MODELLING INSULIN AND GLUCOSE DYNAMICS IN DIABETES MELLITUS TYPE 1: INTRAVENOUS, SUBCUTANEOUS AND INTRAPERITONEAL APPROACH

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Diabetes mellitus type 1 (DM1)
• Normal glucose regulation by insulin
• Destructed insulin secretion in DM1
• Exogenous insulin infusions

State-of-the-art treatment
• Sensor-augmented insulin pumps
• Subcutaneous insulin delivery
• Subcutaneous glucose sensing
• Manual interventions required

Long-term aim
• Artificial Pancreas (AP)
• Fully automated insulin delivery

Strategy
• Easily extendable modular model
• Open- and closed-loop scenarios
• AP algorithm development based on simulation
• Validation by animal and clinical trials

MOTIVATION

Input
• Intravenous glucose bolus
• Insulin bolus

Output
• Measured glucose concentration

Physiological glucose-insulin model [1]

Insulin absorption kinetics
• Intravenous (IV) [1]
• Subcutaneous according to Wilinska et al. (SCWil.) [2]
• Subcutaneous according to Dalla Man et al. (SCD.M.) [1]
• Intraperitoneal (IP) [3]

Glucose kinetics
• Intravenous (IV) [1]
• Subcutaneous (SC) [4]
• Sensor dynamics

MODEL

CONCLUSION

Insulin infusion
• SC: common but large time constants
• IV: fastest but not practical for safety reasons
• IP: promising

Glucose sensing
• SC: significant time delays/constants
• No other options available for outpatient use
• Faster sensing techniques highly desired

REFERENCES