

Physiotherapy and Rehabilitation Approaches to Premature Infants in Neonatal Intensive Care Units

İlknur Ezgi Doğan^{1*}, Nilay Çömük Balcı² and Arzu Güçlü Gündüz³

¹Başkent University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara

²Ondokuz Mayıs University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Samsun

³Gazi University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara

ABSTRACT

In addition to medical care and intervention, physiotherapy and rehabilitation practices are used for the health of premature babies in the neonatal intensive care unit. Thus, it is aimed to reach physiological stability of the premature baby, to maintain growth and development, to minimize the risk of complications due to preterm birth, and to support neuromotor and behavioral development. As a member of the interdisciplinary team in the neonatal intensive care unit, the neonatal physiotherapist plays an active role in family education and environmental regulations, as well as planning the physiotherapy program that includes pulmonary and neuromuscular physiotherapy applications customized according to the gestational age and needs of the baby. With physiotherapy approaches, the health of the premature baby is supported in terms of neuromotor and behavioral development, while contributing to parent-infant attachment. In this review, physiotherapy and rehabilitation approaches applied to premature babies in the neonatal intensive care unit are described.

*Corresponding author

İlknur Ezgi Doğan, Başkent University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara, ORCID: 0000-0002-4720-9691, Tel: 05326773051; Fax: 0312 2466674. E-mail: ilknurezgidogan@gmail.com

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Introduction

Prematurity is stated as the major factor among the causes of neonatal death in the 2014 report of the United Nations International Children's Emergency Fund (UNICEF) [1]. According to the World Health Organization data, it is stated that 2.7% of the 13 million living out of 15 million premature babies born every year have moderate or severe neurological involvement, and 4.4% have mild neurological involvement [2]. Respiratory, neurological, gastrointestinal, metabolic and infectious complications that may adversely affect the development of the newborn can be seen due to prematurity [3]. It is emphasized that 41% of deaths occurring in the postnatal first 6 days, which is the early neonatal period, are caused by complications related to preterm birth [1,4]. Complications frequently encountered as a result of preterm birth; respiratory distress syndrome, patent ductus arteriosus, problems related to the central nervous system, necrotizing enterocolitis, bronchopulmonary dysplasia, retinopathy of prematurity, and long-term neurological and neurodevelopmental problems [5].

Unstable physiological state of the premature baby; it causes difficulty in creating and maintaining cardiopulmonary responses, inability to organize motor movements, and poses a risk in the emergence of complications that may adversely affect the growth and development of the baby. For this reason, receiving physiotherapy

and rehabilitation support in accordance with the needs of the baby in the neonatal intensive care unit has an extremely important place in a holistic and interdisciplinary approach [6,7]. As a member of the interdisciplinary team in the neonatal intensive care unit, the physiotherapist carries out a customized program from pulmonary and neuromuscular physiotherapy approaches, which is suitable for the gestational age of the premature baby, supports neurobehavioral and neurodevelopmental, according to the needs of the baby, while involving the parents in the process with family education. Thus, the physiotherapist contributes to the general health status, growth and development of the premature baby and to support the bond between the parents of the premature baby and the baby. In this review, physiotherapy and rehabilitation approaches applied to premature babies in the neonatal intensive care unit are described.

Frequently Encountered Complications Due to Premature Delivery

Respiratory distress syndrome, which is caused by insufficient production and release of surfactant, is one of the most common complications in premature babies, and it is reported to be seen in 60-80% of premature babies born under 28 weeks [8]. As a result of surfactant deficiency in premature babies, atelectasis occurs in small air units, and hypoxia develops in the baby due to insufficient ventilation.

Although patent ductus arteriosus, in which systemic and pulmonary blood circulation is adversely affected, closes without

treatment in 2/3 of premature babies, it is stated that it is seen in 15-37% of premature babies born under 1750 grams [9]. Although premature babies can adapt to myocardial function by increasing left ventricular contractility in patent ductus arteriosus, systemic hypoperfusion may be seen because blood flow from systemic circulation to pulmonary circulation continues. Systemic hypoperfusion due to patent ductus arteriosus also disrupts cerebral perfusion and causes neuronal involvement in the baby [5].

Intraventricular hemorrhage, periventricular leukomalacia, periventricular hemorrhagic infarction, cortical lesion and deep white matter lesion, which are frequently encountered complications related to the central nervous system, are more common in premature babies as birth weight and gestational age decrease. The fact that the germinal matrix, which regresses after the 36th gestational week, is rich in fine capillaries and can easily develop bleeding, constitutes the physiological basis for premature babies to be at risk [5]. It is also stated that preterm birth may adversely affect neurophysiological processes such as neuronal migration and differentiation, axon dendrite sprouting, synapse formation, myelination, and apoptosis [10]. It has been reported that hydrocephalus is seen in approximately ¼ of infants with intraventricular hemorrhage, and premature infants with periventricular leukomalacia show neurological signs of spastic diparetic cerebral palsy [11,12]. It is stated that the risk of cerebral palsy is 20 to 80 times higher in premature babies with central nervous system lesions compared to term babies [13]. In addition to cerebral palsy, developmental coordination disorder alone or accompanying attention deficit hyperactivity disorder is seen at the beginning of long-term neurological problems. In addition, it has been reported that the incidence of cognitive impairment (IQ<70) increases as the gestational age decreases in premature babies [14]. Physiotherapy approaches are needed in the neonatal intensive care unit due to these complications that premature babies may encounter in the perinatal and postnatal period and the physiological characteristics of preterm birth.

Physiotherapy and Rehabilitation Approaches Applied in the New Born Intensive Care Unit

By controlling the complications that may occur as a result of the respiratory, cardiovascular and central nervous system effects that continue maturation in the postnatal period due to preterm birth, newborn physicians, neonatal nurses and nurses are employed in the neonatal intensive care unit so that the premature baby can continue to grow and develop with the least impact and maintain its physiological stability. An interdisciplinary approach is adopted with the neonatal physiotherapist. According to the International Classification of Functioning, Disability and Health (ICF), neonatal physiotherapists support the functional and structural integrity of the body parts and systems of the newborn, posture and movements suitable for gestational age in the neonatal intensive care unit. plays a role in appropriate interaction between family and other health professionals [15,16].

In the individualized developmental care approach, which is frequently applied in the neonatal intensive care unit, the physiotherapist plans the appropriate approaches for the needs of the baby by making arrangements to eliminate the factors that may disrupt the stability of the baby or create stress, in line with the observational information obtained from the baby's behavioral status and orientation skills [17]. Thus, both the development of neural pathways and neurobehavioral development are supported in the baby. This approach, called the Newborn Individualized Developmental Care and Assessment Program (NIDCAP), is a scientifically based assessment and care guide between the baby

and caregivers within the framework of developmental care [18]. In this framework, necessary physiotherapy applications can be carried out with a program suitable for the baby, taking into account the feeding, sleep-wake times of the baby. In accordance with this approach, the neonatal physiotherapist plans pulmonary physiotherapy and neuromuscular physiotherapy practices, and plays an active role in family education and organization of the necessary environmental regulations in the neonatal intensive care unit [16].

Pulmonary Physiotherapy

In the pulmonary physiotherapy applied in the neonatal intensive care unit, after the vital activities of the baby such as heart rate, respiratory rate, partial oxygen saturation are evaluated, airway cleaning techniques are focused on [19]. These techniques include percussion, vibration, aspiration, stimulating coughing, and postural drainage. While applying these techniques, the goal is to support ventilation by removing secretions adhering to the airways and to prevent airway infection [3]. In addition, ensuring adequate oxygenation, re-ventilation of collapsed lung segments, and reducing the risk of reintubation of the baby are among the aims of pulmonary physiotherapy [19, 20].

In addition, as a result of pulmonary complications, which are frequently encountered in premature babies, gas exchange and ventilation-perfusion balance in the lungs are disrupted, and hypoxia in the baby becomes evident as a result of a decrease in lung compliance and an increase in respiratory workload [21]. In this case, oxygen support, nasal cannula, oxygen mask, oxygen caps, continuous positive airway pressure (CPAP), and endotracheal tube applications are used [3]. Pulmonary rehabilitation is applied to prevent atelectasis after intubation. In the literature, it is stated that the risk of concussion or cerebral hemorrhage in the baby during pulmonary physiotherapy applications was emphasized, but there were no results supporting this idea [21, 22]. In addition, it is stated that there is not enough evidence about the effectiveness of pulmonary physiotherapy applied in newborns receiving mechanical ventilation support in the neonatal intensive care unit, and that the approaches of pulmonary physiotherapy are beneficial in removing secretion from the airway with percussion and vibration applications and preventing atelectasis [3, 21].

Neuromuscular Physiotherapy Approaches

Neuromuscular physiotherapy approaches are determined by taking into account the length of stay of the baby in the intensive care unit, the control of other health problems, musculoskeletal needs, gestational age and developmental characteristics. Neuromuscular physiotherapy applications include normal joint range of motion exercises, positioning, therapeutic grips, infant massage, taping, soft tissue mobilization for post-surgical scar tissue, facilitation of sucking and swallowing, kangaroo care practice, and family education [19, 20].

Normal Range of Motion Exercises

As of the third trimester, the musculoskeletal system shows improvement in terms of mechanical load response and bone mineralization. In premature babies, congenital causes, especially the risk of osteopenia, and anomaly or joint misalignment that can be seen in the contractile tissues around the joint can be encountered [23]. For this reason, in addition to paying attention to the nutrition of premature babies in the neonatal intensive care unit, passive normal range of motion exercises are performed by the physiotherapist [19]. It is known that normal range of motion exercises applied to the extremities, especially to the proximal joints of the baby, are generally beneficial for bone development

[23]. In addition, studies in the literature have shown that range of motion exercises contribute to bone development in various amounts; it is stated that it supports bone mineral density and provides a slight and temporary increase in weight gain and bone mineral density of premature babies [24].

Positioning

Positioning facilitates the organization of posture and movement by supporting the musculoskeletal alignment of the premature baby against gravity with the nesting method. Positioning is an effective method not only for the musculoskeletal aspect of the baby, but also for supporting respiratory functions and providing skin care [16]. The baby is placed in the nest where it is supported by a rolled towel in prone, side lying and supine positions, and positioning is performed that supports the trunk and extremities from various aspects. In addition to supporting trunk flexion in the side-lying position, it is stated that there is an increase in mobility in the baby's direction in more flexion [20]. In prone and supine positions, it is supported by a rolled towel in order to prevent excessive abduction and extension of the extremities due to the effect of gravity, and to maintain the physiological flexion posture of the baby [20]. It is stated that the prone position improves the respiratory functions of the baby and increases oxygenation [21]. In addition, the problem of ventilation restriction in the weight-bearing lower chest of the baby, who is positioned with the upper extremity elevation in the 45 degree raised side lying position, is eliminated and better ventilation is provided [17]. Positioning facilitates hand-mouth contact by directing the extremities to the midline so that the baby can organize his behaviors and calm himself when he shows signs of stress, and reduces the intervention time for the baby, allowing the baby to sleep peacefully for a longer time [25]. In addition, it is stated in the literature that premature babies who stay in the neonatal intensive care unit for a long time and who are not properly positioned have a risk of torticollis, positional plagiocephaly, decrease in the spontaneous movements and quality of movement of the baby, and disorder in the lower extremity joint alignment [16, 19].

Handling

Therapeutic grip- "handling", which is a part of the neurodevelopmental treatment approach, is special therapeutic holding methods that enable the baby to hold, carry, position and calm himself [20,26]. Thanks to therapeutic holding techniques, the physiotherapist facilitates the baby's ability to reveal movements suitable for motor development by acquiring sensorimotor experiences, in line with the strategies that will support the baby's movement repertoire [27].

Baby Massage

The sense of touch, which is the first sense to develop in intrauterine life, is transmitted by the amniotic fluid in the baby, so that the baby can maintain its spontaneous mobility. When the extrauterine life is started, the baby continues to experience the sense of touch along with the gravity effect and all other sensory stimuli. Infant massage is one of the early intervention approaches where the baby can systematically receive information about touch in his extrauterine life [28]. Different forms of tactile sense, such as tactile kinesthetic movements, speaking or eye contact can be added to infant massage, which is often applied to the baby's body parts with stroking movements in the form of gentle and slow hand contact [29]. In the systematic review in the literature, it is stated that massage is effective in the weight gain, growth and development of premature and low birth weight babies and reduces the length of stay in the hospital [29].

Tactile kinesthetic massage is concluded by performing passive joint movements on the extremities after gentle strokes are applied in the direction of the baby's head, neck, trunk and extremities, in the prone and supine lying position. After providing non-excessive, regular and rhythmic tactile stimuli with strokes, kinesthetic stimuli are given with extremity movements. In a study examining the brain waves of premature babies with electroencephalography before and after tactile kinesthetic massage application, it is stated that massage therapy contributes to the brain electrical activity maturation process by reducing the mismatch between the intrauterine and extrauterine environment [28].

Sucking Swallow Facilitation

Nutrition, which has an important place in the growth and development of the premature baby, is a functional activity with high priority in the newborn intensive care unit, which should be supported by the newborn physiotherapist and other caregivers. Sucking activity is supported by the non-nutritive sucking approach, in which a pacifier or a glove-wearing finger is placed in the mouth in order to provide tactile stimulation to the facial muscles and intraoral structures [16]. In addition, positioning the baby in a raised position with the head in semiflexion during feeding and supporting the baby's cheeks from the outside are also approaches used in sucking and swallowing facilitation [23]. In a study in the literature, it is stated that the duration of hospital stay of the premature baby is reduced, feeding behaviors are improved, and impulsive and defensive behaviors are reduced during and after feeding, thanks to non-nutritive sucking with a pacifier before and after feeding with a catheter and bottle [30].

Kangaroo Care

Kangaroo care, also called skin-to-skin contact, is a frequently preferred approach in the neonatal intensive care unit, both as a neuroprotective approach and in terms of mother-infant bonding. Direct mother-infant skin contact is ensured by removing the baby's clothes and laying the baby in a prone position on his mother's chest with only the diaper. It is stated in the literature that kangaroo care, which is described as "the newborn's normal environment", provides the right environment for DNA, epigenesis, neural networks and physiological regulations to function optimally [31]. It is stated that skin-to-skin contact with the mother or father has a direct neuroprotective feature by supporting brain plasticity [32]. In a study, it was determined that the brain maturation of babies whose brain activities were followed by electroencephalography (EEG) accelerated as a result of kangaroo care applied 6 hours a day for 8 weeks [33]. In addition, it is stated that the oxytocin level of parents with premature babies increases during kangaroo care, reducing their stress and anxiety responses, and it is effective in the development of the premature baby's ability to calm himself down [31].

Family Education

Family education is provided for the behavioral organization, movement and postural development of the premature baby, maintaining its physiological stability, supporting parent-infant attachment, as well as the emotional situation and stress management of the family with the premature baby. For this purpose, for the family to care for the baby; activities such as feeding, dressing, sleep positioning, playing and communicating, and training, verbal information, video narration, written sources and practical methods on strategies that support the baby's motor movement organization and therapeutic holding and carrying methods [16, 19].

Environmental Regulations

In addition to environmental conditions such as neonatal intensive care unit, respiratory support equipment, monitors where the baby's physiological status can be followed, unfiltered noise and light, gravity acting on the baby's posture and body segments instead of the uterus and amniotic fluid that will support the baby's postural structure in intrauterine life, invasive interventions may cause when combined with painful stimuli, separation from parents, contact of more than one healthcare professional, and the presence of irregular tactile stimuli, environmental conditions that make it difficult for the premature baby to maintain physiological stability and that may adversely affect neuromotor and neurobehavioral development are mentioned [16]. With environmental regulations such as lighting, sound level adjustment, and ambient temperature to be made for this situation, it is possible to increase the baby's ability to calm himself, to provide physiological stability and to increase the sleep time.

In the neonatal intensive care unit, attention is paid to the following in the regulation of the light level; except for the procedures, the incubator area where the baby is should not be directly illuminated, in order to reduce the direct exposure to light, arrangements should be made to cover the incubator with the help of an incubator cover, blanket or cover. and back, protective equipment such as eye masks should be used for babies who need phototherapy. In addition, care should be taken to keep the ambient lighting at low settings at night, taking into account the night/day cycle of the baby's sleep-wake times [34].

In order to adjust the sound arrangements and prevent noise in the neonatal intensive care unit, health professionals who make up the neonatal team should be trained on the subject. It should be known that the ideal sound level of the environment where the babies are located should not be higher than 50 dB, the sound level of the devices used should not exceed 40 dB, and the sound increase should not exceed 70 dB temporarily [34].

While the ideal room temperature of the neonatal intensive care unit is set in the range of 21-24 °C, incubator temperature and humidity settings should be followed with various arrangements according to the gestational week of the baby, birth weight, and ability to provide physiological stability. While ideal incubator temperature values are set at an average of 32.4± 1.5 to 35.0± 0.5 °C in the first 24 hours postnatally, it is adjusted between 33.5±0.5 and 32.0± 1.5 °C between 5-14 days. While the humidity in the incubator is set at around 70% in the first 7 days postnatally, it can be reduced to 40% according to the baby's ability to organize body temperature, and it can be stopped after 21 days depending on the baby's ability to maintain body temperature [35].

Conclusion

In addition to the medical interventions applied in the neonatal intensive care unit, it is aimed to keep the health levels of premature babies at the highest possible level with physiotherapy approaches. In this respect, the neonatal physiotherapist, who is a part of the interdisciplinary team, plays an important role in this process with family education by creating the most appropriate planning for the premature baby from various physiotherapy approaches.

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