Perioperative Hyperglycemia Increases Risk for Deep Wound Infection After Major Orthopedic

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Objective:

Total hip and knee replacement surgery are one of the most frequent major surgeries performed in USA. In 2002, the number of primary hip and knee arthroplasty was 119,000 and 381,000, respectively.(1) By year 2030 the number is projected to increase to 572,000 and 3,481,000, respectively.(2)

Deep wound infection after major orthopedic surgery is one of the most serious complications causing increase in morbidity and mortality and health care costs.(3) Various risk factors for developing infection after hip and knee replacement surgery were described including age, ASA PS status, obesity, patients' comorbidities and surgical technique factors.(4,5,6,7)

Perioperative hyperglycemia may increase the risk for infection after the surgery,(8) but it is unknown if increases the risk after major orthopedic surgery.

We investigated whether high blood glucose increases a risk for periprosthetic joint infection (PJI) after total hip and knee arthroplasty.

Demographic and surgical data in patients with and without infection

	No Infection N=17,770	Infection N=190	p value
Male sex, n (%)	7,528 (42.36%)	97 (51.05%)	0.018*
Age, mean (SD)	64.02 (12.39)	63.61 (12.06)	0.570
BMI, mean (SD)	30.15 (6.54)	33.03 (9.66)	<0.001*
Bilateral , n (%)	2,669 (15.49%)	37 (20.33%)	0.080
Procedure, n (%) THA TKA	9,636 (54.23%) 8,134 (45.77%)	63 (33.16%) 127 (66.84%)	<0.001*
Charlson Index, mean (SD)	2.32 (1.52)	2.53 (1.67)	0.060
ASA, mean (SD)	2.45 (0.59)	2.68 (0.55)	<0.001*
OR time, minutes, mean (SD)	113.64 (40.07)	138.87 (65.80)	<0.001*
Length of stay, days, mean (SD)	4.17 (2.24)	5.95 (6.51)	<0.01*
Disposition, n (%) Home Health care Rehab Other	6,528 (36.74%) 2,170 (12.21%) 9,035 (50.84%) 37 (0.21%)	54 (28.42%) 38 (20.00%) 98 (51.58%) 0	0.008*
History of MI, n (%)	770 (4.33%)	15 (7.89%)	0.029*
History of Dementia, n (%)	26 (0.15%)	0	1.00
History of CAD, n (%)	180 (1.01%)	3 (1.58%)	0.447
History of CHF, n (%)	270 (1.52%)	10 (5.26%)	0.001*
History of tumor without mets, n (%)	54 (0.30%)	0	1.00
History of metastatic solid tumor, n (%)	165 (0.93%)	4 (2.11%)	0.105
Leukemia, n (%)	34 (0.19%)	0	1.00
DM, n (%)	2,133 (12.00%)	38 (20.00%)	0.002*
Lymphoma, n (%)	40 (0.23%)	0	1.00
Chronic Lung Disease, n (%)	1,773 (9.98%)	20 (10.53%)	0.807
Connective tissue disease, n (%)	531 (2.99%)	12 (6.32%)	0.016*
Mild liver disease, n (%)	19 (0.11%)	1 (0.53%)	0.192
Moderate to severe liver disease, n (%)	45 (0.25%)	1 (0.53%)	0.387
GI Ulcer, n (%)	103 (0.58%)	0	0.631
PVD, n (%)	108 (0.61%)	2 (1.05%)	0.325
Hemiplegia, n (%)	12 (0.07%)	0	1.00
Moderate to severe renal disease, n (%)	227 (1.28%)	8 (4.21%)	0.004*
OSA, n (%)	195 (1.10%)	1 (0.53%)	0.727
RA, n (%) JRA, n (%)	383 (2.16%) 14 (0.08%)	8 (4.21%) 0	0.200
AMI, n (%)	53 (0.30%)	2 (1.05%)	0.115
Angina pectoris, n (%)	98 (0.55%)	2 (1.05%)	0.286
Acute renal failure, n (%)	77 (0.43%)	4 (2.11%)	0.011
DVT, n (%)	70 (0.39%)	3 (1.58%)	0.042*
PE, n (%)	182 (1.02%)	2 (1.05%)	0.722
AF, n (%)	834 (4.69%)	16 (8.42%)	0.024*
Transfusion (auto) ,PRBC units, mean (SD)	0.73 (0.66)	0.64 (0.72)	0.054
Transfusion (allo), PRBC units, mean (SD)	0.48 (1.03)	1.48 (2.21)	<0.001*

* - statistically significant, p <0.05

Methods:

After obtaining IRB approval, we reviewed our computerized database for primary total hip and knee arthroplasty from 2000 to 2008. Demographic information, past medical history of patients, perioperative biochemistry and postoperative complications were reviewed.

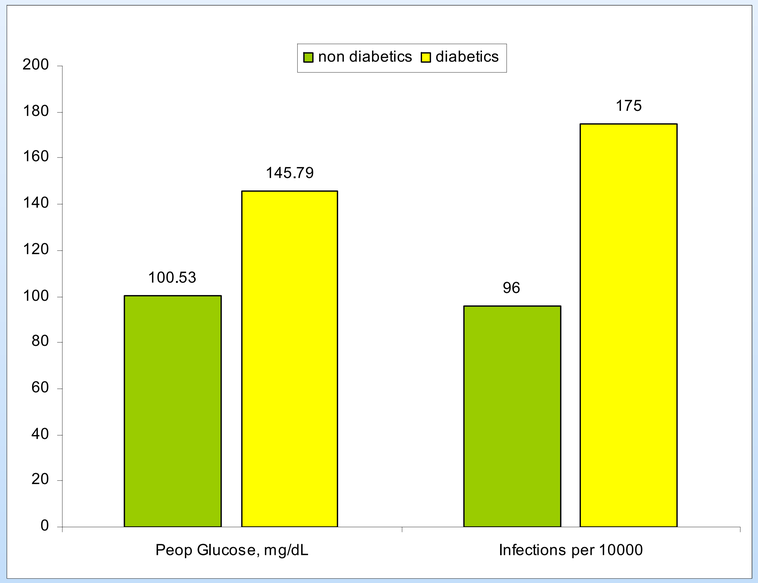
Periprosthetic joint (deep wound) infection was defined as a deep infection below fascia, involvement of muscle and/or bone. The diagnosis of deep periprosthetic infection was made if at least three of the following five criteria were present: (1) abnormal serology (erythrocyte sedimentation rate 30 mm/hour; C-reactive protein 1 mg/dL); (2) strong clinical and radiographic suspicion for periprosthetic infection such as periosteal elevation, focal osteolysis, hot and swollen joint, draining sinus, (3) positive joint aspiration culture; (4) evidence of purulence during the subsequent surgical intervention; and (5) a positive intraoperative culture. The minimum follow-up was 12 months (mean, 43 months; range 12–76 months).

All patients have the same perioperative infection prophylaxis; 1 g intravenous cefazolin on induction and continued for 24 hours post surgery (1 g vancomycin if allergic to cefazolin), laminar airflow operating room environments, and helmet aspirator suits, as well as DVT prophylaxis with warfarin 5 to 10 mg, titrated to achieve an International Normalized Ratio (INR) between 1.5 and 2.0.

Total hip arthroplasty was performed through a modified anterolateral approach using uncemented components in all cases. Knee arthroplasty was performed under tourniquet using a medial parapatellar arthrotomy approach using cemented fixation for all knees. No drains were used in any of the cases. Neuraxial anesthesia was used for all surgeries unless contraindicated.

Continuous variables were tested using the t-test. Categorical variables were tested using Fischer's exact test. P values reported are two-sided.

Preoperative glucose and infection rate in diabetics and non diabetics.



Results:

Data from 17960 patients were included in the study. The incidence of periprosthetic joint (deep wound) infection was 1.06 % (190/17960 patients, 95% CI 0.91, 1.21).

Infected patients tended to be male (51 vs 42 %, P=0.018), had higher BMI (33 vs 30 kg/m^2, P<0.001), higher ASA PS (2.68 vs 2.45, P<0.001), had history of (h/o) MI (7.9 vs 4.3 %, P=0.029), h/o renal disease (4.2 vs 1.9 %, P=0.004), and h/o DM (20 vs 12 %, P=0.002). Longer operative time, knee arthroplasty compared with hip arthroplasty were also significantly higher (p<0.001). Diabetic patients had significantly higher preoperative glucose (145 vs 100, P<0.001) and higher infection rate (1.75% vs 0.96%, P=0.002).

Mean perioperative blood glucose (130 vs 125 mg/dL, P=0.012) was significantly higher in infected patients. Significant metabolic markers of PJI were: higher preoperative creatinin (1.24 vs 0.95 mg/dL, P<0.001), higher postoperative rise in creatinin (0.18 vs 0.04 mg/dL, P<0.001), lower mean perioperative albumin (3.7 vs 4.0 g/dL, P<0.001), lower mean Hb (10.6 vs 11.0 g/dL, P<0.001), higher mean INR (1.36 vs 1.32, P=0.009), and higher BUN (14.7 vs 17.9 mg/dL, P=0.001).

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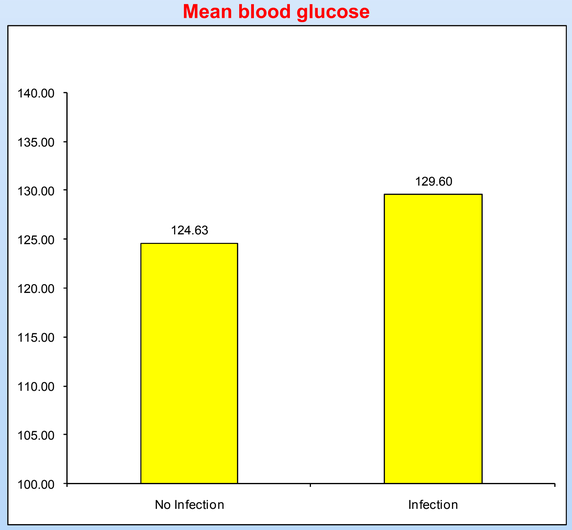
Metabolic factors in patients with infection. Data are mean (SD).

	No Infection N=17,770	Infection N=190	p value
Glucose, mg/dL	124.63 (27.03)	129.60 (31.26)	0.012*
A1C, %	6.70 (1.38)	7.72 (0.57)	0.099
Preop Creatinin, mg/dL	0.95 (0.46)	1.24 (1.76)	<0.001*
BUN, mg/dL	14.71 (5.75)	17.91 (9.88)	<0.001*
Creatinin rise, mg/dL	0.04 (0.25)	0.18 (0.77)	<0.001*
Postop Creatinin, mg/dL	0.93 (0.39)	1.16 (1.41)	<0.001*
Hb, mean, g/dL	11.03 (1.21)	10.62 (1.23)	<0.001*
Post op lowest Hb, g/dL	9.71 (1.42)	9.15 (1.46)	<0.001*
Hematocrit, %	32.84 (3.52)	31.77 (3.69)	<0.001*
Hb drop, g/dL	3.57 (1.34)	3.62 (1.56)	0.698
WBC, B/L	8.83 (2.49)	9.20 (2.70)	0.044*
PT, sec	16.69 (1.88)	17.05 (2.27)	0.009*
PTT, sec	31.14 (6.18)	32.84 (7.72)	<0.001*
INR	1.32 (0.20)	1.36 (0.24)	0.009*
Platelet count, B/L	218.34 (57.48)	220.56 (68.53)	0.598
Fibrinogen, mg/dL	376.98 (92.25)	435 (106.62)	0.013*
Albumin, g/dL	4.03 (0.55)	3.66 (0.71)	<0.001*
ALK phos, IU/L	75.15 (38.97)	106.20 (128.24)	<0.001*
ALT, IU/L	28.13 (42.02)	28.30 (17.31)	0.983
Amylase, U/L	69.93 (72.33)	117.92 (74.84)	0.354
AST, IU/L	32.42 (45.67)	37.53 (32.13)	0.476
Direct Bilirubin, mg/dL	0.36 (0.54)	0.35 (0.27)	0.895
Total Bilirubin, mg/dL	0.76 (0.86)	0.88 (0.55)	0.378
BNP, pg/mL	589.42 (698.15)	210.60 (141.05)	0.233
Troponin, ng/mL	1.51 (8.57)	1.86 (5.00)	0.877
Cholesterol, mg/dL	172.92 (48.20)	161.75 (54.44)	0.224
HDL, mg/dL	41.45 (12.80)	38.31 (13.68)	0.379
LDL, mg/dL	87.51 (32.52)	86.13 (43.92)	0.880
Triglycerides, mg/dL	102.45 (70.11)	91.95 (34.68)	0.590
Lipase, U/L	34.61 (48.80)	75.40 (83.67)	0.114

Mean blood glucose



Conclusion:

We confirmed the known risk factors for PJI after total hip and knee arthroplasty; male sex, BMI, ASA PS, h/o MI, h/o renal disease, h/o DM, longer duration of surgery and knee arthroplasty. Higher mean perioperative blood glucose is a significant risk factor for PJI after total hip and knee arthroplasty. Other significant metabolic risk factors were higher preoperative and mean postoperative creatinin, postoperative rise in creatinin, lower mean albumin and higher mean INR and BUN.

The importance of this study is that the prevalence of PJI is believed to be on the rise once again and the diagnosis of PJI continues to be challenging. Knowing the risk factors associated with PJI could help physicians to indentify patients who may need more aggressive prophylaxis and postoperative infection surveillance.

A prospective, randomized, controlled trial is required to determine whether optimizing blood glucose perioperatively would decrease the incidence of deep would infection in this clinical setting.