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Persistent Pulmonary Arterial Hypertension of the New Born

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Persistent pulmonary hypertension of the newborn (PPHN) characterised by right to left shunting with intense cyanosis is difficult to manage, and in the best of centres carries a 40-60 percent mortality. We report our one year's experience of managing six neonates with PPHN.

There were 5 males and 1 female with mean birth weight of 2.59 ± 0.487 kg and gestation period 39 ± 2.0 wks and 1 minute Apgar score 2.8 ± 2.1. Four to six babies were born by cesarean section and 3-6 babies had aspiration pneumonia. All babies presented within 12 hours of age (mean 5.08 ± 5 hrs) with intense cyanosis and respiratory distress. Diagnosis were confirmed in all by (*a*) hyperoxia test, (*b*) simultaneous determination of preductal and postductal paO_2 (*c*) contrast echocardiography and (*d*) hyperoxia-hyperventilation test. Babies were managed with hyperventilation using mean ventilatory rates of 100 ± 45 per minute, an inspired oxygen concentration of 100%, peak inspiratory pressures 27 ± 9 cm of H_2O, and expiratory pressures 5 ± 1.6 cms of H_2O, and mean air way pressures of 10.4±2.7 cms H_2O. Alkali therapy was used in 3 of the six babies whereas low dose dopamine was infused in all six babies. Inspite of aggressive ventilatory therapy, only 3 out of 6 babies could be salvaged.

Key words : *Persistent pulmonary hypertension; Hyperventilation.*

Persistent pulmonary hypertension in the newborn (PPHN) is a syndrome characterised by severe, labile cyanosis arising from right to left shunting at the level of the foramen ovale or ductus arteriosus secondary to high pulmonary vascular resistance.[1,2] The clinical hallmark is the presence of severe labile hypoxemia disproportionate to the extent of pulmonary parenchymal disease in association with a structurally normal heart. Because of the severe pulmonary hypertension and extremely labile hypoxic 'flip-flop', management of this condition even in the best of centres is very difficult and results in a mortality rate of around 40-60% in severe cases.[3]

There is only one report of PPHN from India. We report our one year's experience in managing PPHN through intensive care, highlighting the problems encountered in their management.

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MATERIAL AND METHODS

During September 1989 to August, 1990,

437 babies were admitted to the neonatal intensive care unit of the Department of Pediatrics, Nehru Hospital, Postgraduate Institute of Medical Education and Research, Chandigarh & 90 babies were ventilated for varying indications during the same period. Six babies were diagnosed to be having PPHN. In these babies with severe cyanosis, and labile hypoxemia, the diagnosis of PPHN was confirmed after performing hyperoxia test, pre and postductal arterial oxygen tension, contrast echocardiography and hyperoxia-hyperventilation test. Once the diagnosis was confirmed, these babies were hyperventilated in 100% oxygen with ventilatory rates 60-150 per minute to achieve an arterial oxygenation of 50-75% mm of Hg and $PaCO_2$ of less than 40 mm Hg. Meticulous nursing, minimal handling and inotropic agent's use were the other modalities of care in these neonates.

RESULTS

During one year study period, 20.5% of the NICU admissions were provided ventilatory assistance for varying indications. Six babies (1.4%) of all NICU admissions were diagnosed to have PPHN based on the standard diagnostic criteria. Tables 1 and 2 summarises the clinical features, management and outcome of these patients. There were 5 males and 1 female with mean birth weight 2590 ± 487 gm and gestation of 39 ± 2.0 wks. All babies had birth asphyxia. PPHN was diagnosed at 5.08 ± 5.1 hours age. These babies were ventilated with mean peak inspiratory pressures (PIP) of 27 ± 9 cm H_2O with positive and expiratory pressure (PEEP) of 5.0 ± 1.6 cms and mean airway pressure (MAP) of 10.4 ± 2.7 at ventilatory rates of 100 ± 45 per minute with 100% oxygen. Inotropic agent (Dopamine) was given to all six, whereas three babies also received high dose alkali therapy. Only 2 out of 6 babies could be successfully weaned off the ventilation, and one baby though improved of PPHN but died subsequently due to hospital acquired fungal infection.

DISCUSSION

Primary pulmonary hypertension of the newborn (PPHN) generally occurs in full term neonates having intense cyanosis due to pulmonary hypertension, causing right to left shunt through ductus arteriosus and/or foramen ovale causing severe hypoxemia. Anatomically pulmonary vasculature may be maladapted, excessively muscularised or underdeveloped.[1,2,4]

PPHN though commonly associated with perinatal asphyxia and meconium aspiration syndrome,[5] it may be associated with group B sterptococcal pneumonia, idiopathic increased airway resistance, diaphragmatic hernia, myocarditis, pulmonary hypoplasia and non-bacterial endocardial thrombosis.[5-12]

PPHN may present early (at birth) or moderately delayed (4-12 hours of age) or late (after 12 hours age). Babies with early presentation are often severely asphyxiated, whereas moderately delayed presentation are associated with MAS or other parenchymal lung disease like group B, beta strept. infection. The late presentation of PPHN generally occurs in association with pulmonary pathology leading to progressive increase in airway resistance.[13] In our patients, 5-6 were severely asphyxiated, 3 presented within 3 hours of age and the others presented within 12 hours age. Diagnosis of PPHN is based on hyperoxia test, comparison of pre and postductal paO_2, contrast echocardiography and hyperoxia hyperventilation test done serialy. Hyperoxia hyperventilation test also

TABLE 1. PPHN Clinical Data

Name of baby	CR No.	Sex	Weight (gms)	Gestation (wks)	Mode of delivery indication	Apgar score at 1', 5'	Meconium aspiration	Onset of PPHN	Duration of PPHN
S	021881	M	2500	40	Low mid cavity	0, 5	+	40 min	96 hrs
S	640251	F	2400	40^{+6}	LSCS	3, 7	+	6 hrs	56 hrs
H	633977	M	3200	40^{+2}	LSCS	3, 5	–	12 hrs	96 hrs
P	641901	M	3100	39^{+5}	LSCS	6, 8	–	0.1 hr	40 hrs
I	640034	M	1882	35	LSCS	1, 4	–	10 hrs	38 hrs
M	030285	M	2500	37^{+2}	NVD	?	–	2½ hrs	

TABLE 2. PPHN--Diagnostic Tests and Management

Name of baby	Hyperoxia test	Preductal/ postductal PaO_2 difference 15 mm Hg	Contrast Echocardio-graphy	Hyperoxia hyper ventilation test	Ventilator settings FiO_2/PIP/ PEEP/Rate/ MAP	Alkali therapy	Dopamine	Outcome
S	+	+	NA	+	100/17/2/150/7	–	+	Recovered Died at 11 days age
S	+	+	NA	+	100/30/3/76/12	+	+	Expired Age 62 yrs
H	+	NA	R-L shunt across atrial level	+	100/18/5/65/9	–	+	Recovered
P	+	+	R-L shunt at atrial and ductal level	+	100/35/4/160/10	+	+	Expired Age 42 hrs
I	+	NA	NA	+	100/35/6/150/14	+	+	Expired Age 41½ hrs
M	+	NA	R-L shunt at atrial and ductal level	+	Hand ventilation	–	+	Recovered

helps in excluding congenital cyanotic heart disease, and determining the inflation pressures required for ventilation to achieve the critical $paCO_2$.

Management of such infants revolves round judicious combination of mechanical ventilation, pharmacological intervention and nursing care. Fox and Duara[13] had recommended the hyperventilation approach producing respiratory alkalosis thereby achieving lower pulmonary pressures. The primary aim is to lower $paCO_2$ to a 'critical level' so as to achieve reduction in pulmonary artery pressures and subsequent reversal of right to left shunt. Duara et al[14] had recommended ventilatory settings using higher peak inspiratory pressures (PIP), low end expiratory pressures (PEEP) with inspiratory expiratory ratios of 1:1 and 100% oxygen. While ventilating these babies, a 'transition

phase' is reached within 1-3 days after which ventilation becomes much easier. While weaning, PIP should be decreased first using caution of not altering the FiO_2 and PIP too suddenly because of increased vascular reactivity of these babies.

Fox[3] while using this aggressive approach of management in their 54 patients showed a survival of 56% with mean duration of ventilation of 5-9 days. We, in our patients, could successfully wean off 3 out of 6 patients using similar approach. One of our three neonates later on died of hospital acquired fungal infection on day 11.

Alternative to hyperventilation has also been suggested by many workers.[16-20] Wung et al[16] while managing 15 neonates with extensive use of pharmacological agents but without hyperventilation achieved a success rate of 66%. Dworetz et al[17] similarly showed a success rate of 90% using conservative approach which was comparable to the results shown by others using extra-corporeal membrane oxygenation (ECMO).

Tolazoline and dopamine have been extensively used as pharmacological agents in the management of PPHN.[6,19-22] Because of its high adverse reactions, Tolazoline is now recommended only as an adjunct to low dose dopamine therapy. However, in India because of its non-availability, we did not use Tolazoline in any of our patients. Use of other pharmacological agents like prostaglandins, nitroprusside, bradykinin, isoproternol, morphine, leukotrienes and high dose bicarbonate therapy are still in experimental stages in the management of PPHN.

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VECTOR CONTROL IN URBAN COLONIES

Owing to population growth, poor levels of hygiene, and increasing urban poverty, the urban environment in many developing countries is rapidly deteriorating. Densely packed housing in shanty towns or slums, and inadequate drinking-water supplies, garbage collection services, and surface-water drainage systems combine to create favourable habitats for the proliferation of vectors and reservoirs of communicable diseases. As a consequence, vector borne diseases such as malaria, lymphatic filariasis and dengue are becoming major public health problems associated with rapid urbanization in many tropical countries.

The problems in controlling these diseases and eliminating vectors and pests can be resolved by decision-makers and urban planners by moving away from the concept of "blanket" applications of pesticides towards integrated approaches. Sound environmental management practices and community education, and firm participation form the mainstay of some of the most outstanding successes in this area. On the basis of these examples, it is argued that the municipal authorities need to apply a flexible methodology, which must be based on the possibilities of mobilizing community resources, with minimal reliance on routine pesticidal spraying. In this way, vector control becomes a byproduct of human development in the city environment. This is now a true challenge.

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