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Circadian Rhythms of the Murine Placenta Change over Gestation

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Preterm birth is the leading cause of infant mortality across the globe, occurring in 11 percent of births in the United States. Given that shift workers, who make up about 15 percent of the work force, experience reproductive problems including an increased risk of preterm birth, we believe that a disrupted sleep-wake cycle and overall circadian rhythms may be the cause. To determine how circadian rhythms are linked to the timing of birth, I studied the circadian rhythms of the murine placenta, hypothesizing that changes in these rhythms predict the timing of birth. To evaluate these rhythms, I cultured placental explants from pregnancy day (P) 9.5, P15.5, and P18.5 from transgenic PERIOD2::LUCIFERASE (PER2::LUC) mice. This knock-in mouse model permitted me to measure the expression of the clock protein PERIOD2 as reported by bioluminescence. I found that the amplitude of placental rhythms decreased from mid- to late gestation, accompanied by a tendency of period to decrease. To identify the driver of these changes, I also isolated the two major layers of the late-gestation placenta: the labyrinth zone and the decidua. I found that the amplitude and period of rhythms of the overall placenta more closely resembled those of labyrinth zone rhythms, and that the phase of placental rhythms the day prior to delivery was intermediate between the two layers. These results indicate that the labyrinth zone drives overall placental rhythms during late gestation, while also communicating with the decidua. If the circadian rhythms of the reproductive system are involved in the timing of birth, disruptions to any of these characteristics of placental rhythms may also be linked to preterm birth.