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Using Allostatic Load as a Framework for Neonatal Research and Practice

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Research Article

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ABSTRACT

This article is a brief overview of the appropriateness of the theory of allostatic load as a framework for performing neonatal research and practice. By using the theory of allostatic load as a framework, researchers and practitioners will not negate the effects of stressors experienced by the fetus during pregnancy - as well as stresses inherent in birth – which are compounded by potentially traumatic interventions. Infant temperament, response to noxious stimuli (such as circumcision, heelstick blood draws, and vaccination for examples), and response to separation from their mother can all be affected by such prenatal and birth stressors when taken in the context of the theory of allostatic load.

INTRODUCTION

Using Allostatic Load as a Framework for Neonatal Research and Practice during pregnancy women undergoes stress; stressors may be related or unrelated to the pregnancy. Work, family, and other every day stressors can influence how a woman may behave (in both healthy, such as exercise as a stress-reliever, and unhealthy ways, for example smoking). Pregnancy related stressors might include morning sickness, early bleeding, genetic testing, or added risk factors. Maternal cortisol, which crosses the placenta to the fetus, increases normally during pregnancy and added stress increases the amount of this exposure [1]. Due to the rapidly developing fetal brain, such exposure can have an effect on the genomic structure and phenotypic characteristics of the infant, as demonstrated in early rat studies [2]. Researchers further found that increased cortisol exposure early in pregnancy resulted in slower infant development, whereas increased exposure in the last weeks of pregnancy resulted in quicker development. Ultimately these differences may contribute to anxiety and depression in the child later in life [1,3].

Normal fetal-to-neonatal transition involves respiratory, circulatory, thermoregulatory and metabolic adaptation. Routine hospital procedures after normal, low-risk birth include assessing, weighing, administering intramuscular Vitamin K and erythromycin to the eyes, which could be interpreted by the newborn as stressors. With the rise in modern obstetrical technology, there has been an increase in the rate of labor induction, augmentation, epidural use, and surgical birth [4].

These practices increase the risk of a difficult transition to extra uterine life for the newborn [5,6]. In an otherwise healthy pregnancy, the addition of these types of interventions can change the labor from low to moderate-risk, and a Neonatal Resuscitation Team (NRT) would be called to the birth. Current practice, per Neonatal Resuscitation Program guidelines, includes taking the baby to a radiant warmer, drying and stimulating the newborn, encouraging crying, suctioning with a bulb syringe, and possibly providing

positive pressure ventilation with 21% oxygen (room air) [6]. These methods of helping the newborn transition are rough and not without potential negative outcomes for the infant. Drying, if done too vigorously, can lead to skin damage. Suctioning can lead to oral aversions. Positive pressure ventilation can contribute to air in the abdomen, and risk of pneumothorax [7]. Additionally, separation between the mother and baby may become prolonged. For example, the baby may remain on the radiant warmer until the NRT is satisfied with his/her condition, often including a full physical assessment by the physician on the team for charting purposes. At that time the baby is wrapped and returned to the mother. If stabilization is not satisfactory, the infant is removed to an intensive care nursery for further observation, monitoring, and treatment if needed. This separation can compound the stress on the infant as he or she adapts to extra uterine life.

Purpose

The purpose of this paper is to:

1) Evaluate the appropriateness of the theory of allostatic load as a theoretical framework for neonatal research when studying mode of birth, potential stressors and newborn outcomes.

2) Recommend the use of the theory of allostatic load for neonatal research and practice.

THEORY OF ALLOSTATIC LOAD

The theory of allostatic load illustrates how one's physical health can be a result of stress accumulation and how, by minimizing that stress, we can improve their short and long-term health [8]. This would indicate that the infant experiencing a stressful birth is at risk for a heightened load earlier in life. Therefore this theory addresses the importance of managing stress in the neonatal period, and is therefore well suited to frame neonatal research and care.

This theory formalizes what many will recognize from anecdotal experience, which is that increased stress load over time can deteriorate physical and emotional health. As the authors describe, there are many factors to how one manages stress, so no two individuals will be alike in what amount of load will lead to physical consequences. Genetic predisposition, age, gender, and learned coping skills can all be mediators the effects of stress on health.

The key concept of allostasis is differentiated from homeostasis – which implies a static norm – defined as "the operating range, and the ability of the body to increase or decrease vital functions to a new steady state on challenge" (page 2094). Allostatic load is defined as "the strain on the body produced by repeated ups and downs of physiologic response, as well as by the elevated activity of physiologic systems under challenge, and the changes in metabolism and the impact of wear and tear on a number of organs and tissues, (which can) predispose the organism to disease" (page 2094).

The theory of allostatic load takes into account how both social context and physical/psychological challenges affect perception of a stimulus. A behavioral as well as biological response to that stimulus then occurs. Genetic predisposition and individual history play a role in how the nervous system processes the stimulus. The stimulus is then interpreted as either a threat or a non-threat. If it is a non-threat, the individual doesn't experience stress, and their allostatic load is not increased. If it is a threat, the source of the threat is then assessed. A known threat may provide the individual with the knowledge of how to cope with the stimulus. An unknown threat puts the individual on heightened alert until the source can be determined, and a coping mechanism uncovered. Biologically, this can affect the immune system, the cardiovascular system, metabolic system, and the muscular system, which can lead to such conditions as infection, coronary heart disease, diabetes and hypertension, to name a few. Behaviorally, they most likely experience anxiety, which can lead to aggression or risk-taking activities. In an adult, such activities might include excessive eating, drinking or smoking. A child might exhibit changes in temperament, play activities, or scholastic performance [8].

The long-term implications of early accumulation of allostatic load on the individual, both prenatally and from birth, can be seen both in physiologic disease - for example tendency toward asthma as a result of autonomic nervous system damage, or diabetes as a result of neuro- endocrine damage and in emotional adjustment, as illustrated by Anand and Scalzo who found traumatic deliveries to be a risk factor in risk taking behaviors and suicides among adults [8,9].

CONCLUSION

As illustrated, infants are not born without stresses on their physiology. There may be stresses such as threats of preterm labor, work or home stresses rises and dips in maternal glucose levels, and so forth - and stress hormones cross the placenta from the mother to the fetus. As demonstrated in animal studies, glucocorticoids crossing the placenta result in an increase in the fetal hypothalamic-pituitary-adrenal axis activity. Due to rapid brain growth at this time, this has been shown to alter brain development [10]. Labor is a natural and necessary stress for effective transition, which alters vital functions for adjustment to extra uterine life, though there may be stressors, added to the process. Genetics, gestational age, and gender will have an effect on how much stress the infant feels, and also what effect this cumulation of stress will have on the individual at birth and in the neonatal period [8].

Using the theory of allostatic load to frame neonatal research allows for an understanding of the likelihood of temporal cause and effect. Specifically, allostatic load builds prenatally, as well as during the labor which can threaten the achievement of

allostasis by the neonate. Therefore, this framework applies well for evaluation of neonatal illness, behaviors and any strategy for optimizing fetal-to-neonatal transition.

Due to the risks of increased allostatic load on the newborn, practitioners should take care to minimize stressors whenever possible. Prenatal and birth stressors should be taken into consideration when recognizing differences in newborn physiologic and behavioral adaptation to extra uterine life. Care providers can then know which infants might be at risk for such difficulties as thermoregulation, breastfeeding, and bonding, allowing for early intervention.

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