Inflammatory and Coagulopathic Etiologies of Femoral Head Avascular Necrosis Are Associated with Highest Mortality, Worst Pain, and Function after Primary Total Hip Arthroplasty Compared to Other Pathogeneses

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INTRODUCTION:

Avascular necrosis (AVN) of the femoral head is the underlying diagnosis for approximately 5-18% of all total hip arthroplasty (THA) recipients in the United States. However, AVN is a final common sequel of a variety of dissimilar etiologies with different pathogeneses. Such variability may compromise the reliability of assessing AVN patients as a single homogenous cohort in THA outcome evaluation. Nevertheless, contemporary rarely distinguishes between various AVN categories in outcome assessment. Therefore, the present study aimed to explore differences in 1) baseline patient characteristics; and 2) outcomes including healthcare utilization, mortality, and patient-reported outcomes (PROMs) among patients with different femoral head AVN etiologies who received primary THA.

METHODS:

A prospective institutional cohort of primary THAs for an underlying diagnosis of femoral head AVN was obtained (n=542). Patients were stratified by underlying AVN cause, yielding four categorical cohorts: Steroid use (high dose steroid use or chronic steroid intake), Hematologic/Inflammatory disorders (i.e., coagulopathies, sickle cell anemia, leukemia, lymphoma, and inflammatory connective tissue disorders), substance abuse (i.e., alcoholism, smoking, or drug use), and idiopathic. Baseline demographics, comorbidities, surgical history, as well as baseline and one-year postoperative patient-reported outcomes were captured. Outcomes included differences in demographic determinants among different AVN etiologic categories as well as healthcare utilization (length of stay, discharge disposition, 90-day readmission), one-year mortality, and one-year joint-specific patient-reported outcomes (Hip disability and Osteoarthritis Outcome Score [HOOS]-Pain and Physical function [PS]). Analyses were performed to explore potential associations between predictors, including AVN etiology, and outcomes.

RESULTS:

The majority of included AVN cases were secondary to chronic steroid use (n=157; 30.0%) and substance abuse (n=156; 28.9%), followed by idiopathic AVN (n=139; 25.6%), and hematologic/inflammatory etiology (n=90; 16.6%). The Idiopathic AVN category had the highest prevalence of elderly patients (70+Y: n=28; 5.2%), while the substance abuse cohort had the highest proportion of young patients (≤49Y: n=59; 10.9%; p<0.001)(Table 1). Obesity prevalence was higher in the idiopathic cohort (n=56; 10.3%) and lowest in the inflammatory/hematologic (n=30; 5.5%) and substance abuse (n=47; 8.6%) groups. Overall, patients who had hematologic/inflammatory etiology of AVN had the highest burden of comorbidities (CCI 3+: n=41; 7.6%; p<0.001). There was no difference in baseline HOOS-Pain and HOOS-PS across different AVN cohorts (p>0.05, each; Table 2). Inflammatory/hematologic AVN patients had the longest average length of stay (3.4 days; p<0.001; Table 3), the highest one-year mortality rate (n=7; 7.8%; p<0.001), worst median HOOS pain (74.9; p=0.001, lower scores indicate worse pain), and HOOS-PS (21.3; p=0.024; higher scores indicate worse function) levels at one-year postoperatively.

DISCUSSION AND CONCLUSION:

AVN of the femoral head is a final outcome of several potential underlying etiologies with dissimilar pathogeneses. Patients with hematologic/inflammatory etiology had the worst overall post-THA outcomes compared to other potential causes including substance use (smoking, alcoholism, or drug use), chronic steroid use, and idiopathic AVN. Specifically, this cohort had the highest burden of comorbidities, longest hospital length of stay, highest mortality rates, and lowest pain and function levels at one year postoperatively. As such, it is critical that surgeons remain cognizant of the implications of the underlying cause of AVN and the dissimilar outcomes between its different etiologies. Patients at high risk should be afforded enhanced preoperative health optimization and offered dedicated care pathways to ensure THA's safety and success.

Table 1. Baseline demographics and comorbidities distribution by AVN etiology category

	Idiopathic (N=139)	Steroids (N=157)	Blood/Inflammatory (N=90)	Drug and Nicotine Abuse (N=156)	p value
Sex (%)					0.011
F	69 (49.6%)	78 (49.7%)	45 (50.0%)	23 (34.0%)	
M	70 (50.4%)	79 (50.3%)	45 (50.0%)	103 (66.0%)	
Age					0.004
Mean	57.338	51.728	51.300	54.510	
Age Group (%)					0.015
Missing			3	0	
18-29	3 (2.2%)	17 (10.8%)	8 (8.2%)	4 (2.8%)	
30-39	15 (10.9%)	16 (10.2%)	11 (11.0%)	19 (12.2%)	
40-49	24 (17.4%)	34 (21.7%)	10 (10.4%)	36 (21.1%)	
50-59	39 (28.3%)	33 (22.3%)	21 (24.2%)	38 (24.4%)	
60-69	26 (18.8%)	34 (24.8%)	19 (21.8%)	39 (23.5%)	
70-79	19 (13.8%)	11 (7.0%)	10 (11.3%)	17 (10.9%)	
80-89	7 (5.1%)	3 (1.9%)	2 (2.5%)	1 (0.6%)	
≥	2 (3.4%)	0 (0.9%)	0 (0.0%)	2 (1.3%)	
BMI (%)					0.008
Missing	7	13	51	50	
Underweight	1 (0.7%)	2 (1.4%)	0 (0.0%)	2 (1.4%)	
Normal Weight	43 (31.4%)	47 (32.6%)	29 (33.2%)	43 (29.5%)	
Overweight	37 (27.0%)	48 (33.5%)	28 (32.2%)	52 (35.6%)	
Obese Class I	29 (21.2%)	24 (16.7%)	10 (21.8%)	31 (26.0%)	
Obese Class II	18 (13.3%)	18 (12.1%)	7 (8.0%)	9 (8.2%)	
Obese Class III	9 (6.6%)	3 (3.3%)	4 (4.6%)	5 (3.4%)	
Charlson Comorbidity Index (%)					<0.001
Missing	36	40	21	18	
Mild (1-2)	50 (73.5%)	72 (95.5%)	28 (40.8%)	31 (73.0%)	
Moderate (3-4)	8 (18.3%)	27 (23.1%)	10 (27.5%)	9 (13.2%)	
Severe (5+)	1 (10.2%)	18 (15.4%)	22 (31.9%)	8 (11.8%)	
Smoking Status (%)					<0.001
Yes	1 (0.7%)	83 (52.9%)	39 (40.3%)	143 (91.7%)	
No	138 (99.3%)	74 (47.1%)	51 (58.7%)	13 (8.3%)	

Table 2. Baseline joint-specific pain and function patient-reported outcomes distribution by AVN etiologic category

	Idiopathic (N=139)	Steroids (N=157)	Blood/Inflammatory (N=90)	Drug and Nicotine Abuse (N=156)	p value
HOOS-Pain					0.047
Mean	31.755	32.083	31.646	30.773	
HOOS-PS					0.819
Mean	58.320	58.140	58.422	57.308	

Table 3. Healthcare utilization, mortality and patient-reported outcomes at one-year post-THA stratified by AVN etiologic category

	Idiopathic (N=139)	Steroids (N=157)	Blood/Inflammatory (N=90)	Drug and Nicotine Abuse (N=156)	p value
90-day readmission					0.978
Missing	1	2	1	0	
Yes	122 (88.4%)	133 (88.5%)	78 (88.7%)	131 (86.5%)	
No	16 (11.6%)	23 (13.7%)	12 (13.3%)	25 (13.5%)	
Length of stay (days)					<0.001
Mean	2.239	2.429	3.318	2.696	
Discharge disposition					0.091
Missing	3	2	0	2	
Home	113 (81.9%)	123 (79.4%)	69 (75.0%)	123 (79.9%)	
Nursing Facility	20 (14.5%)	28 (18.1%)	13 (18.7%)	31 (20.3%)	
Acute Rehab	5 (3.6%)	4 (2.6%)	7 (7.8%)	1 (0.9%)	
One-year mortality					<0.001
Yes	2 (1.4%)	0 (0.0%)	7 (7.8%)	1 (0.6%)	
No	137 (98.6%)	157 (100.0%)	83 (92.2%)	155 (99.4%)	
One-year HOOS-Pain					0.001
Mean	86.947	81.812	74.924	87.284	
One-year HOOS-PS					0.024
Mean	13.111	13.830	21.254	13.080	