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children admitted from 2009 to 2013 were screened for primary or secondary admission diagnoses of septicemia or septic shock. To characterize body habitus, we calculated weight-for-height Z-Score groups for children younger than 24 mo, and Body Mass Index (BMI)-for-age Z-Score groups for children older than 24 mo using CDC growth curves. We constructed mixed-effects regression models to evaluate the association between body habitus and mortality as well as presentation severity of illness controlling for confounding variables, complex and non-complex chronic conditions, and hospital level effects. **Results:** We enrolled 7,169 children from 53 PICUs, with an overall mortality of 10.2%. On univariate analysis, children with weight-for-height or BMI-for-age Z-score groups less than -3.5 to -0.5, as well as greater than 3.5, had higher mortality ($P \leq 0.002$). However, after adjusting for Pediatric Risk of Mortality (PRISM) score, presence of a complex chronic condition, age, race, and a diagnosis of trauma, there was no association between body habitus and mortality (all $P \geq 0.083$). Multivariate modeling using PRISM score as the outcome revealed children with weight-for-height or BMI-for-age Z-score groups less than -3.5 to -0.5, as well as greater than 3.5, had higher PRISM Scores compared to Z-score group -0.5 to 0.5 ($P \leq 0.002$), even after adjusting for other confounding variables including age, race, presence of complex chronic conditions, and trauma ($P < 0.001$). **Conclusions:** Underweight children and severely overweight children have higher ICU mortality which appears to be explained by higher admission severity of illness.

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A TISSUE PERFUSION MEASUREMENT IN CRITICALLY-ILL PATIENTS AS A PREDICTOR OF MORTALITY

Kiersten Norby, Laura Spector, Timothy Perkins, David Inouye, Richard Severino, Danny Takanishi, Mihae Yu

Learning Objectives: Mortality from shock remains high necessitating the need for continued innovations in early detection of shock. Transcutaneous PO2 (PtcO2) changes with PaO2 and FiO2 in non-shock states, but during shock, PtcO2 approximates cardiac output with minimum response to increasing FiO2 and PaO2. This response to FiO2 of 1.0 is called the Oxygen Challenge test (OCT) and has been shown to predict organ failure and mortality. The OCT can also be used as an endpoint of resuscitation. The purpose of this study was to determine whether there is a numeric value of OCT which is best associated with outcome and validate or refute findings of previous studies. **Methods:** The OCT was measured in critically-ill patients at baseline and daily. Patients predicted survival was determined by comparing their 24 hour OCT values to a series of reference values starting at zero and increasing by 5 point increments. For each reference value, predicted survival was compared to actual survival and the positive predictive values (PPV) and negative (NPV) were calculated with the optimal reference value defined as the one which yields the best combination of predictive values. A chi-square test was used to determine the statistical significance of the association of the dichotomized OCT and actual survival. **Results:** Seventy-nine patients were studied. Demographics were: mean age 67 ± 16 yr, 49 males (62%), 30 females (38%), APACHE II 25.9 ± 7.8, Septic Shock/Severe Sepsis 49/79 (62%), Hemorrhagic Shock 21/79 (27%), Cardiac Failure 19/79 (24%), Respiratory Failure 60/79 (76%). Fifty-five (69.6%) of the 79 patients survived to discharge. An OCT value of 25 at 24 hr of resuscitation yielded a PPV of 83.9% and a NPV of 66.7%. Eighty-nine percent of survivors had an OCT ≥ 25 compared to 43% of non-survivors (p<.0001). **Conclusions:** Measurement of tissue perfusion can be valuable in critically-ill patients as a predictor of survival and an endpoint of resuscitation. An OCT value of 25 can be used as an indicator of adequate tissue perfusion and may be predictive of survival.

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AN AUTOMATED ALGORITHM FOR THE EARLY DETECTION OF HEMODYNAMIC INSTABILITY IN THE PICU

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Learning Objectives: Early recognition and timely intervention are critical steps for the successful management of pediatric shock. However, early recognition of shock can be difficult and requires a high index of suspicion by the clinician. The aim of this study was to develop an algorithm that could assist bedside clinicians with the early detection of hemodynamic instability (shock) in the pediatric ICU (PICU). **Methods:** This study was done on a retrospective cohort of all patients admitted to a tertiary PICU at a single center. Patients were labeled as hemodynamically unstable (n=3970) if they received a fluid bolus (i.e., administration of colloid or crystalloid > 10 ml/kg/hr), or blood transfusion (i.e., packed red blood cells > 10 ml/kg over the course of 24 hr), or any dosage of inotropic or vasopressor medications. Patients were labeled as hemodynamically stable (n=7213) if they did not receive any of the interventions mentioned above during the entire PICU stay. Electronic medical records (EMR) were obtained from an electronic flow sheet (Philips Care-Vue, Waltham, MA) and the PICU's own database. A total of 58 features were extracted from the EMR and analyzed to predict (i.e., up to 6 hr before) the occurrence of a hemodynamic instability event. A variant of AdaBoost was used to learn a set of low-dimensional classifiers, each of which was age-adjusted. A small subset of data were used for training and validation, while retrospective evaluation was performed on the entire database. **Results:** Among the 58 features initially included in the analysis, only 16 features were finally selected by AdaBoost. The best classification performance resulted in an area under ROC curve of 0.91, a sensitivity of 0.78, and a specificity of 0.88. Shock index was the most discriminative feature, and it was, by itself, a very good predictor of hemodynamic instability (area under ROC of 0.85). **Conclusions:** We proposed an algorithm for early detection of hemodynamic instability in PICU patients. This algorithm provides a risk score of hemodynamic instability, which can be of significant clinical value in busy PICU environments.

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LIPIDOMICS OF CRITICAL ILLNESS

Michael Maile, Theodore Standiford, Elizabeth Jewell, Charles Burant

Learning Objectives: A number of disease processes can result in critical illness. Interestingly, even when the inciting events are disparate, progression to multiple organ failure and death frequently appears remarkably similar. Metabolomics, by defining the metabolic fingerprint created by the underlying pathophysiology, may be helpful for identifying new biomarkers and novel therapeutic targets in this population. We hypothesized that changes in the plasma lipidome would be associated with mortality in a critically ill patient population. **Methods:** The plasma lipidome of 30 critically ill individuals was measured at two time points using liquid chromatography-mass spectrometry. Pooled samples and internal standards were also included. Compounds were identified by matching peaks in the resulting mass spectrum to known lipids in the LipidBlast database. Concentrations were normalized using internal standards and adjusted for batch effects using loess smoothing. Those with missing values, a relative standard deviation in the upper decile in the pooled samples, or a median concentration in the lowest decile were removed. Lipids that differed between survivors and non-survivors were identified using the multivariate empirical Bayes approach. This data reduction was performed with auto scaled values using MetaboAnalyst 3.0. Top features (those with the highest Hotelling-T2 values) were then compared using Student's t-test and two-way analysis of variance using SAS 9.3. **Results:** Triacylglycerols (TGs) consisting primarily of polyunsaturated fatty acids accounted for ten of the twelve lipids that differed most between survivors and non-survivors. These TGs did not demonstrate a consistent and significant within-subject variation over time. However, survivors did have significantly higher levels of all ten of these compounds. Concentrations were between 2.44 and 4.09 times higher in the survivor cohort and p-values ranged from 0.0002 to <0.0001. **Conclusions:** Triacylglycerols with a high number of polyunsaturated fatty acids may be useful for predicting mortality in critically ill patients.

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AGREEMENT BETWEEN PERIPHERAL VENOUS, CENTRAL VENOUS, AND ARTERIAL LACTATE

Caleb Hsieh, Tristan Grogan, Nader Kamangar, Richard Treger

Learning Objectives: Arterial lactate (a-lac) is considered the criterion standard for lactate determination, but arterial sampling is invasive and carries risks. Venous lactate values, especially peripheral venous lactate (pv-lac), have been considered less reliable; nonetheless their use in clinical practice has increased. The objective of this study was to examine agreement between pv-lac, central venous lactate (cv-lac), and a-lac values in a population of medical Intensive Care Unit (ICU) patients, with an emphasis on agreement at high lactate values (a-lac > 4

mmol/L). **Methods:** A single-center, prospective trial was conducted with adult patients in a medical ICU. Patients with an existing peripheral venous line, central venous line and arterial line were enrolled. Arterial, central and peripheral venous samples were obtained within 10 min of each other. A single blood gas analyzer was used to measure lactate. Bland-Altman plots were used to evaluate agreement. Pearson correlations between a-lac and v-lac were generated and linear regression was used to derive equations for estimation of a-lac from both pv-lac and cv-lac. **Results:** 23 patients were included with a total of 54 paired arterial and venous (pv and cv) samples and 9 a-lac values > 4 mmol/L. A linear mixed effects model indicated that all 54 observations could be reasonably combined. The mean difference for a-lac minus pv-lac and a-lac minus cv-lac was -0.17 and 0.054, respectively. Bland-Altman plots of a-lac and pv-lac, as well as a-lac and cv-lac showed 95% limits of agreement of -1.17 to 0.82 and -0.75 to 0.86, respectively. Regression equations were derived as follows: a-lac = -0.164 + 0.998 × pv-lac and a-lac = 0.077 + 0.992 × cv-lac. The R^2 was 0.93 and 0.95, respectively, although it decreased to 0.60 and 0.65 for a-lac values > 4 mmol/L. **Conclusions:** Both pv-lac and cv-lac showed strong agreement and high correlation with a-lac, and although the relationship is less robust at high lactate values, it would not likely affect clinical management. Pv-lac or cv-lac can replace a-lac in most clinical contexts encountered in the ICU.

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VALIDATION OF THE VASOACTIVE INOTROPIC SCORE IN PEDIATRIC SEPSIS

Amanda McIntosh, Sarah Schmidt, Suhong Tong, Sara Deakyne, Jesse Davidson, Halden Scott

Learning Objectives: Pediatric sepsis is common and has significant associated morbidity and cost. Vasoactive and inotropic medications are often necessary for cardiovascular support. In infants undergoing cardiac surgery, the vasoactive inotropic score (VIS) correlates well with important clinical outcomes and is the standard scoring system for cardiovascular support in that population. Limited data exist to support the use of VIS outside of infant cardiac surgery. This study was performed to assess the validity of VIS as a scoring system for cardiovascular support in pediatric sepsis. **Methods:** This is a secondary analysis of a prospective, single-center sepsis registry. It included children with sepsis clinically identified in the emergency department from 1/12–6/15 who were treated with at least one vasoactive agent in the first 48 hr. VIS was abstracted at 6, 12, 24, and 48 hr post ICU admission. Primary outcomes were ventilator days and ICU length of stay (LOS). Secondary outcomes were endotracheal intubation and combined cardiac arrest/ECMO/in-hospital mortality. **Results:** A total of 139 patients met inclusion criteria. The most common underlying diagnoses were genetic/metabolic (21.6%) and previously healthy (23%) and the most common infectious sources were pneumonia (31.7%) and bacteremia (23%). One third were intubated during their stay and mortality was 5%. On univariate analysis, VIS at 48hr after PICU arrival ranged from 0 to 45 and correlated most strongly with ICU LOS (r=0.53; p<0.0001) and ventilator days (r=0.52;p<0.0001). On multivariate analysis, VIS at 48hr remained a strong independent predictor of both ICU LOS (p<0.0001) and ventilator days (p<0.0001). Logistic regression demonstrated increased odds of intubation and combined ECMO, cardiac arrest, or death with each unit increase in VIS at 48hr (1.19, p<0.0005 and 1.08, p<0.05 respectively).**Conclusions:** This study suggests that a higher VIS score at 48 hr from ICU arrival in pediatric sepsis patients is a predictor for increased ICU LOS, ventilator days, and combined poor outcome.

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ABO BLOOD TYPE A AND INCREASED SEVERITY OF SEPSIS

Hani Kuttab, Collette Williams, Andrew Wilson, Michael Murphy, Megan Rech

Learning Objectives: Blood type A has been linked to increased susceptibility of infection, inflammatory vascular disease, and most recently, risks of acute lung injury and ARDS in patients with severe sepsis. It is unknown if blood type A is associated with an increased risk of organ dysfunction secondary to septic shock. This study evaluated the progression through multi-organ failure secondary to sepsis in patients with blood type A compared to other blood types. **Methods:** This is a retrospective cohort study conducted at an urban, academic tertiary care center. Patients 18 yr and older admitted between January 1, 2010 and March 1, 2014 with a diagnosis of sepsis and a documented blood type were included. The following points were collected: baseline demographics, severe sepsis or septic shock diagnosis, Acute Physiology and Chronic Health Evaluation II (APACHE II) score, comorbidities, sepsis source, serum lactate, hospital length of stay (LOS), and mortality. Sequential Organ Failure Assessment (SOFA) scores were assigned to groups on days 1 and 3. Univariate analysis with Chi-square, Fisher's exact test, or t-test was performed. Multivariate regression analysis was conducted. **Results:** Of the 538 patients in this study, 303 had blood type A and 235 had non-A blood types. Baseline demographics and comorbidities were well matched between groups, with the exception of history of stroke (7.7% type A vs. 2.6% other, p=0.007). Blood type A patients had higher baseline APACHE II scores (24.33 vs. 22.76, p=0.025), higher SOFA scores on day 3 (6.30 vs. 4.64, p <0.001), and less reduction in SOFA scores between day 1 and day 3 (1.81 vs. 3.38, p <0.001). No differences in LOS and in-hospital, 30-day, or 90-day mortality were observed. A multivariate analysis demonstrated that patients with blood type A had higher SOFA scores on day 3 (p=0.003) and that the absolute difference in SOFA scores between day 1 and 3 was lower in patients with blood type A (p=0.007). **Conclusions:** Patients with blood type A had higher severity of illness and delayed recovery from sepsis-induced organ failure when compared to other blood types.

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RETICULOENDOTHELIAL DYSFUNCTION IS CENTRAL IN DIAGNOSING ADULT MACROPHAGE ACTIVATION SYNDROME

Bita Shakoory, Negin Mohtasham, Richard Amdur, Matthew Mullen, Steven Opal, Winn Chatham

Learning Objectives: Macrophage activation syndrome is poorly defined in adults; comorbidities, low index of suspicion, and lack of validated diagnostic criteria in adults limits the early recognition of MAS. This study uses an established adult MAS cohort and respective controls to identify system-based predictors of adult MAS, to propose a preliminary diagnostic criteria for MAS in adults, and to examine the association between MAS and outcomes [death, critical care, length of stay(LOS)]. **Methods:** Using a retrospective, observational study design, adults with MAS and respective controls were identified among patients with ferritin above 2000 ng/dL during hospital admission at a single academic center between January 2009 and December 2012. MAS Cases: those with 5/8 of the HLH-2004 or ≥4/5 adapted HLH criteria, those whose treatment was specifically initiated or adjusted for a diagnosis of MAS. Two age and gender matched controls were selected for each case. Patients with >2 elements of adapted HLH criteria missing, outpatient evaluation, chronic transfusion and chronic hemolytic disorders were excluded. Univariate and multivariate analysis with logistic regression testing, t test and chi square was used for analysis. **Results:** Study subjects: 60 MAS cases (mean age 42, 66% women, 60% non-white) and 76 controls (mean age 45, 69% women, 51% non-white). Univariate analysis: MAS compared to non-MAS experienced more cardiovascular (p=.005), respiratory (p=.0006), hepatobiliary (HBD; p=0.017) dysfunction, coagulation (DIC; p<.0001), infection (p=.007), ferritin>4,500ng/dL. The logistic model prediction of MAS had strong discrimination (c>.90), sensitivity and specificity of .84 and .88 respectively using predictors HBD, DIC, Ferretin>4500 ng/dl. Death occurred in 50% of MAS vs 22% of non-MAS (p=.0001); 71% of MAS required critical care vs. 46% of non-MAS (p=.0034); median LOS was 19 in MAS (IQR 11–30) vs. 11 in non-MAS (IQR 5–25). **Conclusions:** MAS in adults results in higher mortality, higher need for critical intervention, longer stay. Presence of MAS should be suspected in patients with HBD, DIC, ferritin >4,500 ng/dL.

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CLINICAL SIGNIFICANCE OF SERIAL CHANGES IN PLASMA SURFACTANT PROTEIN D IN PATIENTS WITH SEPSIS

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Learning Objectives: Acute respiratory distress syndrome (ARDS) is a heterogeneous entity. Surfactant protein D (SPD) suggested discrimination for diagnosis