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Optimal HbA1c in Orthopedic Surgery

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University of North Dakota

PERMISSION

Title Optimal HbA1C in Orthopedic Surgery

Department Nursing

Degree Master of Science

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Abstract

During an observed simulation clinical exam, a patient presented to the clinic with severe osteoarthritis in bilateral knees. A preoperative consultation was done at this time prior to a scheduled right total knee arthroplasty in Fargo, ND on 3/4/2020. A left total knee arthroplasty was performed less than 1 year ago and now the right knee has been worsening since that time. Preoperative lab work drawn today revealed a fasting blood glucose of 229 mg/dL and a HbA1C of 7.9%.

A literature review was performed to explore the optimal HbA1C prior to orthopedic surgery and how intraoperative and postoperative blood glucose can affect outcomes. It is already known that poorly controlled diabetes with hyperglycemia is directly related to poor wound healing and infections. This review will discuss what HbA1C is optimal prior to proceeding with an orthopedic procedure and how uncontrolled blood glucose can cause complications postoperatively.

The literature review revealed: a HbA1c level <7% is associated with less complications, a fasting blood glucose level of < 200mg/dL is associated with less complications, and a HbA1c level < 8% may be acceptable in some patients after shared-decision making has been done between patient and provider. This data in research can help determine the postoperative risk associated with a total knee arthroplasty. All patients and providers should strive for optimal outcomes after surgery and therefore work together to lower risk factors preoperatively.

Optimal HbA1c in Orthopedic Surgery

Background

Poorly controlled diabetes is directly associated with poor wound healing and many types of infections. When discussing poor outcomes, Carey et al. (2018) report that it's well known that diabetes and infections are associated clinically in several ways including impaired immune response, a hyperglycemic environment, neuropathy, and altered lipid metabolism.

This review discusses a 57-year-old female who was seen in the primary care provider's (PCP) office for a preoperative evaluation. She is scheduled the following week to have a right total knee arthroplasty done in Fargo, ND. She has a past medical history of poorly controlled type 2 diabetes mellitus and is prescribed several diabetes medications but reports that she's not been taking them as prescribed. She had preoperative lab work done for the visit today which revealed a fasting blood glucose of 229 mg/dL and a HbA1C of 7.9%. She reports that she "very rarely" checks her blood glucose at home.

The purpose of this review is to investigate current best practice and define what is considered an optimal preoperative HbA1C level. This review will also discuss how intraoperative and postoperative blood glucose management can cause complications in the postoperative setting. During the perioperative and postoperative phase, many type 2 diabetic patients will need insulin to manage blood glucose, even if they have not used these medications in the past.

Case Report

Assessment / Plan

Preoperative evaluation for a right total knee arthroplasty

Plan: high risk for orthopedic surgery. Further cardiopulmonary testing (stress testing) is not needed at this time but will order EKG, CBC, CMP, HbA1C and discuss results with patient. We discussed that she is currently taking excess NSAIDS when combining Motrin and voltaren, especially with her CKD. She should not take both medications together. Also discussed that she should stop NSAIDs and all supplements at least 1 week prior to the procedure and hold metformin about 48 hours prior to procedure. We discussed that she should start using the Victoza as prescribed and if further teaching is needed, we can provide that. Discussed that she may need to start insulin if diabetes remains uncontrolled. Discussed that it is very important to begin checking blood sugars at least 1-2 times a day to trend blood glucose levels. Due to multiple chronic comorbidities, she is at high risk for intraoperative and postoperative complications. She does verbalize understanding and wishes to proceed. She can proceed pending results of ordered labs/EKG and approval from surgeon. She should follow up prior to surgery if symptoms worsen or new symptoms develop. She is an ASA class 3 and a Mallampati class 3.

HPI:

Patient presents for a preoperative consultation regarding upcoming right total knee arthroplasty in Fargo, ND on 3/4/2020. She had a left total knee arthroplasty less than 1 year ago and now reports that her right knee has been worsening over the last year or so. The pain in the right knee is constant and feels like sharp, grinding pain. Weight-bearing and exercise makes the pain worse and resting and taking NSAIDs makes the pain slightly better. Pain seems worse in the morning but also does seem to be constant throughout the day. Rates the pain 7/10 in severity. Has attempted treatment with NSAIDs but is unable to exercise/lose weight due to the pain.

Allergies: seasonal allergies – reaction: rhinorrhea

Medications

diclofenac sodium (VOLTAREN) Take 1 tablet (75 mg) by mouth 2 times a day
 liraglutide (VICTOZA) Inject 1.8 mg subcutaneously 1 time per day
 fluticasone (FLONASE) 50 mcg/spray nasal spray 1 spray into each nostril 1 time per day
 insulin needle (BD PEN NEEDLE NANO U/F) 32G X 4 mm Use once daily as directed
 metFORMIN (GLUCOPHAGE XR) 1000 mg extended release tablet twice a day
 acetaminophen (TYLENOL) 500 mg tablet Take 1,000 mg by mouth Every 4 hours as needed
 vitamin C, ascorbic acid, 500 MG tablet Take 1,000 mg by mouth 1 time per day
 milk thistle-turmeric (SILYMARIN) CAPS capsule Take 1 capsule by mouth 1 time per day
 glipiZIDE ER (GLIPIZIDE XL) Take 1 tablet (10 mg) by mouth 1 time per day
 hydroCHLOROthiazide 25 mg tablet Take 1 tablet (25 mg) by mouth 1 time per day 90
 lovastatin (MEVACOR) 10 mg tablet Take 1 tablet (10 mg) by mouth 1 time per day 90
 benazepril (LOTENSIN) 40 mg tablet Take 1 tablet (40 mg) by mouth 1 time per day
 Multiple Vitamins-Minerals (ZINC PO) Take 1 tablet by mouth 1 time per day

blood glucose test strip (ONETOUCH VERIO) 1 Strip 1 time per day
Lancets (ONETOUCH DELICA) 1 each 1 time per day 100
Specialty Vitamins Products (ECHINACEA C COMPLETE PO) Take 1 tablet by mouth 1 time per day
CINNAMON PO Take 1 capsule by mouth 1 time per day

Medical History

Primary osteoarthritis of both knees
Controlled type 2 diabetes mellitus without complication, without long-term current use of insulin (HCC)
CKD (chronic kidney disease), stage III (HCC)
Hypercholesterolemia
Essential hypertension
Neuroma of foot
Obstructive sleep apnea of adult
Severe obesity (HCC)

Past Surgical History

JOINT REPLACEMENT TOTAL KNEE Left 5/8/2019

Family History

Father – emphysema (deceased)
Mother – Type 2 diabetes (living)
Brother – no known history (living)

ROS

Constitutional: negative for fever, chills, unexpected weight loss or gain. Denies any recent illness.
Cardiovascular: Denies chest pain, shortness of breath, palpitations, or leg swelling.
Respiratory: Denies cough, shortness of breath, or wheezing. Reports she does have obstructive sleep apnea but does not use the CPAP machine as she does not like it.
Gastrointestinal: Negative for nausea, vomiting, diarrhea or constipation. States her bowel pattern is regular about every day.
Orthopedic: Arthralgias of right knee, mainly with movement. Reports grinding sensation.

Physical / Results

BP 136/90 Pulse 88 Temp 97 degrees F (36.1 degrees C) (Temporal) Wt. 168.3kg (371lb) SpO2 98% BMI 53.23 (morbidly obese)
Constitutional: Is alert and oriented x 4.
Cardiovascular: Regular rate and rhythm, S1 and S2 audible. No murmur, click, rub or gallop audible.
Respiratory: Lungs are clear bilaterally. No wheezing, stridor, rhonchi or rales are heard. Chest expansion is symmetrical. No cough heard.

Gastrointestinal: Abdomen is obese and rounded. No distension noted. Bowel sounds are normoactive. Abdomen is soft, no tenderness or guarding. No masses palpated.

Extremities: peripheral pulses normal, no pedal edema, no clubbing or cyanosis. Some pain with flexion and extension of right knee. No deformity or edema noted. Crepitus present with movement of right knee.

EKG: Normal sinus rhythm with heart rate in the 80's.

Imaging (Xray right knee 2 views): Moderately severe patellofemoral degenerative change. There is marked narrowing of the patellofemoral joint space laterally, with lateral deviation of the patella. Bulky peripheral osteophyte formation. No acute fracture or dislocation.

Labs (CBC, CMP, A1C): Glucose 229mg/dL, BUN 21mg/dL, Creatinine 1.57mg/dL, GFR 46mL/min, HbA1C 7.9%. All other labs normal.

Literature Review

A search of the literature was done through the University of North Dakota's Harley French library in the CINAHL online database. The search was conducted using the phrases "arthroplasty A1C" and "Total knee A1C". This yielded a total of 166 articles: 91 for "arthroplasty A1C" and 75 for "Total knee A1C". Of the 166 articles, ten articles were chosen due to the specificity of their content. A total of 10 articles will be used to review what an optimal HbA1C is and how blood glucose can affect outcomes intraoperatively and postoperatively.

Optimal HbA1C

Hemoglobin A1C is a laboratory measurement of the patient's glycemic status over the past 3-month period and is a good indicator of overall glycemic control. Typically, patients with diabetes have a regular scheduled follow up with their primary care provider to have their HbA1C checked. Ideally this occurs around every 3-6 months for most diabetic patients and is done in order to try to optimize their blood glucose management. The following paragraphs will discuss/summarize the findings of each article in relation to optimal HbA1C.

According to Yang et al. (2017) “Some studies have recommended that an HbA1c level of less than 7% could decrease the risk of systemic complications. Therefore, an HbA1C level of 7% has been considered the cutoff for glycemic control in previous studies.” (p. 5). In the conclusion of this article the authors state their research indicates an elevated HbA1C and intraoperative hyperglycemia increase the risk for periprosthetic joint infections following the joint replacement. In contrast, an article published in International Orthopedics by Joseph Statz, Eric Wagner, John Sperling, and Robert Cofield, the authors performed a retrospective review of their institution’s joint registry to assess the relationship between HbA1C in patients with diabetes mellitus (DM) and outcomes related to shoulder arthroplasty (SA). In the conclusion of their review, Statz et al. (2018) report “Our findings in this study show that HbA1C is not a predictor of adverse outcomes in patients with DM undergoing SA.” (p. 1933). Although the authors concluded that HbA1C was not a predictor of adverse outcomes, it is recommended to attempt to optimize HbA1C prior to surgery. Although they recommend optimizing the HbA1C prior to surgery, the authors do not have an ideal HbA1C that is considered the cutoff value.

To provide reference for an acceptable HbA1C level, an article written by Jennifer Abbasi in the Journal of the American Medical Association discussed what is considered the optimal HbA1C in patients with type 2 diabetes. The article considered patients with type 2 diabetes overall and not just those in the preoperative setting who were planning on having a surgical procedure done. In the article, the American College of Physicians recommends a HbA1C goal of 7%-8% for most patients with type 2 diabetes. This contrasts with the recommendations set forth by the American Diabetes Association (ADA) and the American Association of Clinical Endocrinologists (AACE). The ADA recommends a HbA1C goal of less than 7% in general and the AACE recommends a HbA1C goal of 6.5% or less. This can be

confusing to patients and clinicians and therefore recommends that HbA1C goal should be discussed and agreed upon by both the patient and clinician in a personalized way.

Postoperative Setting

In an article written by Dr. Jourdan Cancienne, Dr. Brian Werner, and Dr. James Browne in 2017, the authors conducted original research by querying a patient records database for orthopedic cases and comparing HbA1C level to postoperative periprosthetic joint infections. In the review of the orthopedic cases, Cancienne, Werner and Browne (2017) report “We believe that although an HbA1c level greater than 8.0 mg/dL is helpful and should be referenced when stratifying a patient’s infection risk, it must be interpreted in the context of the patient’s other risk factors for PJI.” (p. 1648). Further research is needed regarding factors other than HbA1C and how they influence postoperative periprosthetic infections. Further research may lead to better screening tools or guidelines to predict postoperative complications. In support of the American College of Physicians an article written in the Annals of Internal Medicine by Dr. Gerald Smetana, Dr. David Nathan, Dr. David Dugdale, and Dr. Risa Burns and is written in a case study format that asks the readers to decide how aggressive to be in treatment of a patients HbA1c based on available guidelines by the American College of Physicians. The authors of this article concur with the recommendations set for by the ACP by treating most patients to a HbA1c level between 7%-8%. They did not discuss the HbA1C specifically in relation to optimization preoperatively.

In contrast, an article written by Dr. Steven DeFroda, Dr. Me Lee, and Dr. Derek Jenkins in 2016 utilized a retrospective pilot review over 3 months using a risk reduction strategy. This risk reduction strategy included smoking cessation, reduction in weight/BMI, and reduction in HbA1c. In this article, Defroda, Lee and Jenkins (2016) report that a HbA1c >7% led to an

increased risk of postoperative infection and that a specific study that focused on total knee arthroplastys found that a HbA1c >8% increased risk of surgical site infection. This information leads readers to believe any HbA1c level >7% would put patients at increased risk for postoperative complications.

Blood Glucose Related Outcomes

The postoperative complications in patients with diabetes can increase overall healthcare costs, extend hospital stays, and decrease quality of life. When discussing blood glucose related outcomes, an article written by Carey et al. (2018) utilized a retrospective cohort study that compared different types of infections between patients with type 1 diabetes and type 2 diabetes. This article didn't specifically look at adverse outcomes in surgical patients but discussed overall complications seen in diabetic patients with elevated blood glucose levels. In the article, Carey et al. (2018) states "The association between diabetes and infection is well known clinically and has been linked to a number of casual pathways, including impaired immune responses within the hyperglycemic environment, as well as potentially other abnormalities associated with diabetes such as neuropathy and altered lipid metabolism." (p. 513). This gives a basis to understand how elevated blood glucose levels in the pre, intra, and postoperative settings can adversely affect patients.

Furthermore, Morrell, Dr. Gregory Golladay, and Dr. Stephen Kates conducted a retrospective review of 455 patients that underwent an elective total hip arthroplasty within their facility. They followed up 1 year after the procedure to assess complications such as periprosthetic joint infection. When discussing the risk of postoperative infection, Morrell, Golladay, and Kates (2018) state "Potential risk factors include poorly controlled diabetes (glucose >200 mg/L or HbA1c >7%) ..." (p. 523). Therefore, if a patient's blood glucose is kept

below 200 mg/L or their HbA1c was kept <7% they were less likely to have complications such as periprosthetic joint infections.

Additional Glycemic Markers

There are several lab tests available for the clinician to use when assessing glycemic control. Hwang et al (2015) discussed whether different glycemic markers such as HbA1c, fasting blood glucose and postprandial blood glucose would potentially cause complications in diabetic patients undergoing total knee arthroplasty. Hwang et al (2015) found “a positive correlation among the various available glycemic markers in patients undergoing TKA, and HbA1c > 8 or FBG > 200 mg/dL was associated with superficial surgical site infection” (p. 1731). It is suggested that these values are the safe cutoff range for diabetic patients undergoing total knee arthroplasty. These values are not a guarantee that the patient will not have a surgical site infection or other complication after surgery but are the cutoff range at which values higher than these are when increased postoperative infections are seen. An article written by Dr. Gerold Labek looked at the study mentioned above that was written by Hwang et al. In this article, Dr. Labek discussed several questions that need to be asked in order to promote better outcomes. Some examples of questions asked in the article include: What other factors are associated with controlling blood glucose levels? What are modifiable patient or provider factors that are associated with blood glucose levels? Can providers prevent the complications such as infections by using specific implants with antibiotic coatings? If we were to apply these questions to Irene in the above case study, the chance of her having a negative outcome postoperatively could be decreased.

Learning Points

Several “key” learning points can be summarized from this review. These are included below in the following bullet points and could be used as a guide if questioning optimal HbA1c or fasting blood glucose prior to an arthroplasty procedure.

- The optimal HbA1c to decrease the risk of complications is <7%.
- The optimal fasting blood glucose level to decrease the risk of complications is <200 mg/dL preoperatively.
- A HbA1c of < 8% may be acceptable in some patients after a personalized decision is made between patient and provider.

Conclusion

In this review, a patient with severe osteoarthritis in both knees is planning to have a total knee arthroplasty done on the right knee. Comorbidities include uncontrolled type 2 diabetes with poor medication compliance. This is evidenced by the fasting blood glucose level of 229 mg/dL and HbA1C of 7.9%.

A review of the current literature was performed through UND’s Harley French library using the CINAHL database while searching for the optimal preoperative HbA1c and blood glucose levels. Based on a synthesis of the articles reviewed, it can be concluded that patients are at an increased risk of postoperative complications if their HbA1c level is above 7% or if their fasting blood glucose preoperatively is greater than 200 mg/dL. Based on these conclusions, and the recommendations from the ADA, the patient in this review would be considered at an increased risk for postoperative complications. It’s imperative that patient and provider understand the importance of adequate blood glucose management not only in the preoperative setting, but at all times to ensure the best possible outcomes. Primary care providers are in an

optimal position to diagnose, provide adequate treatment, strict follow up and education for patients with diabetes. This will promote active involvement with the PCP and the patient to ensure the best possible outcome during and after surgical intervention.

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