In silico assessment of a computerised model-based glycaemic control approach in a Belgian medical intensive care unit

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Problem: Critical illness
Stress-induced hyperglycaemia
Reduced insulin sensitivity
Glycaemic variability
Increased mortality

Solution: Model-based glycaemic control: exogenous insulin/nutrition inputs
Dosing ? Timing ?

(1) STAR framework
Insulin-only, target-to-range, patient-specific and adaptive glycaemic control approach

New blood glucose (BG) measurement
Identification of the current SI value
Forecast of SI variability
Forecast of BG variability
Hypoglycaemic risk assessment
Optimal insulin dosing and timing

(2) Virtual patients
Identification of insulin sensitivity (SI) profile

Number of patients: 20
% of males: 45.0
Age (years): 68.0 [54.0-76.0]
SAPS II score: 67.0 [51.0-76.0]
Initial glycaemia (mmol/L): 8.5 [7.3-9.9]

Clinical data (glycaemic levels, insulin and nutrition rates/timing)
Virtual patient (hourly SI values)

(3) Virtual trials
In silico assessment of the efficiency, safety and performance of the STAR framework

Virtual patient
STAR framework
Glycaemic outcomes
Insulin input adjustment
Nutrition input adjustment

BG (mmol/L)
Exogenous insulin rate (U/h)
Exogenous glucose rate (g/h)

Target band
Clinical protocol
STAR-Liege 3

Clinical protocol
STAR-Liege 3
Total hours: 5009
5014
Number of measurements: 2125
1912
Blood glucose (BG) levels (mmol/L): 7.0 [6.1-8.3]
7.0 [6.7-7.7]
% BG ≥ 10.0 mmol/L: 7.6
6.12
% BG within 8.3-10.0 mmol/L: 17.04
10.47
% BG within 5.6-8.3 mmol/L: 58.98
81.82
% BG within 4.4-5.6 mmol/L: 13.12
1.49
% BG < 4.4 mmol/L: 3.10
0.10
% BG < 4.0 mmol/L: 1.23
0.04
% BG < 2.2 mmol/L: 0.00
0.00
Number of patients with BG < 2.2 mmol/L: 0
0
Exogenous insulin rate (U/h): 3.0 [2.0-6.5]
3.5 [2.0-6.0]
Exogenous glucose rate (g/h): 9.7 [8.8-11.7]
9.7 [8.8-11.6]

Reduction of clinical workload
Safe, effective glycaemic control
STAR = big improvement over the current clinical protocol

(4) Clinical trials
Assessment of the efficiency, safety and performance in a real, clinical environment (in progress)

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