



Laplace's Law Dictates Birth Timing and Mode of Delivery: A Hypothesis

Ali HEGAZY, FRCOG

Midland Regional Hospital, Mullingar, Co. Westmeath, Ireland



Dublin Midlands Hospital Group

Background

The laws of physics govern the function of the human body organs. However, the law of physics that controls uterine function during pregnancy is still unknown. Spontaneous preterm labor, labor dystocia, and post-term pregnancy are major obstetric complications, and their biological mechanisms are poorly understood. Failure to understand uterine function during pregnancy is a major shortcoming in modern healthcare.

Objective

Supporting the hypothesis

Method

This study investigated the current evidence-based literature and research that may support the hypothesis, accompanied by two 40-second 3D animations.

Results: The cervix's isthmus does not seem to exist.

Uterine mechano-transduction may be the main mechanism and system that controls uterine function during pregnancy through exponential uterine wall tension (EUWT) and the hormonal milieu. EUWT is created and maintained by the interaction between the gestational sac, uterus, and cervix, for which the primary function is EUWT maintenance. EUWT mechano-transduction with progesterone/estrogen modulation induces the stretch-dependent inhibitory system, which is the main system that maintains pregnancy due to the Myometrial Tension-Contraction Interaction characteristic, where high tension induces relaxation and low tension induces contraction. It also induces the stimulatory system by inducing myometrial hyperplasia and hypertrophy. Uterine contractions create direct and indirect uterine-cervical interactions (DIDUCI). DIDUCI transforms the cervix into the lower uterine segment (LUS), through the TYVU pattern formation. Light-dark cycle modulation of inhibitory and stimulatory systems divides gestation into five clinical phases: growth, maturation, transition, parturition, and involution.

Maturation phase (30-40 weeks): Nocturnally, oxytocin and melatonin modulate the stimulatory system. Additionally, cortisol modulates the inhibitory system, causing a transient nocturnal pause. The nocturnal synchronization and synergy of the two systems make the uterus an active organ at night, transforming the cervix into the LUS. This results in nocturnal EUWT failure dictating both pregnancy intervals and circadian timers. A malfunction of the inhibitory system causes preterm labor. A malfunction of the stimulatory system causes post-term pregnancy, and a combined two-system malfunction causes labor dystocia.

Conclusion

Pregnancy is a balance between opposing and interactive inhibitory and stimulatory systems due to EUWT mechano-transduction and progesterone/estrogen modulation. The autonomous creation, maintenance, and eventual termination of EUWT, secondary to light-dark cycle modulation, make pregnancy an autonomic cycle with constant intervals and circadian timers. The malfunction of EUWT alters birth timing and mode of delivery. EUWT is measured by Laplace's Law and Pascal's principle, which might be the laws of physics that govern uterine function during pregnancy

Animations

- https://www.youtube.com/watch?v=_VlaC76kbv8&t=159s
- <https://www.youtube.com/watch?v=YxIt2WO0NXY>