An Experimental Study of the Effects of Sensory Stimulation* on the Low Birth Weight Infant's Early Growth and Development

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Problem, Hypotheses & Background Review

The technological revolution(it means the development of neonatal intensive care) has had a profound effect on perinatal health. Therefore, it has permitted the increasing survival of many small & critically ill preterm neonates. But the incidence of neurologic & developmental problems in this population has not significantly changed during the past decade.

A newborn enters the world with the potential to actively interact with his environment and is not merely a recipient of stimuli. This potential for interaction needs only to be activated by beha vioral stimulations from the environment. But the infant has been largely ignored because he has been viewed as a passive recipient of care, with limited capacity to exert any meaningful influenc on the environment.

Infants who weight 2,500gm or less at birth are considered to have had either a shortened gestational period, less than expected rate of intrauterine growth, or both, and are termed infants of low birth weight. So, about two-thirds of low birth weight babies are born prematurely before 37 wks gestation. It means LBW babies are born in an immature state than normal, full-term infants. Human newborn needs the 40wks in the womb to be prepared to adapt from an aquatic to an atmospheric & social environment. But the shortage of the developmental time in utero makes the baby deprived from adequate environment and stimulation.

The isolette is an incubator that is designed to provide controlled temperature, humidity & oxygen supply and to permit feeding & care of the newborn under aseptic conditions with a minimum of handling. Most of the LBW infants are taken care in an incubator. So, they may suffer from inadequate amound of stimulation and sometimes they receive relatively infrequent coordinated sensory experiences. Furthermore, there is no diurnal rhythmicity in physical social stimulation across days.

In describing the interactive environment of the LBW infants, it is necessary to point out

* 본 글은 제18차 ICN총회(텔아비브, 이스라엘)의 clinical session에서 발표된 논문임.

one aspect of interaction characteristic of the special care nursery that varies from the experience of the full term baby in the normal nursery. This is the separation of sensory modalities. Because, most of the full-term newborn interacting with parents or staff and sensory environment is a matter of integrated sensory stimuli.

The growth of independent functions in perinatal nursing has considerably enriched & improved the quality of care rendered to the high-risk neonate. Care is focused on achievement enhancement of maturation of immature organ systems by provision of supportive care. And also balance unpleasant sensory input with soothing touch and other pleasurable input.

In the last 15 years numerous studies have revealed that if a small premature infant is either touched, rocked, fondled, or cuddled daily during the stay in the nursery he may have significantly fewer apneic periods, increased wt. gain, and, in some studies, even an advance in sensorimotor competences including responsiveness to stimulation, muscle tone, and motor skills.

But, in Korea, manipulation of the infants was discouraged since handling was thought to increase the risk of infection and energy consumption. And also adequate stimulation for the premature baby is still questioned.

Thus, the purpose of this study was to define the effect of sensory stimulation on the low birth weight infant and to determine the factors influencing the infant's growth.

The hypotheses tested in this study was as follows:

1. The experimental group will gain more weight than the control group.
2. The experimental group will show a higher score on the neurobehavioral examination than the control group.
3. The experimental group will be quicker and responsive than the control group.
4. An infant's characteristics (birth weight, gestational period, postnatal complication, sex) will influence upon the growth.

Methodology

Designing the study:

A program designed to provide the LBW infant with or without or without sensory stimulation, in a neonatal intensive care unit.

A two-group experimental design was used to test the hypothesis. The experimental group of LBW infant was provided a sensory stimulation and the control group was not.

* Schematic Diagram of Research Model.

This study indicates that it had one independent variable & two dependent variables. A LBW infant's characteristics are regarded as intervening variables.

Subjects:

Data was collected from July 1983 through January 1984 at Ewha University Hospital. The infants, consisting of 68 LBW infants, were divided equally into a control group & experimental group.

The following criteria were used to select infants for admission to the study:

1) birth weight between 1,500gm & 2,500gm.

2) gestational period between 31 wks & 40 wks.

3) absence of major congenital malformations and chromosomal abnormalities.

4) Apgar score between 4 to 10 and infants with a very poor prognosis for survival were excluded.

* Table : Comparison of Selected Characteristics on LBW infants between Exp. G. and Cont. G.

Selected background factors of LBW infants at birth and at time of testing was compared. No significant differences between the two groups.

Sensory Stimulation Program:

I divided into two levels of treatment and was as follows:

First Stage:

In this period, each baby was in the incubator and scheduled every 3 hr gavage feeding. The stimulation program started after N.P.O. period.

The stimulation program included:

1) tactile stimulation: In the day time, the infant was massaged with the palmer surface & fingers of two hands in a cephalocaudal direction. And the duration of tactile stimulation depended on the infant's wakening. It recognized that the baby's state became awake, at that time, the eyes opened and lip movement showed. Then stimulation was stopped.

2) visual stimulation: After tactile stimulation, baby's state changed. Then a brightly-red colored ball moved between 6 to 8 inches from the infant at eye level, 3 to 5 times.

Second stage:

In this period, each baby was in an open crib and was nipplefed every 3 to 4 hours. At that time, tactile and visual stimulation was same as above and additionally, auditory stimulation was included. Auditory stimulation consisted of nurse's voice and 3 minute 25 second recording, a music box was played. The music box placed in the crib about 8 to 10 inches from the infant's ear at 40~70 decibles, a volume considered adequate to elicit a response from an infant. After that, each infant was fed by a nurse or his mother while she was seated in a comfortable chair, and after feeding the infant was placed back in to the crib.

* Table-frequency distribution of experimental group by sensory stimulation.

(Tactile stimulation was received an average of 938.23 second per day, but it depended on a baby's state and thus a minimum was 755 second & a maximum was 1190 second. And also each infant received tactile & visual stimulation an average of 16 days during hospitalization. auditory stimulation for a short period. Because a Dr. of Otology didn't agree with the auditory stimulation in an incubator.)

LBW infants in the control group received routine hospital care, with handling provided primarily in conjunction with feeding, changing, and medical procedures. Parental visits were similar for both groups and they were limited to touch, feed, and hold their infants while they were in the incubator.

Test Tool

The measurement of infant growth was checked by body weight in grams taken every

other day on all infants at a time and also included sucking ability. Scales used to weigh infants were checked.

The measurement of infant development was not easy. The tool for measurement was the testing protocol for neurobehavioral assessment of the neonate which was developed by Scalon et. al. The examination which has proved to be a simple, rapid, & reproducible is a technique of assessing some aspects of newborn behavior. The examination is based on standard neurologic testing of newborn as developed by Prechtal & Beintema, as well as, some of the behavioral parameters first described by Brazelton. This neurobehavioral test by Scanlon was standardized and reliability & validity were established. So it may be evaluated quantitatively & qualitatively, both as a sensitive outcome measure & as a useful clinical tool. The testing criteria are described in the table.

* Table-The Neurobehavioral Examination.

(In brief, the examination involves an assessment of the infant's state of wakefulness, various reflexes, his muscle tone & power, as well as his responses to various stimuli, including pin prick, light, and sound. In addition, the examiner notes & records response decrement behavior. And finally, the examiner's appraisal of the infant's performance on the entire examination. This requires a value judgement and enables the examiner's decision. Therefore, the general assessment was excluded in this study.)

This testing procedure was administered to both groups prior to discharge from the NICU. At that time, they were placed in an open crib and examined usually approximately midway between feedings with the infant asleep.

Cardiac measures. The infant's response to a stimulus such as touch, rattle, bell & music was measured heart rate change by an E.K.G. Infants were tested for 1 hour after the feeding. Testing began when the infant was in a light sleep state, a rattle & bell rung within a few inches from the infant's ear. The stimulus is repeated 5 times at 5 minutes interval and measured quickness of response & degree of responsiveness. Quickness of response was counted the first time when baby's heart beat accelerated more than 10. Degree of responsiveness identified the maximum amount change of heart beat during 5 trials.

Data was analyzed as follows:

Comparison of selected characteristics of LBW infants at birth & at time of testing was done by x^2-test & t-test. In order to identify the treatment effect on the results of the experimental group, data of the experimental group was compared with that of control group's by the t-test & x^2-test. As an analysis of the influence of infant's characteristics on infant's growth was analyzed by 4 way ANOVA and Least Square Mean.

Result

The results are as follows:

Hypothesis 1 : That the experimental group will gain more weight than the control group was partially supported.

* Table-Comparison of Growth Patterns between Exp. and Cont. G.

That is to say that there was a significant difference found between control & experimental groups in growth as measured by average weight gain after regaining the initial weight loss and experimental group babies nipple feeding faster than control group but initial weight loss and total weight gain was no significance between two groups.

Hypothesis 2 : That the experimental group, as compared with the control group, will show a higher score on the Neonatal Neurobehavioral Assessment was partially supported.

* Table-Comparison of Neurobehavioral Scores between Exp. and Cont. G.

The treated infants performed signficantly better than the control group infants on infant's state, pinprick response, pull to sitting, truncal tone, response to sound, placing, etc. Rooting behavior was less vigorous in the control group but no differences were found in sucking behavior. No significant differences between the two groups in their responses to light in the eyes and Moro reflex.

Hypothesis 3 : That the experimental group will be more sensitive to the stimulation than the control group was partially supported. In light sleep state, both groups of infants showed acceleration of heart beat during the stimulus period. But the babies were tested quickness & degree of response.

* Table-Comparison of Heart Beat Changes between Exp. and Cont. G.

Quickness of response: In the tactile and auditory data, the experimental groups were quicker to respond than the control groups only in bell sound & music. And there was no significant difference in rattle or tactile stimulation.

Degree of response: There was a significant difference between control & experimenal groups in degree of response as measured by heart beat change. In the rattle & bell sound, the experimental groups showed a significant cardiac acceleration, but failed to respond significantly to the tactile stimulus & music.

Hypothesis 4 : That an infant's characteristics will influence upon the growth as partially supported.

* Table-Analysis of Variance of LBW Infant's Characteristics

Relationships between intervening variables (G.P., B.W., postnatal complication, apgar score & sex) and the growth patterns were tested.

In the analysis for G.P., the groups were constituted by shorter than 32 wks into one group & subjects born in the 33 to 37 wks in the other group & more than 38 wks into one sroup. There was significant differences in weight loss, sucking ability and length of hospitalization. The infant's birth weight were distributed in two groups, those 2000gm above & under. Birth weight revealed significant differences in sucking ability & length of hospitalization.

The Apgar scores were distributed in two groups, those 7 or above and those 6 and under. Analysis of variance for sucking ability as a function of Apgar level at birth revealed significant differences betwcen groups. But there was no significant difference in weight gain & weight loss between groups. And infant's postnatal complication was found to be a significant indenx of the infant's growth.

Conclusion

Significant differences were found between control & experimental groups in rate of physical development and sucking ability. And also the treated infants performed higher score than the control group infants on the Neurobehavioral assessment. When infants stimulated tactile and auditory data, the experimental groups were quicker to respond & responsivencss than control groups.

A review of the experimental literature shows that shorter latencies of responding are associated with more mature & better organized central nervous systems. Shorter initial responsiveness is considered on index of better organization. A baby modifies his behavior as a result of experience. Some behavior patterns are ready to operate at birth & require little or no practice. But others emerge only through interaction of infants & environment.

It the present study, sensory stimulation given during the early weeks of life effect on the infant's growth & development. That means this study provides experimental support for the idea that sensory enrichment can improve baby's weight gain, sensory functioning and the nervous system organizing.

Stimulation or interaction between the infants & the environment has been found to be essential for growth & development. So, a systematic approach to early intervention seems important for achieving higher levels of motor & mental functioning. But questions remain concerning the optimal type & amount depend on the baby's maturity level. And also the crucial questions of long-term benefits from early intervention requires additional follow-up studies.