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Maternal Salivary Cortisol in Pregnancy and Pre-, Peri- and Postnatal Medical Complications

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Abstract

Introduction: There are several studies in rodents, primates but also in humans showing that prenatal stress has impact on the foetus and the new-born in terms of his/ her physiological state and growth [1]. Results of the association between prenatal stress and birth outcome are inconclusive, retrospective or assess cortisol only once during pregnancy.

Method: N = 106 pregnant women collected salivary cortisol once during each trimester of pregnancy. Pre-, peri- and postnatal medical adversities were assessed at five months' postnatal age.

Results: Cortisol only at the end of pregnancy correlates with complication in the postnatal period (r = -.21, p = .04).

Conclusions: This finding supports the hypothesis that elevated maternal cortisol level has an impact on birth outcomes. The last trimester of pregnancy seems to play a crucial role.

Keywords: Birth complication; Birth outcome; Pregnancy; Salivary cortisol

Introduction

Prenatal stress and its impact on human infants receive increasing scientific attention in recent years. The foci of primary interest are attentional organization [2]. temperament [3-4]. and developmental consequences affecting infant growth [5]. Derived from these findings the 'Foetal Programming Hypothesis' was confirmed, stating that prenatal events and stressors are programming the infant brain and its metabolism via the stress hormone cortisol. According to this model mother's cortisol level is increased if the mother is confronted with a stressor or she perceives stress during pregnancy. In a prospective study on mothers with a history of abuse it was shown that even past stressors in maternal life had a profound impact on perinatal and postnatal outcome [6] Cortisol can pass the placenta and can influence a variety of birth outcome variables like birth weight, gestational age, head circumstances and length. These early risk factors are assumed to have impact on the cognitive and behavioural development of the child. In a prospective study on mothers with a history of abuse This is the first study looking at the association between prenatal maternal cortisol level during each trimester of pregnancy and medical pre-, peri- and postnatal complication in a prospective study design.

Methods

The sample consists of N = 106 hundred healthy European pregnant women recruited in early pregnancy (week of gestation: 13.6±1.68) through local newspaper, homepages and in obstetricians' offices in Heidelberg and surrounding area. Exclusion criteria were (a) inability to speak and read German language, (b) twin pregnancy, (c) advanced pregnancy (>19 week of pregnancy), (d) inability to come to the laboratory at an infant's age of three and five months. The study protocol was approved by the ethic committee of the university Clinic of Heidelberg. All pregnant women were informed about the course and the aim of the study and gave written informed consent. In each trimester of pregnancy, the subjects collected salivary cortisol on three following days in a defined time interval under controlled conditions. The subjects were asked to suck on cotton rolls for two to three minutes on three following days between eleven and one o'clock in the morning [7]. Subjects were instructed to collect saliva in a quiet, non-stressed situation

before lunch time, with the last meal or brushing of teeth being at least 30 minutes ago [8]. They had to store the salivates in the refrigerator (-20°C) and sent them back in a covered envelope after they collected three cortisol probes. The salivates were centrifuged at 300rpm for 5 minutes and salivary-free Cortisol concentrations were analyzed in the pharmacological laboratory of the University of Heidelberg. Data about the medical course of pregnancy were gathered by the Steinhausen Pre-, Peri- and Postnatal Score [9], an established instrument for the measurement of medical complications related to pregnancy and delivery, rendering separate pre-, peri-, and postnatal scores. It comprises the items of the ALSPAC-index [10]. The perinatal score is formed by medical events occurring during delivery. The items contained are: Prenatal: Bleeding, severe vomiting , EPH ketosis, accidents infectious diseases, X-Ray or radiotherapy in first trimester, medications, alcohol, smoking (>5 cigarettes/day), substance abuse, surgery with anesthesia, abortion, severe strain, threatened abortion with hospitalization, severe illness, more than 5 pregnancies, earlier abortions or miscarriages, complications in earlier pregnancies, Perinatal: Transport in neonatology , intensive care treatment, prolonged labor, breech position, umbilical cord complications, disorders of placenta, forceps or vacuum, section, premature rupture of membranes, meconium in amniotic fluid, hydramnion, APGAR (1 Min.<7/5 min. <8) pathological CTG Postnatal: icterus prolongatus, seizures, feeding disorders, intensive care measures, traumatic birth (fractures), pathological blood chemistry, severe illnesses (sepsis, operations).The scale was filled in by the examiner after access to the routine out-patient documentations filled out by independent obstetricians for each pregnant woman after the prescribed monthly examinations and after access to medical in-patient records.

Kolmogorov-Smirnov-Test was applied to test for normal distribution. The correlation between salivary cortisol in each trimester of pregnancy and pre-, peri- and postnatal medical complication was tested with Spearman's rho correlation as the data were non-normally distributed.

Results

Drop-out rate was N = 2. N = 68 infants were delivered spontaneously, N = 29 by cesarean section and N = 9 by vacuum extraction. Children's mean birth weight was 3381g±492, gestational age was M = 39+3. N = 61 boys and 45 girls were born. Salivary cortisol in none of the three trimester during pregnancy correlates with prenatal medical complications ($r = .10$, $r = .18$, $r = .06$, $p > .05$). Salivary cortisol in none of the measurement points during pregnancy correlates with perinatal medical complications ($r = .08$, $r = .12$, $r = .07$). Salivary cortisol in the beginning ($r = -.08$, $p > .05$) and in mid-pregnancy ($r = -.04$, $p > .05$) does not correlate with postnatal medical complication. Salivary cortisol at the end of pregnancy is significantly associated with postnatal medical complication in the Steinhausen score ($r = -.21$, $p = .04$).

Discussion

Our data reveal an association between maternal prenatal salivary cortisol during the last trimester of pregnancy and medical complication in the neonatal period of the baby like feeding problems, icterus, intubation, intensive care etc. Cortisol level in the first and second trimester of pregnancy did not reveal a similar association with children's outcome. Furthermore, prenatal cortisol levels did not correlate with prenatal medical complication and with perinatal medical complication in our sample. Cortisol seems to only influence children's medical complications after delivery, but not medical complication during pregnancy and during delivery. The last trimester seems to play a crucial role. The results strengthen the 'foetal Programming Hypothesis' implying that prenatal maternal stress is programming foetal/ children's birth outcomes and later cognitive and behavioural development already during pregnancy. So far, this has never been demonstrated in a prospective study design.

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