

NIDCAP and developmental care

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The last ten years, the next ten years in Neonatology

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Abstract

Perinatal mortality in very low birth weight infants has dramatically decreased during the last decades. However, 15-25% of these infants will show neurodevelopmental impairment later on. The aim of implementing early developmental care (EDC), emerged as a new field in neonatology, is to create an intervention program designed to provide support for optimal neurobehavioral development during this highly vulnerable period of brain growth. The theoretical framework, which underlies the approach, is supported by research in different scientific fields, including neuroscience, psychology, medicine and nursing. EDC utilizes a range of medical and nursing interventions that aim to decrease the stress of preterm neonates in neonatal intensive care units (NICUs). The Neonatal Individualized Developmental Care Assessment Program (NIDCAP) is an integrated and holistic form of family-centered developmental care. Changing the traditional NICU towards an EDC-NICU includes training nursing and medical staff, investing in their quality and most importantly keeping parents in proximity to the infants. The new challenge of modern neonatology is to restore the mother-infant dyad applying “couplet care” starting at birth until discharge. Most of the European NICUs apply some elements of EDC, but it is more consistent in northern Europe. The development of NIDCAP training centers in Europe demonstrates the evolution of care. It is likely that future research and intervention programs will optimize our practices. Developmental care could prove to be an important recent step in improving outcome in extremely preterm neonates.

Keywords

NIDCAP, developmental care, NICU, EDC, VLBW.

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Background

Neonatal intensive care started in the 1960s, when artificial ventilation and cardiac monitoring were adapted to newborn and preterm infants. The neonatal intensive care units (NICUs) were conceived and functioned like the adult intensive care units with a very technical environment, invasive procedures and limited access for visitors, including parents. Bedspace did not include even a chair for the mother and many nurseries were quite congested. What has been overlooked is that the preterm infant will stay much longer compared to adults, that these infants have an intense brain growth receptive to sensory inputs and that the natural caregivers are the parents.

Intensive care has been shown to be effective in decreasing mortality of very low birth weight (VLBW) infants. The introduction of surfactant therapy in the early 1990s, fetal medicine, organization of care and recognition of neonatology as a subspecialty further decreased mortality from 50% to 15% in the last decade [1-3]. However, 15% to 25% of the VLBW infants will present later on health problems and neurodevelopment impairment in the following fields: motor function, vision, auditory function, cognition, behaviour, attention deficit and hyperactivity disorders, visual-motor integration and language [4, 5]. Compared to their term pairs there is substantial scientific evidence of altered early brain development. These differences are now documented on magnetic resonance imaging (MRI) whether during the neonatal period or later on [6, 7].

Brain growth and brain construction are in an extremely active process during the second and third trimester of pregnancy. The chronological evolution of these different processes are described in **Fig. 1** [8].

How a preterm birth interferes with the physiological maturation of the brain is studied in basic and clinical research. Several characteristics are well known to impact brain development or later

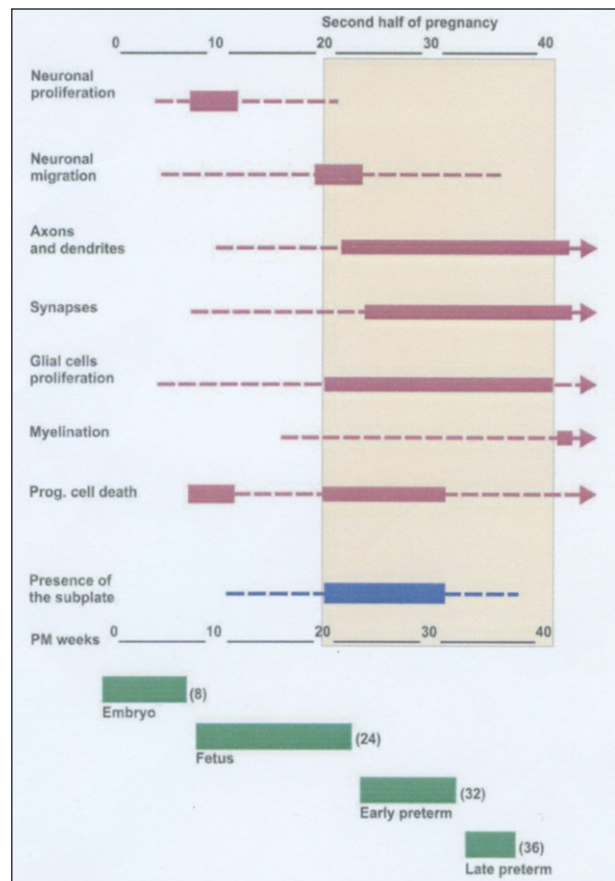


Figure 1. Cerebral growth and maturation *in utero* (adapted from: Amiel-Tison and Gosselin, 2009 [8]).

outcome. Very low gestational age and birthweight, gender, perinatal infection and inflammation, intracranial hemorrhage, periventricular white matter disease, postnatal use of steroids, nutritional imbalances or unfavorable socio-economical situation are among the major risk factors. Which underlying mechanisms are responsible for these developmental difficulties is very complex and not totally understood. Interactions between genetic background, epigenetic effects, vulnerability to oxidative stress and other metabolic disturbances will result in individual consequences for each baby. Outcome will further depend on the family environment of the infants. Transposition from research results into clinical practice changes is even more challenging. The importance of neurodevelopmentally supportive care, the NICU environment and parental closeness has been more obvious and is now a new challenge for changing practices [9, 10]. This paper gives an overview of the scientific background to support the move from traditional NICUs towards early developmental care (EDC) units.

NICU environment, EDC and NIDCAP

The babies in the NICU are overwhelmed by sensory inputs. They perceive pain, thermal changes, movements, olfactory, auditory, vestibular and visual stimuli. Social interactions with parents are not natural.

Recommendations for better practices in care organisation and NICU design have been published [11-13]. Against noisy open wards the focus has evolved to very silent NICUs with single rooms. These have been shown to reduce infections and favor parental presence and breastfeeding [14]. However, in a recent study adverse outcome was attributed to silence of single rooms [15]. It might be indeed inadequate to keep preterm infants too much in silence. But what is appropriate auditory stimulation? Another paper demonstrated that the exposure to parental talk was a significantly stronger predictor of infant vocalizations at 32 weeks and conversational turns at 32 and 36 weeks than language from other adults [16]. So single rooms should be seen as an incentive to favor parental presence which is the most important priority when implementing EDC.

Beyond the global environment, there is now evidence that the way of caring and manipulating these babies matters. Measurement of cerebral hemodynamics with Near Infrared Spectroscopy (NIRS) during a routine diaper change showed significant variations [17].

In a study of infants born at < 30 weeks gestation, the Neonatal Infant Stressor Scale scores were correlated with MRI (brain metrics, diffusion, and functional MRI) and neurobehavioral examinations at term equivalent postmenstrual age.

Exposure to stressors in the NICU was associated with regional alterations in brain structure and function. The most stressed infants showed decreased parietal and frontal cerebral width, altered diffusion measures and functional connectivity in the temporal lobes and abnormalities in motor behavior on neurobehavioral examination [18].

It is against the background of the potential harmful effects of the traditional stressful NICU that EDC and environmental strategies have gained more and more attention.

The term “early developmental care” (EDC) is confusing because it ranges from very simple interventions like light and noise control, positioning or non-nutritive sucking to the very complex Neonatal Individualized Developmental Care and Assessment Program (NIDCAP) [19]. The

NIDCAP model is an early intervention program based on the observation of the preterm infant’s behaviour [20]. The theory behind, developed by H. Als, is designated as “synactive theory”. The concept derives from the interdependency, differentiation, modulation and regulation of five behavioural subsystems: autonomic, motor, state organizational (maturation of well defined sleep and wake states), attentional/ interactional and self-regulatory system. The assessment tool in NIDCAP is a formal and repeated observation of the infant behaviour before, during and after a care. These observations describe the reactions of the baby towards the sensory inputs and his capacity of self-regulation. The developmental goals for each infant will be defined according to his individual skills and weaknesses. Individual care giving plans and environmental adaptations will be recommended.

From a practical view point, care and therapeutical interventions will be organized according to the baby’s individual tolerance and respect of sleep cycles and not according to the staff’s schedule. Specific regulation and support strategies will be proposed to the baby: non nutritive sucking, grasping, tucking and appropriate positioning or Kangaroo mother care. Parents are considered as primary caregivers. The collaboration between caregivers and parents reinforces the individualized care.

Applying formal NIDCAP observations every 2 weeks, as recommended for optimal understanding of the baby’s evolution, is not always possible in a busy NICU, but it will remain the standard for assessing a preterm infant’ level of maturation. As the NIDCAP implementation evolves in the unit, the caregivers become more and more aware of the signs shown by the baby and handling is adjusted accordingly.

NIDCAP is an extensive and complex teaching program. The competence of the NIDCAP observer has to be validated by certified NIDCAP trainers. The official website of the NIDCAP Federation International (www.nidcap.org) documents all aspects of NIDCAP implementation and training. The first of the 20 NIDCAP training centers worldwide was established in Boston in 1982 and the first center of the 8 European centers opened in Stockholm in 1999.

The level of developmental care in the NICU can be evaluated by the NIDCAP Nursery Certification Scales. All aspects of developmental care are analysed: from the architecture of the unit to the behavioral assessment of the baby, the

collaboration with the parents and the skills of the staff.

Implementing NIDCAP is much more than changing the design of the unit and covering incubators. It may require profound changes in the organization of the NICU putting the baby and his family in a central position. In Europe most of the training centers will require a clear commitment from the medical and nursing directors of the NICUs who apply for NIDCAP training. The training process combines general NICU staff training and individual NIDCAP observation certification performed by around 10% of the staff. In Europe NIDCAP training has spread very fast during the last 15 years and the European perspective is very supportive of moving towards EDC [21].

The advantage of NIDCAP for the move towards EDC is that the teaching program is structured and that the NIDCAP Federation International ensures quality control. The main points where NIDCAP will impact are summarized in **Tab. 1**. However, practical implementation has sometimes to cope with resistance to change, depending on the level of motivation and understanding of EDC. There are large differences among NICUs in issues such as parental involvement, breastfeeding rates and staff behavior. These differences are cultural and contextual. Scandinavian countries are traditionally more family centered, but in every NICU the medical and nursing lead will define the local culture.

The emotional brain, the circuits linked to stress, how the baby experiences pain or discomfort and the impact of the separation from the mother have been neglected by many physicians for a long time.

The NIDCAP concept is original, complicated to evaluate and therefore still controversial [22]. In many studies NIDCAP groups were those who had regular observations, but the effects of the global level of EDC for all staff members are not easily evaluable and source of bias.

To pay attention to the capability of the infant to cope with the care received can disturb neonatal routines. However, today traditional neonatal care undergoes evolution and is changing in many NICUs. Most of them are applying some elements of EDC: parental presence is reinforced, Kangaroo mother care is expanding, NICU design is changing and strategies for pain and stress management are applied [23-25]. Other intervention programs like the Mother Infant Transaction Program (MITP) or the Infant Behavioral Assessment and Intervention Program (IBAIP) are also integrating the parents

Table 1. Ten points where NIDCAP impacts EDC.

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| <ol style="list-style-type: none"> 1. Accurate clinical evaluation, integrating the infant behavior related to care 2. Assessment of pain and stress 3. Family centered care 4. Couplet care 5. Breastfeeding 6. Kangaroo mother care 7. Sleep organisation 8. Supportive patient-caregiver relation 9. Hospital humanization and patient empowerment 10. Tool for change |
|---|

in the care during or after discharge. They are less studied than NIDCAP but show promising results [9]. It is likely that growing attention on EDC will induce more studies and better practices according to growing scientific evidence [26].

Mother-infant dyad or couplet care: the new challenge

Despite the fact that the importance of early mother- infant relations is well known since a long time, parental access to the unit has been very often limited [27]. Today the parents have theoretically permanent access, but local resistance towards this rule still exists. Again, in northern Europe it is less often the case [28].

NICUs and maternities are run by different nursing and medical staff and are geographically not always contiguous. Restoring the physical closeness between mothers and babies from birth to discharge is a concrete challenge for modern neonatology.

Emotional and physical closeness are linked. The mother who is separated from her newborn child will show anxiety, stress and is at risk for depression [29]. It is not only a question of a humane attitude but there is also growing evidence of the importance of parent-infant closeness [10]. A group of babies born from mothers who had benefit from an early sensitivity training program showed better maturation and white matter connectivity at diffusion tensor brain imaging (DTI) compared to controls [30]. Kangaroo mother care and skin-to-skin contact favors development, breastfeeding and sleep [31]. Successful breastfeeding without closeness of the mother is unlikely to happen. In a recent review, the authors describe the influence of the quality of the social environment on the development and activity of neural systems

with implications for numerous behavioral and physiological responses, including the expression of emotionality. In animal studies, offspring of grooming and licking mothers showed better stress response modulated by epigenetic changes on the glucocorticoid receptor genes [32].

Some places in Sweden have a long lasting experience in caring for infants with permanent parental presence and fully restored mother-infant dyad. In those “couplet care” settings parents and infants live together from the very first minutes after birth. It is obvious that the design of the nursery and the maternity have to be adjusted accordingly. In Karolinska at the Scandinavian NIDCAP training center couplet care reduced significantly the length of stay [33].

Currently there is an important demand mainly in Europe coming from the nurseries to change their practices towards more developmentally supportive care. Family centered care is also strongly advocated by the European Foundation for the Care of Newborn Infants (EFCNI), including towards political authorities in the EU [34].

Conclusion

NICUs are facing a period of important conceptual changes. The traditional NICU appeared to be inadequate, with harmful effects on brain development during this particularly vulnerable period.

Moving away from traditional NICUs towards family centered developmentally supportive NICUs is the challenge of modern neonatology. The important elements of EDC are parental physical and emotional closeness, fine tuning of care according to appropriate assessment of the preterm infant behavior, strategies to reduce stress and a NICU design adapted to provide this type of care.

At the moment NIDCAP is the most complete tool to achieve these changes. Concepts will evolve with changing practices and the transitional period will depend on the different local strategies. Priority should be given to parent-infant closeness starting at birth and understanding the individuality of the infants behavior. EDC is the first step to help parents in understanding their infants, a task which does not stop at discharge from the NICU.

Declaration of interest

The Author declares that there is no conflict of interest.

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