

On the Problem of Patient-Specific Endogenous Glucose Production in Neonates on Stochastic Targeted Glycemic Control

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Abstract

Background:

Both stress and prematurity can induce hyperglycemia in the neonatal intensive care unit, which, in turn, is associated with worsened outcomes. Endogenous glucose production (EGP) is the formation of glucose by the body from substrates and contributes to blood glucose (BG) levels. Due to the inherent fragility of the extremely low birth weight (ELBW) neonates, true fasting EGP cannot be explicitly determined, introducing uncertainty into glycemic models that rely on quantifying glucose sources. Stochastic targeting, or STAR, is one such glycemic control framework.

Methods:

A literature review was carried out to gather metabolic and EGP values on preterm infants with a gestational age (GA) <32 weeks and a birth weight (BW) <2 kg. The data were analyzed for EGP trends with BW, GA, BG, plasma insulin, and glucose infusion (GI) rates. Trends were modeled and compared with a literature-derived range of population constant EGP models using clinically validated virtual trials on retrospective clinical data.

Results:

No clear relationship was found for EGP and BW, GA, or plasma insulin. Some evidence of suppression of EGP with increasing GI or BG was seen. Virtual trial results showed that population-constant EGP models fit clinical data best and gave tighter control performance to a target band in virtual trials.

Conclusions:

Variation in EGP cannot easily be quantified, and EGP is sufficiently modeled as a population constant in the neonatal intensive care insulin–nutrition–glucose model. Analysis of the clinical data and fitting error suggests that ELBW hyperglycemic preterm neonates have unsuppressed EGP in the higher range than that seen in literature.

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Abbreviations: (BG) blood glucose, (BW) birth weight, (CNS) central nervous system, (EGP) endogenous glucose production, (ELBW) extremely low birth weight, (GA) gestational age, (GI) glucose infusion, (IQR) interquartile range, (NICU) neonatal intensive care unit, (NICING) neonatal intensive care insulin–nutrition–glucose, (STAR) stochastic targeting, (TPN) total parenteral nutrition

Keywords: endogenous glucose production, extremely preterm infants, glycemic control, insulin therapy, physiological modeling

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