Pre-Operative Glycemic Control Predicts Peri-Operative Serum Glucose Levels in Diabetic Patients Undergoing Total Joint Arthroplasty

Brian Godshaw MD[1], Connor Ojard MD[1], Rober Fischer MD[1], Tyler Adams MD[1], Leslie Thomas MD[2], George Chimento MD[1], Alaa Mohammed MPH[3], Bradford S. Waddell MD[1]

Ochsner Medical Center Department of Orthopedics[1]; Ochsner Medical Center Department of Anesthesiolgoy[2]; Ochsner Center for Applied Health Services Research[3]

Introduction

Total joint arthroplasty (TJA) have been increasing in popularity over the past several decades. Prosthetic Joint infection (PJI), is a devastating complication of TJA. Incidence of diabetes mellitus (DM) has been increasing with an estimated 382 million affected in 2013, predicted to grow to 582 million by 2035. Diabetes has been shown to be an independent risk factor for development of PJI. Diabetic patients with post-operative hyperglycemia >200 mg/dL has been shown to significantly increase the rate of PJI. Utilizing hemoglobin A1c (A1c) used as a measure of preoperative glycemic control, a correlation between preoperative A1c and PJI has not been firmly established.

Objectives

Does preoperative A1c level predict post-operative hyperglycemia >200 mg/dL?

Methods & Materials

- IRB approved retrospective chart review of all patients undergoing primary THA or TKA from 2011 – 2016.
- Only those with a diagnosis of DM and an A1c within 3 months of surgery were included
- Perioperative serum glucose levels monitored with point-of-care finger stick and morning metabolic panel
  - Highest value post-operative glucose level was used to capture ”post-operative high” glucose
- Perioperative glucose control: standard regimen of home medications and sliding scale
- Primary end point: serum glucose >200 mg/dL
- Secondary end point: PJI
- 2317 patients underwent TJA during time period
  - 773 met inclusion criteria listed above (3 cohorts):
    - **534 with A1c <7% (well-controlled)**
    - **151 with A1c 7- 7.9% (moderately controlled)**
    - **88 with A1c >8% (poorly controlled)**
- Statistical Methods:
  - Youden’s J computation [area under curve (AUC)] to determine optimal A1c at which statistical increased chance of postoperative glucose above 200 mg/dL
  - Chi-square test, Fischer’s exact test, and Mann-Whitney test were used for bivariate analyses between A1c groups and independent variables. Logistic Regression for odds ratio.
  - Tests were performed with significance level of α=0.05

Results

Figure 1: BMI vs High Post-Operative Glucose

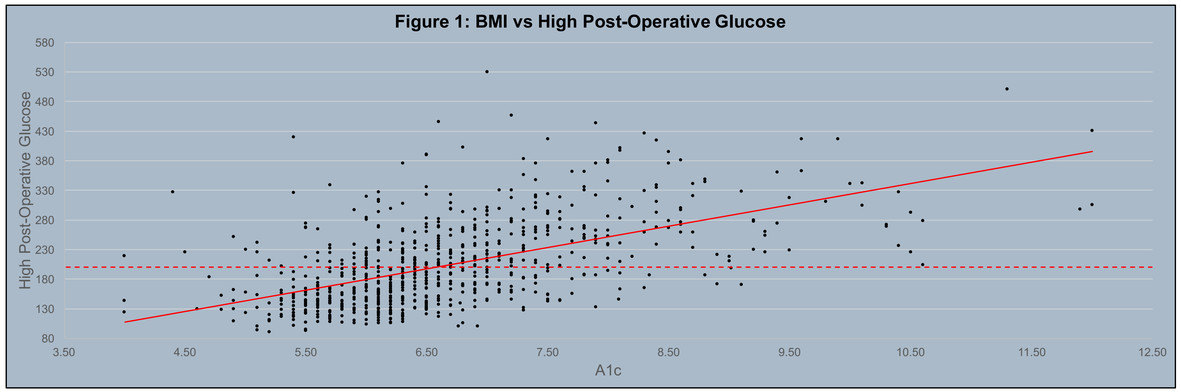
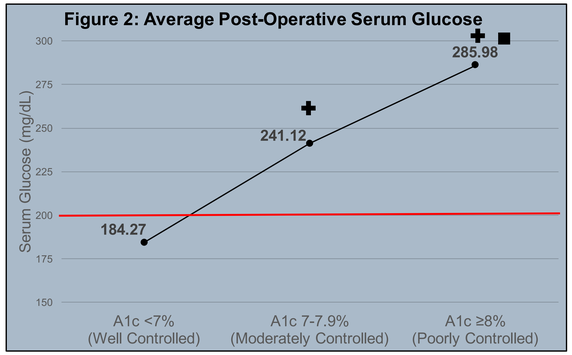
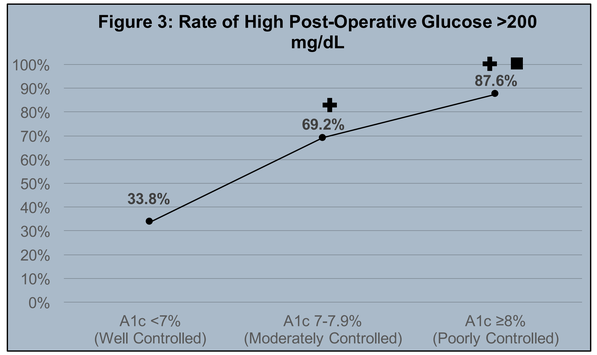


Figure 2: Average Post-Operative Serum Glucose



✚ p<0.05 vs A1c < 7%
■ p<0.05 vs A1c 7 – 7.9%

Figure 3: Rate of High Post-Operative Glucose >200 mg/dL



✚ p<0.05 vs A1c < 7%
■ p<0.05 vs A1c 7 – 7.9%

Figure 4: Rate of PJI

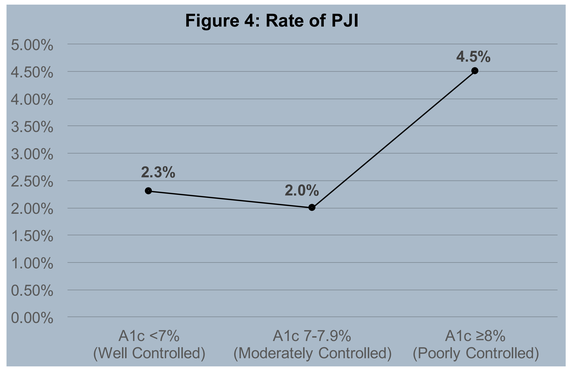


Table 1: A1c < 6.6% vs A1c > 6.6%

	A1c < 6.6%	A1c ≥ 6.6%	p-Value
Glucose > 200 mg/dL (%)	119 (25.98%)	230 (73.02%)	p < 0.0001 Odds Ratio 5.9 (95% CI 4.20 – 8.38))**
Infection (%)	11 (57.89%)	8 (42.11%)	p = 0.9033

Table 2: 3 cohort p-Value and Odds Ratio

	vs A1c < 7%		vs A1c 7 – 7.9%	
	p-Value	Odds Ratio ** (95% CI)	p-Value	Odds Ratio ** (95% CI)
A1c 7 – 7.9%	p < 0.0001	4.5 (2.95 – 6.91)		
A1c ≥ 8%	p < 0.0001	13.3 (6.5 – 26.98)	p = 0.0013	5.2 (3.66 – 7.40)

**Models adjusted for insulin dependent

Results

Using the Youden’s J computational continuous analysis of the entire data set, we found an A1c of 6.6 or greater yields significantly greater chance of hyperglycemia >200 mg/dL post-operatively (Figure 1, Table 1).

In an attempt to stratify the data in a grouping more appropriate to our typical patients, we defined three cohorts for the second analysis (well-controlled, moderately controlled, and poorly controlled).

We found that the moderately controlled and poorly controlled groups were significantly more likely to have postoperative hyperglycemia >200 mg/dL as compared to the well-controlled group (p<0.0001) (Figures 2, Table 2). A significantly greater percentage of the moderately or poorly controlled groups had glucoses >200 mg/dL as compared to the well-controlled group (p<0.0001) (Figure 3).

We did observe a trend towards increased rate of PJI as A1c approaches the poorly controlled group, (Figure 4). However there was no difference between any group in regards to infection (p>0.432).

Conclusions

- Higher pre-operative A1c levels predict higher post-operative glucose levels, specifically a greater chance in postoperative glucose level >200mg/dL
- Caution should be used in performing TKA or THA on patients with high pre-operative A1c
  - Further studies needed to determine efficacy of a cutoff
- We were unable to associate increased A1c levels with infection, likely due to our study being underpowered for this analysis.

Should there be an A1c cutoff?

Other studies suggest A1c cutoffs of 7%, 7.5%, or 8%. We show an A1c of ≥6.6 results in higher likelihood of post-operative hyperglycemia >200 mg/dL, which has been shown to increase PJI risk in other studies. While we cannot advocate a single A1c cutoff due to the lack of correlation with infection in our study, we present evidence for a low threshold on this modifiable risk factor.

References

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