that 25(OH)D levels may not be a predictor of mortality in certain subsets of critical illness such as in septic patients.[40] Interestingly, the existing data on 25(OH)D levels and improved survival occur at a threshold level between 12-26 ng/mL, significantly below what is thought to be a level needed to optimize the non-classic effects of vitamin D.

> "The existing level of evidence does not warrant routine aggressive correction of 25(Oh) D levels, but rather suggests that single point-assessments, especially in the early resuscitative phase, appear to be unreliable measures of vitamin D status."

Taken all together, the exact role of vitamin D in critical illness remains unclear. The effect of the systemic inflammatory response on decreasing concentrations of vitamin D, in combination with a dilutional effect from fluid therapy, suggests that low vitamin D levels may occur independently of nutritional status and that there is a risk of misinterpreting low vitamin D levels as indicating deficiency. The existing level of evidence does not warrant routine aggressive correction of 25(OH) D levels, but rather suggests that single point-assessments, especially in the early resuscitative phase, appear to be unreliable measures of vitamin D status. Decisions regarding supplementation should be based on serial assessments of vitamin D status and for now, should aim to maintain 25(OH)D levels between 20-30 ng/mL.

References:

1. Ginde AA, Liu MC, Camargo CA. Demographic differences and trends of vitamin D insufficiency in the US population, 1988-2004. *Arch Intern Med.* 2009;169(6):626–632.
2. Dobnig H, Pilz S, Scharnagl H, et al. Independent association of low serum 25-hydroxyvitamin d and 1,25-dihydroxyvitamin d levels with all-cause and cardiovascular mortality. *Arch Intern Med.* 2008;168(12):1340–1349.
3. Herr C, Greulich T, Koczulla RA, et al. The role of vitamin D in pulmonary disease: COPD, asthma, infection, and cancer. *Respir Res.* 2011;12(1):31.
4. Lappe JM, Travers-Gustafson D, Davies KM, et al. Vitamin D and calcium supplementation reduces cancer risk: results of a randomized trial. *Am J Clin Nutr* 2007;85(6):1586–1591.
5. Vacek JL, Vanga SR, Good M, et al. Vitamin d deficiency and supplementation and relation to cardiovascular health. *Am J Cardiol* 2012;109(3):359–363.
6. Ginde AA, Scragg R, Schwartz RS, et al. Prospective study of serum 25-hydroxyvitamin D level, cardiovascular disease mortality, and all-cause mortality in older U.S. adults. *J Am Geriatr Soc.* 2009;57(9):1595–1603.
7. Lai JKC, Lucas RM, Clements MS, et al. Assessing vitamin D status: pitfalls for the unwary. *Mol Nutr Food Res.* 2010;54(8):1062–1071.
8. Cashman KD, Kiely M. Towards prevention of vitamin D deficiency and beyond: knowledge gaps and research needs in vitamin D nutrition and public health. *BJN.* 2011;106(11):1617–1627.
9. Holick MF. Vitamin D deficiency. *N Engl J Med.* 2007;357(3):266–281.
10. Glendenning P, Inderjeeth CA. Screening for vitamin D deficiency: defining vitamin D deficiency, target thresholds of treatment and estimating the benefits of treatment. *Pathology.* 2012;44(2):160–165.
11. Kulie T, Groff A, Redmer J, et al. Vitamin D: an evidence-based review. *J Am Board Fam Med.* 2009;22(6):698–706.
12. Durazo-Arvizu RA, Dawson-Hughes B, Sempos CT, et al. Three-phase model harmonizes estimates of the maximal suppression of parathyroid hormone by 25-hydroxyvitamin D in persons 65 years of age and older. *J Nutr.* 2010;140(3):595–599.
13. Holick MF, Binkley NC, Bischoff-Ferrari HA, et al. Evaluation, treatment, and prevention of vitamin D deficiency: an Endocrine Society clinical practice guideline. *J Clin Endocrinol Metab.* 2011;96(7):1911–1930.

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14. Hart PH, Gorman S, Finlay-Jones JJ. Modulation of the immune system by UV radiation: more than just the effects of vitamin D? *Nat Rev Immunol*. 2011;11(9):584–596.
15. White JH. Vitamin D metabolism and signaling in the immune system. *Rev Endocr Metab Disord*. 2011.
16. Schwalfenberg GK. A review of the critical role of vitamin D in the functioning of the immune system and the clinical implications of vitamin D deficiency. *Mol Nutr Food Res*. 2011;55(1):96–108.
17. Aranow C. Vitamin D and the immune system. *J Investig Med*. 2011;59(6):881–886.
18. White JH. Regulation of intracrine production of 1,25-dihydroxyvitamin D and its role in innate immune defense against infection. *Arch Biochem Biophys*. 2011.
19. Méndez-Samperio P. The human cathelicidin hCAP18/LL-37: a multifunctional peptide involved in mycobacterial infections. *Peptides*. 2010;31(9):1791–1798.
20. Bhan I, Camargo CA, Wenger J, et al. Circulating levels of 25-hydroxyvitamin D and human cathelicidin in healthy adults. *J Allergy Clin Immunol*. 2011;127(5):1302–4.e1.
21. Zaloga GP, Chernow B. The multifactorial basis for hypocalcemia during sepsis. *Ann Intern Med*. 1987;107(1):36.
22. Nierman DM, Mechanick JI. Bone Hyperresorption Is Prevalent in Chronically Critically Ill Patients. *Chest*. 1998;114(4):1122–1128.
23. Van den Berghe G, Van Roosbroeck D, Vanhove P, et al. Bone turnover in prolonged critical illness: effect of vitamin D. *J Clin Endocrinol Metab*. 2003;88(10):4623.
24. Lee P, Eisman JA, Center, J.R. Vitamin D deficiency in critically ill patients. *N Engl J Med*. 2009;360(18):1912–1914.
25. Ginde AA, Camargo CA Jr., Shapiro NI. Vitamin D Insufficiency and Sepsis Severity in Emergency Department Patients With Suspected Infection. *Acad Emerg Med*. 2011;18(5):551–554.
26. Leow L, Simpson T, Cursons R, et al. Vitamin D, innate immunity and outcomes in community acquired pneumonia. *Respirology*. 2011;16(4):611–616.
27. Annweiler C, Pochic S, Fantino B, et al. Serum vitamin D concentration and short-term mortality among geriatric inpatients in acute care settings. *Adv Ther*. 2010;27(4):245–249.
28. Venkatram S, Chilimuri S, Adrish M, et al. Vitamin D deficiency is associated with mortality in the medical intensive care unit. *Crit Care*. 2011;15(6):R292.
29. Matthews LR, Ahmed Y, Wilson KL, et al. Worsening severity of vitamin D deficiency is associated with increased length of stay, surgical intensive care unit cost, and mortality rate in surgical intensive care unit patients. *Am J Surg*. 2012.
30. Braun AB, Gibbons FK, Litonjua AA, et al. Low serum 25-hydroxyvitamin D at critical care initiation is associated with increased mortality. *Crit Care Med*. 2012;40(1):63–72.
31. Mata-Granados JM, Vargas-Vasserot J, Ferreiro-Vera C, et al. Evaluation of vitamin D endocrine system (VDES) status and response to treatment of patients in intensive care units (ICUs) using an on-line SPE-LC-MS/MS method. *J Steroid Biochem Mol Biol*. 2010;121(1-2):452–455.
32. Ilahi M, Armas LAG, Heaney RP. Pharmacokinetics of a single, large dose of cholecalciferol. *Am J Clin Nutr*. 2008;87(3):688–691.
33. Amrein K, Sourij H, Wagner G, et al. Short-term effects of high-dose oral vitamin D3 in critically ill vitamin D deficient patients: a randomized, double-blind, placebo-controlled pilot study. *Crit Care*. 2011;15(2):R104.
34. 34. Ross AC, Manson JE, Abrams SA, et al. The 2011 report on dietary reference intakes for calcium and vitamin D from the Institute of Medicine: what clinicians need to know. *J Clin Endocrinol Metab*. 2011;96(1):53–58.
35. Duncan A, Talwar D, McMillan DC, et al. Quantitative data on the magnitude of the systemic inflammatory response and its effect on micronutrient status based on plasma measurements. *Am J Clin Nutr*. 2012;95(1):64–71.
36. Krishnan A, Ochola J, Mundy J, et al. Acute fluid shifts influence the assessment of serum vitamin D status in critically ill patients. *Crit Care*. 2010;14(6):R216.
37. Venkatesh B, Davidson B, Robinson K, et al. Do random estimations of vitamin D3 and parathyroid hormone reflect the 24-h profile in the critically ill? *Intens Care Med*. 2012;38(1):177–179.
38. Tjabringa GS, Rabe KF, Hiemstra PS. The human cathelicidin LL-37: a multifunctional peptide involved in infection and inflammation in the lung. *Pulm Pharmacol Therap*. 2005;18(5):321–327.
39. Jeng L, Yamshchikov AV, Judd SE, et al. Alterations in vitamin D status and anti-microbial peptide levels in patients in the intensive care unit with sepsis. *J Transl Med*. 2009;7:28.
40. Cecchi A, Bonizzoli M, Douar S. Vitamin D deficiency in septic patients at ICU admission is not a mortality predictor. *Minerva Anestesiol*. 2011;77(12):1184-9.

Question:

The non-classic biological actions of vitamin D include:

A. Regulation of cell proliferation
B. Regulation of cell differentiation
C. Enhancement of innate immune system
D. Inhibition of adaptive immune system
E. All of the above

Answer: E

PRO: Should You Pick a PICC?

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Peripherally inserted central catheters (PICCs) are an attractive alternative to central venous catheters (CVCs) for many patients in various hospital settings, including the intensive care unit (ICU). For many ICUs, the prevalence of PICCs in their critically-ill patients has dramatically increased over the last few years. In fact, some intensivists may view PICCs as the preferred route for venous access (compared to CVCs) because PICCs can provide rapid and safe hemodynamic monitoring, are associated with lower rates of complications, and can be used for a longer duration.

Hemodynamic Monitoring

In patients with an established PICC, intensivists gain the ability to obtain central venous pressure (CVP) as a means to rapidly initiate hemodynamic monitoring with little additional delay or patient risk. This may be particularly beneficial during the initiation and monitoring of the effectiveness of resuscitation in patients with severe sepsis, septic shock, cardiac tamponade, or heart failure. While studies to support this practice are scant, Latham and colleagues were able to show that PICCs may be equivalent to CVCs when measuring in vitro pressure.[1] In addition, the use of blood gas analysis from a PICC sample to determine ScvO2 may also provide invaluable information to guide resuscitation for many patients with acute deteriorations and hemodynamic compromise.

Safety of Placement

Compared to CVC placement, the complication rate from PICC placement appears to be very low. The rate of pneumothorax, hemothorax, and arterial puncture are all significantly higher during CVC placement than for PICC placement.[2] In addition, femoral CVC placement (compared to upper extremity PICC placement) can be associated with retroperitoneal hemorrhage and pseudoaneurysm formation. Finally, the rate of complication for CVC appears to be strongly correlated to clinician experience (inexperienced clinicians cause more complications); whereas, PICC placement appears to be especially safe when placed by both experienced and inexperienced healthcare personnel.[3,4]

Duration of Use

PICCs are frequently placed in patients who are either poor candidates for peripheral intravenous catheters or in patients who need long-term veno-irritant therapies such as parenteral nutrition or intravenous antibiotics. These catheters are frequently used throughout the patient's entire hospital course, and occasionally, even after hospital discharge. This is not possible with CVC as many hospitals have specific safety concerns and protocols that mandate CVC removal at the time of ICU or hospital discharge. In published studies, the major reasons for PICC removal were easily treatable complications such as thrombosis, phlebitis, and malposition.[5] These complications can usually be managed conservatively or prevented with proper nursing care and maintenance. In general and compared to CVC, PICCs can be maintained in situ for a prolonged period with a low rate of easily-treatable complications.

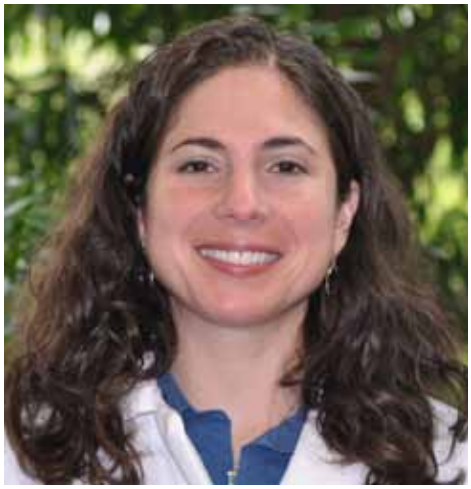
Conclusion

As has been described, PICCs provide a rapid and safe hemodynamic monitoring tool, a significant safety margin, and longer duration of catheter use compared to CVC. For these reasons, PICC may provide significant benefit for critically ill patients and should be considered as a viable alternative to CVC for many critically ill patients.

References:

1. Latham HE, Rawson ST, Dwyer TT, et al. Peripherally inserted central catheters are equivalent to centrally inserted catheters in intensive care unit patients for central venous pressure monitoring. *J Clin Monit Comput.* 2012;26: 85–90.
2. Cowl CT, Weinstock JV, Al-Jurf A, et al. Complications and cost associated with parenteral nutrition delivered to hospitalized patients through either subclavian or peripherally-inserted central catheters. *Clin Nutr.* 2000;19(4): 237-43.
3. Polderman KH, Girbes ARJ. Central venous catheter use part 1: mechanical complications. *Intensive Care Med.* 2002;28: 1–17.
4. Mansfield PF, Hohn DC, Fornage BD, et al. Complications and failures of subclavian-vein catheterization. *N Eng J Med.* 1994;331: 1735–1738.
5. Vanek VW. The ins and outs of venous access: Part II. *Nutr Clin Pract.* 2002;17: 142–155.

CON: Should You Pick a PICC?



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For the critically ill patient, active resuscitation frequently necessitates central venous access to ensure the adequate and timely administration and monitoring of life-saving therapies. After this resuscitation period, the treating clinicians must decide whether central venous access should be continued, and if so, whether a peripherally-inserted central catheter (PICC) might provide the best type of care. Unfortunately, it is unclear (and probably unlikely) whether critically-ill patients derive significant benefit from PICCs and emerging data suggests that patients may even be placed at some harm due to the risks of phlebitis, venous thrombosis, and central venous stenosis when PICCs are placed.

Basic (But Frequent) PICC Complications

PICCs, while easy to place for physicians and specifically-trained support personnel, are associated with a significant risk of port thrombosis, phlebitis and catheter malposition complications at a rate greater than central venous catheters (CVC). (1) In fact, patients with PICCs require early PICC removal up to 30-40 percent of the time before the intended therapy has been completed (and some data even suggests that up to 38 percent of these catheters may be removed within one week of placement).[1-3] PICCs are also associated with a host of other nonspecific mechanical and clinical problems requiring frequent early discontinuation.

Deep Venous Thrombosis and Central Venous Stenosis

PICC lines also have a significantly higher incidence of deep venous thrombosis (DVT) than do CVCs (27.9% vs. 9.6%).[4,5] According to the published literature, approximately 5 percent of the patients with these DVTs will develop a symptomatic pulmonary embolus.[6] The use of prophylactic anticoagulation does appear to decrease (but not abolish) the risk of DVT formation in patients with PICCs.[7] Addtionally, the proximal location of these DVTs frequently requires long-term therapeutic anticoagulation.[8] Perhaps more importantly, up to 7 percent of PICC recipients develop chronic central vein stenosis and post-thrombotic syndrome.[9]

Infection

PICCs are frequently placed because, compared with CVC, they have been associated with a lower rate of bloodstream infection (BSI). Unfortunately, the data to support this claim is related to PICC use in the outpatient setting and it is unclear whether this data can be translated to the critically-ill population.[9] In fact, data for high-risk hospitalized patients suggests that PICCs have comparable BSI rates when compared to CVCs placed in the internal jugular or subclavian veins.[10] Additionally, the published rate of BSI with CVCs is very low in the first week after placement and the overall best strategy to reduce BSI appears to be removal of invasive venous catheters altogether rather than to consider a catheter (such as a PICC) that can be left in place for a prolonged period.[11]

Conclusion

Although easy and convenient to place, PICCs are not benign and have not earned an evidenced-based place in the critical or acute care settings. CVCs in the internal jugular and subclavian site may have fewer complications after insertion and may provide a more reliable route to complete therapy and should be considered when continued central venous access is mandated.

References:

1. Cowl CT et al. Complications and cost associated with parenteral nutrition delivered to hospitalized patients through either subclavian or peripherally-inserted central catheters. *Clin Nutr.* 2000; 19:237-243.
2. Loewenthal MR et al. The peripherally inserted central catheter: a prospective study of its natural history after cubital fossa insertion. *Anaesth Intensive Care.* 2002; 30:21-24.
3. Walshe LJ et al. Complication rates among cancer patients with peripherally inserted central catheters. *J Clin Oncol.* 2002; 20:3276-3281.
4. Bonizzoli M et al. Peripherally inserted central venous catheters and central venous catheters related thrombosis in post-critical patients. *Intensive Care Med.* 2011; 37:284-9.
5. Scott ER. Risk of Symptomatic DVT associated with Peripherally Inserted Central Catheters *Chest.* 2010; 138:803-810.
6. Lobo BL et al. Risk of venous thromboembolism in hospitalized patients with peripherally inserted central catheters. *J Hosp Med* 2009;4:417-22.
7. Paauw JD et al. The Incidence of PICC line-associated thrombosis with and without the use of prophylactic anticoagulants. *J Parenter Enteral Nutr* 2008;32:443-447.
8. Gonsalves CF et al. Incidence of central vein stenosis and occlusion following upper extremity PICC and port placement. *Cardiovasc Intervent Radiol* 2003;26:123-127.
9. Safdar N, Maki D. Risk of Catheter-Related Bloodstream Infection With Peripherally Inserted Central Venous Catheters Used in Hospitalized Patients. *Chest* 2005;128:489-495.
10. Turcotte S et al. Peripherally Inserted Central Venous Catheters Are Not Superior to central Venous Catheters in the Acute Care of Surgical Patients on the Ward. *World J Surg* 2006;30:1605-1619.
11. Ritchey NP et al. Optimal interval for triple-lumen catheter changes: a decisional analysis. *Med Decis Making* 1995;15:138-142.

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Literature Review: Renal Doppler Ultrasound: A New Tool to Assess Renal Perfusion in Critical Illness

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Matthieu Le Dorze, Andrien Bougle, Stephane Deruddre, Jacques Dutanteau. Shock. 2012; (37)4:360 -365.

This article highlights the potential for expanding current echocardiography practice of intensive care physicians to include assessment of renal perfusion in the bedside ICU management of critically ill patients.

The incidence of Acute Kidney Injury (AKI) in the perioperative period varies based on the definition of AKI and type of surgery. The reported incidence is between 1-25 percent. Renal dysfunction after cardiac surgery is often associated with multiorgan dysfunction syndrome (MODS) and may result in a mortality of up to 60percent.[1]

In cardiac surgery patients, widely accepted perioperative preventive strategies for AKI include: deferring elective surgery until there is adequate recovery following a known renal insult and considering less invasive procedures in those with greatest risk. From the standpoint of the anesthesiologist and intensivist, perioperative renal protective strategies include: hemodynamic optimization, avoidance of renal toxicity and use of pharmacologic agents. To date, pharmacological agents that have shown a protective role in the prevention of AKI include: use of sodium bicarbonate to prevent contrast – induced nephropathy and early postoperative use of statins to lower incidence of AKI in cardiac surgery patients.[2,3]

In terms of hemodynamic monitoring in the perioperative period, to date there are no established optimal hemodynamic targets (MAP, CVP, CO, oxygen delivery, SVO_2or other) for the prevention and recovery of AKI.

For early diagnosis of AKI, previously studied individual biomarkers such as NGAL (neutrophil gelatinase-associated lipocalin) have shown poor sensitivity and specificity in predicting AKI, as judged by receiver operating curve. A panel of biomarkers may show in the future to be a more predictive tool in early identification of AKI compared to standardized laboratory tests.

Doppler – based renal resistive index (RI) and contrast-enhanced ultrasound (CEUS) are rapid bedside ultrasound techniques that allow for early detection of acute AKI.

The Doppler resistive index (RI) described by Pourcelot is an index that is used as a measure of vascular resistance.

RI = (peak systolic velocity – end diastolic velocity / peak systolic velocity). A value of 0.60 is considered normal, whereas 0.70 is usually considered the upper threshold of normal in adults,[4] The RI is a ratio of velocities and not a ratio of flow. RI varies directly with changes in renal vascular resistance, RVR.

RI measured at the level of the interlobar-arcuate arteries has shown to provide most consistent results.[5]

Several factors affect RI including: renal vascular compliance, arterial stiffness, age, pulse pressure, heart rate, renal interstitial pressure, intra abdominal pressure (IAP) and underlying kidney disease.[6,7,8]

In ICU patients, RI has shown to predict the development of AKI. It can be used to distinguish between functional and organic AKI. In a study conducted by Darmon et al in mechanically ventilated ICU patients, the measured RI was significantly different between patients with no AKI, transient AKI and persistent AKI, 0.71 (0.66-0.77), 0.71 (0.62-0.77) and 0.82 (0.81-0.89) respectively, ($p<0.0001$). RI > 0.795 had shown a 92 percent sensitivity and 85percent specificity for the development of persistent AKI.[9] In patients with sepsis that had a normal RI on admission and developed a RI > 0.74 had a 78percent sensitivity and 77percent specificity in predicting AKI.[10] In the immediate post operative period in cardiac surgery patients a RI > 0.74 had a 85percent sensitivity and 94 percent specificity in predicting AKI.[11]

On the other hand contrast - enhanced ultrasonography (CEUS), represents a noninvasive, bedside technique that utilizes gas filled microbubbles to assess microvascular tissue perfusion. Microbubbles remain confined to the intravascular space due to their relative size (1 - 6 µm). This technique enables evaluation of the microcirculation in several organs at the bedside in ICU patients. Studies have been performed to validate results and confirm safety of this methodology.[12]

The value of renal sonography is the ability to assess regional perfusion rather than making assessments based only on global determinants of tissue perfusion such as (CO, oxygen delivery, SVO_2 and other). Future studies may provide evidence for the use of bed side renal sonography to supplement existing strategies in ensuring optimal renal perfusion tailored on a patient to patient basis, target (MAP and volume) for titration of vasopressor therapy and fluid in critically ill patients.

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Literature Review: Renal Doppler Ultrasound: A New Tool to Assess Renal Perfusion in Critical Illness

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References:

1. Chertow GM et al. Independent association between acute renal failure and mortality following cardiac surgery. *Am J Med*. 1998; 104:343 -8.
2. Gregory J. Merten, MD et al. Prevention of Contrast – Induced Nephropathy with Sodium Bicarbonate. A Randomized Controlled Trial. *JAMA*. May 19, 2004 – Vol 291, No.19
3. Frederic T. Billings, MD et al. Early Post operative Statin Therapy Is Associated With a Lower Incidence of Acute Kidney Injury After Cardiac Surgery. *Journal of Cardiothoracic and Vascular Anesthesia*, Vol 24, No 6 (December), 2010: pp 913 -920.
4. Tublin ME et al, Review: The resistive index in renal Doppler sonography: where do we stand ? AJR Am J Roentgenol 180: 885,2003.
5. Knapp R et al, Variability of Doppler parameters in the healthy kidney: an anatomic-physiologic correlation. *J Ultrasound Med* 14:427.1995
6. Bude RO, et al, Relationship between the resistive index and vascular compliance and resistance. *Radiology* 211:411,1999
7. Terry JD, et al, Intrarenal Doppler: characteristics of aging kidneys. *J Ultrasound Med* 19:303,2000
8. Umgelter A, et al, Renal resistive index and renal function before and after paracentesis in patients with hepatorenal syndrome and tense ascites. *Intensive Care Med* 35:152,2009
9. Darmon M, et al: Diagnostic accuracy of Doppler renal resistive index for reversibility of kidney injury in critically ill patients. *Intensive Care Med* 37:68-76,2011
10. Lerolle N, et al: Renal failure in septic shock: predictive value of Doppler –based renal arterial resistive index. *Intensive Care Med*. 32: 1553,2006.
11. Bossard G, et al: Early detection of postoperative acute kidney injury by doppler renal resistive index in cardiac surgery with cardiopulmonary bypass. *Br J Anaesth* 107:891 -898,2011
12. Dolan MS, et al: Safety and efficacy of commercially available ultrasound contrast agents for rest and stress echocardiography: a multicenter experience. *J Am Coll Cardiol* 53: 32, 2009.

Quiz:

What is (are) the factor(s) that affect RI (resistive index) and therefore renal function in the perioperative period

1. Renal vascular compliance
2. Age
3. Renal Interstitial pressure and Intra-abdominal pressure (IAP)
4. Central Hemodynamics (Pulse pressure, arterial stiffness and heart rate)

A. 1,2,3
B. 1,3
C. 2,4
D. 4
E. 1,2,3,4

Answer: E

Literature Review: Tubed From the Blindside

Michael Woo, M.D.

Ramachandran SK, Nafiu OO, Ghaferi A, Tremper KK, Shanks A, Kheterpal S. Independent predictors and outcomes of unanticipated early postoperative tracheal intubation after nonemergent, noncardiac surgery. *Anesthesiology.* 2011; 115(1):44-53.

In what would appear to be the first in a series of data lodes from a massive surgical database, Dr. Ramachandran and his group from Michigan describe unexpected early postoperative intubations (UEPIs). Beyond a spectrum of predictors, they found that almost half of UEPI's occur within 3 days of surgery, and that UEPI's represent a 9-fold increase in 30-day mortality. These findings are a launch point to define respiratory failure in terms of expectation, or lack thereof.

The database originates from the American College of Surgeons–National Surgical Quality Improvement Program (ACS-NSQIP). It's really big. The study evaluates over 300,000 adult patients undergoing non-emergent, non-cardiac, non-outpatient surgeries. Other exclusion criteria include preoperative ventilator dependence and surgical procedures with less than 100 cases. Roughly 200,000 patients were analyzed to determine predictors of UEPI, with the remaining 100,000 patients used to validate their risk-class model.

The size of the study and database are its greatest strengths. The authors found an incidence of 0.83-0.9 percent of UEPI in the patient cohorts. Is there any other way to analyze low incidence events? The database, unfortunately, suffers from voluntary membership and lack of standardization. Separation from sources prevents useful data mining in the face of compelling findings. The writers acknowledge that supporting perioperative information is beyond their reach, being outside the scope of the database.

The ACS-NSQIP database does not encompass interventions such as PCA (patient controlled analgesia) use and anesthetic technique. Consequently, this study focuses solely on comorbid conditions. Clinicians are left to hope that anesthetic or surgical techniques may decrease unexpected complications.

While usual suspects are present as independent predictors (tobacco use, COPD, active CHF, sepsis), a pursuit of unexpected events was sure to reveal zebras. These predictors include hypertension requiring medication, recent weight loss, and current ethanol use. Depending on your practice demographic, these predictors (excluding recent weight loss) may be unfortunate epiphenomena as much as determinants of mortality.

As it stands, this study serves the clinician in prognosis. It highlights comorbidities that may answer the question "how did we get here?" But what if the question is "how do we avoid going there?"

Some of the predictors appear treatable such as active CHF. Others may be unavoidable, some dependent on definitions. The definition of active tobacco use predates surgery by one year, which obviates practical intervention. The feasibility of curbing active ethanol use may affect the incidence of UEPI but increase delirium tremens (unless withdrawal is the effector here). Medicated hypertension is an independent predictor. While a transition to unmedicated hypertension is not an option, stratification to medication regimens might be very interesting.

The study suggests that half (49.4 percent) of surprise intubations happen within the first 72 hours after surgery; the rest occurring within a month. This coincides with hypoxemia, sleep disorders, and susceptibility to opioids. Intuitively, independent predictors combine with altered respiratory physiology to create these events. This study takes the first step to bridge this gap between physiology and data.

If a multidisciplinary database were available, one might assess neck circumference or STOP-BANG points as predictors (Table 1). The logic of pathophysiology would implicate undiagnosed obstructive sleep apnea as a link between disordered breathing and unexpected respiratory events.

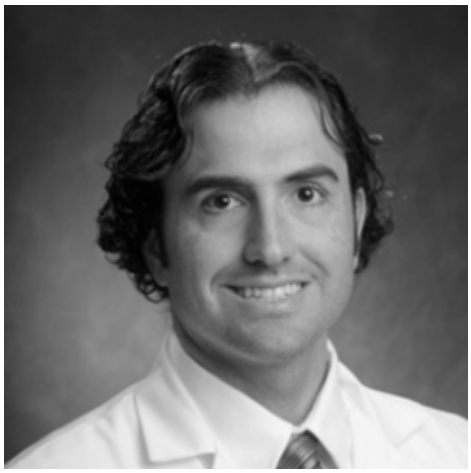
While retrospectovision has its limitations, the size, if not the scope, of this database and study creates a new focus in respiratory failure. Unexpected predictors in unexpected events may highlight blame in non-traditional areas. "It was the verapamil, with the 10 lb. weight loss, and cigarettes last winter that put in that tube."

Table 1: STOP-BANG Acronym for Screening for OSA

(>3 points = high-risk)

1. Snoring during sleep
2. Tiredness during daytime
3. Observed apnea during sleep
4. Pressure, high blood pressure
5. BMI (Body mass index) > 35 kg/m^2
6. Age >50 years
7. Neck circumference > 15.75 inches
8. Gender male

Literature Review: Perioperative Fluid Management: The Holy Grail Remains Elusive



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Tomas Corcoran, MB, BCh, BAO, MRCPI, FCARCSCI, MD, FCICM; Julia Emma Joy Rhodes, MBBS(Hons); Sara Clarke, MBBS (Hons); Paul S. Myles, MB, BS, MPH, MD, FCARCSCI, FANZCA, FRCA; and Kwok M. Ho, MPH, PhD, FRCP, FCICM. *Anesthesia & Analgesia.* 2012; March (114):3.

Like the knights of the Arthurian Legend who sought fruitlessly the divine chalice[1], anesthesiologists and critical care physicians continue their quest for the optimal intra- and post-operative fluid management strategy. In the past, peri-operative fluid management, if any, was something akin to a "more is more" approach, but recent studies have shown that perhaps the famed architect Mies Van der Rohe's "less is more" philosophy also applies to fluid administration: some patient populations may benefit from a restrictive approach to fluid therapy. For example, the fluids and catheters treatment trial (FACTT) demonstrated that restrictive fluid strategy, when applied to critically ill patients with ARDS, had better outcome across several metrics, including ICU length of stay (LOS) and ventilator-free days.[2] Other investigators have similarly demonstrated that carefully restricting intra-operative fluid intake in a goal directed (GD) manner improves postoperative outcome, while other have shown this not to be the case conclusively.[3] In the March 2012 issue of Anesthesia & Analgesia, Tomas Corcoran and colleagues posited that goal directed fluid therapy is not equivalent to a liberal "goal-less" fluid strategy and performed a comprehensive meta-analysis to test their hypothesis.

Study Design

The investigators performed a carefully structured search of the following databases: MEDLINE®, EMBASE®, PubMed®, and the Cochrane Collaboration. Their article search was comprehensive in both breadth and depth, and included publications across six decades. No animal studies were analyzed, but relevant works in non-English languages were included. For timeliness and completeness, the authors also included the most recent gray literature.[1]Y

To be eligible for the analysis, published studies had to be randomized controlled trials that evaluated standard vs. goal-directed therapies (i.e. those with objective data such as cardiac output or pulse wave contour analysis). Studies were included if the associated surgical procedure was not expected to result in a systemic inflammatory response (SIRS) or sepsis. Finally, all studies were required to have defined endpoints, such as length of stay, or organ-specific endpoints, such as return of bowel function. Excluded from analysis were studies that examined only biochemical or laboratory endpoints, those that included specific subsets of patients (e.g. trauma, neurosurgical, obstetric), and those associated with minimally invasive procedures.

The analysis of studies was two-tiered (liberal vs. restrictive fluids and GD vs. non GD). Organ and procedure-specific endpoints were assessed and a subgroup analysis of the GD studies was performed. Standard statistical techniques germane to meta-analyses were applied as well.

Results

The authors' literature review and analysis yielded 23 studies of GD therapy and eleven non-GD evaluations. Of these seven were adequately blinded and six adequately concealed.

Tier-1 analysis showed that patients in the liberal volume replacement (LVR) stratum were more likely to experience pneumonia, pulmonary edema, slower return of bowel function, and longer LOS. However, if one looks closely at the data presented, few studies showed individual statistically significant differences. The Tier-2 analysis showed that patients in the GD stratum received more intra-operative fluids and had improved outcomes when compared to a non-goal-directed approach. The authors attribute this to the increased use of colloids in GD studies. There was no difference in mortality

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1. Y Grey literature (or gray literature) is a term that refers to a body of materials that cannot be found easily through conventional channels, such as medical publisher databases, but which is usually considered both original and timely. Examples of grey literature include proceeding abstracts from professional societies, technical reports from government agencies or scientific research groups, working papers from research groups or committees, white papers, or preprints.

Literature Review: Perioperative Fluid Management: The Holy Grail Remains Elusive

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either in the overall analysis or the subgroup analysis. Analysis of reports of the highest quality showed that patients in the LVR stratum did not have longer LOS, while those in the GD stratum continued to demonstrate shorter LOS.

Conclusions

The Corcoran meta-analysis is the most comprehensive of its kind to date. However, like so many efforts preceding it, the paper raises more questions than it answers. Its methodology is sound and the authors strove for rigor in study selection. The authors' findings would favor a goal-directed approach to fluid management in patients undergoing major surgery to improve outcome. They surmise, however, that "significant uncertainty remains concerning the relative benefits of GD and restrictive fluid strategies." Additionally, the authors excluded procedures associated with trauma, cardiac and septic patients because those procedures would include a much stronger inflammatory response than elective or emergent surgical procedures. Yet they included emergency major abdominal procedures that have a much higher inflammatory response than elective procedures.[4] The investigators also included studies using inotropic drugs as part of their fluid strategies to optimize predefined hemodynamic goals. This adds another cofounder in the analysis of the GD vs. liberal fluid therapy. Finally, the authors assert that their analysis showed that all forms of hemodynamic monitoring to be equally effective in reducing perioperative complications but that the esophageal Doppler may be a slightly more precise signal for reduction in length of stay.[5] Other PAC, CVP, TEE, etc. have their limitations and require a skilled clinician to appropriately use and interpret the data. Furthermore, central venous pressure and pulmonary capillary wedge pressure are not as accurate in predicting fluid responsiveness as other modalities.[6] They cannot differentiate fluid responsive from nonresponsive with baseline values. Lastly, a strong correlation has not been defined between cardiac filling pressures before volume expansion and the hemodynamic response to volume expansion.[7] These limitations might explain the limitations in outcomes that are seen in this meta-analysis and with GD vs. restrictive therapy.

Ultimately, Corcoran and colleagues could not conclude that one fluid monitoring modality was superior in terms of improving mortality. Colloids may be the better choice when GD therapy is chosen, but the authors point out that the ongoing debate regarding the use of colloids versus crystalloids cannot be put to rest with their results. Furthermore, a randomized controlled trial published just prior to but not included in the Corcoran study concluded that physically fit patients managed with GDT undergoing major colorectal surgery had worse outcomes.[8] As the authors point out, a randomized controlled trial with the power to detect significant differences in mortality has yet to be undertaken, and it is not clear that we can use a surrogate measure, such as ICU length of stay, reliably. Thus, the quest for a strategy for peri-operative fluid optimization continues on.

References:

1. King Arthur in legend: the holy grail. 2011. http://www.britannia.com/history/arthur/grail.html.
2. Wiedemann HP, Wheeler AP, Bernard GR, et al. Comparison of two fluid-management strategies in acute lung injury. N *Engl J Med*. Jun 15 2006;354(24):2564-2575.
3. Hughes CG, Weavind L, Banerjee A, Mercaldo ND, Schildcrout JS, Pandharipande PP. Intraoperative risk factors for acute respiratory distress syndrome in critically ill patients. *Anesth Analg*. Aug 2010;111(2):464-467.
4. Sarbinowski R, Arvidsson S, Tylman M, Oresland T, Bengtsson A. Plasma concentration of procalcitonin and systemic inflammatory response syndrome after colorectal surgery. *Acta Anaesthesiol Scand*. Feb 2005;49(2):191-196.
5. Roche AM, Miller TE, Gan TJ. Goal-directed fluid management with trans-oesophageal Doppler. Best Pract Res Clin *Anaesthesiol*. Sep 2009;23(3):327-334.
6. Kumar A, Anel R, Bunnell E, et al. Pulmonary artery occlusion pressure and central venous pressure fail to predict ventricular filling volume, cardiac performance, or the response to volume infusion in normal subjects. *Crit Care Med*. Mar 2004;32(3):691-699.
7. Osman D, Ridel C, Ray P, et al. Cardiac filling pressures are not appropriate to predict hemodynamic response to volume challenge. *Crit Care Med*. Jan 2007;35(1):64-68.
8. Challand C, Struthers R, Sneyd JR, et al. Randomized controlled trial of intraoperative goal-directed fluid therapy in aerobically fit and unfit patients having major colorectal surgery. *Br J Anaesth*. Jan 2012;108(1):53-62.

Critical Care Fellowship at Vanderbilt University

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The Critical Care Medicine fellowship at Vanderbilt University is a year-long comprehensive training program which encompasses an unparalleled breath of critical care services. Located in Nashville, Tennessee, Vanderbilt University Medical Center (VUMC) is the tertiary referral and Level I trauma center for middle Tennessee and parts of four surrounding states. Currently, the critical care units staffed by Critical Care Anesthesiology at Vanderbilt include a 23-bed Surgical Intensive Care Unit, a 26-bed Cardiovascular Intensive Care Unit, a 24-bed Neurological ICU, a 10-bed Regional Burn Center ICU, and a 13-bed SICU at the Nashville Veterans Affairs Medical Center. In November, 2009, Vanderbilt unveiled a 10-story, 170-bed, state-of-the-art Critical Care Tower. Thus far, the tower contains new Surgical and Neurological ICUs, but has significant room for expansion and further growth. The facility is designed for advanced remote patient monitoring, and places these ICUs at the vanguard of clinical care. The growth of critical care at Vanderbilt continues apace; the medical center is actively growing its transplant, cardiac surgery, and ventricular assist device programs, and our current Anesthesia Critical Care faculty of 17 continues to grow as well to provide continuously expanding clinical coverage.

The diverse range of ICUs covered by our faculty and fellows gives our training program its greatest asset. The diverse mix of clinical services gives Vanderbilt's Critical Care fellowship broad exposure and added flexibility to meet the individual needs of each fellow in preparation for Board certification, evidence-based critical care practice, and personal interests in accordance with their post fellowship employment. Our fellows organize teaching/work rounds, formulate care plans, and facilitate communication between the critical care team and surgical services, consultative services, and family members. Fellows also serve as instructors for FCCS, ATLS, and organize a weekly multidisciplinary critical care journal club. Additionally, they co-direct and teach portions of the Division of Critical Care's nationally-recognized Critical Care Skills Week, which exposes junior medical students to anesthesiology and critical care early in their medical school careers. Our fellows also have the opportunity for a combined fellowship with either Cardiac Anesthesiology or Vanderbilt's Master of Science in Clinical Investigation program.

Our educational curriculum is an innovative, systems-based approach. Each monthly module focuses on a different aspect of critical care, and we tailor our didactic lectures, journal clubs, and simulation sessions around this topic. This systems approach allows in-depth understanding of the fundamentals and recent innovations in each field in a way that maintains interest and knowledge retention. In addition to didactic lectures given by experts from all over the medical center, our fellows run their own quality initiative and organize their own research program to foster an environment for group participation in critical care research. This structured approach to research has resulted in numerous research projects that our fellows have then continued as junior faculty at both VUMC and elsewhere.

In addition to standard clinical exposure and didactics, our fellows are exposed to many aspects of modern critical care. Starting next year, all of our critical care fellows will undergo focused training in critical care ultrasonography, both surface and TEE. Furthermore, our curriculum will include a business course to educate our fellows in the practical aspects of critical care billing, cost structuring, and long--term profitability and sustainability.

Clinical exposure is also augmented by monthly medical simulation training at Vanderbilt's cutting-edge Center for Experimental Learning and Assessment (CELA). The purpose of simulation in our fellowship training is to provide a realistic yet safe environment to improve leadership, personal interaction, and clinical skills. In the simulation, our fellows work through complicated, real life

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Critical Care Fellowship at Vanderbilt University

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scenarios and afterward undergo a thorough debriefing by critical care faculty in which they receive detailed, immediate feedback on their actions and thought processes. The topics of the simulations are based on the current education module, and provide yet another facet upon which to hone their clinical skills and academic knowledge.

The fellowship program offers a diverse array of electives, which can be tailored to individual interest or to acquire advanced training in a specific field necessary for future employment. In addition to mandatory rotations in the VUMC Surgical, Neurological, Cardiovascular, Burn, Trauma ICUs, and the Veterans Affairs Surgical ICU, our critical care fellows can electively rotate in Medical or Pediatric ICUs or in subspecialties including nephrology, infectious diseases, transplant medicine, adult cardiology, critical care nutrition, palliative care, and ethics. Another option is a one--month elective in the Vanderbilt International Anesthesiology (VIA) Program providing anesthetic and medical services to poorly--served countries in Africa. This program presents a singular opportunity for trainees to experience the challenges and rewards of practicing medicine in the developing world.

Vanderbilt is located in downtown Nashville, which is known as Music City for good reason. Blocks away from the medical center is the famed Music Row, the world epicenter of the country music industry. Live music venues abound in Nashville, and the city has a vibrant nightlife and numerous destinations for music lovers, including the Grand Ol' Opry and Ryman Auditorium. In addition to a creative music and art scene, the temperate climate and abundant lakes and parks near Nashville means ample opportunities for outdoor activities.

Interested applicants can contact:
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SOCCA Innovator Award

The SOCCA Innovator Award award is given in recognition of an individual who has a device and/or an idea (concept) addressing the practice of anesthesiology and/or critical care medicine qualifying as a "true innovation."

The Award is for $10,000 for the selected winner. There will also be travel grants of $500 each to the top three finalists to attend the Award presentation at SOCCA's Annual Meeting.

The Nominee can be a resident, fellow or clinical faculty member at an accredited North American training program. The nominee must be a member of the Society of Critical Care Anesthesiologists (SOCCA), the American Society of Anesthesiologists (ASA), the Society of Critical Care Medicine (SCCM), Canadian Anesthesiologists Society (CAS) or Canadian Critical Care Society (CCCS).

The deadline for nominations for the 2012 Innovator Award is Monday, August 27, 2012. Applications must be completed on the SOCCA web site at www.socca.org or faxed to the SOCCA office at (847) 825-5658.

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SOCCA 25th Annual Meeting and Critical Care Update

This year's meeting features a full day Ultrasound Workshop on October 11th

October 11-12, 2012
Washington, DC

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