



Effects of Hypercarbia in Lower Extremity Primary Total Joint Arthroplasty: Preliminary Data Analysis



Teigen Goodeill, DO; Justin Than, DO; Jordan Wells, BS; Nicholas Tedesco, DO

BACKGROUND

- Prosthetic Joint Infection (PJI) is one of the most serious complications of total joint arthroplasty (TJA)
- Incidence of lower extremity PJI is approximately 0.3-2%¹
- Wound oxygenation is critical for proper wound healing
- Diminished oxygen availability causes a decrease to fibroblast proliferation, production of collagen, angiogenesis, re-epithelialization, and the activity of leukocytes which all may inhibit healing potential.¹
- As bicarbonate is exchanged in the lungs for inhaled O₂, higher levels of serum bicarbonate may reflect poor overall oxygenation.²

OBJECTIVES

- Explore whether patients who experienced PJI or wound complications within one year of lower extremity TJA correlated with elevated pre-operative serum bicarbonate levels
- Wound healing complications to explore include superficial infection, deep infection, and dehiscence.
- We hypothesize that an elevated pre-operative serum bicarbonate level leads to increased likelihood of PJI and aseptic dehiscence due to poor oxygenation.

METHODS

- Retrospective chart review of lower extremity TJA patients from 03/2013 through 11/2018
- Inclusion criteria: Patients who underwent lower extremity TJA who had pre-operative serum bicarbonate levels recorded within 30 days prior to surgery
- Exclusion criteria: Revision TJA, Uni-compartmental arthroplasty, Bilateral TJA, and Immunocompromised patients
- Primary Outcome measures: PJI, Wound healing complication to include superficial or deep infections and wound dehiscence
- Secondary Outcome measure: Revision surgery rates within one year (all cause) of index procedure

RESULTS

- Pre-operative serum bicarbonate did not significantly differ between patients with vs without a post-op infection (p=0.47).
- Higher A1C did reach statistical significance in patients who did not experience infection; however, this finding was based on only 33 patients that had an A1C measured preoperatively, only 2 of whom had the outcome of interest.
- There is a trend associating hypertension and increased PJI (37.8% vs. 23.5%)
- The Infection Cohort had a higher proportion of males (48.6% vs. 38.6%)

	No Infection (N=2,632)	Infection (N=37)	P-value
Mean (SD)			
Age	68.5 (9.7)	66.4 (9.9)	0.21
Bicarbonate level¹ (N=1,690)	26.9 (2.6)	27.2 (2.1)	0.47
BMI¹ (N=2,557)	32.0 (6.5)	32.7 (6.8)	0.53
A1C² (N=33)	6.3 (0.9)	5.5 (0.1)	0.002*
% (N)			
Sex			0.28
Female	61.4% (1,615)	51.4% (19)	
Male	38.6% (1,017)	48.6% (18)	
Procedure			0.64
Total Ankle Replacement	1% (26)	0% (0)	
Total Hip Replacement	33.5% (882)	27% (10)	
Total Knee Replacement	65.5% (1,724)	73% (27)	
Operating Region			0.47
Knee	65% (1,720)	73% (27)	
Hip	32% (851)	27% (10)	
Other	2% (61)	0% (0)	
Ever Smoker³ (N=2,654)	50.2% (1,314)	54.1% (20)	0.77
Arthritis	87.2% (2,295)	91.9% (34)	0.62
Osteoarthritis	83.9% (2,209)	89.2% (33)	0.52
HTN	23.5% (619)	37.8% (14)	0.07
Diabetes	13.6% (357)	13.5% (5)	1.00
Obstructive Sleep Apnea	11.1% (293)	13.5% (5)	0.60
CKD	4.4% (117)	5.4% (2)	0.68
Asthma	4.4% (115)	8.1% (3)	0.22
CAD	4.3% (112)	8.1% (3)	0.21
Peripheral Vascular Disease	2.6% (68)	0% (0)	1.00
Alcoholism	2.4% (62)	2.7% (1)	0.59
COPD	2.1% (56)	2.7% (1)	0.55
Stroke	1.6% (42)	0% (0)	1.00

Table 1. Lower extremity TJA patients with and without post-op infection or wound complication within 1 year of surgery (N=2,669)

1. Serum bicarbonate and BMI were recorded from the most recent measure within 30 days prior to surgery.

2. A1C was recorded from the most recent measure within 90 days prior to surgery.

3. Smoking status was recorded from the most proximal measure to the date of surgery within 6 weeks (42 days).

* P-values < .05 indicate statistical significance. Significance was estimated by t-test for continuous variables and by chi-squared for categorical variables or exact Fisher test when the expected frequency was less than 5 in any cell.

CONCLUSIONS

- The primary outcome of interest, PJI, was relatively rare; only 1.4% of patients experienced an infection or wound complication within one-year post-op. This is consistent with incidence reported in literature¹
- Samaritan Health System rate of PJI (1.4%) falls within the reported rate of 0.3-2%¹
- Statistical power was limited by the small sample size of an infrequent outcome and incomplete data on some exposure variables.

FUTURE IMPLICATIONS

- Further analysis to include why there is higher rate of elevated A1C in the No Infection Cohort
- A1C analysis would include multiple A1C cutoffs for more in-depth investigation
- Desire to further extrapolate the "other" category in regard to operating region

REFERENCES & ACKNOWLEDGEMENTS

- Joseph, T., Chen, A., & Di Cesare, P. (2003). Use of Antibiotic-Impregnated Cement in Total Joint Arthroplasty. *Journal of American Academy of Orthopaedic Surgeons*, 11, 38-47.
 - Brandi C, Grimaldi L, Nisi G, et al. The role of carbon dioxide therapy in the treatment of chronic wounds. *in vivo*. 2010;24:223-226.
 - Howell K, Ooi H, Preston R, McLoughlin P. Structural basis of hypoxic pulmonary hypertension: the modifying effect of chronic hypercapnia. *Experimental Physiology*. 2003;1:66-72.
- Dr. Tedesco does own stock in ROM3, an orthopedic rehabilitation company. ROM3 is neither directly nor indirectly involved with this study.