Synovial fluid presepsin as a novel diagnostic biomarker for periprosthetic joint infection

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INTRODUCTION:

Joint replacement are used to improve activities of daily living and quality of life in patients with joint dysfunction due to various joint diseases. However, there are several complications to be aware of, one of which is periprosthetic joint infection (PJI), which often requires multiple surgeries and prolonged treatment. One of the problems of PJI is the lack of diagnostic biomarker with high sensitivity and specificity, which delays the definitive diagnosis.

In 2009, presepsin was identified as a CD14 fragment produced when monocyte phagocytoses bacteria in the blood and cathepsin degrades them, and elevated presepsin in the blood have been reported as a specific biomarker for sepsis. In a previous report, we reported that presepsin in synovial fluid was significantly higher in septic arthritis of native joint than in osteoarthritis. Presepsin is produced without inflammatory cytokines, and it has been reported that presepsin correlated better with the course of sepsis than C-reactive protein in the posttraumatic acute treatment. Thus, we hypothesized that presepsin may be useful as a specific biomarker in PJI cases.

In this study, we measured presepsin in blood and synovial fluid of PJI patients and non-PJI patients who underwent arthrocentesis for some reason other than infection after joint replacement, and examined whether presepsin may be a useful biomarker for PJI diagnosis.

METHODS:

From May 2015 to October 2023, a total of 115 patients with joint pain, swelling, or other symptoms after joint replacement surgery had arthrocentesis performed to collect synovial fluid, and 119 joints were prospectively included in this study. PJI group was defined as cases that met the criteria of the international consensus meeting 2008. Non-PJI group was defined as those with joint effusions, negative synovial fluid cultures, and no antimicrobial therapy since the onset of the infection. Finally, there were 45 joints in the PJI group and 74 joints in the non-PJIgroup.

Blood and syonvial fluid samples were collected on the same day for each case, and the samples were immediately centrifuged and the supernatant was measured. Preseptin was measured by PATHFAST (LSI medience corporation), based on the principle of Chemiluminescent Enzyme Immunoassay, using approximately 100 µL of specimen.

The two groups, the PJI group and non-PJI group, were compared in terms of age, type of joint prosthesis, blood presepsin, and synovial fluid presepsin levels. Receiver Operating Characteristic curves were created for each group, and area under the curve (AUC), sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) were calculated and compared between two groups.

RESULTS:

The mean age of the PJI group and non-PJI group was 74.3 ± 11.7 and 72.6 ± 10.2 years, respectively, and the type of prosthesis was 31 total knee arthroplasty (TKA), 11 total hip arthroplasty (THA), and 3 bipolar hip arthroplasty (BHA) in the PJI group, and 54 TKA, 12 THA, and 8 BHA in the non-PJI group, with no significant differences between the two groups. Bacteria in the PJI group included 26 *Staphylococcus species*, 5 *Methicillin-resistant Staphylococcus aureus*, 6 *Streptococcus species*, 1 *Escherichia coli*, 2 *Pseudomonas aureginosa*, and 5 culture negative infection.

Blood presepsin was a median of 394.0 pg/mL in the PJI group and 154.5 pg/mL in the non-PJI group, and synovial fluid presepsin was 2227.2 pg/mL and 822.0 pg/mL, respectively (Figure 1). Both values significantly higher in the PJI group. The AUC, sensitivity, specificity, PPV, and NPV of blood presepsin were 0.849, 73.1%, 79.4%, 73.1%, and 79.4%. The AUC, sensitivity, specificity, PPV, and NPV of synovial fluid presepsin were 0.957, 90%, 92.5%, 87.5%, and 92.3% (Figure 2), respectively, and all values were higher for synovial fluid presepsin compared to blood presepsin.

DISCUSSION AND CONCLUSION:

In this study, we focused on presepsin in synovial fluid and found that the presepsin level in synovial fluid was statistically significantly higher in the PJI group than in the non-PJI group, with a sensitivity of 90% and specificity of 92.5%. Furthermore, the advantage of presepsin is that the measurement time of presepsin using PATH fast is very fast (approximately 17 minutes) and relatively inexpensive, making it a useful biomarker for the early diagnosis of PJI.

Although blood presepsin is recognized as a biomarker for sepsis, the sensitivity and specificity of synovial fluid presepsin were higher than those in blood in the PJI group. The reason for this is that in the case of sepsis, presepsin is mainly produced against bacteria in the blood. On the other hand, in the case of PJI, the greatest number of bacteria is considered to be in the synovial fluid. Therefore, more presepsin would be produced, resulting in higher sensitivity, specificity, PPV, and NPV.

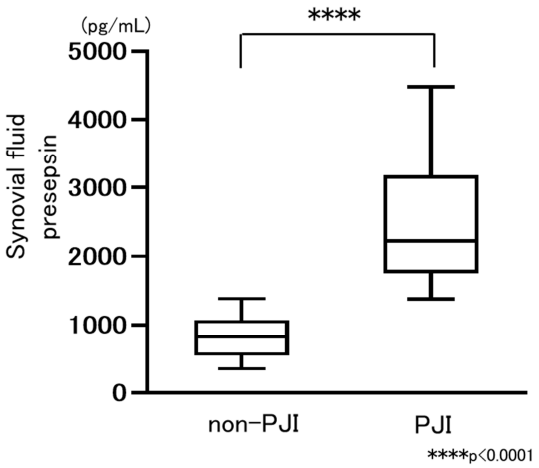

Figure 1

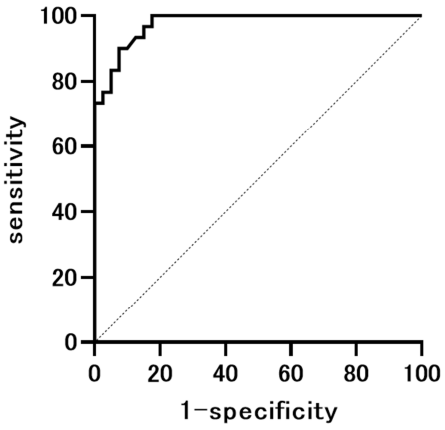

Figure 2