Development and Evaluation of a Nurse Anesthetist-Directed Perioperative Hyperglycemia Protocol (PHP) for Patients Undergoing Elective Major Abdominal and Vascular Surgery in an Academic Center

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DNP Project Data Presentation
Introduction
Facts

- $327 billion in 2017
- 26% increase from 2012 to 2017
- Hyperglycemia = increase M&M
- Hyperglycemia perioperatively = poor surgical outcomes
  - Infection
  - Reoperation
  - Death
- Hyperglycemia = modifiable risk factor

Increased LOS = escalated costs
Problem Description

• Diabetics grossly mismanaged during perioperative phase of surgery

• THRH no standardized protocol/guideline

• Reason ➔ no clear practice guidelines or standards of care for noncardiac surgical patients

• Multiple treatment options

• We have an obligation to ensure optimal patient outcomes

BG monitoring and insulin administration during the perioperative phase of surgery given can improve patient outcomes.
PICOT Question

“Does the implementation of a perioperative hyperglycemia protocol (PHP) for elective major abdominal/vascular surgical patients with type 2 diabetes (T2DM) impact blood glucose values in the Post Anesthesia Care Unit (PACU)?”
Rationale/Framework

Plan

Gather data
Problem identified

Do

Capitalize on opportunity
Implement protocol

Check

Collect data

Adjust

Evaluate

P-D-C=A Cycle
Continuous process improvement
Framework

Lewin’s Change Management Model (LCMM)

- Embrace PHP, incorporate into practice
- Providers support new direction d/t benefits
- to accept PHP into practice – motivation

CHANGE:
Specific Aims

• Does the use of a PHP ↓ the incidence of PH, without resultant hypoglycemia, in T2DM surgical patients undergoing major abdominal/vascular procedures?

  ○ **ST goal** ➔ ↓ incidence of PH in PACU, without hypoglycemia

  ○ **LT goal** ➔ ↓ risk of complications resulting from PH – SSI, M/M
    • Expand to all surgical procedures
    • Expand to T5
Available Knowledge
Search Strategy

- CINAHL
- Ovid Nursing Full Test Plus
- PubMed
- Cochrane Central Register of Controlled Trials
- Cochrane Database of Systematic Reviews

Key Terms
- Hyperglycemia
- Major abdominal surgical patients
- Vascular surgical patients
- Hyperglycemia protocol
- Perioperative hyperglycemia
- Perioperative hypoglycemia
- Clinical practice guidelines
- Complications of hyperglycemia
- Management of hyperglycemia
- Hypoglycemia
- Type 2 Diabetes Mellitus
Key Reoccurring Themes

- Adverse outcomes in the presence of perioperative hyperglycemia
- Impact of HbA1c values on postoperative outcomes
- Clinical practice guidelines/recommendations
- Hypoglycemia
- Intraoperative glucose control – intensive vs. conservative treatment
- Hyperglycemia in abdominal and vascular surgery
- Healthcare costs
**Perioperative Hyperglycemia = Adverse Outcomes**

<table>
<thead>
<tr>
<th><strong>Major Abdominal Surgery</strong></th>
<th><strong>Vascular Surgery</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>SSI</td>
<td>Increased 30-day post-op mortality</td>
</tr>
<tr>
<td>Reoperation</td>
<td>Ventilator dependence</td>
</tr>
<tr>
<td>Death</td>
<td>MI</td>
</tr>
<tr>
<td></td>
<td>ARF</td>
</tr>
<tr>
<td></td>
<td>SSIs</td>
</tr>
<tr>
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<td>Wound complications</td>
</tr>
</tbody>
</table>
Impact of HBA1C Values Post op

- Data varies – safe HbA1c levels from 7-8.5%

- Diabetics report being well controlled despite ↑ HbA1c values

- Indifferent results for M+M relationship to ↑ preop HbA1c values
  - In abd surgery can be predictor of major complications if HbA1c >6.5%
  - Chronic hyperglycemia or HbA1c >8% associated with poor surgical outcomes

- HbA1c value may predict average periop BG value

- Per ADA, surgery should not be performed in patients with HbA1c >7%
Hyperglycemia

Major Abdominal Surgery
- SSI
- Inpatient death
- Reoperation
- Increased LOS
- MI

Vascular Surgery
- Vascular surgical patients considered high risk
- Association between 30-day mortality, SSIs, preop HbA1c values >7% and increased BG values (>180 mg/dL)
Intraoperative Glucose Control

- Higher blood glucose levels intraoperatively = higher levels postoperatively
- \( \uparrow \) age/BMI = \( \uparrow \) levels postoperatively
- Postoperative organ dysfunction \( \downarrow \) with TGC
- Conflicting evidence regarding TGC vs. CGC
- Optimum level of control widely debated
- Goal of blood glucose level intraoperatively widely debated outside of cardiac surgery
- Hyperglycemia = \( \uparrow \) LOS, SSI, M&M, costs
Clinical Practice Guidelines

• Developed by the American Association of Clinical Endocrinologists (AACE) and the American College of Endocrinology (ACE), and the Endocrine Society (ES)

• All surgical pts assessed for DM history and should have BG value obtained – if elevated, HbA1c should be obtained
• BG values >140 mg/dL should be monitored for 24-48 hours and treated as needed
  ◦ Access to hypoglycemia protocol

• Target BG range <180-200 mg/dL
• If procedure <4 hours, expected hemodynamic stability, procedure minimally invasive, subq insulin is adequate if rechecked every 2 hours

• Necessary for systemic approach including glycemic protocols with an interdisciplinary steering committee with administrative support
Impact on Healthcare Costs

- 2017 DM Report Card from CDC – 30 million individuals or 9.4% of population was diabetic in 2015 – 7 million unaware of diagnosis

- Diabetic healthcare costs ↑ yearly

- DM economic costs ↑ 26% from 2012 to 2017

- Diabetic care = one in four of healthcare dollars spent
Methods
Context

- Academic Medical/Level I Trauma Center
- New health plex
- 22,500 procedures annually
- Anesthesia team ➔ 84 providers
- “Culture of Excellence”
Population Criteria

**Inclusion**

- ≥ 18 years of age
- Major elective abdominal surgery *(Elective)*
- Vascular surgery *(Elective)*
- T2DM

**Exclusion**

- Emergent surgery
- T1DM
- Pregnant patients
- SICU post op
Variables

- **Independent Variable ➔ PHP**
- **Dependent Variable ➔ POC CBG in PACU**
- **Comparison Group ➔ 3-month retrospective review of benchmark POC CBG values in PACU**

The intent of this project was to determine if a patient participating in the PHP had a BG value less than or equal to 180 mg/dL on admission to PACU, compared to those in the baseline review that had no hyperglycemia management intraop.
## Major Abdominal Surgical Procedures

**List of Major Abdominal Surgical Cases in Alphabetical Order**

- Closure of Loop Colostomy
- Closure/Revision ileostomy
- Sigmoid/Low Anterior Colon Resection/Reversal of Hartman Procedure/Proctectomy
- Distal Pancreatectomy
- Gastrectomy/Gastric Resection
- Laparoscopic Robotic Roux En Y Gastric Bypass
- Hartman Procedure
- Laparoscopic Sigmoid/Low Anterior Resection/Proctectomy
- Laparoscopic Distal Pancreatectomy
- Diagnostic Laparoscopy/Lysis of Adhesion
- Laparoscopic Assisted Esophagogastronomy
- Laparoscopic Gastric Banding
- Laparoscopic Liver Resection/Ablation
- Laparoscopic Nissen Fundoplication
- Laparoscopic Roux En Y Gastric Bypass
- Laparoscopic Right Hemi Colectomy
- Laparoscopic Sleeve Gastrectomy
- Laparoscopic Splenectomy
- Resection Lobe of Liver/Ablation
- Nissen Fundoplication
- Laparoscopic Robotic Colon Resection
- Laparoscopic Robotic Duodenal Switch
- Laparoscopic Robotic Gastric Banding
- Laparoscopic Robotic Sleeve Gastrectomy
- Laparoscopic Roux En Y Gastric Bypass
- Laparoscopic Distal Pancreatectomy/Splenectomy
- Laparoscopic Robotic Long Limb Roux En Y Gastric Bypass
- Laparoscopic Robotic Sleeve Gastrectomy XI
- Right Hemi Colectomy
- Whipple Procedure/Proximal Pancreatectomy/DX Lap
## Major Vascular Surgical Procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Procedure</th>
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<tbody>
<tr>
<td>Exploration Groin</td>
<td>Axillofemoral Bypass Graft</td>
</tr>
<tr>
<td>Transcarotid Artery Revascularization</td>
<td>Axillofemoral Bypass Graft</td>
</tr>
<tr>
<td>Repair Abdominal Aortic Aneurysm/Aorta Femoral Bypass</td>
<td>Axillopopliteal Bypass Graft</td>
</tr>
<tr>
<td>Endograft Repair Abdominal Aneurysm</td>
<td>Brachial Artery Repair</td>
</tr>
<tr>
<td>AV Fistula</td>
<td>Brachial Endarterectomy</td>
</tr>
<tr>
<td>Carotid Endarterectomy</td>
<td>Brachial Radial Bypass Graft</td>
</tr>
<tr>
<td>Resection False Aneurysm Leg</td>
<td>Carotid Subclavian Bypass Graft</td>
</tr>
<tr>
<td>Femoral Endarterectomy</td>
<td>Femoral Artery Repair</td>
</tr>
<tr>
<td>Femoral to Femoral Bypass</td>
<td>Femoral Peroneal Bypass Graft</td>
</tr>
<tr>
<td>Femoral to Popliteal Bypass</td>
<td>Femoral Pseudoaneurysm Repair</td>
</tr>
<tr>
<td>Aortic Endograft Repair with IVUS</td>
<td>Femoral Tibial Bypass Graft</td>
</tr>
<tr>
<td>Aortoiliac Bypass Graft</td>
<td>Iliac Endarterectomy</td>
</tr>
<tr>
<td>Aortoiliac Endarterectomy</td>
<td>Iliofemoral Bypass Graft</td>
</tr>
<tr>
<td>Aortopopliteal Bypass Graft</td>
<td>Iliopopliteal Bypass Graft</td>
</tr>
<tr>
<td>Aortorenal Bypass Graft</td>
<td>Iliotibial Bypass Graft</td>
</tr>
<tr>
<td>Arterial Femoral to Femoral-Popliteal Bypass</td>
<td>Popliteal Aneurysm Endovascular Graft Repair</td>
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<tr>
<td>Arteriovenous Access Graft</td>
<td>Popliteal Artery Aneurysm Repair</td>
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<tr>
<td>Arteriovenous Access Graft Central Line</td>
<td>Popliteal Endarterectomy</td>
</tr>
<tr>
<td>Artery Repair</td>
<td>Popliteal Peroneal Bypass</td>
</tr>
<tr>
<td>AV Graft Chest Wall</td>
<td>Popliteal Tibial Bypass</td>
</tr>
<tr>
<td>Axillo Axillary Bypass Graft</td>
<td>Distal Revascularization Internal Ligation</td>
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<tr>
<td></td>
<td>Iliac Aneurysm Repair</td>
</tr>
</tbody>
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Study of Intervention

Data was analyzed from the Epic charting system to determine if POC CBG levels were lower in the population who received the PHP compared to those who did not during the three-month retrospective analysis.
Data Captured

- Date of surgery
- Surgical procedure
- In and out times for both OR and PACU
- Length of case
- Intraop BG value
- Insulin treatment given intraop
- PACU BG value

- Patient specific data captured:
  - Patient age
  - Sex
  - Ethnicity
  - BMI
  - History of CAD
  - ASA
Perioperative Pathway for Elective Major Abdominal/Vascular Surgical Patients with Type 2 DM
(Duggan, Klopman, Berry, & Umpierrez, 2016)
**Perioperative Hyperglycemia Protocol**

(Duggan, Klopman, Berry, & Umpierrez, 2016)

*Macro will trigger POC BG checks every hour intraop to monitor for hypoglycemia*

<table>
<thead>
<tr>
<th>BG mg/dL</th>
<th>Regular Insulin (Humulin R) SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>181-220</td>
<td>2</td>
</tr>
<tr>
<td>221-260</td>
<td>3</td>
</tr>
<tr>
<td>261-300</td>
<td>4</td>
</tr>
<tr>
<td>301-350</td>
<td>5</td>
</tr>
<tr>
<td>351-400</td>
<td>6</td>
</tr>
<tr>
<td>&gt;400</td>
<td>8</td>
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</tbody>
</table>

*Check POC BG values every hour after initiation of the PHP and treatment with regular insulin (Humulin R) SQ. Insulin dosing should not be repeated intraop to avoid stacking and subsequent hypoglycemia*
Ethical Considerations
Ethical Considerations

- No standard PHP or BG level
- Hypoglycemia
  - Diabetic Steering Committee
- Key stakeholders approval
- Approvals obtained:
  - Wilmington University Human Subjects Research Committee (HRSC)
  - Tower Health Reading Hospital DNP Committee
  - IRB approval deemed not required
Hypoglycemia Protocol

(Daggan, Kloppman, Berry, & Umpierrez, 2016)

Snack=2 packs of graham crackers with peanut butter OR 8 oz. milk

*No IV access=1 mg Glucagon IM*
Severe Hypoglycemia Protocol
(Umpierrez et al., 2012)

POC BG @ anytime <40 mg/dL

Initiate Severe Hypoglycemia Protocol

POC BG <80, >40 mg/dL

½ amp D50

Check POC BG q15 min until BG is at least 100 mg/dL x 2 consecutive readings & consult hospitalist in PACU

1 amp D50 IVP

Recheck POC BG in 15 minutes

POC BG >80 mg/dL

POC BG <40 mg/dL

*No IV access=1mg Glucagon IM*

WILMINGTON UNIVERSITY
Elective Major Abdominal Surgical Population
Sample Characteristics

- **Benchmark Data:** 43 cases, 38 for PACU BG comparison
- **Project Data:** 50 cases, 48 for PACU BG comparison
Results

- POC CBG values in PACU
  - Mean 170 mg/dL & 185 mg/dL
- Compare PHP vs. three-month benchmark

30% & 39.5% = hyperglycemia vs. observational studies 20%-40%
Measures/Analysis

- Raw data
  - Interval data = POC CBG PACU
- Inferential statistics
  - T-test
    - Not normal distribution
  - Log transform
    - P-value 0.17
    - Zero significance
Elective Vascular Surgical Procedures
Sample Characteristics

• Benchmark Data: 41 cases, 35 for PACU BG comparison

• Project Data: 40 cases, 32 for PACU BG comparison
History of CAD

Results

• Baseline – Mean POC PACU BG ➔ 142.7 mg/dL

• Project – Mean POC PACU BG ➔ 144.2 mg/dL
Interpretation

- PACU BG values NOT normally distributed
- Log Transformed $\rightarrow$ normal distribution $\rightarrow t$-test
  - $t$-test - $p$-value 0.918 $\rightarrow$ no statistical significance
Limitations
Non-compliance

- 38% in major abdominal procedures
- 35% in vascular surgical procedures
What Now?
Clinical Significance

- **↑ intraoperative BG monitoring**
- **Zero** incidence hypoglycemia
- BPA and macro → trigger automatic intraoperative reminders
- Standard of Care → *standardize intraoperative T2DM treatment*

**Perioperative Hyperglycemia Protocol**
Plans for Sustainability

• Continued staff education, sharing of data tracking, addressing non-compliance (personal coaching)

• Solidifying and maintaining
  ○ Improve compliance

• Expanding to applicable areas
  ○ All elective surgical patients with T2DM – COMPLETED
  ○ Eventually…. T5
Implications for Advanced Nursing Practice

- Dive into research = TOE
- Collaborate = multidisciplinary approach/Dr. Duggan
- Overcome barriers = hypoglycemia
- Evaluate findings = PDCA and LCMM Frameworks
- Improve practice & patient outcomes = PHP
Staff Feedback

• User friendly
  ◦ Laminated copies of protocols in every OR
  ◦ Automatic reminders
  ◦ Purchase of additional glucometers
  ◦ Pre-made insulin syringes

• Protocols = simple to follow

• Super user availability for questions/concerns
Clinical Updates

Protocol now inclusive to all elective surgical T2DM patients
Conclusions

• Hyperglycemia = complications postoperatively

• Opportunity for growth

• Individualized approach replaced with PHP

• Strive to increase compliance to 100%

• Institute an organizational wide change
Thank you!
References


• Onderdonk, Alexander, personal communication, September 19, 2019


