Performance of Stochastic Targeted Blood Glucose Control Protocol by virtual trials in the Malaysian intensive care unit


View ResearcherID and ORCID

COMPUTER METHODS AND PROGRAMS IN BIOMEDICINE

Volume: 162 Pages: 169-155
DOI: 10.1016/cmpb.2018.03.001
Published: AUG 2018
Document Type: Article
View Journal Impact

Abstract

Background and objective: Blood glucose variability is common in healthcare and it is not related or influenced by diabetes mellitus. To minimise the risk of high blood glucose in critically ill patients, Stochastic Targeted Blood Glucose Control Protocol is used in intensive care units at hospitals worldwide. Thus, this study focuses on the performance of stochastic modelling protocol in comparison to the current blood glucose management protocols in the Malaysian intensive care unit. Also, this study is to assess the effectiveness of Stochastic Targeted Blood Glucose Control Protocol when it is applied to a cohort of diabetic patients.

Methods: Retrospective data from 210 patients were obtained from a general hospital in Malaysia from May 2014 until June 2015, where 123 patients were having comorbid diabetes mellitus. The comparison of blood glucose control protocol performance between both protocol simulations was conducted through blood glucose fitted with physiological modelling on top of virtual trial simulations, mean calculation of simulation error and several graphical comparisons using stochastic modelling.

Results: Stochastic Targeted Blood Glucose Control Protocol reduces hyperglycaemia by 16% in diabetic and 9% in nondiabetic cohorts. The protocol helps to control blood glucose level in the targeted range of 4.0-10.0 mmol/L for 71.8% in diabetic and 82.7% in nondiabetic cohorts, besides minimising the treatment hour up to 71 h for 123 diabetic patients and 39 h for 87 nondiabetic patients.

Conclusion: It is concluded that Stochastic Targeted Blood Glucose Control Protocol is good in reducing hyperglycaemia as compared to the current blood glucose management protocol in the Malaysian intensive care unit. Hence, the current Malaysian intensive care unit protocols need to be modified to enhance their performance, especially in the integration of insulin and nutrition intervention in decreasing the hyperglycaemia incidences. Improvement in Stochastic Targeted Blood Glucose Control Protocol in terms of u(ε) model is also a must to adapt with the diabetic cohort. (C) 2018 Elsevier B.V. All rights reserved.

Keywords

Author Keywords: Blood glucose control protocol; Stochastic modelling; Sliding scale method; Hyperglycaemia; Insulin sensitivity

Keyword(s) Plus: CRITICALLY-Ill PATIENTS; TIGHT GLYCEMIC CONTROL; INSULIN THERAPY; HYPOGLYCEMIA; MODEL; HYPERGLYCEMIA; MANAGEMENT; MORTALITY

Author Information

Reprint Address: Jamaludin, UK (reprint author)

Addresses:

[1] Univ Malaysia Pahang, Fac Mech Engn, Pekan 26600, Pahang, Malaysia


[3] Univ Tenaga Nas, Coll Engn, Putrajaya Campus, Kajang 4300, Selangor, Malaysia
Grant Number
7.
6.
5.
4.
3.
2.
1.

Showing Cited References
See more data fields

Cited References: 46
Showing 30 of 46 View All in Cited References page (from Web of Science Core Collection)

1. Glycemia management in critical care patients
   By: Bilotta, Federico; Rosa, Giovanni
   WORLD JOURNAL OF DIABETES Volume: 3 Issue: 7 Pages: 130-134 Published: JUL 15 2012
   Times Cited: 17

2. Validation of a model-based virtual trials method for tight glycemic control in intensive care
   By: Chase, J. Geoffrey; Suhaimi, Fatnah; Penning, Sophie; et al.
   BIOMEDICAL ENGINEERING ONLINE Volume: 9 Article Number: #4 Published: DEC 14 2010
   Times Cited: 36

3. Tight glycemic control in critical care - The leading role of insulin sensitivity and patient variability: A review and model-based analysis
   By: Chase, J. Geoffrey; Le Compte, Aaron J.; Suhaimi, Fatnah; et al.
   COMPUTER METHODS AND PROGRAMS IN BIOMEDICINE Volume: 102 Issue: 2 Special Issue: SI7 Pages: 156-171 Published: MAY 2011
   Times Cited: 17

4. Organ failure and tight glycemic control in the SPRINT study
   By: Chase, J. Geoffrey; Pretty, Christopher G.; Pfeifer, Leesa; et al.
   CRITICAL CARE Volume: 14 Issue: 4 Article Number: R154 Published: 2010
   Times Cited: 45

5. Implementation and evaluation of the SPRINT protocol for tight glycaemic control in critically ill patients: a clinical practice change
   By: Chase, J. Geoffrey; Shaw, Geoffrey M.; Le Compte, Aaron J.; et al.
   CRITICAL CARE Volume: 12 Issue: 2 Article Number: R63 Published: 2008
   Times Cited: 111

6. Model-based insulin and nutrition administration for tight glycemic control in critical care
   By: Chase, J. Geoffrey; Shaw, Geoffrey M.; Leitz, Thomas; et al.
   Current Drug Delivery Volume: 4 Issue: 4 Pages: 283-296 Published: OCT 2007
   Times Cited: 34

7. Title: [not available]
   By: Compte, A.L.; Chase, J.G.; Lynn, A.; et al.
   Blood Glucose Controller for Neonatal Intensive Care: Virtual Trials Development and First Clinical Trials Published: 2009
   Publisher: SAGE Publications
   [Show additional data]
8. **Intensive Insulin Therapy in Practice: Can We Do It?**
   By: Dossett, Lesly A; Collier, Bryan; Donahue, Ra; et al.
   JOURNAL OF PARENTERAL AND ENTERAL NUTRITION Volume: 33 Issue: 1 Pages: 14-20 Published: JAN-FEB 2009
   Times Cited: 13

9. **Pilot proof of concept clinical trials of Stochastic Targeted (STAR) glycemic control**
   By: Evans, Alicia; Shaw, Geoffrey M; Le Compte, Aaron; et al.
   ANNALS OF INTENSIVE CARE Volume: 1 Article Number: 38 Published: 2011
   Times Cited: 30

10. **Stochastic targeted (STAR) glycemic control: design, safety, and performance.**
    By: Evans, Alicia; Le Compte, Aaron; Tan, Chia-Sieng; et al.
    Journal of diabetes science and technology Volume: 6 Issue: 1 Pages: 102-15 Published: 2012 Jan 01
    Times Cited: 26

11. **Intensive versus Conventional Glucose Control in Critically Ill Patients**
    By: Finfer, S; Blair, D; Bellomo, R; et al.
    Group Author(s): NICE-SUGAR Study Investigators; NICE Australia-New Zealand; SUGAR North Amer Management Comm; et al.
    NEW ENGLAND JOURNAL OF MEDICINE Volume: 360 Issue: 13 Pages: 1283-1297 Published: MAR 26 2009
    Times Cited: 2,413

12. **Hypoglycemia and Risk of Death in Critically Ill Patients**
    By: Finfer, Simon; Liu, Bel; Chilcott, Dean R; et al.
    Group Author(s): NICE-SUGAR Study Investigators
    NEW ENGLAND JOURNAL OF MEDICINE Volume: 367 Issue: 12 Pages: 1108-1114 Published: SEP 20 2012
    Times Cited: 395

13. **Glucose control and mortality in critically ill patients**
    By: Finney, S; Zekveld, C; Ella, A; et al.
    Show additional data
    Times Cited: 1

14. **STAR Development and Protocol Comparison**
    By: Fisk, Liam M; Le Compte, Aaron J; Shaw, Geoffrey M; et al.
    IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING Volume: 59 Issue: 12 Pages: 3357-3364 Published: DEC 2012
    Times Cited: 31

15. **Intensive insulin therapy and mortality among critically ill patients: a meta-analysis including NICE-SUGAR study data**
    By: Griesdale, Donald E. G.; de Souza, Russell J.; van Dam, Rob M.; et al.
    CANADIAN MEDICAL ASSOCIATION JOURNAL Volume: 180 Issue: 8 Pages: 821-827 Published: APR 14 2009
    Times Cited: 582

16. **Years of life lost and healthy life-years lost from diabetes and cardiovascular disease in overweight and obese people: a modelling study**
    By: Grover, Steven A.; Kaouache, Mohammed; Rempel, Philip; et al.
    LANCET DIABETES & ENUCROLOGY Volume: 3 Issue: 2 Pages: 116-122 Published: FEB 2015
    Times Cited: 54

17. **Application of conventional blood glucose control strategy in surgical ICU in developing countries: Is it beneficial?**
    By: Hammy, Waileed; Khedr, Hisham; Rushdi, Tarek; et al.
    EGYPTIAN JOURNAL OF ANAESTHESIA Volume: 32 Issue: 1 Pages: 123-129 Published: JAN 2016
    Times Cited: 4

18. **Integral-based parameter identification for long-term dynamic verification of a glucose-insulin system model**
    By: Hann, CE; Chase, JG; Lin, J; et al.
    COMPUTER METHODS AND PROGRAMS IN BIOMEDICINE Volume: 77 Issue: 3 Pages: 259-270 Published: MAR 2005
    Times Cited: 107

19. **Reducing hypoglycaemia with insulin analogues**
    By: Heller, S
    INTERNATIONAL JOURNAL OF OBESITY Volume: 26 Supplement: 3 Pages: S31-S36 Published: SEP 2002
    Times Cited: 27

20. **Management of severe/acute hyperglycemia in hospitalised type 2 diabetes mellitus patients**
    By: Hari, H.Z.; Permalu, V; Kasim, N.B.
    Times Cited: 3

21. **Guidelines for the use of an insulin infusion for the management of hyperglycemia in critically ill patients**
    By: Jacoby, Judith; Bircher, Nicholas; Kinsley, James; et al.
    CRITICAL CARE MEDICINE Volume: 40 Issue: 12 Pages: 3251-3276 Published: DEC 2012
    Times Cited: 210
22. Performance of STAR Virtual Trials for Diabetic and Non-Diabetic in HTAA Intensive Care Unit
   By: Jamakudin, Ummu K.; Daharudin, Fatimah; Razak, Normy Norfiza A.; et al.
   2016 IEEE EMBS CONFERENCE ON BIOMEDICAL ENGINEERING AND SCIENCES (IECBES) Book Series: IEEE EMBS Conference on Biomedical Engineering and Sciences Pages: 193-198 Published: 2016

23. Title: [not available]
   Group Author(s): K.K.M.M.S. o. I. Care
   Management Protocols in ICU, in enteral and parenteral nutrition in the intensive care unit Pages: 42-50 Published: 2012

24. Glycemic variability: a strong independent predictor of mortality in critically ill patients
   By: Krinsley, J.S.
   Crit Care Med: Volume: 36 Published: 2008

25. Diabetic status and the relation of the three domains of glycemic control to mortality in critically ill patients: an international multicenter cohort study
   By: Krinsley, James S.; Egg, Moritoki; Kiss, Alex; et al.
   CRITICAL CARE Volume: 17 Issue: 2 Article Number: R37 Published: 2013

26. Association between hyperglycemia and increased hospital mortality in a heterogeneous population of critically ill patients
   By: Krinsley, JS
   MAYO CLINIC PROCEEDINGS Volume: 78 Issue: 12 Pages: 1471-1478 Published: DEC 2003

27. Title: [not available]
   By: Kulnik, R.; Plank, J.; Pachler, C.; et al.
   Evaluation of Implementation of a Fully Automated Algorithm (Enhanced Model Predictive Control) in an Interacting Infusion Pump System For Establishment of Tight Glycemic Control in Medical Intensive Care Unit Patients Published: 2008
   Publisher: SAGE Publications
   [Show additional data]

28. Effect of intensive insulin therapy on insulin sensitivity in the critically ill
   By: Langouche, L.; Wouters, P.J.; D'Hoore, A.; et al.
   [Show additional data]

   By: Lin, Jessica; Razak, Normy N.; Pretty, Christopher G.; et al.
   COMPUTER METHODS AND PROGRAMS IN BIomedicine: Volume: 102 Issue: 2 Special Issue: SI Pages: 192-205 Published: MAY 2011

30. A simple insulin-nutrition protocol for tight glycemic control in critical illness: Development and protocol comparison
   By: Lonergan, Timothy; Le Compte, Aaron; Willacy, Mike; et al.
   DIABETES TECHNOLOGY & THERAPEUTICS Volume: 8 Issue: 2 Pages: 191-206 Published: APR 2006

Showing 30 of 46 View All in Cited References page