† **1744** CONTROLLED TRIAL OF A PROTEIN-FREE SYNTHETIC SURFACTANT IN PRETERM RABBITS. Neil M. Derechin, Mureen A. Schlueter, Cynthia L. Brown, William H. Tooley, John A. Clements, and Richard D. Bland. Cardiovasc Res Inst, Dept Pediatr, Univ Calif, San Francisco, CA 94143

Rabbit pups born at 27d gestation (term=31d) die quickly from respiratory failure. Past reports have shown that surfactant replacement for such animals may improve lung stability and lengthen survival. We developed a synthetic surfactant containing dipalmitoylphosphatidylcholine, hexadecanol and tyloxapol (EXOSURF) that we instilled into the trachea of 7 fetal rabbits, each from a different litter, delivered operatively at 27d gestation. A littermate of each of the 7 pups served as a saline-treated control. After anesthesia, paralysis, tracheostomy, and treatment with 0.3ml of either EXOSURF (75mg/kg) or isotonic saline, each pair of rabbit pups received positive-pressure mechanical ventilation with 100% $O_2$ at 48 breaths/min for 2-3h. Each pup had its own ventilator and rested supine in a plastic body plethysmograph surrounded by a 37°C water bath. Initial peak inspiratory pressure (PIP) was 40 $cmH_2O$, subsequently adjusted to keep tidal volume constant at 6-7ml/kg body weight. End-expiratory pressure was 1 $cmH_2O$. All 7 studies lasted at least 2h and ended when the control pup died. At both 1 and 2h, PIP was significantly less (27±1 vs 33±1 $cmH_2O$) and total lung compliance was significantly greater (.26±.01 vs .19±.01 mg/kg/$cmH_2O$) in EXOSURF-treated pups than in controls. Extravascular lung water content was similar for the 2 groups. We conclude that EXOSURF improves lung mechanics and survival of rabbits delivered very prematurely. Supported in part by NIH Grants HL-24075 and HL-27356 and AHA.

**1745** RESPIRATORY FAILURE IN CONGENITAL DIAPHRAGMATIC HERNIA: VENTILATION BY HIGH FREQUENCY OSCILLATION. Desmond Bohn, Masa Tamura, Charles Bryan. Intensive Care Unit and Resp. Physiol. Research Institute, Hospital for Sick Children, Toronto. Spon by Marlene Rabinovitch.

Congenital diaphragmatic hernia (CDH) is characterised by immaturity both of alveoli and pulmonary vasculature. In a prospective analysis of 46 infants with CDH presenting within the first 6 hours of life, simultaneous blood gases drawn from umbilical and right radial artery lines identified a group of 23 patients with severe hypoxemia due mainly to preductal rather than ductal shunting. All were treated with paralysis, hyperventilation, and vasodilator therapy. The single consistent feature in this severely affected group was hypercarbia ($P_aCO_2$>50mmHg) which remained elevated despite manipulations of both ventilator rates and mean airway pressures. All 23 patients in this group died while 21 of 23 patients with ductal shunting only, survived. In ten of the 23 patients in whom we were unable to control $P_aCO_2$ we changed from conventional ventilation (CMV) to high frequency oscillation (HFO). The mean $P_aCO_2$ on CMV was 59±15mmHg with mean $P_aO_2$ in the right radial artery of 36±11mmHg. The mean $P_aCO_2$ fell to 32±5mmHg with HFO but while there was a temporary improvement in $P_aO_2$, this was not sustained. The fact that control of $P_aCO_2$ was readily achieved by HFO suggests that the hypercarbia and hypoxemia in this group of patients is based on intrapulmonary rather than intracardiac shunting and represents severe bilateral pulmonary hypoplasia, where pulmonary vasodilator therapy will not be of benefit.

**1746** OPERATING CONVENTIONAL INFANT VENTILATORS AT UNCONVENTIONAL RATES. Stephen J. Boros, Dennis R. Bing, Mark C. Mammel, Margaret J. Gordon, and Eric J. Hagen, Children's Hospital, St. Paul, MN

We examined the effect of progressive increases in ventilator rate on delivered tidal (VT) and minute volumes ($\dot{V}$), and the effect of changing peak inspiratory pressure (PIP), PEEP, and I:E at different ventilator rates. Five different pressure preset infant ventilators were studied using a pneumotachograph, airway pressure monitor, and lung simulator. As rates increased from 10 to 150 bpm, VT stayed constant until 25-30 bpm; then progressively decreased. In all, VT began to decrease when proximal airway pressure waves lost inspiratory pressure plateaus. As rates increased, $\dot{V}$ increased until 75 bpm; then leveled off; then decreased. Substituting Helium for Oxygen increased the ventilator rate at which this $\dot{V}$ plateau effect occurred. Increasing PIP consistently increased VT. Increasing PEEP decreased VT. At rates less than 75 bpm, I:E (inspiratory time) had little effect on VT or $\dot{V}$. At rates above 75 bpm, inspiratory time became a prime determinant of delivered $\dot{V}$.

Conclusions: 1) Conventional pressure preset infant ventilators perform differently at rapid rates than they do at slower, more conventional rates. 2) There is a maximum rate beyond which VT progressively decreases and another maximum rate beyond which $\dot{V}$ progressively decreases. 3) At slower rates, delivered volumes are determined primarily by changes in proximal airway pressures. 4) At very rapid rates, inspiratory time becomes a key determinant of minute ventilation.

**1747** THORACIC DEFORMITY AND RESPIRATORY FAILURE IN INFANTS WITH GIANT OMPHALOCELE. Marc B. Hershenson, Robert T. Brouillette, Linda Klemka, John D. Raffensperger, Andrew S. Poznanski, and Carl E. Hunt. Northwestern University, Departments of Pediatrics, Surgery, and Radiology, Chicago, IL.

Although respiratory failure in infants with abdominal wall defects has been attributed to increased intra-abdominal pressure after closure, we have observed prolonged respiratory insufficiency in several such infants despite operations designed to minimize intra-abdominal pressure. We therefore reviewed the charts of 108 infants from 1975-82 who had abdominal wall defects: gastroschisis - 54; small omphalocele - 29; liver-containing or giant omphalocele (GO) - 21; and cloacal extrophy - 4. Nine of 21 infants with GO (43%) had prolonged respiratory insufficiency and 5 eventually died. Only 2 of 87 infants with other abdominal wall defects had prolonged respiratory insufficiency and neither died of respiratory failure. Infants with GO required longer durations of both oxygenation ($p < .01$, ANOVA, $\bar{X}$ = 122 days, range 0-1030) and ventilation ($p < .001$, ANOVA, $\bar{X}$ = 66 days, range 0-387) than infants in the other groups. Clinical observation suggested that infants with GO have small, narrow chests resembling thoracic dystrophy. Therefore, chest radiographs from all groups were examined for several parameters of thoracic size. After correction for birth weight, the chests of babies with GO were significantly narrower than the chests of the other babies ($p < .001$, ANOVA). Prolonged respiratory insufficiency in infants with giant omphaloceles appears to be explained by pulmonary hypoplasia or by the narrow chest deformity which limits lung expansion.

**1748** TRANSCUTANEOUS $PO_2$ AND $PCO_2$ OBTAINED BY A SINGLE DUAL PROBE IN NEWBORN INFANTS. Luis Cabal, Bijan Siassi, Carolyn Plajstek, Don Lewis, Joan Hodgman. Univ. of So. Calif. Sch. of Med., LAC-USC Med. Ctr., Dept. of Peds., L.A.

Transcutaneous measurements of $PO_2$ and $PCO_2$ are routinely used for blood gas monitoring of sick neonates; however, simultaneous measurements require the use of two separate skin probes each needing periodic calibration and site rotation. Thus, prolonged transcutaneous measurements of $PO_2$ and $PCO_2$ interfere with the principle of minimal handling of the tiny premature neonate. To overcome this difficulty, we have evaluated a single dual probe for use in the newborn. The probe consists of 2 distinct electrodes separated by a barrier while utilizing a common electrolyte and covering membrane, with a reference electrode of only 5.6 mm in diameter. The accuracy of the probe was evaluated by 55 simultaneous transcutaneous and arterial $PO_2$ and $PCO_2$ measurements obtained from 9 newborn infants, BW 510 to 4200 gm, GA 27 to 41 wks, in respiratory distress. Close correlations were obtained for both transcutaneous $PO_2$ ($r=0.86$) and $PCO_2$ ($r=0.87$) and their corresponding arterial measurements ($p<0.001$). It is possible to measure transcutaneous $PO_2$ and $PCO_2$ with a single dual probe with comparable accuracy to that obtained from separate probes. Both the handling of the infant and the number of skin sites necessary to obtain transcutaneous blood gas values are reduced by half as a result.

**1749** POLYAMINES, POLYMORPHS AND EXPERIMENTAL RESPIRATORY DISTRESS SYNDROME. Robert A. Campbell, Phuong Nguyen, Kathleen E. McGrath, Barry R. Naylor, Dagmar Bartos and Frantisek Bartos (Spon. by Stephen H. LaFranchi), Department of Pediatrics, Oregon Health Sciences University, Portland, OR.

The polyamines (PAs) spermine (SPM) and SPM plus spermidine (SPD) produce lesions in B alb C mice as found in Adult Respiratory Distress Syndrome (ARDS). Endocapillary margination of polymorphs (PMNs) was seen 30 min. after i.p. SPM (75 mg/kg bw). At 60 min. endothelial cell vacuolization, RBC engorgement and hemorrhage were observed. Loss of interdigitating cell boundaries suggested edema formation. Seven day PA exposure (SPM 15 mg/kg/d plus SPD 30 mg/kg/d, i.p.) produced severe damage. Leukergy, band-form margination, microatalectasis and hyperplastic type II epithelial cell desquamation in suffused alveoli were noted. Resident PMN swelling included both nuclear chromatin reorganization and cytoplasmic liquifaction. Dissolution of organelles preceded plasma and nuclear membrane lysis. Residual moth-eaten stroma suggested widespread proteolysis. SPM (15 mg/kg/d, i.p.) for 21 days induced fibroblast and type II cell proliferation and fibrotic replacement of parenchyma. Infection, surgery, irradiation, cytoxic drug and collagen-vascular disorders cause increased blood and urinary PA levels and are initial clinical events in ARDS. In our model PAs promote a sustained PMN-endothelial cell membrane association and interstitial edema as the earliest morphological events in the ARDS sequence. This is provisionally attributed to several possible concurrent reactions including polyelectrolyte bridging, endocytotic receptor down-regulation and/or structural surface point charge alteration.