Protrusio acetabuli in ankylosing spondylitis patients with end-stage hip involvement

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Protrusio acetabuli (PA) is a complication of a wide spectrum of pathological disorders involving the hip joint.[1] The underlying causes can be inflammatory,[2,3] traumatic, genetic, metabolic, infectious, and idiopathic. Inflammatory causes lead to destruction and weakening of the bone surrounding the hip with resultant migration along the joint-reaction vector. Consequently, PA is relatively common in inflammatory arthritis (IA), including rheumatoid arthritis (RA),[4,5] juvenile idiopathic arthritis (JIA), ankylosing spondylitis (AS),[2] and psoriatic arthritis (PsA).[2] Previous studies mainly focused on the clinical characteristics and treatment options for PA in various stages of hip involvement in RA patients.[6] In contrast, only one research has discussed the prevalence of PA in spondyloarthritis (SpA) and its correlations with clinical manifestations.[2]

It has been widely documented that total hip arthroplasty (THA) in the treatment of AS patients provides reliable clinical results and implant survivorship. The existence of PA presents technical difficulties in the placement of the acetabular component and reconstruction of the hip center of rotation (COR). This condition has been fully discussed in the THA reconstruction for RA patients. To our knowledge, there have been no studies addressing this issue for AS patients.

The purposes of this study were to (1) judge the prevalence of PA in AS patients with end-stage hip involvement, as well as its relation to clinical characteristics, and (2) identify all possible related factors predisposing to PA in these patients.

A total of 670 consecutive hips with AS who were evaluated at Beijing Jishuitan Hospital were reviewed from 2005 to 2020. The study was approved by the Institutional Review Board of Beijing Jishuitan Hospital (No. 2015-259) was obtained for this study. The inclusion criteria consisted of (1) diagnosis with AS by the 1984 modified New York criteria and (2) end-stage hip involvement ready for THA. The exclusion criteria consisted of (1) history of congenital, developmental, metabolic, or endocrine hip disease; (2) previous hip surgery, deep infection, trauma, and tumor; (3) combined IA and connective tissue disease other than AS; and (4) poor quality of radiographic recordings. Finally, 332 hips were enrolled in this study.

The patient demographics were collected retrospectively. These parameters included gender, side (left of right hip), and body mass index (BMI); AS-related clinical information including age at THA, age at onset of AS, diagnosis delay, disease activity, functional status; extra-articular manifestations (EAMs) (current or past) including uveitis, psoriasis, and inflammatory bowel disease (IBD); and smoking habits (current or past). EAMs were diagnosed by an ophthalmologist, dermatologist, and gastroenterologist, respectively. The degree of pre-operative flexion contracture was also recorded. Disease activity and functional status were judged by using the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) and the Bath Ankylosing Spondylitis Functional Index (BASFI), respectively. The patient-reported outcomes (PROs) were assessed by using the Short Form-12 (SF-12). These data for clinical characteristics were collected by two independent rheumatologists (Siliang Man and Hongchao Li) who had not participated in radiographic evaluations from chart review. Hip pain and function status were assessed by Harris Hip Score (HHS) system.

Laboratory parameters were also collected at enrollment, including the level of serum erythrocyte sedimentation rate (ESR), C reactive protein (CRP), hemoglobin (HGB), and albumin (ALB).
Pre-operative anteroposterior (AP) radiographs of the pelvis showing both hips were evaluated for bony ankylosis and PA according to the criteria proposed by Sotello-Garza and Charnley, which uses the rim of the pelvis, taken as a projection of the upper margin of the pubic ramus, as a reference, and grades PA as follows: I, mild with an acetabular-ilioischial distance (AID) from 1 mm to 5 mm; II, moderate with an AID from 6 mm to 15 mm; and III, severe with an AID >15 mm. The center-edge angle (CEA) of Wiberg, obturator foramen ratio (OFR), canal flare index (CFI), and neck-shaft angle (NSA) were also measured on pelvic AP radiographs. These radiographs were obtained in all cases within 1 week before THA. These radiographs were evaluated by the same reviewer (Tao Bian) who was blinded from patients’ clinical information. Each parameter was measured twice with the use of Mimics software (version 16.0, Nemaris, NY, USA) and averaged.

The statistical analysis was used by SPSS software for Windows (version 25.0; IBM, Armonk, NY, USA). Descriptive analyses for categorical variables were based on percentages and frequencies and for continuous variables on mean and standard deviation (SD) or median and quartile (Q1, Q3) if the data were skewed. The intergroup differences were compared by using independent sample Student’s t-tests or Mann–Whitney U tests for continuous variables and chi-squared tests for dichotomous variables, respectively. Then, a multivariate logistic regression model was used in the assessment of related factors identified as significant in the univariate analysis, and the odds ratio (OR) with 95% confidence intervals (CIs) and the associated P value were determined. All reported P values are two-tailed with an alpha of 0.05. The area under the curve (AUC) value was calculated to assess the accuracy of the model.

The patient demographics and clinical parameters were listed in Table 1. A total of 103 (19.4%) of 532 hips met the criteria for PA: grade I in 87 (16.4%) hips and grade II in 16 (3.0%) hips. The radiographic parameters are listed in Supplementary Table 1, http://links.lww.com/CM9/A783.

The differences in demographics and clinical parameters between the PA group and non-PA group are presented in Table 1. Compared with hips in non-PA, the hips in the PA group had a significantly higher percentage of IBD (9.7% vs. 4.2%, P = 0.024), a higher BASFI (62.0 ± 19.1 vs. 57.1 ± 19.4, P = 0.014), a lower SF-12 physical component summary (PCS) (30.5 ± 7.7 vs. 33.1 ± 8.5, P = 0.003), and a lower HHS (30.0 ± 14.3 vs. 33.9 ± 13.2, P = 0.020), compared with hips in non-PA.

We also compared the radiographic parameters of the hips, including CEA, OFR, CFI, and NSA between PA group and non-PA group [Supplementary, Table 1, http://links.lww.com/CM9/A783]. Compared with hips in non-PA, the hips in the PA group had a significantly higher percentage of CEA (41.0 ± 10.6 vs. 36.5 ± 10.3, P = 0.001). Next, these patient demographics, clinical, laboratory, and radiographic factors were introduced into a multivariate logistic regression model to allow us to observe the possible relationship between them and PA. The model revealed that significant parameters for PA were IBD (OR = 0.335; 95% CI: 0.147–0.764; P = 0.009), SF-12 PCS (OR = 0.966; 95% CI: 0.940–0.992; P = 0.012), and HHS (OR = 0.982; 95% CI: 0.966–0.998; P = 0.026) [Supplementary Table 2, http://links.
PA is commonly diagnosed in the setting of IA. The occurrence of PA has been widely reported in RA,[3-5] as a typical representation of IA. Unfortunately, there is still a lack of studies with a large sample size on the incidence of PA. Gusis et al[3] reported a prevalence of 23% in 100 cases. PA of the hips was present in 28 of 193 (14.5%). This complication was more frequent in women, with 19 of 23 cases (82%), and its presence and severity were associated with a longer duration of disease. In contrast, PA in AS has gained less attention, which was mainly due to the relatively small sample size in clinical practice. Only early in 1993, Gusis et al[2] reported PA prevalence to be 25% (19/75) in SpA. There were no significant differences in SpA subtypes, including AS, PsA, and Reiter’s syndrome.

We, therefore, determined the incidence of PA in AS cases with end-stage hip involvement and evaluated associations between PA and patient demographics, clinical, laboratory, and radiographic factors. The incidence of PA in our series described herein was 19.4% (103/532) with 16.4% of hips in grade I, 3.0% of hips in grade II, which was comparable to the previously reported outcomes from studies for RA or SpA. Notably, this percentage was from cases with end-stage hip involvement. We also found a relationship between PA and CEA, which was routinely used to define the amount of acetabular coverage of the femoral head. While PA has been defined most commonly by the acetabular fossa projecting medial to the ilioschial line, some studies have used CEA to classify hips as having PA.

In the study by Gusis et al,[2] PA did not correlate with disease duration, clinical severity of hip involvement, or previous medication. In our results, compared with hips in non-PA, the hips in PA group had a significantly higher BASFI ($P = 0.014$), a lower SF-12 PCS ($P = 0.003$), and a lower HHS ($P = 0.020$). The multivariate logistic regression model also revealed that significant parameters for PA were SF-12 PCS (OR = 0.966) and HHS (OR = 0.982). These results suggested that the development of PA was associated with disease-specific general functional status and clinical severity of hip involvement. Interestingly, IBD was a significant protective factor with an OR value of 0.335, which was rarely reported in the previous literature. We think that it was related to active medication therapy, a particular biological agent, for this special patient group.

The introduction and development in clinical practice of biological agents and treat-to-target approach (T2T) have dramatically changed the prognosis of patients with AS. However, once hip aggravation reaches the end-stage stage with irreversible pain and ROM limitation combined with severe gait and posture deviations, THA seems inevitable. The presence of PA in the involved hip presents a series of technical challenges to surgeons, including restoration of bone stock and hip COR, survivorship of the implant, and abductor function.[5]

Our study has several limitations, including those related to a single-centered, retrospective, and nonlongitudinal design. The sample was not representative of all AS patients. All patients exclusively came from cases with endstage hip involvement, and we were unable to adequately evaluate the dynamic change of PA and its impact on the functional status of the involved hip. The method of recruitment used in this study could have possibly been confounded by selection bias. Meanwhile, it was impossible to assess all related factors for the development of PA. Some great contributors to PA, including HLA-B27, history of pharmacological interventions, and rehabilitation, were not taken into consideration in our analysis of the regression model.

In conclusion, PA is a common radiographic finding in AS patients with end-stage hip involvement and correlates with general functional status and clinical severity of hip involvement. The presence of PA presents technical challenges to surgeons, and special reconstruction techniques should be taken into consideration.

**Conflicts of interest**

None.

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