Glycemic Control in Surgery Patients: A Cross-Specialty Educational Intervention for Residents

Ashley Titan[1], Ioana Baiu[1], Kacy Church[2], Edmund W. Lee[1], James N. Lau[1]

Corresponding author: Dr Ioana Baiu ibaiu@stanford.edu
Institution: 1. Stanford University, 2. Palo Alto Medical Foundation
Categories: Curriculum Planning, Educational Strategies, Learning Outcomes/Competency, Teachers/Trainers (including Faculty Development), Teaching and Learning

Received: 21/02/2020
Published: 05/05/2020

Abstract

Introduction: Glycemic control in surgical patients with diabetes is critical to their recovery. Residents play a significant role in the management of these patients and glucose control while inpatient. Surgery residents are not trained in diabetes management and there is a significant knowledge deficit of first year surgical residents with regard to perioperative and inpatient diabetes management.

Methods: Together with the endocrinology team, we developed an inpatient diabetes management curriculum for incoming surgical residents. The session was incorporated into a larger 2-day intern preparation course given in anticipation of the start of residency. The course is taught by surgery attending physicians and surgical residents and is meant to prepare new interns for common problems that they will encounter on the patient floors.

Results: The curriculum was highly rated by residents led to significantly greater comfort and versatility with the management of various types of insulin regimens in surgical patients.

Discussion: This study demonstrates the effectiveness of a brief intervention in developing, managing and altering insulin regimens by surgical residents through a multidisciplinary approach. Our curriculum can be easily adopted for other learner groups including all other interns and medical students prior starting their clerkships. The materials created for the curriculum can be downloaded free of charge to be used by other programs.

Keywords: graduate medical education; diabetes management; resident education; insulin; glycemic control; curriculum development
Introduction

Glycemic control in diabetic surgical patients is critical to their recovery and adequate glucose levels have been associated with improved mortality and morbidity (Kwon et al., 2013). Surgical residents play a critical role in the management of patients in the perioperative period, including titration of insulin regimens. Unfortunately, there is a known knowledge gap in perioperative and inpatient diabetes management (Levetan et al., 1998; Schipper et al., 2006; Knecth et al., 2006). Prior studies of medical learners and diabetes care describes dramatic variation in skill levels (Amori and Simon, 2016; Cheekati et al., 2009; Powers et al., 2009; Tang et al., 2009). There is a great deal of literature already published on how to best manage diabetes mellitus and how to maintain adequate glycemic control (Seley, 2014; The NICE-SUGAR Study Investigators, 2009). However, surgical residents rely heavily on predetermined and simplistic sliding scales rather than developing an individualized treatment plan for each patient. Such a tailored treatment would require expertise in the use of prandial and basal insulin regimens. There have been several computer-based learning modules developed which provide a more in-depth understanding of diabetes management (Amori and Simon, 2016; Cook et al., 2009; Moattari et al., 2014). Most residents have very limited time for in-depth formal training on topics outside of the scope of their chosen specialty. As such, our project aimed to provide all residents with a targeted uniform curriculum and a quick simple reference for insulin management to improve glycemic control in the surgical patient population.

Methods

Curriculum Development:
The inpatient glycemic control curriculum was integrated as a component of a 2-day intern preparation course (boot camp) that occurs prior to the start of intern-year at Stanford University Hospital. The content of the sessions was designed to address essential skills identified from a stakeholder needs assessment done with endocrinology attendings, endocrinology fellows, general surgeon attendings, surgical residents, surgical interns, ward nurses, and diabetes nurse educators. The development and adjustment of various insulin regimens, as well as knowledge regarding the different types of insulin were identified as the most important topics to ensure effective inpatient diabetes management by interns. The resulting curriculum sought to prepare interns for these essential tasks.

Using an interdisciplinary team-approach with contributions from endocrinology attendings, endocrinology fellows, general surgery attendings, surgical residents, surgical interns, ward nurses, and diabetes nurse educators, we created a concise and precise curriculum in accordance with the American Diabetes Association Guidelines (American Diabetes Association, 2016). Interdisciplinary approaches have been associated with superior educational programs (Institute of Medicine (US) Committee on Building Bridges in the Brain, Behavioral, and Clinical Sciences, 2000; Aboelala et al., 2007; Helm et al., 2016).

Target Learners:
Approximately 35 new interns participate in the course each year. The content requires basic medical knowledge and minimal clinical experience. We designed the curriculum so that it can be implemented across a variety of resident educational venues and for residents of all specialties.

Material Required:
- Pocket handout (Supplementary File 1)
- Power Point (Supplementary File 2)
- Projector for slides
- Whiteboard (to go over insulin regimens, the case, and help facilitate with answering participant questions at during and at the end of the session)
- Evaluation Survey (Supplementary File 3)

**Educator Personnel:**
All physician facilitators were briefed on the overall goals, objectives, and key teaching points of the curriculum prior to the education session. During this meeting the handout and PowerPoint with facilitator notes were reviewed. Facilitators were experienced clinicians with relevant clinical experience in glycemic control.

**Session Flow:**
Each session was timed to last 15 minutes and to take place in a conference room with new interns and a physician facilitator. A brief orientation, including learning objectives and intended session structure, was presented. Key components of the curriculum include: developing an insulin regimen in both insulin-naïve and insulin-dependent diabetics, understanding various types of insulin formulations, adjusting regimens to ensure adequate glycemic control depending on feeding regimens and perioperative timing.

**Learner Evaluation:**
Several months following the session, interns completed a self-assessment of preparedness and answered a short survey (Supplementary File 3). This study was approved by the Institutional Review Board (approval number: 43770). Respondents were asked to rate their preparedness on a 5-point Likert scale, with 5 reflecting the greatest degree of preparedness and 1 as the least. Furthermore, we averaged the glucose levels of diabetic patients admitted to the general surgery service in the year prior to our intervention and compared them to the glucose levels from the same month of the year following the implementation of our intervention. This allowed for an objective measurement of effect of our study and an even comparison among different years and residence experience level.

The intervention included an educational handout/cognitive aid (Supplementary File 1) given to residents alongside the 15-minute educational lecture (see Supplementary File 2 for Power Point presentation and facilitator notes).

**Results/Analysis**
In the first year of our intervention, there were 35 participants. The survey response rate was 51% (18/35 participants). These interns felt that the educational sessions enhanced their preparation for internship. Prior to the glycemic control education session, 83% of participants (n = 15) did not feel comfortable with developing insulin regimens. Following the session, 94% of participants (n = 17) felt comfortable developing insulin regimens. A similar improvement was noted with self-assessment of knowledge of adjusting insulin regimens. Prior to the session, 66% of participants were not comfortable adjusting insulin regimens. Following the session, 94% of participants (n = 17) felt comfortable with these adjustments.

When the participants were asked about the effectiveness of the session, they felt that it enhanced their understanding glycemic control. Selected comments include:
- "It was a general introduction to basic insulin dosing skills."
- "Very helpful information that comes up regularly in clinical practice but that we have no other instruction on."
- "I felt more comfortable with ordering NPH after the session."

When asked what should be changed about the curriculum in the future, interns expressed a desire for additional reinforcement of the material throughout the year.

Despite the fact that glycemic control on the wards did not significantly improve compared to the same month the
year prior, in clinical practice both senior residents observing the interns as well as the interns themselves felt like they had a better understanding of insulin management of complex diabetic patients. Interns felt that having the cognitive aid provided them with more confidence in managing insulin regiments and changing insulin orders without additional consultation from endocrinology specialists. Following the educational intervention, interns were more likely to have developed more complex and appropriate insulin regimens even prior to consulting endocrinology.

Discussion

In summary, this handout and educational intervention allow residents with limited time and baseline endocrinology knowledge to have access to a glycemic control guide and provides them a new tool to use on the wards. This content not only is applicable to surgical residents, but also residents from all other specialties and learners from other professional programs who care for patients with diabetes mellitus. We demonstrated the effectiveness of a brief glycemic control curriculum for new surgical interns. While our learner group is well defined, there is potential for broad adaptation for all interns and medical students prior to starting their clinical clerkships. In the future, we will plan to assess residents’ knowledge periodically throughout the year. Furthermore, we plan to create didactic videos that allow for additional reinforcement of material learned during the session.

We are publishing this project as we hope to inspire other programs to implement a similar curriculum. The resources that we used, including the power point and handout, are available to download and use at other institutions. We hope that the success illustrated by our project can be mirrored at other programs.

Conclusion

Formal curriculum development and strategic implementation of teaching objectives along with a simple pocket-size handout can compensate for lack of specialty specific training in particular domains such as perioperative diabetes management. We show the use of simple intervention and handout that residents across any specialty can benefit from in caring for diabetic patients, and share our resources for free download for other institutions to use.

Take Home Messages

1. A 15 min lecture and pocket-size handout can significantly improve residents’ comfort and knowledge of insulin regimens.
2. Residents benefit from interdisciplinary teaching on topics that are not otherwise included as part of specialty training.
3. We encourage programs to download the educational material created for use within their own residency curriculum.

Notes On Contributors

Ioana Baiu, MD MPH is a general surgery resident at Stanford University. ORCID iD: https://orcid.org/0000-0003-3541-0846

Ashley Titan, MD is a general surgery resident at Stanford University. ORCID iD: https://orcid.org/0000-0003-2711-7172
James N Lau, MD MHPE FACS is a Professor of Surgery at Stanford University and the Director of the Goodman Surgical Education Center. ORCID iD: https://orcid.org/0000-0002-4046-6783

Kacy Church, MD is an endocrinology fellow at Stanford University.

Edmund W Lee, MD is a medical surgical education fellow at Stanford University.

Acknowledgements

We would like to thank the Stanford IT department, specifically Richard Wilson for his technical support. We are also very grateful to Loice Ongwela for all of her contributions.

Bibliography/References

Aboelela, W. S., Larson, E., Bakken, S., Carrasquillo, O., et al. (2007). 'Defining Interdisciplinary Research: Conclusions from a Critical Review of the Literature'. Health Services Research. 42 (1p1):329–346. https://doi.org/10.1111/j.1475-6773.2006.00621.x

American Diabetes Association. (2016) 'Diabetes care in the hospital. Sec. 13. In Standards of Medical Care in Diabetes'. Diabetes Care. 39(Suppl. 1):S99–S104. https://doi.org/10.2337/dc16-S016

Amori, R. E., Simon, B. (2016) 'A primer on diabetes mellitus: foundations for the incoming first-year resident'. MedEdPORTALPublications. 12:10469. https://doi.org/10.15766/mep_2374-8265.10469

Cheekati, V., Osburne, R. C., Jameson, K. A., Cook, C. B. (2009) 'Perceptions of resident physicians about management of inpatient hyperglycemia in an urban hospital'. J Hosp Med. 2009;4(1):E1-E8. https://doi.org/10.1002/jhm.383

Cook, C. B., Wilson, R. D., Hovan, M. J., Hull, B. P., et al. (2009) 'Development of Computer-Based Training to Enhance Resident Physician Management of Inpatient Diabetes'. Journal of Diabetes Science and Technology. 3(6):1377-1387. https://doi.org/10.1177/193229680900300618

Helm, D. T., Rubin, I. L., Merrick, J., Greydanus, D. E., et al. (2016) Interdisciplinary Training. Health Care for People with Intellectual and Developmental Disabilities across the Lifespan. Springer, Cham, 2141-2147. ISBN 978-3-319-18096-0

Institute of Medicine (US) Committee on Building Bridges in the Brain, Behavioral, and Clinical Sciences; Pellmar, T. C., & Eisenberg, L. Bridging Disciplines in the Brain, Behavioral, and Clinical Sciences. Washington (DC): National Academies Press (US) (2000). 3, Barriers to interdisciplinary research and training. Available from: http://www.ncbi.nlm.nih.gov/books/NBK44876 (Accessed: 22 April, 2020).

Knecht, L. A., Gauthier, S. M., Castro, J. C., Schmidt, R. E., et al. (2006). 'Diabetes care in the hospital: is there clinical inertia?', J Hosp Med. 1(3):151–160. https://doi.org/10.1002/jhm.94

Kwon, S., Thompson, R., Dellinger, P., Yanez, D., et al. (2013). 'Importance of Perioperative Glycemic Control in General Surgery: A Report From the Surgical Care and Outcomes Assessment Program'. Annals of surgery. 2013;257(1):8-14. https://doi.org/10.1097/SLA.0b013e31827b6bbc
Levetan, C. S., Passaro, M., Jablonski, K., Kass, M., et al. (1998). 'Unrecognized diabetes among hospitalized patients'. *Diabetes Care*. 21(2):246–249. [https://doi.org/10.2337/diacare.21.2.246](https://doi.org/10.2337/diacare.21.2.246)

Moattari, M., Moosavinasab, E., Dabbaghmanesh, M., ZarifSanaiey, N. (2014) 'Validating a Web-based Diabetes Education Program in continuing nursing education: knowledge and competency change and user perceptions on usability and quality'. *J Diabetes Metab Disord.* 13(70):1.

Powers, B. J., Grambow, S. C., Crowley, M. J., Edelman, D. E., et al. (2009) 'Comparison of medicine resident diabetes care between Veterans Affairs and academic health care systems', *J Gen Intern Med*. 24(8):950-955. [https://doi.org/10.1007/s11606-009-1048-z](https://doi.org/10.1007/s11606-009-1048-z)

Schnipper, J. L., Barsky, E. E., Shaykevich, S., Fitzmaurice, G., et al. (2006). 'Inpatient management of diabetes and hyperglycemia among general medicine patients at a large teaching hospital'. *J Hosp Med*. 1(3):145–150. [https://doi.org/10.1002/jhm.96](https://doi.org/10.1002/jhm.96)

Selen, J. J. (2014) 'Inpatient Glycemic Management: What Are the Goals and How Do We Achieve Them?: Preface'. *Diabetes Spectrum A Publication of the American Diabetes Association* 27(3):159-161. [https://doi.org/10.2337/diaspect.27.3.159](https://doi.org/10.2337/diaspect.27.3.159)

Tang, J. W., Freed, B., Baker, T., et al. (2009) 'Internal medicine residents’ comfort with and frequency of providing dietary counseling to diabetic patients'. *J Gen Intern Med*. 24(10):1140-1143. [https://doi.org/10.1007/s11606-009-1084-8](https://doi.org/10.1007/s11606-009-1084-8)

The NICE-SUGAR Study Investigators (2009). 'Intensive versus Conventional Glucose Control in Critically Ill Patients’. *N Engl J Med*. 360:1283-1297. [https://doi.org/10.1056/NEJMoa0810625](https://doi.org/10.1056/NEJMoa0810625)

**Appendices**

None.

**Declarations**

*The author has declared that there are no conflicts of interest.*

*This has been published under Creative Commons “CC BY 4.0” ([https://creativecommons.org/licenses/by-sa/4.0/](https://creativecommons.org/licenses/by-sa/4.0/))*

**Ethics Statement**

Approved by Stanford University Institutional Review Board - IRB-43770.

**External Funding**

This article has not had any External Funding

*MedEdPublish: rapid, post-publication, peer-reviewed articles on healthcare professions’ education. For more*
information please visit www.mededpublish.org or contact mededpublish@dundee.ac.uk.