Evaluation of biomarkers in patients with potential periprosthetic joint infections after hip and knee arthroplasty

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BACKGROUND

The number of total joint replacements performed each year to treat pain related to end stage knee osteoarthritis (OA) has steadily increased in the last decade. Despite overall efficacy in the majority of patients, a subset of about 20% experience prosthetic complications in the short or in the long run, most often due to aseptic failure or prosthetic joint infection. Accurate diagnosis is therefore crucial.

Biomarkers of tissue remodeling are promising diagnostic tools to characterize joint pathological mechanisms, provide a better understanding of how prosthetic complications affect the tissue remodeling to improve diagnosis and intervention.

Aim of the study
- Investigate the relationship between joint tissue remodeling and inflammation biomarkers with diagnosis in patients with hip or knee prosthetic joint complications
- The effect of joint corrective surgery on acute and long-term biomarker levels.

METHODS

Study participants
The study included 66 patients referred with pain and complication from a prosthetic joint. Patients received corrective surgery for either aseptic failure (n=47) or prosthetic joint infection (n=17). Blood was drawn before revision (BL), 1-3 days after surgery (V2) and after
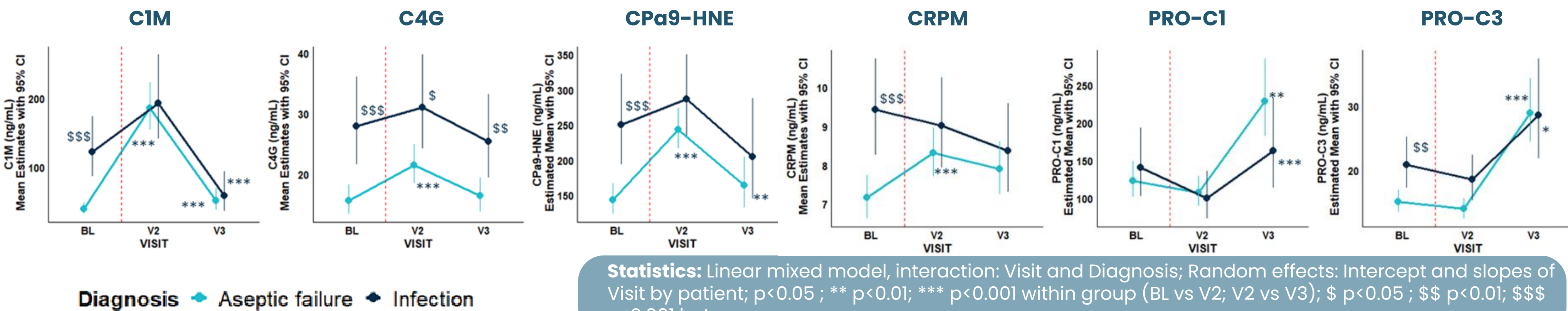
Biomarkers
Biomarkers of synovial tissue degradation **C1M**, tissue inflammation **CRPM**, immune cell activation **C4G**, **CPa9-HNE**, and tissue fibrogenesis **PRO-C1**, and **PRO-C3**, were measured at baseline and at least one follow-up visit, using ELISA.

Statistics
Longitudinal biomarker levels were modeled using linear mixed models and average levels compared within and between groups by t-tests.

RESULTS

Longitudinal biomarker levels in patients with revision surgery following total knee or hip replacement complication

Statistics: Linear mixed model, interaction: Visit and Diagnosis; Random effects: Intercept and slopes of Visit by patient; p<0.05 ; ** p<0.01; *** p<0.001 within group (BL vs V2; V2 vs V3); $ p<0.05 ; $$ p<0.01; $$$ p<0.001 between groups.

Demographics

	Aseptic failure (n = 48)	Infection (n = 17)
Age (years) Median (Q1, Q3)	72.0 (67.0, 79.0)	68.0 (64.0, 77.0)
Sex Female	23 (47.9%)	9 (52.9%)
BMI (kg/m^2) Median (Q1, Q3)	28.9 (26.8, 32.9)	28.8 (26.6, 33.7)
Joint Hip Knee	24 (50.0%) 24 (50.0%)	9 (52.9%) 8 (47.1%)
Intervention Surgery for aseptic failure Surgery for infection	47 (97.0%) 1 (2.1%)	3 (17.3%) 14 (82.4%)
Redness	0 (0.0%)	7 (43.8%)
Warmth	0 (0.0%)	5 (31.2%)
Swelling	10 (20.8%)	14 (87.5%)
Pain	47 (97.9%)	12 (75.0%)
Fever	0 (0.0%)	7 (43.8%)

Findings

Elevated Biomarkers in Infections: At baseline, markers C1M, C4G, CPa9-HNE, CRPM, and PRO-C3 were higher in infection cases than in aseptic failures.

Post-Surgery Increase: Biomarkers C1M and CPa9-HNE increased transiently after surgery for aseptic failure.
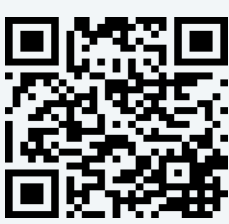
Normalization Post-Surgery: Most biomarkers returned to pre-surgical levels 1-3 months post-surgery, except CRPM.

Persistent Inflammation in Infection Group: Infection group showed no significant change at the second visit but normalized by the third, similar to aseptic cases.

Long-Term Trends: By the third visit, most biomarkers normalized, except C4G remained high; fibrogenesis markers PRO-C1 and PRO-C3 increased, indicating tissue repair.

CONCLUSION

Patients with PJI had higher baseline levels of synovial degradation and inflammation markers.

Post-surgery, these markers temporarily rose in AF cases but remained elevated in PJI cases before normalizing in both.

This demonstrates unique tissue remodeling responses to different joint complications, underscoring diagnosis, prognosis, and monitoring utility.

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