

## Parenteral Glucose and Glucose Control in the Critically Ill: A Kinetic Appraisal

Roman Hovorka, Ph.D.<sup>1</sup> and Jeremy Cordingley, M.B.B.S.<sup>2</sup>

### Abstract

#### Background:

We investigated the influence of parenteral glucose infusion on insulin-driven tight glucose control (4.4–6.1 mmol/liter) in the critically ill by appraising kinetic characteristics of the gluoregulatory system.

#### Methods:

Turnover characteristics of the gluoregulatory system associated with constant 0, 1.2, and 2.4 mg/kg/min parenteral glucose infusion were obtained by literature review and mass-balance calculations.

#### Results:

Without parenteral glucose infusion, the achievement of tight glucose control is hampered by long time delays with an anticipated glucose equilibration half-time ( $T_{1/2}$ ) of 185 min. The constant parenteral glucose infusions of 1.2 and 2.4 mg/kg/min reduce  $T_{1/2}$  to 80 and 40 min, respectively. This follows on from the accelerated glucose turnover brought about by the insulin-modulated glucose uptake, which increases in response to increasing exogenous insulin required to achieve tight glucose control. However, large variations exist among glucose turnover characteristics in the critically ill.

#### Conclusions:

The constant parenteral glucose infusion greater or equal to 2.4 mg/kg/min is expected to simplify the achievement of tight glucose control by reducing system delays and may facilitate the development of more intuitive, efficacious, and safer insulin-titration guidelines.

*J Diabetes Sci Technol* 2007;1(3):357-365

**Author Affiliations:** <sup>1</sup>Department of Paediatrics, University of Cambridge, Hills Road, Cambridge CB2 2QQ, United Kingdom; and <sup>2</sup>Department of Adult Intensive Care Unit, Royal Brompton Hospital, Sydney Street, London, SW3 6NP, United Kingdom

**Abbreviations:** (ACCP) American College of Chest Physicians, (EGP) endogenous glucose production (mg/kg/min), (G) glucose (mmol/liter), (IMGU) insulin-mediated glucose uptake (mg/kg/min), (MCR) metabolic clearance rate (ml/kg/min), (NIMGU) noninsulin-mediated glucose uptake (mg/kg/min), (Rd) glucose uptake (mg/kg/min), ( $T_{1/2}$ ) equilibration half-time (min)

**Keywords:** critical illness, glucose control, glucose metabolism, insulin titration, kinetic analysis, parenteral nutrition

**Corresponding Author:** Dr. Roman Hovorka, Diabetes Modelling Group, Department of Paediatrics, University of Cambridge, Box 116, Addenbrooke's Hospital, Hills Road, Cambridge CB2 2QQ, UK; email address [rh347@cam.ac.uk](mailto:rh347@cam.ac.uk)