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BRIEF REPORT

Gout and healthcare utilization and complications after hip arthroplasty: a cohort study using the US National Inpatient Sample (NIS)

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Abstract

Little is known about the effect of gout on in-hospital complications and healthcare utilization after total hip arthroplasty (THA). We used the 1998-2014 U.S. National Inpatient Sample (NIS) to examine this question using cohort study design. Multivariable-adjusted Cox regression analyses included age, race, gender, underlying diagnosis, Deyo-Romano comorbidity index, insurance payer, and income. In adjusted analyses, we found that gout was associated with 9-20% higher healthcare utilization and 6% higher hazard of transfusion after primary THA. These findings can inform surgeons and patients of gout-associated complications post-THA.

Keywords Gout · Healthcare utilization · Hip arthroplasty

Introduction

Gout, a common inflammatory arthritis, was associated with a 1.4–1.5 times higher risk of total joint arthroplasty (TJA) [1, 2]. Population-based studies assessing the impact of gout on total hip arthroplasty (THA) outcomes are lacking. We assessed whether and to what extent gout is associated with higher healthcare utilization and in-hospital complications post-THA.

Methods

We used the 1998–2014 US National Inpatient Sample (NIS), a 20% stratified sample of discharges obtained from the US community hospitals [3], for this cohort study. The study cohort included all index hospitalizations with a primary diagnosis of primary THA, identified with an International Classification of Disease, ninth revision, common modification (ICD-9-CM) code, 81.51, a validated approach [4]. The cohort was divided into two groups based on the presence or absence of gout as a secondary diagnosis, identified by ICD-9-CM code, 274 [5]. We examined healthcare utilization outcomes and in-hospital complications for the index THA hospitalization: (1) length of hospital stay, total hospital charges (proportion above the median, US $37,791), and the discharge disposition, i.e., to home vs. an inpatient facility; (2) in-hospital complications coded as secondary diagnoses: (a) infection: 711.xx, 730.xx, 996.66 or 996.67; (b) transfusion: 99.0x; and (c) revision: 81.53. 00.70 00.72, 00.73, 84.56, 84.57 or 80.05; and (3) in-hospital mortality.

We used separate multivariable-adjusted logistic regression analyses to assess the association of gout with each outcome, controlling for several covariates/potential confounders including age, race, gender, underlying diagnosis, Deyo-Romano comorbidity index, insurance payer, and income. Sensitivity analyses additionally adjusted the main model for hospital location/teaching status, bed size, and region.

Results

Of the 4,116,485 primary THA in study cohort, 104,792 (2.5%) had gout (Table 1). Compared to those without gout, people with gout were older, and more likely to be male,

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Table 1 Demographic and other cohort characteristics

	All cohort ($N = 4,116,485$)*	No gout ($N = 4,012,387$)*	Gout ($N = 104,098$)*
Age, mean (SE); median	65.2 (0.04); 65.9	65.5 (0.04); 66.0	67.0 (0.09); 67.0
Age category			
< 50	449,642 (10.9%)	442,224 (11.0%)	7418 (7.1%)
50–64	1,364,821 (33.2%)	1,330,919 (33.2%)	33,902 (32.6%)
65–79	1,732,014 (42.1%)	1,683,378 (42.0%)	48,636 (46.7%)
≥ 80	566,521 (13.8%)	552,389 (13.8%)	14,132 (13.6%)
Gender			
Female	2,330,188 (56.6%)	2,303,984 (57.4%)	26,204 (25.2%)
Male	1,776,722 (43.2%)	1,698,847 (42.3%)	77,875 (74.8%)
Race			
White	2,882,040 (70.0%)	2,807,827 (70.0%)	74,213 (71.3%)
Black	225,772 (5.5%)	217,805 (5.4%)	7967 (7.7%)
Hispanic	104,385 (2.5%)	102,364 (2.6%)	2021 (1.9%)
Other/missing	904,234 (22.0%)	884,338 (22.0%)	19,896 (19.1%)
Primary diagnosis			
Rheumatoid arthritis	29,173 (0.7%)	28,946 (0.7%)	227 (0.2%)
Avascular necrosis	285,623 (6.9%)	277,134 (6.9%)	8489 (8.2%)
OA	3,447,224 (83.7%)	3,357,983 (83.7%)	89,241 (85.7%)
Other	354,307 (8.6%)	348,167 (8.7%)	6140 (5.9%)
Fracture	117 (0.0%)	117 (0.0%)	0 (0.0%)
Hospital location/teaching			
Rural	444,188 (10.8%)	433,750 (10.8%)	10,438 (10.0%)
Urban	1,722,391 (41.8%)	1,680,203 (41.9%)	42,188 (40.5%)
Urban teaching	1,939,989 (47.1%)	1,888,827 (47.1%)	51,162 (49.1%)
Insurance			
Medicaid	138,809 (3.4%)	136,302 (3.4%)	2507 (2.4%)
Medicare	2,234,674 (54.3%)	2,174,154 (54.2%)	60,520 (58.1%)
Other	102,276 (2.5%)	100,185 (2.5%)	2091 (2.0%)
Private	1,600,829 (38.9%)	1,562,620 (38.9%)	38,209 (36.7%)
Self	32,308 (0.8%)	31,697 (3.0%)	611 (0.6%)
Income category			
0–25th percentile	653,243 (15.9%)	635,111 (15.8%)	18,132 (17.4%)
25–50th percentile	1,009,677 (24.5%)	984,542 (24.5%)	25,135 (24.1%)
50–75th percentile	1,086,954 (26.4%)	1,059,575 (26.4%)	27,379 (26.3%)
75–100th percentile	1,285,855 (31.2%)	1,254,558 (31.3%)	31,297 (30.1%)
Hospital bed size			
Small	685,209 (16.6%)	667,201 (16.6%)	18,008 (17.3%)
Medium	1,037,561 (25.2%)	1,010,906 (25.2%)	26,655 (25.6%)
Large	2,383,797 (57.9%)	2,324,673 (57.9%)	59,124 (56.8%)
Hospital region			
Northeast	818,700 (19.9%)	797,318 (19.9%)	21,382 (20.5%)
Midwest	1,089,883 (26.5%)	1,062,567 (26.5%)	27,316 (26.2%)
South	1,358,856 (33.0%)	1,323,743 (33.0%)	35,113 (33.7%)
West	849,046 (20.6%)	828,759 (20.7%)	20,287 (19.5%)
Annual hospital THA volume			
< 25	486,120 (11.8%)	472,939 (11.8%)	13,086 (12.5%)
26 to 100	1,461,615 (35.5%)	1,425,450 (35.5%)	25,980 (24.8%)
101 to 200	1,051,561 (25.5%)	1,025,560 (25.6%)	36,312 (34.7%)
> 200	1,117,189 (27.1%)	1,087,744 (27.1%)	29,414 (28.1%)

Table 1 (continued)

	All cohort ($N = 4,116,485$)*	No gout ($N = 4,012,387$)*	Gout ($N = 104,098$)*
Deyo-Charlson score			
0	2,193,575 (53.3%)	2,151,940 (53.6%)	41,635 (40.0%)
1	926,286 (22.5%)	902,768 (22.5%)	23,518 (22.6%)
≥ 2	996,624 (24.2%)	957,679 (23.9%)	38,945 (37.4%)
Post-THA healthcare utilization and in-hospital complications			
Infection	7592 (0.2%)	7437 (0.2%)	155 (0.1%)
Revision	17,932 (0.4%)	17,552 (0.4%)	380 (0.4%)
Transfusion	937,803 (22.8%)	915,245 (22.8%)	22,558 (21.7%)
Gout	104,098 (2.5%)	–	104,098 (100.0%)
Discharge status			
Inpatient facility†	2,448,107 (59.5%)	2,386,634 (59.5%)	61,473 (59.1%)
Home	1,649,102 (40.1%)	1,606,861 (40.0%)	42,241 (40.6%)
Length of stay, mean (SE); median	3.71 (0.01); 2.74	3.73 (0.01); 2.75	3.67 (0.02); 2.69
Length of stay category			
≤ 3	2,499,883 (60.7%)	2,434,036 (60.7%)	65,847 (63.3%)
> 3	1,616,602 (39.3%)	1,578,351 (39.3%)	38,251 (36.7%)
Died during hospitalization	8889 (0.2%)	8737 (0.8%)	153 (0.1%)

*US National estimates were based on the following in the 20% NIS sample: all, $N = 855,634$; no gout, $N = 834,115$; gout, $N = 21,519$; N (%), unless specified otherwise

† Inpatient facility included short- or long-term care hospital, skilled nursing facility (SNF), intermediate care facility, or a certified nursing facility

Black, have Medicare or Medicaid insurance, or in the lowest income quartile (Table 1). In multivariable-adjusted analyses, gout was associated with a higher odds of total hospital charges above the median with odds ratio [OR] (95% Confidence Interval (CI)) of 1.20 (1.17, 1.24) and discharge to a rehabilitation facility, 1.09 (1.05, 1.12) post-THA (Table 2).

In multivariable-adjusted analyses, gout was associated with a higher risk of transfusion, OR (95% CI) was 1.06 (1.03, 1.10) and a lower risk of mortality post-THA, with

Table 2 Multivariable-adjusted association of gout with health care utilization and in-hospital complications after primary THA

	Main model[a] OR (95% CI)	Sensitivity analysis[b]: main model + hospital characteristics OR (95% CI)
Length of hospital stay more than median (> 3 days)[c]	*0.95 (0.92, 0.98)*	*0.95 (0.92, 0.98)*
Discharge to a rehabilitation facility	*1.09 (1.05, 1.12)*	*1.09 (1.05, 1.12)*
Total hospital charge above the median	*1.20 (1.17, 1.24)*	*1.20 (1.17, 1.24)*
In-hospital complications[d]		
Transfusion	*1.06 (1.03, 1.10)*	*1.06 (1.03, 1.10)*
Revision	1.08 (0.85, 1.37)	1.08 (0.85, 1.37)
Infection	0.88 (0.67, 1.15)	0.87 (0.66, 1.14)
Death	*0.54 (0.37, 0.78)*	*0.55 (0.38, 0.79)*

Italic values represent statistically significant odds ratios that do not include unity in the 95% confidence interval

OR odds ratio, *CI* confidence interval

[a] Main model was run separately for each outcome and was adjusted for demographics (age, race/ethnicity, gender), the Deyo-Charlson comorbidity index, the underlying diagnosis for THA, the insurance payer type, and the annual household income

[b] Sensitivity model additionally adjusted the main model for the hospital variables including the region, the bed size, and location/teaching status

[c] Median length of hospital stay was 3.7 days, rounded off to 3 days for categorization of the length of hospital stay variable

[d] In-hospital complications detected by the presence of respective ICD-9-CM codes as secondary diagnoses

OR of 0.54 (0.37, 0.78) (Table 2). Gout was not associated with the risk of infection, with OR, 0.88 (0.67, 1.15) or revision post-THA, OR was 1.08 (0.85, 1.37).

Discussion

In this cohort study of US hospital discharges from 1998 to 2014, we found that gout was associated with increased healthcare utilization and in-hospital complications after primary THA. Joint inflammation in gout related to urate crystals associated with accelerated cartilage wear [6] may contribute to higher risk of TJA [1, 2]. Acute and chronic joint inflammation in gout may potentially interfere with optimal recovery from primary THA in patients undergoing THA, leading to higher healthcare utilization including discharge to a rehabilitation facility and higher charges. A higher in-hospital transfusion risk may have partially contributed to higher healthcare utilization. We are unclear of the reasons for a lower mortality in patients with gout. Study findings must be interpreted considering key limitations: (1) NIS counts discharges, nor people; (2) residual confounding bias due to cohort study design; (3) the lack of longitudinal data; and (4) no data on gout severity or treatments. Study strengths include the use of a national sample, adjustment for multiple variables, and robust findings. This study informs surgeons and patients of gout-associated risks post-THA. Future studies should assess whether optimal pre-operative gout management can reduce utilization and complications post-THA.

Author contributions Mr. Cleveland had full access to all of the data in the study and takes the responsibility for the integrity of the data and accuracy of the data analysis. He was supervised by Dr. Singh, who reviewed all results.

Study concept and design: Singh

Data acquisition, analysis, and interpretation of results: Singh and Cleveland

Drafting of the manuscript: Singh

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Compliance with ethical standards

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Ethics/IRB approval and consent to participate The University of Alabama at Birmingham's Institutional Review Board approved this study and waived the need for informed consent for this database study. All investigations were conducted in conformity with ethical principles of research.

References

1. Kuo CF, Chou IJ, See LC, Chen JS, Yu KH, Luo SF, Hsieh AH, Zhang W, Doherty M (2018) Urate-lowering treatment and risk of total joint replacement in patients with gout. Rheumatology (Oxford) 57:2129–2139
2. Teng GG, Leung YY, Ang LW, Yuan JM, Koh WP (2017) Gout and risk of knee replacement for severe knee osteoarthritis in the Singapore Chinese Health Study. Osteoarthr Cartil 25:1962–1968
3. HCUP Databases (2017) Healthcare Cost and Utilization Project (HCUP). Overview of the Nationwide Inpatient Sample (NIS). http://www.hcup-us.ahrq.gov/nisoverview.jsp. Last modified 3/22/17. In. Rockville, MD: Agency for Healthcare Research and Quality
4. Katz JN, Losina E, Barrett J, Phillips CB, Mahomed NN, Lew RA, Guadagnoli E, Harris WH, Poss R, Baron JA (2001) Association between hospital and surgeon procedure volume and outcomes of total hip replacement in the United States medicare population. J Bone Joint Surg Am 83-A:1622–1629
5. Singh JA, Hodges JS, Toscano JP, Asch SM (2007) Quality of care for gout in the US needs improvement. Arthritis Rheum 57:822–829
6. Chhana A, Callon KE, Pool B, Naot D, Gamble GD, Dray M, Pitto R, Bentley J, McQueen FM, Cornish J, Dalbeth N (2013) The effects of monosodium urate monohydrate crystals on chondrocyte viability and function: implications for development of cartilage damage in gout. J Rheumatol 40:2067–2074