

DEVELOPMENTALLY SUPPORTIVE CARE IN NEONATAL INTENSIVE CARE UNIT (NICU):-A REVIEW

Prasenjit Halder*, Debabrata Bera, Arindam Banerjee

*College of Medicine and Sagore Dutta Hospital(Department of Pediatrics medicine), Kolkata, India.

Apollo Gleneagles Hospital (Department of Cardiology), Kolkata, Indian

Email: prasenjit0024@gmail.com

Abstract

Although new advancement in health care technology in perinatal medicine the survival of preterm infants and extremely low birth weight neonates has increased. However, the increased survival rate in this group of neonates has not been matched by are reduction in disability rate. Research suggests that the cognitive disabilities, poor academic achievements, and disordered behavioral regulation seen in preterm due to early disruption of their intrauterine life and sudden exposure to entirely unfamiliar NICU environment .So, these newborn needs more developmentally oriented supportive care while they are still in intensive care. Developmentally supportive care is aimed at decreasing the the stress levels in these babies by individualized care which also involves family. Growth and developmental outcomes has been shown enhanced by this approach. This article presents a brief review of current literature as well as the scope of such practices in NICU setting.

Keywords:

Development, neonate, supportive care, NIDCAP.

Introduction

Preterm birth has an incidence varying from 5-12%.Advance in neonatal and perinatal technologies has resulted in improved survival especially amongst the extremely low birth weight neonates. However, the increased survival in this group of neonates has not been matched by are reduction in disability rate which has been reported to range from 15-25 % (1, 2). Research suggests that the cognitive disabilities, poor academic achievements, and disordered behavioral regulation seen in preterm, are the result of early disruption of their intrauterine life and sudden exposure to entirely unfamiliar NICU environment. The fetus requires secure environments for their neurodevelopment- the maternal uterine environment, their parents and their family and community's social groups. Preterm infants are akin to a fetus developing in the extra uterine environment. Thus, a preterm delivery removes the infant from these secure environments which contribute to malwiring of the neural network and consequent adverse neurodevelopmental consequences. Fetuses experience continuous sensory and kinesthetic stimuli from the amniotic fluid which aids in motor system development. The exposure to maternal diurnal rhythms helps in differentiations sates of consciousness and provides inputs to prepare the primary senses of hearing, smell, taste and sight. The NICU environment fails to provide these vital neurodevelopmental stimuli for the extra-uterine preterm fetus (3) .Besides the separation from parents and family in NICU environment results in later developmental difficulties. Therefore, there is a need to change our neonatal care practices in NICU to support the neurodevelopmental processes in extra uterine environment.

Theoretical basis of developmental care

Newborn should be viewed as intrinsically social beings who attempt to achieve self-regulation through their interaction with their care giving environment and their consequent feedback.

Als et al (4) distinguished categories of behavior in preterm infants: 1.**Self-regulatory**: Behaviors of approach and groping and seeking stimulations. These behaviors are favorable for infants and need to be encouraged. 2. **Stress related**: Behavior of withdrawal and avoidance. This result from overwhelming stimulation which the infant cannot integrate and are nonfavorable. Based on these observations Als (5) put forth the synactive theory of development.

Synactive theory of development :- The synactive theory of development provides a framework for understanding premature infants' neurobehavior. The fetus from conception onward is thought to be organized in five distinct

interrelated subsystems. These sub system are autonomic, motor, state, attention /interaction and self-regulatory and guide the neonate's interaction with the environment. Autonomic: Regulation of cardiopulmonary activity, gastrointestinal peristalsis, peripheral skin blood flow. Motor: Muscle tone, posture, quality of movement. State: Governing consciousness from sleep to wake fullness, ability to sustain the state, smooth state transitions. Attention /interaction: Governing the ability to attend to and interact with care giver. Self-regulatory: Governing ability to maintain balanced ,relaxed and integrated functioning of all subsystem. The self-regulatory or organized behavior are signs of stability and need to be encouraged and stress related or disorganized behavior are signs of instability and need to be muted.

Sign of stability and sign of stress

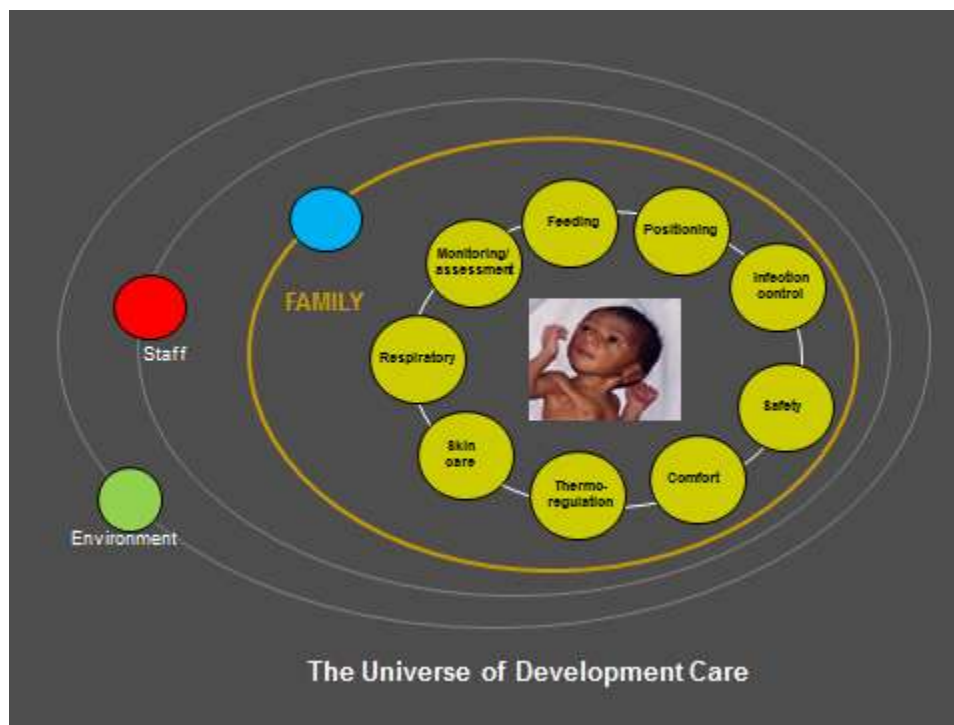
Table 1

<i>Organized(sign of stability)</i>	<i>Disorganized(sign of stress)</i>
1) Autonomic system: Even respiration, good stable colour, stable digestion.	Respiratory pauses, tachypnea, grunting, ,colour changes, startling, twitching, coughing, sneezing
2)State system: Clear robust sleep state, rhythmical/robust crying, good self-quieting and consolability,	Diffuse sleep/awake states, Eye floating, Strained or fussy crying, Panicked or worried alertness, Irritability.
3)Motor system: Smooth, modulated posture, Well-modulated tone, Smooth movements	Hypertonicity(hyperextensions),fisting,Flaccidity,Frantic/diffuse activity, Unstable tone

Universe of developmental care (UDC) model

The major limitation of synactive theory is that the developing brain cannot be directly observed. Gibbins et al have suggested an imprevision of the synactive theory.i.e the universe of developmental care.(6)Core to this theoretical model is the concept of a 'shared surface interface'. According to this model, the organism's nervous system and the environment share a boundary at the point of interaction. In the human infants, this boundary interface is the skin. The skin's epidermis and brain share a common embryological origin-the ectoderm. The skin is the surface of the brain in neurodevelopmental terms and can be easily observed. The skin through its participating in multiple care giving interactions from the observable boundary which would influence the development of the preterm. The UDC is a theoretical framework that provides a practical focus for patient care, education and research. It look like our solar system, where planets are distinct entities that share a common orbit and each planet is integral to the universe and bound by "gravitational force" that promotes balance. Exclusion of one planet risks this balance. In the UDC is the infant, who cannot be separated from the physiological systems includes both caregivers and families. In UDC model newborn is in the center. Immediately beyond the care planets is the family unlike older views that place parents outside of the immediate care circle. The UDC encourages early and ongoing involvement of parents inside the NICU. The NICU staff is represented in the UDC as a separate orbit that situated outside the family orbit to supports the family. The outermost orbit in the model is the environment, which includes both micro (light, noise, privacy) and macro (culture, values, team behaviors) elements that provide structure and sustainability for developmental care.

Figure:



The UDC model of developmentally supportive care shows family centered core.

Implementation of developmentally supportive care practices by modifying the macro and micro environment of NICU

Developmental care is an approach to provide intervention adjusted to the individualized developmental needs of each infant to facilitate improve neurodevelopmental outcome(7,8,9)

A. Modification of Macro-environmental factors in NICU :-

Light in NICU: Less than 2% of external light is transmitted in utero(10). Exposure to high intensity light to a preterm infant in NICU is disconcerting and poses a risk for structural and growth alterations of the eye (such as ROP, amblyopia, myopia etc.) as well as alterations in visual function that may reflect changes in visual cortex(11).Lighting in NICU needs to balance between dimmed ambient lighting , natural lighting and brighter task lighting. Continuous bright light in NICU can disrupt sleep/wake cycles and if the light intensity never changes, infant will never experience diurnal rhythm necessary for development. Diurnal cycle also causes increased weight gain(12-15). Premature infants are photophobic; however, they will open their eyes in dim light. Reducing light levels may facilitate rest and subsequent energy conservation and promote organization and growth.The modifications that need to be implemented include adjustable ambient light at each bedside that should not increase light levels of adjacent babies. The intensity of light should be adjustable between 0.5ft candles to 60ft candles(16). Simulated day night environment to promote diurnal rhythms.

Sound in the NICU: Unlike light, noise is a normal aspect of fetal development. The amniotic fluid attenuates the noise in utero and modulates its intensity (17). Fetuses normally mature in utero accompanied by a variety of noises generated by the maternal viscera and voice. These uterine noises are generally low frequency, at a mean of 50 dB. Something as simple as abruptly closing a solid plastic porthole can generate in excess of 100 dB (18). Although normal NICU room noise, which averages less than 70 dB (19), has not been proved to cause classic hearing loss, a link has been established between exposure to constant room noise and loss in frequency and pattern discrimination essential to understanding the spoken word(20). Loss of an ability to discriminate speech can cause profound developmental delay in survivors with no other disabilities by interfering with language acquisition(21). In addition to the connection between noise levels and deficits in hearing discrimination, clear connections also exist between noise and physiological instability(22). Preterm infants can experience repeated apneic episodes and clinically important reductions in oxygen saturation and bradycardia when exposed to normal adult activities in a NICU(23).

Limiting neonates' exposure to adult activities can decrease the number of alarms that represent physiological decompensation(24). Continuous background sound and transient sound in the neonatal intensive care unit shall not exceed an hourly continuous noise level (Leq) of 45 decibels (dB) and an hourly L10 (the noise level exceeded for 10% of the time) of 50 dB. Transient sounds or Lmax (the single highest sound level) shall not exceed 65 dB(25).

B. Modification of care-giving factors / micro-environmental factors :-

Gravity, medical equipment, hard and flat surfaces, and improper positioning are all factors that contribute to the mal-adaptation of the NICU infant. However, with appropriate positioning, care-giving, and handling, these factors may be minimized.

Handling: The majority of the caregiving experienced by the infants in the NICUs involves medical or other interventions associated with high levels of sensory input. Infants should be handled with gentle, slow modulated manoeuvres without sudden movements. Pharmacological as well as non pharmacological comforts should be provided with painful procedures. Frequent handling and touching disturbs sleep which leads to decreased weight gain and decreased state regulation. Routine procedures often cause hypoxia. Most episodes of hypoxemia happen during handling by caregivers. **Clustering,** the idea of performing more care giving tasks at one time limiting the frequency of interruptions as well as providing appropriate quality and intensity of stimulation during wakefulness(26).

Positioning: Physiological flexion induced to the growing fetus in utero by the resistance and confinement by the well defined boundaries of the uterus is believed to be vital for the development of normal body movement and control. Additionally physiological prone flexion may promote physiologic subsystem stability as evidenced by improved oxygenation and stable heart rate and respirations (27). After delivery, the infant should be placed on a flat surface with limited physical boundaries to enhance or support flexion. The infants head is often turned to one side or the other, regardless of whether the infant is prone, supine or side lying and as a result a flattening of the sides with an elongated narrow head shape ensues. This has potential to affect parent bonding, self image and possibly even shape of the hard palate (28). Developmentally supportive care giving practices aims at minimizing energy expenditure while promoting a balance between flexion and extension of any infant. Appropriate positioning such as – midline orientation, hand-to-mouth activity, flexion, self-soothing, and self regulatory abilities –contributes to neurobehavioral development. Grenier et al, found that infants performed fewer stress behaviors in prone nested, prone un-nested or side lying nested positions(29). Correct body positioning can prevent postural deformities. In proper positioning and alignment, regardless of the prone, supine or side lying position, the knees and the nipples should be in the same plane. Hips should not be unsupported, shoulder girdle should be supported in fixed position.

Containment: It refers to the 360 degrees of surface pressure the fetus is provided in utero. Body containment is important because it increases the infants feeling of security and self control and decreases stress. Infants who are contained tend to be calmer, require less medication, and gain weight more rapidly.

Family-centered care: In the NICU it offers a philosophy that acknowledges that family has the greatest influence over an infant's health and well being. Key principles of this include respect for the infant and parents, promotion of shared information, and parent planning and participation. True family centered care creates a collaborative partnership between the health care team and the family(30). Assisting families to have a positive outcome from their NICU experience should be the priority when providing care. Open communication with the family is the foundation for family centered caregiving decisions. Free access of mother to the infant in NICU promotes mother-infant bonding and results in better outcomes.

Touch and massage in NICU: As massage seems to both decrease stress and provide tactile stimulation, it has been used as an intervention to promote growth and development of preterm and VLBW infants(31). Infant massages inherently have the four principles of developmental care viz, relationship based, cure based, individualized, and family centered.

Systematic programs of developmentally supportive care practices

There are many approaches to follow these practices but the one which has received widespread recognition is the NIDCAP which was proposed by Als, H based on her Synactive theory of development(27).

NIDCAP – Newborn Individualized Care and Assessment Program:-

An approach to intensive care has been developed that is geared to support the individual infant's own efforts toward self-regulation and competent functioning. Since even very immature infants display reliably observable behaviors

in the form of autonomic and visceral responses, movement patterns, postures, tone fluctuation, and levels of awakesness, repeated systematic observation of the infants' behavior before, during, and after provision of care is used to identify the infants' current behavioral goals, strengths, and vulnerabilities. Trained staff then delivers care in a way that makes use of and enhances the infants' specific strengths and diminishes their vulnerabilities. The approach is referred to as individualized, developmentally focused intensive care and is increasingly advocated clinically(32). Integration of the NIDCAP approach and principles into newborn intensive care reduces the iatrogenic complications of newborn intensive care for infants, parents and staff alike, and in turn enhances the infant's competence, the parents' confidence, and the staff's role satisfaction. For each observation, the developmental specialist systematically records an infant's behavior for 20 minutes before a planned medical or nursing caregiving interaction and continues to observe throughout the duration of the interaction and for 20 minutes beyond the caregiving interaction. Ninety-one behaviors, as shown in annexure A are monitored every 2 minutes(33)²⁴. Behaviors conceptualized as indicating stress and regulatory (refer table 1) based on these observations are interpreted as indices of the infants' current vulnerabilities and strengths, respectively. These are later used to provide basis for inference of infant's current goals, and recommendations for further management in terms of care-giving, which might enhance infant's goal achievements, increase its strengths and reduce stress.

Effectiveness of developmentally supportive care practices

All the existing trials of various developmentally supportive care programs have shown positive results for the infants and families and none have found any negative effects. Most of the studies that have been conducted have taken short term outcome measures at discharge as their outcome measures. The major areas where positive results are seen include - improved lung function, feeding behaviour and growth, reduced hospital stay, improved neuro-behavioural, neuro-physiological, and neuro-structural functioning(34). Several other studies have demonstrated significantly better Bayley Mental and Psychomotor Developmental Index scores at 3, 5 and 9 months(32,38) corrected age, as well as improved attention, interaction, cognitive planning, affect regulation, fine and gross motor modulation, and communication as measured with the Kangaroo-Box Play Paradigm(32,37). A study to see NIDCAP's effect on brain development showed significant improvement in electrophysiology and brain structure for experimental group infants as compared to control group(38). At 2 weeks corrected age the experimental group infants showed better APiB scores, increased cortical coherence between frontal and a broad spectrum of mainly occipital brain regions as measured with EEG, and higher MRI diffusion tensor imaging documented relative anisotropy in left and right internal capsule with a trend in frontal white matter. These results indicate not only better neurodevelopmental function but also more mature brain fibre structure for infants who received NIDCAP when compared to their controls. A reduction in the cost of care with NIDCAP, compared to conventionally implemented care in the same NICU, ranged from \$4,000 to \$120,000 per infant(36).

Challenges to practice of developmentally supportive care in resource limited nurseries

Most of the practices of developmentally supportive care are already followed in such nurseries viz – any time access of mothers to babies, infant massages, nesting, proper handling. But most of such practices are arbitrary and there are no set protocols for each of these practices. The major drawback of these nurseries is in their designing according to the recommendations already described and the lack of co-ordinated goal oriented approach to preterm newborn care with respect to neuro behavioural outcomes. Also there is a shortage in the dedicated staff required to provide systematic care as well as in the training of the available staff.

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