
Review Article

NICU Environment — A Need for Change

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During the last decade there has been tremendous progress in the care of critically ill children. Technological advance has resulted in improved diagnosis and treatment. Consequently there has been an impressive fall in neonatal mortality and the reduction of impairment and disability. However, in the present era of mechanization, considerations for psychological well being and the human touch have receded to the background. Recent research has suggested that the current Neonatal Intensive Care Unit (NICU) environment may exert adverse iatrogenic effects on newborns, particularly the preterms and the sick newborn. Such an adverse effect may prolong recovery or even affect long term morbidity. There is thus a need for introspection regarding the current environment of the special care baby unit and whether we can improve the situation.

Two main types of environment can be distinguished in an intensive care unit: (i) *Physical environment* consisting of the design of the nursery, factors such as noise and light levels, placing of the infant (cot, under radiant warmer and incubator), the bedding, the distance between the cots and incubator and the objects that are near the

infant, *i.e.*, monitors, ventilators and suction apparatus; and (ii) *Social environment* which relates to the experience that a neonate undergoes in an intensive care setting. This includes handling by staff and parents. A few important components of the NICU environment are discussed in detail below.

A. Noise

Noise is perceived differently by different professionals. The physicist perceives it as sound whose character can be defined and whose properties can be measured with the same equipment that measures other sounds. However, the psychologist perceives it as an undesired sound as contrasted to speech and music which are usually desired sounds. Man made technological advances have led to the installation of a broad spectrum of machines and as a result the work environment is now threatened with undesired sounds resulting in noise pollution. Its effects are insidious and often go undetected. British safety standards require that the mean noise level inside the incubator should not exceed 60 dB(A). Noise is one of the most important factor having adverse effect on a neonate in the intensive care. Preterm infants staying longer are exposed to moderate noise levels for weeks and months. The usual source of noise are the staff talking and laughing, telephone ring, placing of bowls and other equipment on the incubator, oxygen cylinder changing and squeaking door hinges. The mean noise levels outside the incubator are in the range 55-75 dB(A) which resembles the noise pollution recorded in a busy office environment. Incubator alarm records a noise level of 85 dB. It has been observed that tape recordings from inside

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the incubator pick up human speech but it is muffled and indistinct(1).

Adverse effects: In the early 70's animal studies suggested a possible relationship between chronic noise exposure and hearing loss. This led to concern for preterm infants. However, research(2) indicated that hearing loss in the absence of other aggravating factors is negligible. Subsequently(3,4), it was observed that sudden and loud noise leads to physiological and behavioral disturbances including sleep disturbances, motor arousal's such as startles and crying, hypoxemia, tachycardia and increased intracranial pressure. The latter could contribute to intraventricular hemorrhage. The positive benefit of human voice on the infant is lost because of the masking effect of the incubator. The infant will not acquire recognition and integration of a particular sound (*e.g.*, a voice) with a particular visual stimulus (*i.e.*, the face). It has been suggested that preterm infants may have problems in concept learning and recognition^).

How to improve: An overall disciplined approach on the part of the nursery staff is essential. Hence the staff behavior has to be changed. Cot side rounds should be abandoned if no patient contact is necessary. Talking should be at a considerate low level and loud laughter should be discouraged. No bowls or other equipment should be placed on the incubator. Opening and closing of the portholes of the incubator should be gentle. Portable equipments should be maneuvered in the unit carefully. Sounds from the monitoring equipments should be minimal or replaced with visual alarms. Ideally new nursery design should include sound proofing for ceilings, walls and floor. Manufacturers of biomedical equipments should be encouraged to reduce noise levels in their products. During the night, a noise policy must be applied.

There is a scope for introduction of meaningful sounds such as gentle music or recordings of parent voice during the period when the infant is awake.

B. Light

Over the past two decades, sources of light in the NICU have increased to a great extent(5). The light levels are approximately 60-90 foot candles (200 - 500 lumen/sq m). The additional light sources such as phototherapy lamps or sunlight (*i.e.*, the infant is placed near the nursery window) could add up to 400 foot candles. Most of the resuscitative trolleys have their own spot light as well.

Adverse effects: Little is known about the effects of light exposure on the small neonate. Structural and functional damage to retina in animal studies on exposure to strong light have been documented. A randomized study(5) did suggest that sick and vulnerable preterms on exposure to normal light levels of NICU may develop retinopathy of prematurity. Exposure to sunlight (*i.e.*, being nursed near the window) is an additional contributing factor. However, more studies are required to conclude that excess light does affect the neonate.

Changes required: It is common knowledge that in most of the neonatal nursery, the whole nursery is brightly lit even if only one neonate is being taken care of. The concept of flexible point lighting source should be introduced. The smallest and the vulnerable infants should not be nursed near a window and getting exposed to sunlight. Incubators probably could have light density filter sheets. Similarly use of dimmer switch and policy of day/night rhythms could help in reducing the total light exposure.

C. Handling and Social Contacts

In the management of a neonate, han-

dling plays a great role both beneficial and adverse. In the early seventies, preterm infants were handled for about 32 episodes/day(6). This has increased to 140-150 episodes/day in the current NICU(7). On an average, an infant gets handled every 5-10 minutes, and handling accounts for 4 hours in a 24 hour period. More sick the infant, greater the handling. The main disturbers are the nursing and support staff, then the Pediatricians and only lastly the parents. In an academic institution, postgraduate students and fellows contribute the maximum. Injudicious investigation, frequent monitoring, medical procedures and nursing practices contribute to these handling episodes.

Social contacts such as soothing talking, gentle touching or rocking occur infrequently in both intensive care nursery and the post-natal wards. Such encounters account for less than 25% of the total contact period. Managing these small infants has become more mechanical with less human touch. The policy of not allowing parents in many centers has inevitably reduced the social contact to bare minimum.

Adverse effects: Frequent handling carried out by the nursing and medical staff has been consistently found to disrupt the infant's sleep pattern. Associated high impulse sounds are also likely to increase the time the infant is spending in REM sleep. It is an established fact that the incidence of apnea is higher during REM sleep. Research indicates that 83% of all incidents of hypoxemia, 93% of bradycardias and 38% apneas occur during or immediately after routine handling of preterm infants(7). In another study(8), 75% of undesirable events were related to handling procedures. Increased levels of catecholamines (equivalent of levels found in stressed adults) have been documented. In relation to the most vital aspect, *i.e.*, cerebral blood

flow, it has been observed that prolonged crying leads to decreased systolic and diastolic pressures and a drop in PaO₂ leading to decrease in cerebral blood flow and brain tissue oxygenation(9). On the other hand, parental handling has been found to be mostly benign except that it sometimes may interfere with the infant's sleep(6).

Prevention: The basic policy of minimal or on as required basis handling of infants should be adopted. Sequential handling by different staff at a particular time schedule could also be adopted in the routine of NICU. Performance of procedures such as suction and chest physiotherapy should be judicious and criteria can be laid down in the form of a protocol. There can be a restricted access for staff (not the parent) and this can be regulated by the primary care giver for that infant. All procedures and monitoring could be done during awake state of the infant. After a procedure, soothing words and gentle stroking should be practiced. Importance of analgesia for painful procedure is a must and must be part of the intensive care protocol.

D. Daily Rhythms

Diurnal rhythms are characteristic features of human behavior and day/night rhythms in sleeping and waking are acquired in the early months of life. Diurnal rhythms in light, noise levels and caretaking are practiced in most of the postnatal wards. However, in intensive care units, there is no pronounced diurnal rhythm for noise, light level or staff activities.

The lack of diurnal rhythm has been suggested to be responsible for the delayed onset of periodicity, sleep problems and impaired social development in some preterm infants. Mann *et al.*(10) demonstrated that the introduction of reduced noise, light and handling at night in an

intensive care unit had beneficial effects; infants spent longer sleeping, less time feeding and they gained weight more rapidly after being discharged home.

E. Pain in the Neonate

Pain is an unpleasant sensation with strong emotional connotations. It is very clear that the anatomical, neurochemical and functional requirements for nociceptive reception and the ability to respond to noxious inputs in an organized way are present in the infant at 22-26 weeks gestation(11). Although the preterm infant cannot verbally express his pain and discomfort, physiological and behavioral changes in response to insults provide a window into the preterm infant's nociceptive reception. Cardiorespiratory, hormonal and metabolic changes, simple motor responses, facial expressions, crying and complex behavioral responses indicate that the newborn infant can respond to noxious stimuli.

F. Opportunities for Early Learning

The term 'infancy' derives from the latin 'infants' which means speechless. Young infants have no verbal language apart from crying. They acquire concepts about the world through sensorimotor experiences. These can be tactile, kinesthetic, vestibular, motor, auditory and visual experiences. During the infancy, development is strongly related to interaction with the environment(12).

The description of current intensive and special care baby unit environment indicates that there is little opportunity or support for early constructive learning(4). Many of the sensory motor experiences are unpleasant. During incubator care there are few opportunities for concept learning. When the infant is discharged to postnatal ward, the staff pattern changes and again the lack of sensorimotor experience conti-

nues. The current evidence suggests that being housed in the neonatal unit may contribute to poor attention span, irritability and restlessness leading to interference in learning(13).

There have been many studies on appropriate stimulation programs for a small infant being cared for in an intensive care unit. These hospital based programs were targeted at taste and suckling stimulation, tactile, auditory, vestibular and social stimulation. Most have shown some beneficial effects on the growth and development in short term. However, these short term developmental gains were not maintained at later age(1). The current consensus of opinion is that these stimulation program have to be on individualized basis and finely tuned to the developmental status of the preterm and his/her special needs.

G. Role of Parents

The whole aim of neonatal intensive care is to discharge a healthy infant into the care of his parents. To facilitate this process and to promote gentle loving care for the small patient, parents should be provided with opportunities to contribute to and slowly take over the care of their infant while in the hospital. It has been observed that parents withdraw from an environment which is high tech, noisy and busy, anxiety oriented and established perception that only the experts can provide the right care. Restricted visiting hours contributes further to the feeling of inadequacy.

Changes required: Depending upon the policies and protocol being followed in a center, the following changes have been suggested:

- (a) Unrestricted access to neonatal units by parents, grandparents, siblings and close friends. Late visits should not interfere with the policy of reduced

noise, light and handling level at night. In a developing country like ours, this policy may have to be modified restriction for example, only the parents are allowed to visit.

- (b) Environment could be made more inviting to the parents. They should feel that the staff cares for them. The setting may be 'made more baby centered, rather than oriented to the staff. It is quiet common to see a number of protocols hanging from the wall instructing the staff in a neonatal care unit. This could be changed to 'parent oriented' pictures and wall paper. Spacing between cots and incubators should be sufficient and comfortable sitting chairs provided for the mothers. Parents could be provided with education material in the form of booklet, pamphlets, picture cards and album of nursery graduates giving an insight into the working environment of the unit.
- (c) The parents must be given the feeling that their infant needs them at all stages while they are in the hospital. In the intensive care area this can be the provision of soothing techniques for the agitated infant, for example, during and after painful procedures. They keep records of their infants' behavior which are valuable. Parents can carry out tube feeding and hygiene care. Breastfeeding should be encouraged and facilities for rooming in of parents should be available.
- (d) Self help groups or educational classes for parents should be established and are beneficial.
- (e) It is obvious that medical and nursing staff can provide emotional support to parents if they themselves are emotionally available and coping. This is one

aspect that has been given the least importance. This could be achieved by various means including team work, staff support groups and regular formal and informal meetings between the different professions involved in the unit. A good work ethos and conducive atmosphere are essential.

Concluding Comment

The hazards of modern day intensive care are numerous and not very obvious to the casual observer. It is the moral duty of the staff of such intensive care unit to prevent and correct such practices that may affect the patient. The aim of neonatal intensive care is no longer merely survival or avoidance of severe disability but rather the preservation of normal brain function.

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