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## *Brief Reports*

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### **Intermittent Positive Pressure Ventilation in a Neonatal Intensive Care Unit: Hyderabad Experience**

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Respiratory distress is one of the common indications for admission into a Neonatal Intensive care unit(1). Neonatal assisted ventilation has revolutionized the outcome of these babies who are in respiratory failure(2). The present study was undertaken retrospectively to analyze the indications, survival, mortality and complications related to intermittent positive pressure ventilation(IPPV) in the neonates at our center.

#### **Subjects and Methods**

All the babies admitted to the Neonatal Intensive Care Unit who required IPPV between December 1991 to November 1996

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were included in the study. The unit has twenty four beds and has a staff of six pediatric consultants, five registrars with post-graduate qualifications, one DNB trainee, four residents and nursing staff of 14.

At admission, details of antenatal, intranatal and postnatal history were obtained. The birth weight, gestational age, type of delivery, Apgar score and onset of respiratory distress was recorded. Gestational age was assessed using modified Ballard score. Hyaline membrane disease \* (HMD), meconium aspiration syndrome (MAS), birth asphyxia (BA), transient tachypnea of newborn, sepsis, pneumonia, congenital heart disease and congenital anomalies were diagnosed using standard clinical, laboratory and/or radiological criteria(3).

IPPV was initiated on babies with respiratory distress, associated with pH of < 7.20, PaCO<sub>2</sub> of > 60 mm Hg, PaO<sub>2</sub> < 50 mm Hg, with FiO<sub>2</sub> of 0.8 to 1.0 or recurrent apenic spells or worsening respiratory distress using modified Silvermans score. If a baby was on continuous positive airway pressure (CPAP) and required CPAP of 10 cm of water through nasal prongs with FiO<sub>2</sub> of 0.8, IPPV was initiated. Those who were withdrawn from support for any reason were excluded from the study. Babies who required short term ventilation (< 6 hours) for severe birth asphyxia and those who required ventilation for surgical congenital malformations were not included in the present study.

Time cycled, pressure limited, continuous flow infant ventilators with varying peak inspiratory pressure (PIP), positive

end expiratory pressure (PEEP), flow rates, inspiratory time and  $\text{FiO}_2$  were used. Initial settings varied with the underlying disease and arterial blood gas analysis. The aim was to use minimal possible pressures and  $\text{FiO}_2$  to maintain normal blood gases(4).

Babies were nursed under servo-controlled open care systems. Peripheral or low umbilical catheters were used. Some babies required femoral or subclavian catheters. Radial arterial puncture was done for blood gas analysis as and when indicated. Oxygen saturation was monitored with pulse oximeter. Chest skiagrams were taken whenever indicated.

All babies were monitored for air leaks, congestive cardiac failure, patent ductus arteriosus (PDA) and intraventricular hemorrhage. Sepsis screening including C-reactive protein, total and differential count, band cell count and blood culture were undertaken. Cefotaxime and amikacin were given initially to babies. These were changed depending on the sensitivity pattern, if necessary. Other drugs were used, wherever indicated.

Intravenous fluids and parenteral nutrition where necessary were given. After initially stabilizing the babies on IPPV, enteral feeds were started through nasogastric tubes between 3 to 8 days. Chest physiotherapy with frequent postural changes was given during and after ventilation. Endotracheal suction was done routinely every 4-8 hours with aseptic precautions.

Babies were weaned if they showed improvement clinically, radiologically and on arterial blood gas analysis with ventilator settings of rate 10-15/min, PIP 12-15 cm, PEEP 2-4 cm and  $\text{FiO}_2$  0.4-0.5. Aminophylline was started for some babies 24 hours before the expected extubation time. In addition, dexamethasone and nebulized salbutamol was used. Child was placed

under oxygen hood with  $\text{FiO}_2$  of above 0.5 after extubation. Some babies were put on CPAP before being placed on oxygen hood.

## Results

A total of 2190 babies were admitted in NICU during the 60 months period. Three hundred and eighty four babies were ventilated-CPAP in 103 and IPPV in 281 (13%) Fourteen (4.9%) babies were born at our hospital and 267 (95.1%) were outborn and referred to us. Fourteen babies were electively withdrawn from support on request of the parents citing personal reasons and these were excluded from the study.

In addition 35 babies received ventilation (< 6 h) for short term and surgical congenital malformations and were not included as per protocol. Of these 3 babies survived and 7 were electively extubated due to expected poor outcome. Seventeen babies who satisfied the criteria for IPPV did not receive IPPV due to various reasons including economic.

The indications and survival of babies on IPPV are shown in *Table I*. The commonest indication for IPPV was HMD. The overall survival of ventilated infants during the 5 years ranged from 53.7% to 62.5%.

Survival based on the gestational age was: (i) < 28 weeks - 25% (6/24); (ii) 29-32 weeks - 52.6% (51/97); (iii) 33-36 weeks - 60% (54/90); and (iv) > 37 weeks - 67.8% (38/56). Survival of babies in relation to their birth weight was: (i) < 1000 g - 20% (3/15); (ii) 1001 -1500 g - 59% (59/109); (iii) 1501-2500g-59.7% (49/82); and (iv) > 2500 g - 62.2% (38/61). The smallest survivor who was on IPPV was 720 g at birth and 26 weeks of gestational age. Babies who were attended by our staff at the time of delivery had a better survival (84.6%) and so was the survival of babies born at our hospital (92.8%). The duration for IPPV was < 24 h

**TABLE I**—*Survival in Relation to Indications*

Indications	IPPV No. (%)	Birth weight (g) Mean (range)	Gestation (weeks) Mean (range)	Age at Initiation (h) Mean (range)	Duration (h) Mean (range)	Survivors No. (%)
Hyaline membrane disease	110 (41.1)	1240 (560-3400)	30.4 (24-38)	3.6 (0-81)	96.4 (4-504)	62 (56.3)
Apnea	39 (14.6)	1960 (1100-2900)	32.4 (28-40)	7.1 (1-168)	48.4 (3-142)	22 (56.4)
Asphyxia	27 (10.1)	2330 (940-4150)	36.4 (32-42)	5.6 (0-72)	54.8 (6-96)	13 (48.1)
Meconium aspiration syndrome	31 (11.6)	2880 (1900-4000)	38.6 (36-42)	12.7 (0-48)	76.4 (18-288)	19 (61.2)
Sepsis	34 (12.7)	1740 (940-3200)	33.4 (30-40)	30.4 (24-144)	94.3 (18-312)	15 (44.1)
Pneumonia	9 (3.3)	1480 (1050-2750)	32.6 (28-40)	28.4 (36-144)	66.4 (24-120)	7 (77.1)
Others	17 (6.3)	2640 (1750-3770)	38 (30-40)	24.2 (18-120)	34.5 (3-96)	11 (64.7)

in 32, > 24 h to 72 h in 104, > 72 h to 168 h in 110 and > 168 h in 21 babies.

The common complications seen in these babies on IPPV were septicemia (36.7%), pneumonia (28.8%), pulmonary air leaks (PAL) (6.71), IVH (10.1%) and PDA (14.6%). Oral indomethacin in 24 and/or ligation in 6 babies with PDA was done. Of the survivors who followed up with us, bronchopulmonary dysplasia (BDP) was seen in 6 (4.1%) and retinopathy of prematurity (ROP) in 4 (2.6%) babies. Main causes of death included septicemia (26.2%), intraventricular hemorrhage (IVH) (23.7%), pulmonary hemorrhage (22.8%), birth asphyxia (7.6%), shock (11%) and pulmonary air leak (PAL) (10.1%).

### Discussion

Ventilatory services were initiated in our NICU in 1991 and 17% of the babies admitted required ventilation, of which in 73% IPPV was necessary. Ninety five per cent of the babies were outborn and this had an important bearing on the survival.

HMD was the commonest indication for ventilation and this was comparable with earlier reports (5-7) from other centers in India. Meconium aspiration syndrome, birth asphyxia and apnea were the other indications for IPPV.

The survival rate was 55.8%, comparable to reports from other centers in India. Survival in babies with HMD was 56.3%. Survival is known(8,9) to be better with increasing gestational age and birth weight and our results were consistent with these. Survival was better in babies born at our hospital (92.8%) and those where the deliveries were attended by our staff and transport facilities were available (84.6%).

Complications which were commonly seen were septicemia, pneumonia, PAL, IVH and PDA. PAL were comparably less in our center than those reported in the western literature(10). Higher levels of PEEP and mean airway pressure (11,12) are usually attributed to their higher incidence. In MAS, the air leaks and pneumonia could

be due to the disease or due to the assisted ventilation. This however is difficult to differentiate. PDA was significant in 15% and needed interventions. Incidence of BPD and ROP were not comparable to the western literature but this may not be a true incidence due to inadequacy of follow up.

Our experience of 267 babies ventilated over 5 years period by IPPV shows that assisted ventilation is an effective method to reduce neonatal mortality. Babies < 28 weeks of gestational age and those with < 1000 g birth weight have poor outcome and efforts may not be cost effective. Better results can be achieved by better transport facilities and if deliveries are attended by trained personnel. IPPV is not without complications and stringent watch for air leaks, septicemia, IVH *etc.* is needed as these would be major causes of morbidity and mortality.

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