SECTION ON CRITICAL CARE

SATURDAY, OCTOBER 9, 1999

Section on Critical Care
2:00–4:15 pm
Room 30, Washington Convention Center

Afternoon–Joint Session with Cardiology

SUNDAY, OCTOBER 10, 1999

Section on Critical Care
8:30 am–5:00 pm
Farragut Square Room, The Grand Hyatt

8:30 am Continental Breakfast
8:45 am Introduction and Welcome: Niranjan Kissoon, MBBS, FAAP, FCCM, FRCP(C)

Morning—Abstract Session I

1) 9:00 am Intraosseous is Faster and Easier than Umbilical Venous Catheterization in Newborn Emergency Vascular Access Models
K.K. Abe, MS; G.T. Blum, BS; L.G. Yamamoto, MD, MPH, FAAP. Department of Pediatrics, University of Hawaii, John A. Burns School of Medicine Emergency Services, Kapiolani Medical Center for Women and Children, Honolulu, HI.

2) 9:15 am Comparing a New Screw-Tipped Intraosseous Needle Versus a Standard Bone marrow Aspiration Needle for Speed and Ease of Establishing Intraosseous Infusion in Two Different Bone Models
H.W. Jum; A.Z. Haruqama; K. Chang; L.G. Yamamoto, MD, MPH, FAAP. Department of Pediatrics, University of Hawaii, John A. Burns School of Medicine Emergency Services, Kapiolani Medical Center for Women and Children, Honolulu, HI.

3) 9:30 am Ionised Magnesium in Patients Admitted to Pediatric Intensive Care Unit: Do We Need It?
P.S. Shah, MD, MRCP, MRCPCH, DCH; P. Baines, MRCP, FRCA. Department of Pediatric Intensive Care Unit, Royal Liverpool Children Hospital, Liverpool, United Kingdom.

4) 9:45 am Are Infant Transport Patients at Increased Risk for Iatrogenic Related Complications While at Referral Facilities?
G.B. Zuckerman, MD; B.J. Grossman, MD; F.V. Castello, MD; P.M. Gregory, PhD. Department of Pediatrics and Family Medicine, Robert Wood Johnson Medical School, New Brunswick, NJ

10:00 am Coffee Break and Poster Review

Morning—Abstract Session II

Moderators: TBA

5) 11:00 am Intravenous Nicardipine for Treatment of Systemic Hypertension in Children
S.C. Sartori, MD; T.A. Nakagawara, MD, FAAP; M.J. Sollihaug, MD; A. Morris, RN, BSN; R.D. Adeleman, MD Children’s Hospital of the Kings’ Daughters, Division of Pediatric Critical Care Medicine and Pediatric Nephrology, Department of Pediatrics, Eastern Virginia Medical School, Norfolk, VA.

6) 11:15 am A Cost Savings Projection for Respiratory Syncytial Virus Immunization of Older Children with a History of Bronchopulmonary Dysplasia
L. Passerotti, MS, ARNP; W. Walters, RN, MS II; V. Desai, MD; A. Otgbeeye, MD Department of Pediatrics, Florida Hospital, Orlando, FL; and MCP-Hahnemann University School of Medicine, Philadelphia, PA.

7) 11:30 am Autonomic Manifestations of Spinal Muscular Atrophy
S. DeSilva, MD, FAAP; J. Weingarten-Arams, MD, FAAP. Division of Pediatric Critical Care, Department of Pediatrics, Montefiore Medical Center, Albert Einstein College of Medicine, West Orange, NJ.

8) 11:45 am Variation in Asthma Care in Ten U.S. Children’s Hospitals
A. Torres, MD, FAAP; S. Horn, PhD; J. Gasaway; R. Smout. Department of Pediatrics, University of Illinois College of Medicine at Peoria, IL; and ISIS, Inc., Salt Lake City, UT.

12:00 pm Lunch and Section Business Meeting

1:30 pm Presentation of Distinguished Career Award
Recipient: George Lister, MD

2:00 pm Coffee Break

Afternoon Abstract Session—Best Abstract/Physician in Training

Moderator: Niranjan Kissoon, MD

9) 2:30 pm Energy Metabolism, Nitrogen Balance and Substrate Utilization in Critically Ill Children
J.A. Coss-Bu, MD; W.J. Klish, MD, FAAP; F. Stein, MD, FAAP; D. Walding, BSBE; R. Sachdeva, MD, FAAP; L.S. Jefferson, MD, FAAP. Department of Pediatrics, Baylor College of Medicine, Houston, TX.

10) 2:45 pm Safe Restraint of Pediatric Patients for Ambulance Transport: Interdisciplinary Collaboration in Pediatric Ambulance Transport Safety
N.R. Levick, MD, FACEM. Division of Pediatric Emergency Medicine, Johns Hopkins University School of Medicine, Baltimore, MD.

11) 3:00 pm Epidural Analgesia in Newborns After Congenital Diaphragmatic Hernia Repair Facilitates Pulmonary Preservation Strategy.
S.M. Goobie, MD; C.S. Houck, MD, FAAP; C. Seefelder, MD. Department of Anesthesia and Critical Care, Children’s Hospital, Boston, MA

12) 3:15 pm Contribution of Intraosseous Infusion Rate to Fat Embolism
M.Y. Hasan, MD; N. Kissoon, MD; V. Saldañeno, MD; T. Khan, MD; K. Sullivan, MD;
INTROOSSEOUS IS FASTER AND EASIER THAN UMBILICAL VENOUS CATHETERIZATION IN NEWBORN EMERGENCY VASCULAR ACCESS MODELS.

Keith K. Abe, MS, Gary T. Blum, BS, Loren G. Yamamoto, MD, MPH, FAAP Department of Pediatrics, University of Hawaii John A. Burns School of Medicine Emergency Services, Kapiolani Medical Center for Women and Children Honolulu, HI

Background: Intraosseous (IO) infusion and umbilical vein catheterization (UVC) are two methods of obtaining emergency vascular access in newborns. Both are taught in pediatric resuscitation courses but UVC is done less frequently by pre-hospital providers and emergency physicians. The purpose of this study is to compare the speed and ease of establishing newborn emergency vascular access using IO versus UVC.

Methods: The study is an experimental design. A total of 42 medical students, without prior IO and UVC experience, were recruited as study subjects. All subjects performed the UVC procedure and were randomized (by a coin flip) to perform the IO procedure in one of two models: 1) turkey bone or 2) plastic infant leg. Each subject performed an initial trial for both the IO and UVC procedures without practice (“Inexperienced attempt”) and a second trial in both procedures after practice (“Experienced attempt”), such that in total, each subject completed 4 attempts (2 IO and 2 UVC). IO and UVC placement times were measured, and placement difficulty scores for IO and UVC were measured using a 10 cm visual analog scale (VAS).

Results: The averaged elapsed time to successful access was significantly shorter for the IO procedure on both the initial “inexperienced” attempt (52 vs. 134 seconds, p < 0.001) as well as the “experienced” attempt (45 vs. 95 seconds, p = 0.011). Procedure difficulty scores were lower in the IO procedure for both “inexperienced” and “experienced” attempts (3.5 vs. 5.5, p = 0.001 and 2.6 vs. 4.7, p < 0.001) as measured on a 10 cm VAS. Results in the turkey bone and plastic infant leg models were similar.

Conclusion: While UVC may be preferred by neonatologists, this model suggests that IO results in easier and more rapid vascular access achieved by those who do not frequently perform newborn resuscitation. As such, the benefit of teaching UVC in pediatric resuscitation courses should be reconsidered. The recommended method of emergency newborn vascular access should be reconsidered pending further studies on this subject.

The authors wish to thank the Chun Foundation for their financial support of this study.

2

COMPARING A NEW SCREW-TIPPED INTRAOSSEOUS NEEDLE VERSUS A STANDARD BONE MARROW ASPIRATION NEEDLE FOR SPEED AND EASE OF ESTABLISHING INTRAOSSEOUS INFUSION IN TWO DIFFERENT BONE MODELS.

Hye Won Jun, Atsuko Z. Haruyama, Kimberly Chang, Loren G. Yamamoto, MD, MPH, MBA, FAAP Department of Pediatrics, University of Hawaii John A. Burns School of Medicine Emergency Services, Kapiolani Medical Center For Women And Children Honolulu, HI

Background: Intraosseous (IO) infusion is a method of establishing emergency vascular access. Standard bone marrow needles can be used, but several needles specifically designed for IO infusion are available. A screw-tipped IO needle has recently become available, requiring less downward pressure during IO needle insertion. The purpose of this study is to compare the speed and ease of establishing IO infusion using a standard bone marrow needle (SBMN, $8) and a new screw-tipped intraosseous
needle (Sur-Fast, §42). Methods: The study is an experimental design. A total of 42 medical students, without prior IO experience, were recruited as study subjects. Subjects were randomized to perform the IO procedures in one of two models: 1) turkey femur or 2) pork ribs. Each subject performed an initial trial using both IO needles without practice (inexperienced attempt) and a second trial using both IO needles after practice (experienced attempt). The total number of attempts (2 with each needle type). IO placement times were measured, and placement difficulty scores were measured using a 10 cm visual analog scale (VAS). Results: The averaged elapsed time to successful IO completion was significantly shorter for the S8MN in the initial “inexperienced” attempt (33 vs. 54 seconds, p=0.019), but there was no significant difference in the post-practice “experienced” attempt. VAS difficulty scores were lower (easier) for the S8MN for both inexperienced and experienced trials. Success rates were significantly higher for the Sur-Fast needle during the experienced attempt (95% vs. 79%, p<0.05), but there was no significant difference in success rates during the inexperienced attempt. For each needle type, the placement times, VAS scores and success rates did not differ significantly between the two bone models which were used suggesting that the two bone models are similar, though this is inconclusive since the sample size is small. Conclusion: The Sur-Fast screw-tipped intrasosseous needle does not demonstrate superiority over the standard bone marrow needle in this intrasosseous model, therefore its higher cost is difficult to justify based on this study. The authors wish to thank the Chun Foundation for their financial support of this study and Cook Critical Care for supplying materials for this study.

3

IONISED MAGNESIUM IN PATIENTS ADMITTED TO PEDIATRIC INTENSIVE CARE UNIT: DO WE NEED IT?

Prakesh S Shah, MD, MRCP, MRCPCH, DCH and Paul Baines, MRCP, FRCA. Department of Pediatric Intensive Care Unit, Royal Liverpool Children Hospital, Liverpool, United Kingdom.

Background: To evaluate the incidence and biochemical correlate of ionized hypomagnesemia in critically ill children we undertook a prospective, observational study. We studied a total of 82 specimens collected from 82 patients admitted to Pediatric Intensive Care Unit (PICU). Methods: Concentrations of ionized magnesium, ionized calcium and pH were measured in the intensive care unit by ion sensitive electrode analyzer. Concentrations of total magnesium was measured in the laboratory using spectrophotometric analysis and corrected calcium, creatinine, urea, albumin and total protein were measured in the biochemistry laboratory using conventional methods. Results: Ionized Magnesium was determined in all samples. Eight (9.75%) patients demonstrated serum ionized hypomagnesemia of which one demonstrated abnormality of cardiac rhythm. 33 (40.25%) demonstrated total serum hypomagnesemia. All the patients who had ionized hypomagnesemia had total hypomagnesemia. There was good correlation (r2=0.66) between ionized and total magnesium. There was no relationship between ionized calcium and ionized magnesium in our observations. Patient’s cardiopulmonary bypass status, albumin status, pH or creatinine level of the patients did not affect ionized and total magnesium. Conclusions: Ionized hypomagnesemia is an important finding in patients admitted to Pediatric Intensive Care Unit (PICU). Higher incidence of total hypomagnesemia should be confirmed by ionized hypomagnesemia to avoid unnecessary treatment. We did not observe the impact of other factors playing role in the seriously ill children as far as magnesium concentration is concerned. Immediate and early evaluation of magnesium status is extremely helpful in PICU patients. Acknowledgement: Authors acknowledge AVL Medical Instruments LTD for installing and running the analyzer for measuring ionized magnesium.

4

ARE INFANT TRANSPORT PATIENTS AT INCREASED RISK FOR IATROGENIC RELATED COMPLICATIONS WHILE AT REFERRAL FACILITIES?

Gary B. Zuckerman MD*, Bruce J. Grossman MD*, Frank V. Castello MD*, Patrice M. Gregory PhD* Depts of Pediatrics* and Family Medicine†, Robert Wood Johnson Medical School, New Brunswick, NJ

Background: Pediatric patients often arrive at non-tertiary care facilities requiring transport to a Pediatric Intensive Care Unit. While at the referral facilities, iatrogenic related complications (RF-IRC) may arise. Such complications may impact on morbidity and mortality. No recently published studies have sought to determine whether infant transport patients are at higher risk for RF-IRCs than are their older pediatric counterparts. The objective of this study is to determine whether the incidence of RF-IRCs is greater in infants less than 6 months than in the rest of the pediatric transport patient population. Methods: The charts of all patients, less than 18 years of age, transported to the Robert Wood Johnson University Hospital Pediatric Intensive Care Unit from 7-1-95 through 6-30-98, were retrospectively analyzed. Demographic data was abstracted and the occurrence of RF-IRCs noted. RF-IRCs were defined as referral facility patient assessments or management decisions which were not in accordance with Pediatric Advanced Life Support Guidelines. RF-IRCs were grouped as follows: Triage Errors; Airway, Breathing, Circulation, Neurologic, and Metabolic management errors. Patients were divided into 2 groups: < 6 months and 6 months to < 18 years. The average Pediatric Risk of Mortality (PRISM) scores for the 2 groups were calculated and compared using the t Test. The incidence of each IRC category was calculated and compared between the 2 groups using the chi-square test. P values of less than 0.05 were considered to be statistically significant. Results: During the study period, 564 patients were transported to our facility.

<table>
<thead>
<tr>
<th></th>
<th>&lt;6 mos. (n = 116)</th>
<th>6 mos to &lt;18 yrs (n = 448)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRISM Score</td>
<td>5.9</td>
<td>4.0</td>
</tr>
<tr>
<td>Triage Errors</td>
<td>13.8*</td>
<td>7.1*</td>
</tr>
<tr>
<td>Airway (%)</td>
<td>12.9</td>
<td>7.6</td>
</tr>
<tr>
<td>Breathing (%)</td>
<td>23.3*</td>
<td>12.3*</td>
</tr>
<tr>
<td>Circulation (%)</td>
<td>7.8</td>
<td>4.5</td>
</tr>
<tr>
<td>Neurologic (%)</td>
<td>1.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Metabolic (%)</td>
<td>12.8</td>
<td>8.7</td>
</tr>
<tr>
<td>Total (%)</td>
<td>66.4*</td>
<td>38.6*</td>
</tr>
</tbody>
</table>

* P < 0.05.

Conclusions: The total incidence of RF-IRCs was significantly higher for infants than for older pediatric transport patients. RF-IRCs related to Triage Errors and Breathing management were significantly higher in the infant group. Infants had higher incidences of all other RF-IRCs, however, statistical significance was not achieved. This study suggests that infants requiring interhospital transport may be at higher risk for RF-IRCs than their older pediatric counterparts.

5

INTRAVENTOUS NICARDIPINE FOR TREATMENT OF SYSTEMIC HYPERTENSION IN CHILDREN.

Suzanne C. Sartori, M.D., Thomas A. Nakagawa, M.D.,F.A.A.P.*, Michael J. Solhaug, M.D.*, Amelia Morris, R.N., B.S.N., Raymond D. Adelman, M.D. Children’s Hospital of The King’s Daughters, Division of Pediatric Critical Care Medicine and Pediatric Nephrology*, Department of Pediatrics, Eastern Virginia Medical School, Norfolk, VA 23507
Methods: A retrospective review was conducted of children admitted to the PICU who developed systemic hypertension and were treated with IV nicardipine. Inclusion criteria were: systolic blood pressure >95th percentile for age, and documentation of arterial blood pressures by an indwelling arterial catheter. Data collection included: patient age, diagnosis, dose and response to nicardipine, duration of therapy, and any adverse effects such as hypotension. Results: Over a four year period, 15 children met study criteria. The median age was 9 years (range 19 days to 17 years). Nine children were treated post-operatively for hypertension: 4 had coarctation of the aorta, 2 had intracranial tumors, 2 had cerebral arteriovenous malformations, and 1 had spinal surgery. The remaining 6 children had: renal insufficiency/failure with encephalopathy (2), leukemia, intra-abdominal tumor, GI bleeding, and cardiac transplant. Following an initial median dose of 1 µg/kg/min (range 0.5 to 4 µg/kg/min) of IV nicardipine, median treatment dose was 1.5 µg/kg/min (range 0.15 to 6 µg/kg/min). Median duration of therapy was 41 hours, (range 3.75 to 187 hours). Mean arterial pressure (MAP) over time is shown in Graph 1. No significant change in mean heart rate (HR) was noted. Ten children were receiving additional anti-hypertensive therapy when IV nicardipine was initiated. One child with leukemia and central nervous system disease became hypotensive 4 hours after initiation of therapy while receiving 1 µg/kg/min of nicardipine. No other adverse effects were noted.

Conclusion: IV nicardipine reduced MAP with minimal change in mean HR and no adverse effects in a diverse patient population. Additionally, children receiving prior anti-hypertensive therapy exhibited a reduction in MAP with IV nicardipine IV nicardipine is a safe and effective agent for treatment of acute systemic hypertension in children.

A COST SAVINGS PROJECTION FOR RESPIRATORYSYNCYTIAL VIRUS IMMUNIZATION OF OLDER CHILDREN WITH A HISTORY OFBRONCHOPULMONARY DYSPLASIA.

LeeAnn Passerotti MS, ARNP, William Walters RN, MS IP*, Vivek Desai MD, Ayodegi Otegbeye MD Department of Pediatrics, Florida Hospital, Orlando, FL, and MCP-Hahnemann University School of Medicine, Philadelphia, PA*

Background: Current recommendations for Respiratory Syncytial Virus (RSV) immunization include children with a history of Bronchopulmonary Dysplasia (BPD) during their first 24 months of life. This retrospective study seeks to project a cost comparison between the hospitalization of children, age 2-5 years, with BPD complicated by RSV and the immunization of these children. Methods: All children, age 2-5 years, with history of BPD or admission for RSV related disease, admitted to a pediatric referral center between 1/96 and 12/98 were identified. A chart review was conducted to identify those patients with BPD admitted for RSV bronchiolitis or pneumonia. Patient weight (kg), age (yrs), admission date, hospital length of stay (LOS), intensive care length of stay (ILOS), and total hospital charges (HCS) were collected. HCS did not include physician fees. Cost of immunization was calculated using a 15 µg/kg monthly dose (Palivizumab, Ross Pharmaceuticals), a 6 month (Oct.-Mar.) RSV season, and an acquisition cost of $901.17 per vial (100 mg/vial). Results are reported as mean ± SD, with range as appropriate. Results: 8 children, ages 2-4 years, with a history of BPD, were admitted to our facility for treatment of RSV bronchiolitis or pneumonia during the 36 month period, for a total of 73 hospital days. Average LOS was 9.13 ± 8.29 days (range 3-26 days). 5 of these children required intensive care treatment with an average ILOS of 10.4 ± 7.4 days. Total HCS were $270,012.86, with an average HCS of $33,751.61 ± $40,046.18 (range $650.24-$120,629.71). BPD/RSV admissions were responsible for 34.8% of BPD admissions, 34.9% of BPD LOS days, 21.6% of RSV admissions and 39.2% of RSV LOS days. Average BPD/RSV HC$ were 103.8% and 324.5% of average BPD and RSV HC$, respectively. Cost for RSV vaccination of the BPD/RSV patients was projected at $91,919.34. Assuming a 20% failure rate in immunoprophylaxis, HCS would be reduced to $54,002.57, yielding a total projected cost of $145,921.91, and a savings of $124,090.45 (46%). Conclusions: A considerable savings may be realized through continued vaccination of these children beyond the current recommendations of 24 months of age. A prospective study may be warranted to evaluate these projections.

AUTONOMIC MANIFESTATIONS OF SPINAL MUSCULAR ATROPHY.

Da-Silva S, MD FAAP, Weingarten-Arams J, MD FAAP. Division of Pediatric Critical Care, Department of Pediatrics, Montefiore Medical Center, Albert Einstein College of Medicine.

Objectives: To confirm an observation of persistent tachycardia in patients with Spinal Muscular Atrophy (SMA) type I. The tachycardia was unresponsive to adequate pain control, management of fever and correction of anemia. Methods: A retrospective review of the medical records of patients admitted to the pediatric intensive care unit between January 1994 and December 1998 with the diagnosis of SMA. Data collected included age at diagnosis, method of diagnosis, age at admission and chest x-ray findings. Age matched patients that were intubated and ventilated for between 1-5 days were used as controls. Patients who were postoperative, on beta agonists or on inotropic support were excluded. Other variables that affect heart rate such as anemia and fever were not different between the two groups. Vital sign records for the third day of admission were used for comparison. The vital signs chosen were heart rate, respiratory rate and mean arterial blood pressure. Patients who died during the hospitalization or had a DNR order were excluded from the analysis. Results: Data from seven patients were analyzed. All the patients had manifestations of SMA before six months and were categorized as type I. Diagnosis was by DNA (5), electromyography (3), muscle biopsy (2) and CT scan (1). Mean age at admission was 24.6 months. Six patients had a positive chest x-ray finding and one patient had a positive blood culture. Six age-matched controls were analyzed. Mean age at admission was 27.8 months. Five had airway obstruction and one had a brain tumor. All patients had a hemoglobin level that was normal for age and had not required a blood transfusion within two days of data collection. Graphic comparison demonstrates a difference in the heart rate between the study and the control patients. This difference was more pronounced in the younger patients. There was also a statistically significant difference in the heart rate in the SMA group compared to the control group (table) with a p< 0.01. There was a statistically significant difference in the respiratory rate between the two groups. This was not of clinical significance in the raw data.
Conclusion: The data from this study is consistent with the observation of tachycardia seen in our experience with patients with SMA. This tachycardia is only transiently responsive to sedation and analgesia and unresponsive to blood transfusion. Our theory is that continuing apoptosis of the motor neurons of the anterior horn cells in the spinal cord results in an elevation of circulating catecholamines causing the tachycardia in these patients. The observation of greater tachycardia in the younger patients is consistent with the pathology of SMA, with the progressive loss of neuronal cells resulting in depletion of anterior horn cells as the patients get older. A prospective study to assess serum catecholamine levels and their degradation products is warranted in these patients.

8

VARIATION IN ASTHMA CARE IN TEN U.S. CHILDREN’S HOSPITALS.

Adalberto Torres*, MD, FAAP, Susan Horn, PhD, Julie Gasaway, Randall Smout. *Dept of Peds, Univ. of Illinois Coll. of Medicine at Peoria, IL and ISIS, Inc. Salt Lake City, UT

Background: Guidelines from the National Heart, Lung, and Blood Institute (NHLBI) on the management of asthma are well accepted and readily available. The purpose of this study was to examine the practice of asthma care at 10 U.S. children’s hospitals for variation and for differences from the NHLBI guidelines. Methods: Data were collected retrospectively on 762 children with the principal diagnosis of asthma admitted to 10 US children’s hospitals from April 1st, 1995 to September 30th, 1996. These data documented patient variables (demographics, severity of illness, process variables (therapeutic interventions including PICU use), and outcome variables (morbidity, mortality, length of stay [LOS], cost). Severity of illness was measured using the Comprehensive Severity Index (CSI), an age-specific severity model designed to assess the physiologic derangements of a patient’s diseases and their interactions. Multiple logistic regression modeling was used to detect significant (p < 0.05) variation in asthma practices while controlling for severity of illness. Results: The median (range) age of the 762 asthmatic children was 5.3 yr (0.33–28.3). One-third (251/762) of these children were admitted to the PICU. The median LOS in PICU was 1.8 d (0.12–10.6). PICU LOS did not correlate with mean CSI for a site. The majority of asthmatic children admitted to the PICU, 95.2%, had a severity of illness ranging from normal/mild (CSI I) to moderate disease (CSI II). Two patients died. Only 4% (32/762) had an increase in severity during their hospital stay. Continuous nebulized delivery of albuterol was performed in 9/10 PICUs despite the low overall severity. Continuous sedation, aminophylline, chest physiotherapy, beta agonist frequency ≥ 3 h, ipratropium bromide, and antibiotic use had significant institutional variability, were associated with increased LOS and cost, and are not recommended by the NHLBI guidelines. Metered dose inhaler form of albuterol and peak expiratory flow measurements in children > 5 yr old were only used in 1/3 of asthmatic children. Conclusion: Medical outcome of inpatient asthma is good. Significant variation in asthma care exists despite the availability of sound clinical practice guidelines. Implementing clinical protocols, based on these data, supported by the medical literature, and recommended by the NHLBI guidelines, will likely improve outcomes in hospitalized children with asthma. Funded in part by an AHCPR Small Business Contract.

9

ENERGY METABOLISM, NITROGEN BALANCE AND SUBSTRATE UTILIZATION IN CRITICALLY ILL CHILDREN

Jorge A. Coss-Bu, MD; William J. Klieh, MD, FAAP; Fernando Stein, MD, FAAP; David Walding, B.S.B.E.; Ramesh Sachdeva, MD, FAAP; Larry S. Jefferson, MD, FAAP. Department of Pediatrics, Baylor College of Medicine, Houston TX.

Background: Critically ill patients are characterized by a hypermetabolic state, an increased catecholamine response as assessed by nitrogen balance (NB) studies, higher nutritional needs, and a decreased capacity for utilization of parenteral substrate. The aim of this study was to evaluate the effect of energy expenditure and substrate intake on NB and substrate utilization (SU) in this population. Methods: This cross-sectional study measured NB and SU in 33 critically ill children on mechanical ventilation (MV) and receiving total parenteral nutrition (TPN). Resting energy expenditure (REE) was measured by indirect calorimetry (IC) with a metabolic cart. Expected energy requirements (EER) were obtained from Talbot’s tables. REE/EER index > 1.1 defined a hypermetabolic state. Caloric intake (Tcal/kg) was calculated and NB was calculated based on nitrogen intake (NI) and total urinary nitrogen (TUN) measured by the Kjeldahl method. Tcal/NI and non-protein calories to NI (npTcal/NI) ratios were calculated. Adjusted REE, non-protein RQ (npRQ), carbohydrate (CHO), protein (PROT), and (FAT) utilization rates were calculated by the Consolazia formulas. The percentage of relative use for each substrate was calculated as (Amount oxidized-amount ingested/ amount oxidized). Lipogenesis was defined: npRQ > 1.00. A high CHO intake was defined as > 8 mg/kg/min. Statistical analysis was done by unpaired t-test and simple regression analysis. Results: Values are mean ± SD. N = 33

<table>
<thead>
<tr>
<th>Age (yr.)</th>
<th>Weight (kg.)</th>
<th>PRISM</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 ± 5</td>
<td>21 ± 17</td>
<td>10 ± 7</td>
</tr>
<tr>
<td>Tcal/kg</td>
<td>Tcal/NI</td>
<td>Nb Tcal/NI</td>
</tr>
<tr>
<td>60 ± 33</td>
<td>334 ± 153</td>
<td>347 ± 142</td>
</tr>
<tr>
<td>Tcal/min</td>
<td>NpRQ</td>
<td></td>
</tr>
<tr>
<td>35 ± 24</td>
<td>5 ± 5</td>
<td>1.01 ± 0.31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TISS</th>
<th>REE cal/kg</th>
<th>REE/EER</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 ± 6</td>
<td>54 ± 24</td>
<td>1.20 ± 0.5</td>
</tr>
<tr>
<td>Nb mg/kg</td>
<td>Tcal/NI</td>
<td>Tcal/NI</td>
</tr>
<tr>
<td>−89 ± 166</td>
<td>190 ± 84</td>
<td>165 ± 84</td>
</tr>
<tr>
<td>CHO mg/min</td>
<td>PRO mg/min</td>
<td>FAT mg/min</td>
</tr>
<tr>
<td>119 ± 115</td>
<td>32 ± 31</td>
<td>6 ± 61</td>
</tr>
</tbody>
</table>

Pts. with a hypermetabolic state (n=19) had a higher fat oxidation (27±70 mg/min vs 22±29 mg/min, p < 0.05) and lower npRQ (0.86±0.2 vs 1.21±0.3, p < 0.001) compared to non-hypermetabolic pts. (n=14). Pts. with a high CHO intake (n=12) had a lower CHO oxidation (-78±124 % vs 16±44 %, p < 0.005) compared to pts. with normal CHO intake (n=21). Pts. in lipogenesis (n=13) had a higher CHO intake 8.5±3 mg/kg/min vs 6.1±3 mg/kg/min, p < 0.05) and a lower FAT oxidation rate (-39±26 mg/min vs 36±60 mg/min, p < 0.005) compared to pts. without lipogenesis (n=20). Pts. with a (+) NB (12) had a higher protein intake (2.8±1 g/kg/day vs 1.7±1 g/kg/day, p < 0.001) compared to pts. with normal CHO intake (n=21). Pts. in lipogenesis (n=20). Pts. with a (+) NB had a higher PRO oxidation rate (42±35 mg/min vs 13±5 mg/min, p < 0.01) compared to pts. with a (+) NB. CHO intake did not correlate with rate of oxidation (r= 0.29, p= 0.09), higher PRO intake had a significant correlation with oxidation rate (r= 0.63, p < 0.0001), and FAT intake did not
correlate with rate of oxidation (r = 0.29, p=0.09). Conclusions: Critically ill children on mechanical ventilation are hypermetabolic, and in negative nitrogen balance. This population preferentially uses fat for oxidation, carbohydrate is poorly utilized, with higher intake associated with lipogenesis and less oxidation of fat. A higher PRO intake was associated with a positive NB and effective oxidation rates. A negative NB induces higher levels of PRO oxidation.

Grant support: Genevieve R. McClelland Fund for Pediatric Intensive Care Research

10

SAFE RESTRAINT OF PEDIATRIC PATIENTS FOR AMBULANCE TRANSPORT: INTERDISCIPLINARY COLLABORATION IN PEDIATRIC AMBULANCE TRANSPORT SAFETY.

Levick, Nadine R., MD, FACEM, Division of Pediatric Emergency Medicine Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Background: Ambulance crash fatalities have been reported internationally, some involving children. Approximately one in ten patient transports involves a child. The special needs of transported pediatric patients raise unique safety issues beyond those of domestic pediatric transport. Testing standards and design of child restraints for domestic vehicles are well developed, however there is no federal standard or testing requirement for ambulance pediatric restraint devices or practices. Commonly used restraint practices for children in ambulances have not been subjected to comprehensive dynamic safety testing to validate occupant safety. This study describes in an interdisciplinary framework, the safety testing of currently available devices and practices in addition to prototype devices currently being developed to address this problem. Aims: To pilot dynamic safety tests of devices for pediatric patient transport. Methods: A range of currently used or available restraint devices for the transport of pediatric patients were assembled, as well as prototype devices. A standard ambulance gurney was secured to an approved sled test rig. All restraint devices were tested secured to the gurney as in current ambulance practice. These devices were tested in a simulated 30 mph frontal impact, equivalent to a deceleration force of 24 G. Crash test dummies of 3, 9, and 15 kilograms, were used in the testing. Endpoints were ejection of the dummy or disruption of the restraint device. High speed video and digital imaging and computerized analysis of the crash impact data were performed. Results: The restraint systems tested which were available for transport or in current use, failed preliminary dynamic testing, some catastrophically. Outcomes included either ejection of the occupant, disruption of the device or both. In contrast, newly developed prototype restraint systems adequately restrained the occupant and maintained structural integrity during testing. Conclusions: This preliminary study suggests that some currently available ambulance pediatric restraint devices may be ineffective. A multidisciplinary approach to the development of such devices is needed, with a focus on clinical needs and safety engineering expertise. The direction of future research and development in the safety of all ambulance patients, occupants and equipment should be reviewed. Video footage will demonstrate testing.

11

EPIDURAL ANALGESIA IN NEWBORNS AFTER CONGENITAL DIAPHRAGMATIC HERNIA REPAIR FACILITATES PULMONARY PRESERVATION STRATEGY.

S.M. Goobie, M.D., C.S. Houck, M.D., FAAP, C. Seefelder, M.D Department of Anesthesia and Critical Care, Children's Hospital, Boston, MA.

Background: Although the early perioperative survival after congenital diaphragmatic hernia (CDH) repair improved markedly with the availability of extracorporeal membrane oxygenation (ECMO) in the 1980’s, long term survival remained unchanged at approximately 50%. (1) Autopsy studies showed that in the absence of other congenital anomalies, the leading causes of death were pulmonary hypoplasia and iatrogenic barotrauma. A strategy aimed at pulmonary preservation was instituted at this hospital in the early 1990’s, which allowed permissive hypercapnia and promoted spontaneous ventilation with neonatal pressure support ventilation. (2) As a part of this, perioperative analgesia was provided with thoracic epidural analgesia in an effort to avoid the respiratory depression associated with opioid analgesics and the ineffective ventilation noted with inadequate pain relief. Methods: After approval from the Committee on Clinical Investigation, we retrospectively reviewed the hospital records of all infants undergoing CDH repair between August 1995 and January 1998. Demographic data such as age, weight, estimated gestational age, associated diagnoses, and need for preoperative ECMO were recorded. The epidural insertion site, tip location by radiographic study, type and infusion rates of local anesthetics administered, duration of epidural infusion and need for additional analgesics or anxiolytics were recorded. Time to return of spontaneous ventilation and duration of mechanical ventilation were noted. Results: During the study period a total of 38 infants with congenital diaphragmatic hernia were identified. Thirteen infants (34%) required ECMO preoperatively and were removed from further analysis. Of the remaining 25 infants, 21 infants had an epidural catheter placed just prior to surgical repair, 2 had a catheter placed at the conclusion of surgery and 2 did not have a catheter placed due to technical difficulties with placement. Epidural infusions consisted of 0.05% bupivacaine with 1 mcg/cc fentanyl at rates between 0.1 and 0.3 ml/kg/hour. With the exception of one infant who developed profound hypoxia and shunting at the end of surgery and required emergent ECMO support, all infants who received epidural analgesia were breathing spontaneously on neonatal pressure support on the day of surgery. There were no episodes of apnea recorded during epidural use. Five infants were given either fentanyl or midazolam while the catheter was in place; 3 infants were given single doses for procedures and 2 infants received midazolam for agitation. All of the infants survived and were extubated successfully an average of 12 days after surgery. Median duration of mechanical ventilation after surgery was 6 days with a range of 1 to 55 days. Conclusion: Continuous epidural analgesia was an effective method to provide analgesia and promote spontaneous ventilation in neonates undergoing congenital diaphragmatic hernia repair. Further investigations are needed to determine if this strategy of permissive hypercapnia and neonatal pressure support ventilation will lead to improved outcomes and less morbidity from iatrogenic barotrauma. (1) J Pediatr Surg 1997;32:401-405. (2) J Pediatr Surg 1995;30:406-409.

12

CONTRIBUTION OF INTRAOSSEOUS INFUSION RATE TO FAT EMBOLISM

M. Yousuf Hasan, MD, Niranjan Kissoon, MD, Virgilio Salda- jeno, MD, Taj Khan, MD, Kevin Sullivan, MD, Suzanne Mur- phy, PhD. University of Florida Health Science Center/ Jacksonville, Nemours Children’s Clinic, and Wolfson Children’s Hospital, Jacksonville, Florida.

Introduction: Intravenous (IO) infusions are used when venous access is difficult. It is used for the infusion of fluids and resuscitation medications in hypovolemic and critically ill pediatric patients. The most serious complication that may arise from intravenous infusion is fat and bone marrow embolism. The objective of our study was to determine the incidence of fat embolization with pressure or gravity infusions. We hypothesize IO there will be no differences in the incidence of fat embolism.
between these two methods. Methods: Twelve mixed breed piglets (average weight 30.9 kg) were divided into two groups. They were anesthetized, intubated, mechanically ventilated, and instrumented. IO needles were placed in the tibial bone. Group 1 received fluid under 300mmHg pressure and Group 2 received infusion at free flow under gravity (infusion bags were suspended at one meter above the animal for both groups). Buffy coat samples were obtained from pulmonary arterial catheter at baseline, IO placement, and at the end of infusion. Following infusion, the animals were euthanized and both upper and lower lung sections were obtained from each lung. Buffy coats were kept uncoagulated and lung sections were snap frozen on dry ice for transport. Specimens were stained with Oil red O stain and reviewed by a pathologist blinded to experimental conditions. Specimens were graded for the number of fat emboli seen per high power field. The groups were compared using student t test and analysis of variance as appropriate. Results: Fat emboli were found in about 30% of the lung specimens, with the number ranging between 1 to 3 emboli per high power field. In both groups receiving fluid, either under 300mm of Hg pressure or free flow under gravity, the difference in number of fat emboli seen was not statistically significant. Buffy coat stains yielded fat emboli in very small amounts which were sporadically distributed in both groups. Conclusion: The risk for fat embolism is minimal and independent of whether IO fluid is administered under gravity or pressure. Our study therefore implies that the intraosseous route is safe and may be used in children until more stable access is obtained. Funded by the Nemours Children’s Clinic and Groh Foundation.

13

COMPARISON OF PLASMA LEVELS AND PHARMACODYNAMICS AFTER INTRAOSSEOUS AND INTRAVENOUS ADMINISTRATION OF FOSPHENYTIN AND PHENYTOIN IN PIGLETS.

Taj M Khan, MD, Niranjan Kisson, MBBS, M Y Hasan, MD, Virgilio Saladajeno, MD, S P Murphy, PhD, J Lima, PharmD. University of Florida HSC, Nemours Children’s Clinic, and Wolfson Children’s Hospital, Jacksonville, Florida.

Introduction: Difficulty in achieving therapeutic drug levels via the intravenous route may be due to failure to standardize drug and fluid solutions. We compared drug levels and pharmacodynamics in standard doses of fosphenytoin and phenytoin given via the intraosseous and intravenous route.

Methods: Piglets (30-40kg) were anesthetized, intubated, instrumented and mechanically ventilated. A peripheral intravenous line and intraosseous needle (15 gauge Sur FastTM Cook Inc.) was inserted for drug infusions. Forty animals (10 per group) were randomly assigned for intravenous and intraosseous phenytoin and fosphenytoin infusions. Phenytoin (20mg/kg) was infused over 20 minutes and fosphenytoin (20mg PE/kg) over 7 minutes. All infusions were followed by 5ml normal saline flush (as done clinically). Blood samples (3 ml) for drug levels were then drawn before infusion (base line) and at 0, 5, 10, 15, 20, 30, 40, 50, 60 and 75 minutes following infusion. Repeated measures Analysis of variance (ANOVA) was used to evaluate statistical significance (p<.05). Results: Phenytoin levels were undetected at base line. Free (10-20 mcg/ml) and total (80-110 mcg/ml) were well above therapeutic range (free 1-2mcg/ml and total 10-20 mcg/ml) post infusion in fosphenytoin groups as compared to phenytoin. From 20–75 minutes, all groups had free and total levels within therapeutic range. Significant differences in values were seen in free phenytoin at 0-10 minutes (p<0.05) and total phenytoin at 0-20 minutes (p<0.05) between intraosseous phenytoin and fosphenytoin. Similarly, differences were also seen when intravenous phenytoin and fosphenytoin groups were compared. There was no significant difference in heart rate and blood pressure between groups. Conclusion: There is no need to adjust standard drug doses of phenytoin when given via the intraosseous route if followed by adequate flush of 5ml. The initial high levels of phenytoin in the fosphenytoin groups are of concern since neurological toxic effects may occur at these levels. Slower infusion rates may be needed for fosphenytoin to avoid toxic levels. Funded by the Nemours Children’s Clinic and Groh Foundation.

P1

ASSOCIATION OF MYCOPLASMA PNEUMONIA INFECTIONS WITH STATUS ASTHMATICUS.

Usama Hanhan, M.D., FAAP, James Oriowski, M.D., FAAP, and Mariano Fiallos, M.D., FAAP, University Community Hospital, Tampa, FL.

Background: Viral respiratory infections (VRI) have been commonly associated with exacerbation of wheezing in asthmatic children. Mycoplasma pneumonia (MP) causes many respiratory syndromes that clinically mimic VRI. Due to the nature of the organism, cultures are of no practical value and the diagnosis is usually made by serology. This study was an attempt to assess the incidence of recent mycoplasma infections in patients with status asthmaticus and to review their laboratory, clinical and radiological findings. Methods: Retrospective review of all patients admitted to PICU over 12 month period with status asthmaticus. Recent mycoplasma infection was determined utilizing the Immunocore mycoplasma ELA for detection of MP IgM antibodies (Meredian Diagnostics, Inc., Cincinnati, OH) Results: 44 patients reviewed. 9 were excluded because MP tests were never obtained during hospitalization. 15/35 (42%) were MP Positive. There were no statistically significant differences (P>0.05) in length of hospitalization (LOH), ICU days, duration of continuous albuterol hours (cont. Nebs), days on O2 (02 days) or WBC between the two groups. Patients with evidence of recent MP infection were more likely to have one or more infiltrates on their CXR (13/15 vs 7/20) P = 0.002. Conclusion: Recent MP infections play a much greater role in exacerbation of asthma and occurrence of status asthmaticus. Presence of infiltrates on CXR in status asthmaticus warrants tests for MP.

<table>
<thead>
<tr>
<th></th>
<th>Pts</th>
<th>Sex</th>
<th><strong>Age</strong> (Yrs)</th>
<th>LOH (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Age</strong> (Yrs)</td>
<td>LOH (Days)</td>
</tr>
<tr>
<td>MP +</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP -</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P-value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ICU (Days)</th>
<th>O2 (Days)</th>
<th>Cont Nebs (Hrs)</th>
<th>WBC</th>
<th><strong>CXR +</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.75</td>
<td>3.5</td>
<td>27.7</td>
<td>15.2</td>
<td></td>
</tr>
<tr>
<td>2.65</td>
<td>3.35</td>
<td>29</td>
<td>13.6</td>
<td></td>
</tr>
<tr>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>0.002</td>
<td></td>
</tr>
</tbody>
</table>

*15/35 (42%).

**Age Range 2-19 years.

***Presence of one or more infiltrates.

P2

USE OF AMINOPHYLLINE IN THE PEDIATRIC PATIENT WITH MODERATE AND SEVERE STATUS ASTHMATICUS.

Luis Torero, MD, FAAP AND J. Carlos Maggi, MD, FAAP, FCCP. Department of Pediatric Critical Care and Pulmonary Medicine, Miller Children’s at Long Beach Memorial Medical Center, Long Beach, CA.

Background: The role of aminophylline in the management of patients with severe asthma remains controversial. Children with severe asthma are treated initially with continuous BETA-2 ago-
nists, inhaled anticholinergics and intravenous steroids. When expected improvement does not occur, aminophylline is considered as an adjunctive therapy, but there is no scientifically proven benefit in this addition. It is hoped that this study will provide objective data to answer this question. Methods: A prospective, randomized, double blind, placebo controlled trial in patients > 30 days and up to 18 years of age, with status asthmaticus and admitted to the PICU. The clinical severity of the event was assessed before and during therapeutic interventions by using the Woods-Downes-Lecks clinical asthma score. Patients were randomized to treatment and placebo groups. The patients in the treatment group receive a loading dose of aminophylline followed by a continuous infusion of this drug. Patients in the control group receive a bolus of Normal Saline followed by a continuous infusion of this solution. A clinical pharmacist adjusted the infusion of aminophylline in the treatment group patients to achieve a level between 13-18 mcg/ml. Similar adjustments were made in the Normal Saline infusions in the control group to ensure the blinding. Results: A total of 21 patients have been included in the study. Eleven of the 21 patients received aminophylline and 10 received placebo. Variables from both groups were statistically compared. 1. There was a significant difference in the number of PICU days, with the aminophylline treated group requiring less days in the PICU (log rank and Wilcoxon test). (P=0.04 ≦ 0.04). 2. No significant difference in initial asthma score and adverse effects during infusion of aminophylline or placebo. (P=0.28 and ≦0.30). 3. There was no significant difference in the time of continuous albuterol required to achieve a clinical asthma score equal or less than 4 (significant clinical improvement), using log rank and Wilcoxon tests. (P=0.32 ≦ 0.22). 4. No difference in complications (respiratory failure) or use of other medications such as intravenous Terbutaline or Magnesium Sulphate. Conclusions: Our study suggests that aminophylline use may shorten the length of stay in the PICU, may not decrease the interval between admission and significant clinical improvement, and may not decrease the incidence of complications. The cost of hospitalization may be decreased by using aminophylline in this patient population. The final analysis will be performed when a total of 25 patients are included in each group.

P3
COMPLICATIONS OF NIFEDIPINE USE IN CHILDREN.

David W. Egger, MD, Ronald M. Perkin, MD, MA, FAAP, FCCM, Shobha Sahney, MBBS, FAAP, Norman Hamada, Pharm D. Dept of Peds, Loma Linda University Medical Center, Loma Linda, CA.

Background: Concerns regarding the safety of Nifedipine emerged in 1995, with the report of increased risk of myocardial infarction associated with adult patients receiving short acting calcium channel blockers. Cerebrovascular ischemia, stroke, severe hypotension, and death, have also been reported adverse effects of Nifedipine. Given the seriousness of reported adverse effects, avoiding the use of Nifedipine has been proposed. We sought to investigate the incidence of complications of Nifedipine use in the pediatric population. Methods: We conducted a retrospective chart review of patients who received Nifedipine during the period of 1995-1998. For each patient and dose administered, all reported adverse outcomes, and all BP measurements reported up to six hours after the dose were obtained. Results: 2,438 doses of Nifedipine in 182 pediatric patients were reviewed. Effect on blood pressure: In 10.4% of the administered doses there was a decrease in systolic blood pressure (sbp) of 30% or more. The maximum fall in sbp was 66% (159 to 54). In 36.1% of doses there was a decrease in diastolic blood pressure (dbp) of 30% or greater. The maximum fall in dbp was 89.2% (120 to 13). Adverse Effects noted: a) Change in CNS status, 6 cases (stroke 1, altered level of consciousness 4; seizure 1); b) Hypotension requiring change in therapy, 4 cases; c) Chest pain without evidence of myocardial ischemia, 3 cases; d) Hypoxemia, 24 cases. Conclusion: Nifedipine is associated with unpredictable and sometimes, profound changes in blood pressure. Although we did not find any patients who experienced myocardial ischemia associated with Nifedipine, we did find that it is associated with significant adverse effects in children, including severe hypotension and CNS events. Nifedipine must always be used with caution, especially in children with underlying CNS disease.

P4
USE OF MILRINONE IN THE PEDIATRIC CRITICAL CARE UNIT.

Sally Watson, MD, Karla Christian, MD, Kevin B. Churchwell, MD, FAAP. Dept, of Peds, Vanderbilt University School of Medicine, Nashville, TN.

Background: Milrinone lactate is a bipyridine derivative inotropic/vasodilator that acts by inhibiting the isoenzyme phosphodiesterase III in cardiac and vascular muscle. This raises intracellular cAMP, which in turn a) increases intracellular cardiac muscle calcium levels, producing increased cardiac contractile force and b) increases cAMP-dependent vascular smooth muscle protein phosphorylation, producing vasodilation. In adults, primary reported side effects of both milrinone and its older analogue amrinone are cardiovascular. These include arrhythmias (milrinone 15.9%, amrinone 3%) and hypotension (milrinone 2.9%, amrinone 1.3%). Thrombocytopenia is a well-described side effect of amrinone (2.4%). It is dose-related, resolves with dose reduction, and occurs most frequently in patients receiving prolonged therapy. Thrombocytopenia was reported in 0.4% of adults receiving milrinone. Milrinone is being increasingly used in pediatric patients with myocardial dysfunction. There exists, however, a paucity of data regarding the side effect profile of this agent in children. This investigation compares the incidence of milrinone-related cardiac arrhythmias and thrombocytopenia described in adults to that observed in a population of children who received this agent in our PCCU. Methods: A retrospective chart review was conducted on children who received milrinone for inotropy and afterload reduction in the Pediatric Critical Care Unit between September 1996 and February 1999. Inclusion criteria were children immediately status post open heart surgery who received milrinone for more than 48 hours and who did not receive extra-coraporeal membrane oxygenation (ECMO) post-operatively. To minimize interference from post-bypass sequelae of transient thrombocytopenia and arrhythmias, data collection began 48 hours after the operation. Data recorded included patient age, diagnosis, milrinone hours and average dose per patient, presence of thrombocytopenia (platelets <100,000), and occurrence of cardiac arrhythmias requiring medical or electrical therapy. Average milrinone duration and dose (mcg/kg/min) were determined for the population. Incidences of thrombocytopenia and arrhythmia were determined as a percent of total patients receiving milrinone. Data from patients with other likely sources of thrombocytopenia or arrhythmias were then excluded, and the remaining patient data re-analyzed in the above fashion. Results: Data from 30 children from newborn to 36 months of age were included. Most common cardiac diagnoses for which patients received milrinone after operative repair included atrioventricular septal defect (6), tetralogy of Fallot (3), D-TGA (3), and pulmonary atresia with VSD (3). Beyond the first 48 post-operative hours, patients received milrinone for an average of 4.7 days (114 hours; range 1 to 428 hours). Average milrinone dose was 0.63 mcg/kg/min (range 0.2 to 1.2 mcg/kg/min). Two (6.6 %) of children receiving milrinone exhibited arrhythmias (sinus Bradycardia and SVT respectively) that could not otherwise be explained. Thrombocytopenia occurred in 8 (26.7 %) patients. Five of these had other compelling reasons for low platelets including severe CNS anoxia, disseminated intravascular coagulation, infection, and concurrent heparin infusions. When these patients were excluded, the remaining three patients...
represented 10% of children receiving milrinone. Conclusion: These preliminary data suggest that milrinone-related arrhythmias are less common in children than in adults (6.6% vs. 16.2%), whereas milrinone-related thrombocytopenia is more common in children than in adults (10% vs. 0.4%). Larger patient numbers are needed to more clearly detect and define an accurate milrinone pediatric side effect profile.

**P5**

METHEMOGLOBINEMIA: TOXICITY OF INHALED NITRIC OXIDE (NO) THERAPY.

Mary B. Taylor, MD, Karla Christian, MD, Kevin B. Churchwell, MD, FAAP. Dept. of Pediatrics, Vanderbilt University School of Medicine, Nashville, TN.

Background: Elevations in methemoglobin (METH) is a known toxicity of inhaled NO therapy, although in clinical practice the incidence is rare. Most studies of the use of NO have not shown significant METH in moderate to low concentrations. We have enrolled over 100 pediatric patients with congenital heart disease (CHD) that have identified or suspected pulmonary hypertension in a NO dose response protocol. Doses of NO used range from 80 to 5 ppm. We monitored NO and NO2 concentrations continuously (Pulmonox II system/Invent system) and monitor METH levels on a daily basis. This abstract describes two significant episodes of Methemoglobinemia requiring treatment. Method: Patients were prospectively assigned to a dose response NO protocol who had clinical and or hemodynamic evidence of pulmonary hypertension. Patient# 1: status post repair of total anomalous pulmonary veins (TAPVR) developed profound cyanosis after completion of the protocol. O2 saturation was 86%, pO2-185 with measured arterial saturation of 67%. Methemoglobin level was 31.2%. Treatment included discontinuation of NO, blood transfusion, methylene blue and Vitamin C. Rapid decline in the METH level occurred; 4.4% at 40 min and 0.5% at 12 hours. Patient#2: Presently receiving NO, was receiving NO at 60 ppm for over 40 minutes. O2 saturation was 86%, pO2-78, measured arterial saturation not obtained. METH level was 14.3%. Treatment was as above with prompt reduction in METH level; 7.6% in 60 minutes, 4% in 120 minutes. There were no adverse sequelae from either event and both patients were discharged home in good condition. Both patients’ measured methemoglobin reductase activity was within normal limits. Conclusion: All equipment used in the delivery of NO was examined, dry lab tested and found to be functioning properly. Although the etiology of the METHemia observed remains unclear, we believe dead space accumulation of NO, in the ventilator circuit not detected by the analyzer contributed to the METHemia observed. With these observations, we have changed the ventilator circuit setup to minimize this potential problem. Our experience demonstrates that the potential for inadvertent overdosing of NO resulting in methemoglobinemia exists with moderate concentrations of delivered NO. We have shown that despite high levels of METH, therapies aimed at reducing METH are rapid and effective.

**P6**

INTERNATIONAL SURVEY ON THE USE OF CUFFED VS UNCUFFED ENDOTRACHEAL TUBES.

Gerardo Reyes, MD, FAAP, Manuel J. Lorente, MD, Ira N. Horowitz, MD, FAAP, Tarek S. Huseyni, MD, Rabi Sulayman, MD, and David G. Jaimovich, MD, FAAP. *Division of Critical Care, Hope Children’s Hospital and the University of Illinois School of Medicine, Chicago, IL and 2Hospital Torrecardenas, Almeria, Spain.*

Background: There has been much discussion among pediatric critical care physicians on the use of cuffed vs uncuffed endotracheal tubes (ETT) in pediatric patients. A review of the literature found only one article in humans by Deakers et al addressing this issue. The article concluded that high-volume/low-pressure cuffed ETTS are not associated with significant short or long term side-effects. However, the American Heart Association and the American Academy of Pediatrics in their Pediatric Advanced Life Support Textbook advocate the use of uncuffed ETTS in children ≤ 8 years of age even though there is no literature to support this practice. We decided to undertake an international survey through the Internet on the use of cuffed vs uncuffed ETTS.

Methods: A questionnaire was electronically submitted to the following addresses: picu@post.its.mcw.edu and ucip-net@listserv.rediris.es. These addresses were created to facilitate the exchange of information among healthcare personnel in pediatric critical care worldwide. Participants were asked to answer the following questions: 1) Do you use cuffed or uncuffed tubes? 2) Is there any age group in which you do not use cuffed tubes, and why? 3) Have you experienced any complications directly related to the use of cuffed tubes? 4) Do you use high-volume/low-pressure cuffs? 

Results: Eighty intensivists (N=80) answered the survey with the following geographical distribution: Argentina 6, Australia 5, Belgium 1, Canada 2, Colombia 1, Costa Rica 1, Great Britain 1, Israel 3, Italy 2, Netherlands 1, South Africa 1, Spain 10, and U.S.A. 46. The responses were as follow: Question #1: Cuffed – 5 (6.25%), uncuffed – 7 (8.75%), both – 68 (85%). Question #2: 71 (N=71) responded as follow: Patients ≤ 6-8 years of age – 11 (15.5%), ≤ 8 years – 23 (33%), ≤ 5 years – 7 (10%), ≤ 6 years – 7 (10%), ≤ 1 year – 4 (6%), ≤ 30 kgs – 1 (1.5%), ETT ≤ 4.0 – 2 (3%), and ETT ≤ 5.5 – 8 (12%). Most respondents (> 90%) said that if the patient develops an air leak (or the potential for one), or if the patient can develop aspiration pneumonia, they would switch to a cuffed ETT. Reasons for using uncuffed ETTS were: a) Lack of cuffed tubes smaller than 5.5. b) Recommendation from P.A.L.S. c) Potential damage to the subglottic area. d) The anatomical narrowing at the level of the cricoid cartilage in children functions as a “natural” cuff. Question #3: No complications with the use of cuffed ETTS – 69 (86%), complications – 11 (14%) (stridor and/or subglottic/tracheal stenosis). Question #4: All respondents said they always use high-volume/low-pressure cuffs.

Conclusions: 1) There is wide discrepancy among pediatric intensivists regarding the use of cuffed vs uncuffed ETTS in the different age groups. 2) Despite the lack of evidence in the literature, many respondents feel cuffed tubes can cause airway damage. 3) With the advent of high-volume/low-pressure ETTS, P.A.L.S. recommendations on cuffed vs uncuffed ETTS may need to be reviewed. 4) The Internet can be a valuable medium for clinical research projects.

REFERENCES

The online version of this article, along with updated information and services, is located on the World Wide Web at:

http://pediatrics.aappublications.org/content/104/Supplement_4/674.citation