NITRIC OXIDE ADMINISTRATION

SCOPE:
To outline the management of the infant receiving Nitric Oxide (NO) therapy, emergency and safety procedures, and the roles of various staff in NO administration.

DEFINITIONS:

Nitric Oxide (NO): A highly diffusible, colorless gas with a sharp, sweet odor. It combines rapidly with oxygen to form toxic NO2. It is supplied in combination with N2 in a compressed gas cylinder. NO is a molecule that occurs naturally in vascular endothelial cells. Its presence is vital in triggering smooth muscle relaxation and vasodilatation. NO increases cyclic guanosine 3-5 monophosphate (cGMP) which in turn decreases intercellular calcium resulting in vascular smooth muscle relaxation and vasodilatation. The NO is then diffused into the intravascular space, where it is bound with hemoglobin and inactivated. It is a potent, short-acting pulmonary vasodilator.

Met Hemoglobin: A non-oxygenating form of hemoglobin that has an affinity for NO2, and rises in the presence of NO.

SPECIAL CONSIDERATIONS
None.

INSTRUCTIONS
Nitric Oxide therapy is initiated by a respiratory therapist, assisted by a nurse, upon physician order. Once in operation, respiratory therapists maintain the system. The iNO vent is our delivery system.

A. Role of Personnel
   1. Registered Nurse
      a. Infant care and monitoring according to the Nitric Oxide Therapy Protocol.
   2. Respiratory Therapist
      a. See inhaled Nitric Oxide (I-NO) Guidelines and Administration Policy 931.997.
      b. Set up of the ventilator and iNO vent.
      c. Calibration and maintenance of iNO vent.

B. Goals of NO Administration:
   1. Relaxation of pulmonary vascular smooth muscle thus decreasing PPHN.
   2. Cause selective vasodilatation of vessel only to well-ventilated lung regions resulting in improved matching of ventilation and perfusion.

C. Criteria for starting NO (one of the following):
   1. MD Order.
   2. Confirmed PPHN by Cardiac Echo.
   3. Oxygen Index (O.I.) greater than 15. Oxygen index = Paw x Fio2 x 100/PaO2.
D. Prior to starting the patient on NO

1. Obtain baseline vitals:
2. ABG
3. OI – document on Respiratory Data Sheet
4. TC and oximetry saturation
5. Mean BP
6. Ventilator settings – document on Respiratory Data Sheet

E. Starting NO

1. Confirm physician order.
2. Start NO at 20 ppm and 100% FiO2
3. Record baseline vitals
4. ABG 30 minutes after starting NO and per MD order thereafter
5. Met Hb to be done 4 hours after NO started and every day thereafter.

F. Management and Weaning recommendations:

1. Monitor vital signs closely for signs of fluid volume depletion.
2. Avoid alveolar over distension – damage to lungs may trigger inflammatory mediators that deactivate surfactant, these same mediators may also cause multi-system failure.
3. Optimize circulatory blood volume to maintain right ventricular filling and cardiac output – monitor BP, assess acid base balance and the need for fluid bolus or inotropic support.
4. Minimize stimulation and handling.
5. Keep patient comfortable and well sedated (paralytics used as last resort due to third spacing and electrolyte imbalance).
6. The RT, RN, MD, and NNP will develop and communicate the management parameters of pH, PC02 and PO2 at the beginning of each shift. Any changes in the plan of care will be discussed by these team members.
7. The recommended method for weaning NO is by decreasing ppm by ½ until 5 ppm is reached (e.g. 20-10-5). A negative response is a drop if PaO2 of 10%, at which time the NO should be returned to the previous setting. From 5ppm the NO is weaned slowly by 1 ppm per MD order*. 
G. Other considerations

1. Inhaled NO therapy may cause a down regulation of the patient’s endogenous NO production. Therefore, a rebound effect may occur during the last stages of NO weaning. Wean slowly from 5 ppm.

2. Terminate therapy if the methemoglobin level exceeds 5% of normal hemoglobin (excess nitric oxide is inactivated and combines with hemoglobin to produce methemoglobin. While this compound is inert, high levels reduce the oxygen carrying capacity of the blood).

3. Terminate therapy if Nitric Dioxide levels exceed 5 ppm (nitric oxide combines with oxygen to produce nitric dioxide. Levels are constantly monitored in the delivery system due to it’s potential for cell toxicity.

H. Safety

Nitric Oxide is delivered from a compressed gas cylinder containing 1,000 to 2,200 ppm NO. OSHA determines toxic levels in the air to be greater than 25 ppm. As we will be delivering 40 ppm or less in the ventilator circuit through the iNO vent the only possibility for an exposure would be related to a tank rupture. A rupture would only produce a toxic exposure if the ambient air in NICU registered greater than 25 ppm. This is extremely unlikely considering the level in the tanks and the air exchange in the unit. Any major tank leak or rupture is an emergency and dealt with according to PAMC policy A-113-17, Hazardous Materials Spills: Emergency Response. See also NICU policy 931.970B, Hazard Communication Program.