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Editorial
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Time-Associated Effect of Cesarean Delivery on Maternal Behaviors and Breastfeeding

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Editorial

Cesarean Delivery (CD) is a surgical procedure made through mother's abdomen and uterus to deliver the baby. In the United States, about 33% of deliveries are through CD; in China, an overall hospital-based rate of CD was 41.1% in 2016 [1,2]. This procedure is helpful when a vaginal delivery is likely putting the baby's or mother's life at risk; however, most women after CD experience low rate of long-term breastfeeding with certain mental disorders [3,4]. Thus, CD emerges as a global health issue for the mothers and babies.

The negative impacts of CD on maternal behaviors and lactation are likely associated with delayed initiation of breastfeeding following surgical stress during CD. It is extensively identified that early initiation of breastfeeding is critical for lactation beyond 6 months since parturition and its associated neuroendocrine profiles are essential for the maturation of brain machinery for the milk-ejection reflex shown in animal studies [5]. However, early suckling in CD mothers is limited by surgical stress and pains; imposed early suckling on the operation table in CD women exhibited more breast symptoms in postpartum breastfeeding [6]. Thus, the regulation of CD effect on maternal behaviors and lactation remains to be clarified to provide optimal guidance for health providers and for CD mothers.

To identify the regulation of CD influence on maternal health, Wang's laboratory has examined effects of timing of CD on maternal behaviors and lactation efficiency using a rat model [7]. They found that all CD dams showed obvious limitation of movement and reduction of maternal behaviors during the first ~8 h following the CD. However, different times of the operation had different effects on maternal health. When CD was performed after the appearance of parturition signs, there was no significant difference in dam's interest to the offspring as manifested in the latency of pup retrieval, latency and times of anogenital licking and latency of lactation between control and CD dams at the 4th day after the operation [8]? Similarly, the number of self-grooming (a sign of maternal anxiety) and the Litter's Body Weight Gains (LBWGs) in CD dams were not significantly different from the control dams. By contrast, CD performed 1 to 3 days before parturition initiation (preterm CD) had significant influence on the maternal behaviors and lactation performance. That is, the incidence of active pup retrieval and anogenital licking was significantly lower while the latency of retrieval and anogenital licking was significantly longer in those preterm CD dams. Correspondingly, the LBWGs were also reduced significantly in the dams with preterm CD. Interestingly, if the dam-pup reunion started at 8 h to 12 h after the CD, maternal self-grooming was reduced significantly; however, the LBWGs did not significantly different from the CD dams initiating suckling shortly after awakening from CD procedure. Different from that observed in the lactating rats undergoing maternal separation from their pups, maternal behaviors and milk yields in the dams with preterm CD exhibited a trend of spontaneous improvement as the elapses of post-CD time [9].

Parturition is a turning point of neuroendocrine profile that determines the mental status and lactation efficiency of the mothers. Normal parturition is driven by a pulsatile secretion of oxytocin following expansion of the cervix; the generation of this pattern of oxytocin secretion depends on the maturation of the mechanisms underlying the milk-ejection reflex in the hypothalamus at the term, which allows the oxytocin-secreting system to facilitate maternal behaviors and milk yields during nursing the baby in cooperation with prolactin and other hormones. Correctly selecting the time of CD operation is important for reducing disturbance of maternal behaviors and breastfeeding, which should not start until parturition initiation. This possibility is verified in this study that when the CD was performed after parturition initiation, the interest and milk availability of CD dams to the pups

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had no significant difference from the control dams.

In the reality, the majority of CD was performed before the term and thus, maternal depression and breastfeeding difficulty become unavoidable issues to the health providers and CD mothers. Obviously, acute post-operational pain could activate stress response and result in postpartum depression largely due to disruption of the neuroendocrine control of oxytocin secretion by the activation of the Hypothalamic-Pituitary-Adrenal (HPA) axis [10]. Noticeably, aberrant maternal behaviors are associated with the time of reunion. As shown in the result, dams of early reunion with the litter showed severe sign of maternal anxiety than those that reunited with pups 8 h to 12 h later. In general, anxiety is associated with decreased inhibitory neural process and increased excitatory process, such as reduced GABAergic signaling and increased glutamatergic transmission in the brain. During lactation, suckling-evoked oxytocin release is essential for positive maternal mood by reducing stress through dampening the circadian rhythm of HPA axis, reducing noradrenergic input activity and inhibition of amygdala activity. However, strong psychiatric impacts like the CD can still disrupt the "defense system" that is built on the anxiolytic effects of endogenous OT; leading to maternal anxiety [11,12]. The maternal anxiety in return worsens mother-baby relationship and consequently disrupts lactation performance during suckling.

In parallel with the disorders in mental activity, milk availability to the litters was also lower in the preterm CD group despite the trend of gradual recovery of the LBWGs over time, a finding consistent with the report in women [13]. The milk shortage likely reflects the immaturity of the milk-ejection reflex machinery of the hypothalamus because the "pre-term" birth can terminate morphological and functional change in the hypothalamus around term that is essential for the maturation of the oxytocin-secreting system [14]. On the other hand, CD-evoked hypogalactia during lactation could result from surgical stress and the lack of suckling stimulation. Surgical stress is a dramatic feature in CD dams and can increase activity of the HPAaxis, sympathetic output and adrenaline release from adrenal medulla. The activation of HPA axis can inhibit oxytocin neuronal activity, oxytocin release and the maternal care while increased adrenaline can cause contraction of teat sphincter and block milk removal, thereby disrupting the milk-ejection reflex [15]. These factors could explain why mothers with CD become a predictable population of breastfeeding failure at the early stage of lactation.

CD influences on maternal health are different from the effect of maternal separation from the babies although the latter could partially contribute to the effect of the CD [16]. With the progress of postpartum days, signs of maternal depression and hypogalactia faded gradually in this report. This finding is in agreement with the report that there may be a somewhat higher incidence of postpartum depression in the first weeks after childbirth for women who have CD, but this difference does not persist [17]. Thus, in the preterm CD, if applying some measures like intranasal application of oxytocin to facilitate the maturation of the hypothalamic oxytocin-secreting system, it is possible to help the mother to overcome initial postpartum depression and hypogalactia, and in turn achieve the goal of long-term breastfeeding with fewer disturbances of maternal behaviors [16].

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