Superimposed Crystalline Arthropathy in Total Joint Arthroplasty: Impact on Periprosthetic Joint Infection Workup

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INTRODUCTION:
Diagnostic workup of peri-prosthetic joint infection (PJI) after total joint arthroplasty (TJA) remains a challenge. Our study aims to assess the prevalence of crystalline arthropathy (CA) in a large group of patients undergoing PJI workup after TJA and to compare the impact of CA on diagnostic criteria in patients with and without PJI.
METHODS:
A retrospective study of 703 TJA patients who underwent joint aspiration sent for crystal analysis and PJI workup between June-2011 and January-2024 was conducted. Patient demographics, serum (erythrocyte sedimentation rate [ESR], C-reactive protein [CRP]), and synovial (white blood cell [WBC] count, neutrophil percentage [PMN]) lab values were collected. Patients were categorized into cohorts based on presence of crystalline arthropathy (either monosodium urate crystals [MSU] or calcium pyrophosphate dihydrate [CPPD]) from synovial fluid aspirates and based on whether they met ICM PJI criteria. Statistical significance was reported as median of lab values.
RESULTS:
Of the 703 patients, 87 patients (12.4%) were positive for CA, of which 11 were MSU (1.4%) and 76 were CPPD (11%). Patients who were negative for crystals and positive for PJI had higher median serum ESR (P<0.030) and synovial fluid PMN % (P<0.001) values compared to the cohort that was positive crystals and positive PJI. The patient cohort with positive crystals and positive PJI had a higher serum CRP (P<0.001) and synovial fluid WBC (P<0.001) median values compared to the cohort negative for crystals and positive for PJI.
DISCUSSION AND CONCLUSION:
The prevalence of CA after TJA in patients undergoing PJI workup is greater than previously reported (12.4%). Our study showed that PJI seems to increase synovial WBC and PMN% more than CA does, however, further studies should be done to identify any recurring trends on how CA complicates of diagnostic workup of PJI in TJA patients.

Table 1: Patient Demographics

	Negative for Crystals n = 616 (87.6 %)	Positive for Crystals n = 87 (12.4 %)	*P*-value
Sex, n (%)			0.878
Men	295 (47.9)	43 (48.43)	
Women	321 (52.1)	44 (50.57)	
Mean Age (years), [range]	64.04 [24 - 91]	67.41 [38 - 96]	0.011
Race, n (%)			0.549
White	368 (59.74)	56 (64.37)	
African American	121 (19.64)	17 (19.54)	
Asian	14 (2.27)	3 (3.45)	
Other	113 (18.34)	11 (12.64)	
Smoking Status, n (%)			0.281
Current	41 (6.66)	3 (3.45)	
Former	262 (42.53)	33 (37.93)	
Never	313 (50.81)	51 (58.62)	
BMI (kg/m2), mean [range]	31.01 [15.22 - 55.78]	29.49 [18.28 - 47.07]	
ASA score, n (%)			0.874
1	16 (2.6)	3 (3.45)	
2	317 (51.46)	41 (47.13)	
3	258 (41.88)	39 (44.83)	
4	25 (4.06)	4 (4.6)	
CCI, mean [range]	3.34 [0 - 14]	3.28 [0 - 14]	0.809
Diabetes, n (%)	123 (19.97)	17 (19.54)	0.999
Revisions, n (%)	177 (28.73)	19 (21.84)	0.224
Septic revisions, n (%)	77 (12.5)	6 (6.9)	0.180
Aseptic revisions, n (%)	100 (16.23)	13 (14.94)	0.879

BMI, Body Mass Index; ASA, American Society of Anesthesiologists score; CCI, Charlson Comorbidity Index

Table 2. Demographics and Key Lab Values based on types of Crystals

	Negative for Crystals n = 616 (87.6 %)	MSU n = 11 (1.4 %)	CPPD n = 76 (11 %)	*P*-value
Age (years), mean [range]	64.03 [24 - 91]	64.0 [53 - 77]	67.91 [38 – 96]	0.015
Sex, n (%)				0.246
Men	295 (47.89)	8 (72.73)	35 (46.05)	
Women	321 (52.11)	3 (27.27)	41 (53.95)	
Serum				
ESR, median [range]	35 [1.0 – 140.0]	75 [21.0 – 99.0]	43 [2.0 – 130.0]	0.309
CRP, median [range]	28.6 [0.1 – 529.0]	77.8 [2.9 – 243.6]	28.3 [0.1 – 464.9]	0.399
Synovial fluid				
WBC (n/uL), median [range]	2,325 [4.0 – 545000.0]	9,279 [1116.0 – 52870.0]	2,943 [13.0 – 171250.0]	0.142
PMN %, median [range]	74 [0 – 99.0]	87 [2 - 96]	79 [1 – 98]	0.285

MSU, Monosodium urate crystals; CPPD, Calcium pyrophosphate dehydrate; ESR, erythrocyte sedimentation rate; CRP, C-reactive protein, WBC, white blood cell; PMN, Polymorph neutrophils.

Table 3. Demographics and Key Lab Values based on Crystal Presence and PJI Status

	- Crystals -PJI n = 77	+ Crystals -PJI n = 6	- Crystals- PJI n = 539	*P*-value
Age (years), mean [range]	64.56 [31 - 91]	60.83 [38 - 84]	63.96 [24 – 89]	0.348
Sex, n (%)				0.324
Men	32 (41.56)	4 (66.67)	263 (48.79)	
Women	45 (58.44)	2 (33.33)	276 (51.21)	
Serum				
ESR, median [range]	65 [7.0 – 140.0]	49 [7.0 – 220.0]	54 [1.0 – 140.0]	0.030
CRP, median [range]	63.4 [0.1 – 529.0]	119.7 [0.4 – 229.9]	25.43 [0.1 – 527.9]	<0.001
Synovial fluid				
WBC(n/uL), median [range]	21,221 [40.0 – 348000.0]	24,150 [190.0 – 139480.0]	1508 [4.0 – 545000.0]	<0.001
PMN %, median [range]	90 [3 – 99.0]	85 [1 - 97]	66 [0 – 99]	<0.001

PJI, Periprosthetic joint infection; ESR, erythrocyte sedimentation rate; CRP, C-reactive protein; WBC, white blood cell; PMN, Polymorph neutrophils.

Table 4. Demographics and Key Lab Values based on Crystal Presence and PJI Status

		Crystals			Total
		Positive	Negative	*P value*	
PJI	Positive	n = 6 ESR = 49 CRP = 119 WBC = 24,100 PMN % = 85	n = 77 ESR = 65 CRP = 63 WBC = 21,221 PMN % = 90	*0.639* *0.285* *0.921* *0.252*	83
	Negative	n = 81 ESR = 48 CRP = 38 WBC = 2896 PMN % = 81	n = 539 ESR = 54 CRP = 23 WBC = 1508 PMN % = 66	*0.597* *0.612* *0.618* *0.264*	620
Total		87	616		703

PJI, Periprosthetic joint infection; ESR, erythrocyte sedimentation rate; CRP, C-reactive protein, WBC, white blood cell; PMN, Polymorph neutrophils.