

▲188

VOLUME EXPANSION INCREASES CARDIAC OUTPUT (CO) BUT NOT OXYGEN DELIVERY ($\dot{Q}O_2$) IN PIGLETS. W.L. Meadow, B.F. Rudinsky, K.J. Komar, V. Hill (spon. K-S Lee) Wyler Children's Hosp., U. of Chicago, Chicago IL

Volume expansion is common in neonatal medicine despite suggestions that cardiac performance in newborns is not enhanced by increased myocardial preload. We investigated the effects of volume expansion in piglets.

Piglets (1-3 wks; n=12) were anaesthetized, intubated, and ventilated. Blood pressure (BP), pulmonary artery pressure (PAP), left atrial pressure (LAP), central venous pressure (CVP), and CO were measured directly. Arterial and mixed venous (PA) blood samples were obtained to determine $\dot{Q}O_2$, O_2 consumption ($\dot{V}O_2$), and O_2 extraction. Six piglets (GENT) received 6% Gentrane/0.9% NaCl to elevate LAP from approximately 5 to 15 mm Hg over 30 minutes. Six additional piglets (SAL) received 0.9% NaCl for 30 minutes.

Cardiac index (CI) rose during GENT in each piglet, reaching a plateau (+54.2 +/- 38.5 (S.D.) cc/kg/min; p .01) at LAP between 12 - 15 mm Hg. CI fell at the highest LAP reading in 4/6 piglets. GENT raised LAP, PAP, and CVP equivalently (7.3 +/- 1.4, 7.2 +/- 2.6, 5.6 +/- 1.2 mm Hg; all p .01 vs SAL), but had no effect on BP or HR. Hb fell during GENT from 10.4 +/- 1.8 to 7.4 +/- 1.9 gm/dl (p .01) so that $\dot{Q}O_2$ was not enhanced after GENT (17.6 +/- 1.5 vs 17.9 +/- 2.3 cc O_2 /kg/min) despite the rise in CO. $\dot{V}O_2$, O_2 extraction, pH, and base excess did not change after GENT.

Conclusions: 1. CO consistently rises with increased LAP from 5-12 mm Hg. At higher LAP, CO may fall. 2. $\dot{Q}O_2$ does not rise and O_2 extraction does not fall during GENT, as increased CO is opposed by hemodilution. 3. To the extent that improved $\dot{Q}O_2$, not CO, is the endpoint of hemodynamic resuscitation, volume infusion without concurrent blood transfusion may be of little benefit.

EFFECTS OF MECHANICAL VENTILATION WITH PEEP ON CARDIAC OUTPUT MEASURED USING PULSED DOPPLER IN CHILDREN.

189

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In order to meet metabolic demands, oxygen delivery ($\dot{D}O_2$) must be sufficient. However, in children with acute respiratory failure (ARF), $\dot{D}O_2$ is often partially estimated because cardiac output (CO) is rarely taken into account. This work reports the effects of mechanical ventilation with PEEP (CPPV) on $\dot{D}O_2$.

Methods: 7 newborns (GA: 34+2wks) with hyaline membrane disease and 3 children (5-10mos-12yrs) with ARF were evaluated. SO_2 was measured using Nellcor (tcSO₂). The mean ascending aortic velocity was measured from suprasternal notch using a Pulsed-Doppler Vingmed SD-100 while the aortic diameter was measured at the aortic leaflets level. CO was automatically measured and averaged every 2.5 sec. Without modifying other settings, PEEP was stepwise increased and Paw, tcPO₂, tcSO₂ and CO were measured.

Results: (*p < 0.01 vs ZEEP - paired t-test)

| PEEP (cmH ₂ O) | 0 | 3 | 6 | 9 |
|---------------------------|---------|---------|----------|-----------|
| Paw (cmH ₂ O) | 8 ± 2 | 11 ± 2 | 13 ± 2 | 15 ± 2 |
| tcPO ₂ (torr) | 54 ± 18 | 69 ± 24 | 83 ± 20* | 83 ± 23* |
| tcSO ₂ (torr) | 85 ± 13 | 87 ± 9 | 92 ± 7 | 94 ± 5 |
| CO (% baseline) | 0 | -4 ± 11 | -7 ± 21 | -15 ± 18* |
| $\dot{D}O_2$ (% baseline) | 0 | 0 ± 13 | +1 ± 23 | +6 ± 20 |

Thus, $\dot{D}O_2$ may be non-invasively measured in children. The stepwise increments in PEEP and Paw induced both an increase in arterial oxygenation and decrease in CO, leading to the concept of using the minimal effective or "optimal" PEEP in ARF.

ACUTE MECHANICAL VENTILATION: AN INDEX OF PEDIATRIC ICU BED UTILIZATION. * John J. Mickell, ** Terry L. Furguele, (Spon. by * Harold M. Maurer), * Medical College of Virginia, Children's Medical Center, Richmond, and ** University of California, Davis Medical Center, Sacramento.

190

Only 28.0% of pediatric ICU (PICU) admissions to a tertiary-care center (MCV) over an 8-year period required acute mechanical ventilation (MV), yet these accounted for 52.5% of total PICU patient days. Transport admissions had a greater than average requirement for MV (40.4%). The median duration of intensive care (MDIC) for all MV patients was 4 days. Subgroups differing in MDIC at the p < 0.01 level included: a) under 2 years (5d) vs. older (4d); b) medical (5d) vs. all perioperative (3d); and c) cardiac surgery (3d) vs. other perioperative (4d). Only 4.8% of MV patients required more than one month in the PICU, but 67.8% of that long-term subgroup were less than 2 years old (p < 0.01).

We concluded that: 1) 3.79 PICU beds per million general population (1.39 per 100,000 children under age 18 years) were occupied daily by MV patients at MCV; 2) the total number of PICU beds utilized was 7.54 PICU beds per million general population (2.76 per 100,000 children under age 18 years) or twice that needed for MV patients alone; 3) the regression equation for MV census/day = 0.028(# adm/yr < 2-years-old) + 0.157(# adm/yr exceeding 30 ICU days) + 0.387 accurately predicted annual variability at both MCV (r² = 0.984, SEE 0.173, p < 0.01) and a neighboring tertiary-care center (predicted/observed = 103%); and 4) the difference in MV census/day between the two centers was due to a difference in the number of patients requiring prolonged MV (30-90 days) for primary respiratory failure.

191

DAILY VARIABILITY IN ICU NURSING WORKLOAD: CHANGE IN CENSUS VERSUS CHANGE IN THERAPEUTIC INTENSITY LEVEL. John J. Mickell, Steven E. Lucking, (Spon. by Harold M. Maurer). Virginia Commonwealth University, Medical College of Va., Children's Medical Center, Richmond.

Variability in workload in a Pediatric ICU (PICU) often results in the reassignment of nursing staff to or from other patient care areas. Inability to predict whether they will have adequate help or be reassigned is a source of stress for PICU nurses. Thus, both increases and decreases in workload are stressful. The Therapeutic Intervention Scoring System (TISS) quantitates ICU nursing care and has been used as a measure of staffing needs (Polachek: Crit Care Med 1986;14:417). We asked whether patient census adequately reflects unit total (UT) TISS points as a measure of daily variability in nursing workload.

Data were collected over 12 months from October 1985 through September 1986 in a medical/surgical PICU. A total of 3,133 patient-days of care were rendered with a median daily census of 9 (range 2-12) patients. A total of 58,352 TISS points were recorded with a median TISS points per patient-day of 16 (range 3-78) and a median daily UT-TISS of 160 (range 26-305) points. The medians for absolute change over 1-day were 1 (range 0-5) patient, and 20 (range 0-110) UT-TISS points.

The relationship between 1-day change in census and 1-day change in UT-TISS was described by the regression equation:

$$\Delta \text{UT-TISS} = 14.6 (\Delta \text{Census}) - 0.1, \text{ SEE } 24.4, r = 0.68.$$

Thus, only 46% of change in UT-TISS could be explained by a change in census. This invalidated census as an index of workload, and emphasized the need for objective measurement of therapeutic intensity when considering nursing reassignment.

MORPHINE, VALIUM, AND PAVULON REQUIREMENT VERSUS AGE IN ENDOTRACHEAL INTUBATED CHILDREN. John J. Mickell, Sheila A. Pedigo, (Spon. by Harold M. Maurer). Virginia Commonwealth University, Medical College of Virginia, Children's Medical Center, Richmond.

192

Endotracheally intubated (EI) patients usually require some combination of sedative (morphine = M, Valium = V) and paralyzing (Pavulon = P) medications to minimize anxiety, discomfort, and the risks of self-extubation, tracheal injury, and pulmonary barotrauma. We reviewed a database of all admissions to a Pediatric ICU to find patients who were EI for >= 7 full days (excluding days of intubation and extubation). We excluded cases where MVP administration would be influenced by neurological (encephalopathy, seizures, muscle weakness, mental retardation), cardiovascular (shock), or painful diagnoses (malignancy, trauma, burns, surgical incisions).

Thirty-one cases were selected, and the daily sum of MVP dosages was calculated for each case for each of the 7 study days. This was valid since the starting dose (0.1 mg/kg) and interval (q2h PRN) were the same for each drug. We sought to confirm our clinical impression that the patients aged 6m-2y required more MVP than younger or older patients by using the Mann-Whitney U-test for non-parametric comparisons.

| Age | Cases | Days | Median MVP mg/kg/d (range) | P value |
|-------|-------|------|----------------------------|---------|
| < 6m | 15 | 105 | 1.20 (0.00-4.89) | NS |
| 6m-2y | 10 | 70 | 2.78 (0.10-7.52) | < 0.001 |
| > 2y | 6 | 42 | 1.03 (0.00-3.79) | NS |

Thus, it appears that because of either behavioral or pharmacologic idiosyncrasy, patients aged 6m-2y often require double the dosage of MVP usual for younger or older patients.

POSTNATAL INCREASE OF SERUM CALCITONIN (CT) CONCENTRATION: NO CONTRIBUTION TO NEONATAL HYPOCALCEMIA (NHC) IN INFANTS OF DIABETIC MOTHERS (IDM'S). Francis Mimouni, Jeffrey Loughhead, Reginald C. Tsang*, Jane Khoury, Victoria Neumann. Univ of Cincinnati Col of Med, Dept Pediatrics, Cincinnati, OH.

193

It has been suggested that high serum CT concentrations may contribute to NHC in IDM's. Since the role of CT in Ca metabolism in humans is questionable, we hypothesized that increased CT occurs after birth in a similar fashion in IDM's and control infants, and that serum CT does not correlate with serum calcium (Ca). 46 full term IDM's (class B-RT) were compared to 31 controls. Control infants were born after normal pregnancies, labors and deliveries. Samples were taken from cord blood and at age 24hrs for measurement of Ca, magnesium (Mg), parathyroid hormone (PTH) and CT. Repeated measures analysis showed the following: increasing serum Mg, PTH, and CT, and decreasing serum Ca concentration over time. However, the decrease in serum Ca concentration (mg/dl) was more marked in the diabetic group than in the control group (p < 0.01). The increase in serum CT concentration (m+SEM, pg/ml) was similar in the 2 groups (from 42+10 (cord) to 229+35 (24 hr) in IDM's vs 58+19 to 220+28 in controls). There were no differences in cord or 24 hrs serum concentrations of Mg, PTH, and CT between groups. In a multiple regression analysis model including all subjects, Ca correlated with PTH (P < 0.02, R² = 0.25) but not with CT. We conclude that 1) serum CT increases after birth irrespective of the rate of decrease of serum Ca in both IDM's and controls; 2) high CT concentrations observed after birth (as compared to adult norms) do not play a role in the pathogenesis of NHC in IDM's.