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Implementation of a referral to discharge glycemic control initiative for reduction of surgical site infections in gynecologic oncology patients

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HIGHLIGHTS

- Surgical site Infections are a common, costly complication of surgery.
- Screening for HbA1C predicts patients likely to suffer post-operative hyperglycemia
- Interventions maintaining perioperative normoglycemic lowers risk of surgical site infections
- Screening for HbA1C diagnoses previously unaware diabetes/pre-diabetes patients.

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ABSTRACT

Objective(s). To evaluate the frequency of surgical site infections before and after implementation of a comprehensive, multidisciplinary perioperative glycemic control initiative.

Study methods. As part of a CUSP (Comprehensive Unit-based Safety Program) initiative, between January 5 and December 18, 2015, we implemented comprehensive, multidisciplinary glycemic control initiative to reduce SSI rates in patients undergoing major pelvic surgery for a gynecologic malignancy ('Group II'). Key components of this quality of care initiative included pre-operative HbA1c measurement with special triage for patients meeting criteria for diabetes or pre-diabetes, standardization of available intraoperative insulin choices, rigorous pre-op/intra-op/post-op glucose monitoring with control targets set to maintain BG ≤10 mmol/L (180 mg/dL) and communication/notification with primary care providers. Effectiveness was evaluated against a similar control group of patients ('Group I') undergoing surgery in 2014 prior to implementation of this initiative.

Results. We studied a total of 462 patients. Subjects in the screened (Group II) and comparison (Group I) groups were of similar age (avg. 61.0, 60.0 years; $p = 0.422$) and BMI (avg. 31.1, 32.3 kg/m^2; $p = 0.257$). Descriptive statistics served to compare surgical site infection (SSI) rates and other characteristics across groups. Women undergoing surgery prior to implementation of this algorithm ($n = 165$) had an infection rate of 14.6%. Group II ($n = 297$) showed an over 2-fold reduction in SSI compared to Group I [5.7%; $p = 0.001$, adjRR: 0.45, 95% CI: (0.25, 0.81)]. Additionally, approximately 19% of Group II patients were newly diagnosed with either prediabetes (HbA1C 6.0–6.4) or diabetes (HbA1C ≥ 6.5) and were referred to family or internal medicine for appropriate management.

Conclusion(s). Implementation of a comprehensive multidisciplinary glycemic control initiative can lead to a significant reduction in surgical site infections in addition to early identification of an important health condition in the gynecologic oncology patient population.

1. Introduction

Surgical site infections (SSIs) are defined as infections occurring at the site of surgery within 30 days of procedure [1]. SSI's represent a complication occurring in approximately 2% of inpatient surgical patients in the USA [2], and are often considered to be the most common cause of nosocomial infection [3]. SSIs increase patient morbidity

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through complications related to prolonged length of hospital stay (average of 7–10 days) and importantly carry a mortality rate of up to 3%, with nearly 75% of these deaths being directly attributable to complications from the SSI itself [4]. Furthermore, SSIs are a significant expense for healthcare systems, with an estimated cost of at least $3.0 billion dollars annually in the United States [5,6].

Patient safety monitoring networks, including the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP), have been instrumental in measuring and comparatively assessing rates of various healthcare associated medical and surgical complications. Guided initiatives such as CUSP (Comprehensive Unit-Based Safety Program) have led to reduced rates of these complications, including SSIs, in both non-gynecological [7,8,9] and gynecological surgery [10]. These studies demonstrate clearly that SSIs are a potentially preventable complication of surgical procedures, and the study of their rates and risk factors, along with monitoring the effectiveness of policy interventions, is important to improving quality in clinical practice.

One known risk factor for SSIs causing morbidity/mortality following surgery is postoperative hyperglycemia. Postoperative Hyperglycemia is a common phenomenon due to the insulin resistance caused by the surgical stress hypermetabolic response from surgical trauma [11], with one review suggesting that hyperglycemia is the most important risk factor for SSI's [12]. Hyperglycemia is known to impair the immune system through a variety of pathways/mechanisms including leukocyte migration and response capacity [13] thus increasing susceptibility to infection, particularly in the context of a healing wound. It has been previously demonstrated that postoperative hyperglycemia control protocols reduce the risk of SSIs in general surgery patients [12] and gynecologic oncology patients [14].

No published data thus far has explored the impact of comprehensive, multidisciplinary glycemic control initiative spanning from patient referral to discharge on the frequency of SSI's. However, recent Cochrane reviews concluded that insufficient evidence currently exists demonstrating that maintaining normoglycemia throughout the entire perioperative period leads to reduction in the rate of overall infections [15] and SSIs specifically [16]. The primary objective of this study was therefore to determine if a comprehensive, multidisciplinary glycemic control initiative from referral to discharge would lead to lower rates of SSIs in gynecologic oncology patients.

2. Methods

The Ottawa Hospital (TOH) has been a member hospital of ACS NSQIP since 2010. Our division of Gynecologic Oncology was a "negative outlier" when compared with other same-size, same-intention hospital organizations across North America with regards to our SSI risk-adjusted rates, which previously ranged between 18 and 24% depending on year. As part of a CUSP quality improvement initiative at TOH, all women ($n = 297$) in advance of undergoing major gynecologic oncology surgery at TOH between January 5, 2015 and December 18, 2015 were screened for glycosylated hemoglobin (HbA1C) as a measure of prediabetes/diabetes (group II) at least 2 weeks before surgery, with a median wait time of 28 days (interquartile range (IQR) 18–42 days). Major gynecologic oncology surgeries included robotic-assisted total hysterectomy (RATH) and laparotomy (LAP) for cervical, endometrial/vaginal, or fallopian tube/ovarian/primary peritoneal cancer. Surgical outcomes were compared to a similar cohort of women ($n = 165$) also undergoing gynecologic oncology surgery at TOH between January 6, 2014 and June 27, 2014, before protocol implementation (group I). All patients in both groups received similar standard of care with regards to other perioperative interventions aimed to reduce SSI, including administration of preoperative Cefazolin, chlorhexidine-isopropyl alcohol based skin preparation, and maintenance of normotheric core body temperature.

Baseline patient demographic characteristics recorded for both groups prior to surgery included patient age, BMI, smoking history, type of cancer, surgical modality, neoadjuvant chemotherapy or radiation therapy, diabetic status, and prior use of insulin. Comparative operative outcomes recorded included quantity of estimated blood loss, and necessity of bowel resection. Because at the beginning of the study A1C was not included in the study protocol, this data was available only in part of the 2014 data.

2.1. Preoperative management

Group II patients were managed in accordance to our protocol depending on pre-surgical HbA1C <6%, between 6 and 6.9%, or ≥7% (Fig. 1). Those with HbA1C <6% were exempt from intensive pre-surgical follow-up, those with HbA1C 6–6.9% were referred to their general practitioner, and those with HbA1C ≥7% were referred to internal medicine, with all glucose management being left up to the discretion of the individual provider.

Patients taking oral hypoglycemic were instructed to hold their morning doses of these medications. Patients received standardized instructions regarding their insulin doses the night prior to surgery and on the morning of surgery. Full pre-operative glycemic protocol beginning the night before surgery is described in Appendix 1.

2.2. Intraoperative management

All patients flagged with a HbA1c ≥6% were to receive intensive intraoperative glucose monitoring every 2 h starting from the beginning of surgery or from the last correction dose of insulin. Intraoperative glucose was to be corrected to a value <10 mmol/L (180 mg/dL) with subcutaneous Insulin Aspart (Novorapid®) injections based on the patient's degree of insulin resistance following an established sliding scale. Blood glucose was checked on arrival to the Post-Anesthesia Care Unit (PACU) and once transferred to the ward, four times per day.

2.3. Postoperative management

For group II patients with A1C ≥7%, pre-printed orders for glycemic control were filled by the internal medicine team. These pre-printed orders also prescribed protocols for glucose checks and management of hypoglycemia. For patients with A1c 6.0–6.9%, post-operative insulin pre-printed orders were completed by the surgical team based on recommended guidelines developed for post-operative management by the study team (Appendix 2). Basal-bolus subcutaneous insulin regiments were preferred over oral medications and sliding scale alone [17]. Group I patients were treated by the nursing team with usual care with or without the pre-printed orders as per physician discretion. At the nursing team's discretion, a Diabetes Nurse Specialist and the Endocrinology team was contacted if the glucose was >10 mmol/L (180 mg/dL). These specialist nurses would assist in glucose management through an Advance Directive management system. The goal was to keep the glucose between 6 and 10 mmol/L (108–180 mg/dL) and the protocol included orders for dealing with hypoglycemia (glucose < 4.0 mmol/L (72 mg/dL)). Target blood glucose range was chosen based on findings of previous studies, and recommendations from the Canadian Diabetes Association Clinical Practice Guidelines [18]. All blood glucose measurements were performed using Accu-Chek ® Inform II System. The post-operative hyperglycemic control measures were respected through the duration of hospital stay, irrespective of length of stay.

2.4. Statistical analysis

Patient's demographic and clinical characteristics between 2014 and 2015 were compared. The primary outcome for our study was differences in SSI infection between the two groups requiring additional

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