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ORIGINAL ARTICLE

Observational Study

Changes in postoperative depression and anxiety and their relationship with recovery from femoral head necrosis: A longitudinal study

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Abstract

BACKGROUND

Femoral head necrosis (FHN) can significantly affect patients' psychological well-being and functional outcomes. However, the long-term relationship between postoperative depression, anxiety, and functional recovery in patients with FHN remains unclear.

AIM

To investigate the dynamic changes in postoperative depression and anxiety and their relationship with functional recovery in patients with FHN for 3 years.

METHODS

Ninety-three patients with FHN who underwent surgical treatment in March 2020 to 2023 were enrolled in this longitudinal study. Depression and anxiety status were assessed using the hospital anxiety and depression scale (HADS) at baseline, 6 months, 1, 2, and 3 years postoperatively. Functional recovery was evaluated using the Harris hip score (HHS). The dynamic changes in HADS and HHS were analyzed using repeated measures ANOVA; the relationship between depression/anxiety status and functional recovery was examined using Pearson's correlation analysis.

RESULTS

The mean HADS-depression (HADS-D) and HADS-anxiety (HADS-A) scores

significantly improved over time ($P < 0.001$). The prevalence of depression and anxiety decreased from 36.6% and 41.9% at baseline to 10.8% and 12.9%, respectively, at 3 years postoperatively. The mean HHS increased significantly from 52.3 ± 10.5 at baseline to 88.1 ± 7.2 at 3 years postoperatively ($P < 0.001$). Significant negative correlations were found between HADS-D/HADS-A scores and HHS at all time points ($P < 0.05$).

CONCLUSION

The severity of depression and anxiety negatively correlated with functional recovery, highlighting the importance of psychological interventions in the management of patients with FHN.

Key Words: Femoral head necrosis; Postoperative depression; Postoperative anxiety; Functional recovery; Longitudinal study; Psychological intervention

Core Tip: This study highlights the dynamic changes in postoperative depression and anxiety in patients with femoral head necrosis (FHN) for 3 years and their impact on functional recovery. The findings revealed significant improvements in depression and anxiety levels, with a marked decrease in their prevalence over time. Concurrently, functional recovery demonstrated a substantial postoperative increase. A negative correlation was observed between depression/anxiety scores and functional recovery, highlighting the critical role of psychological interventions in improving the overall management of patients with FHN. These results highlight the importance of addressing mental health and physical recovery in patients undergoing surgical treatment for FHN.

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INTRODUCTION

Femoral head necrosis (FHN), also known as avascular necrosis of the femoral head, is a debilitating condition characterized by bone cell death due to disrupted blood supply[1]. The etiology of FHN is multifactorial, with risk factors including corticosteroid use, alcohol consumption, smoking, and trauma[2]. It typically affects young and middle-aged adults with a mean age of 38 years at diagnosis[3]. FHN can cause severe hip pain, limited range of motion, and decreased quality of life, often requiring surgical intervention to alleviate symptoms and improve function[4,5].

The psychological impact of FHN and its treatment on patients has not been well studied. Depression and anxiety are common psychological disorders that negatively affect postoperative recovery and functional outcomes in these patients [6,7]. Previous studies have reported a high prevalence of depression and anxiety in patients with chronic musculoskeletal conditions, such as osteoarthritis and rheumatoid arthritis[8,9]. In patients with FHN, the prolonged duration of symptoms, functional limitations, and the need for surgical intervention can further contribute to the development of psychological distress[10].

The complex interplay between psychological factors and functional recovery in patients with FHN highlights the importance of a comprehensive management approach. Understanding the dynamic changes in postoperative depression and anxiety status, and their relationship with functional recovery is crucial to optimizing patient care. However, few studies have investigated this topic and the long-term psychological outcomes of patients with FHN remain largely unknown[11,12].

To address this knowledge gap, we conducted a longitudinal study to investigate dynamic changes in postoperative depression and anxiety statuses and their relationship with functional recovery in patients with FHN over a 3-year period. We hypothesized that patients with FHN would experience significant improvements in psychological well-being and functional outcomes after surgical treatment and that the severity of depression and anxiety would be negatively correlated with functional recovery.

MATERIALS AND METHODS

Study design and participants

This longitudinal study enrolled 93 patients with FHN who underwent surgical treatment [total hip arthroplasty (THA) or core decompression] From March 2020 to March 2023, at Baoshan Luodian Hospital in Shanghai, China. The study protocol was approved by the institutional review board and written informed consent was obtained from all participants. The inclusion criteria were: (1) Age ≥ 18 years; (2) Diagnosed with FHN according to clinical and radiographic

findings, including plain radiographs and magnetic resonance imaging; (3) Underwent surgical treatment for FHN, THA, or core decompression, according to the stage of the disease and the surgeon's recommendation; and (4) Able to complete the follow-up assessments. Patients with preexisting psychiatric disorders, cognitive impairment, or other severe comorbidities that could interfere with the assessment of psychological status or functional recovery were excluded. Power analysis was performed using G*Power software (version 3.1.9.4) to determine the required sample size[13]. Assuming an effect size of 0.25, an alpha level of 0.05, and a power of 0.80, a minimum sample size of 82 patients was required for repeated measures ANOVA. Ninety-three patients were enrolled to account for possible dropouts.

Data collection and outcome measures

Demographic and clinical data, including age, sex, body mass index, symptom duration, and type of surgical treatment, were collected at baseline through patient interviews and medical record reviews. Depression and anxiety statuses were assessed using the hospital anxiety and depression scale (HADS) at baseline and 6 months, 1 year, 2 years, and 3 years postoperatively. HADS is a 14-item self-report questionnaire with two subscales [HADS-depression (HADS-D) and HADS-anxiety (HADS-A)], each consisting of seven items scored on a 4-point scale (0–3)[14]. A subscale score of ≥ 8 indicates the presence of depression or anxiety. HADS has been widely used in clinical settings and has demonstrated good reliability and validity in various patient populations, including those with musculoskeletal conditions[15].

Functional recovery was evaluated using the Harris hip score (HHS) at the same time points. HHS is a clinician-administered tool that assesses pain, function, range of motion, and deformity, with a total score ranging from 0 to 100 (with higher scores indicating better function)[16]. HHS has excellent reliability, validity, and responsiveness in patients with hip disorders, including those undergoing THA or core decompression[17].

To ensure the quality and consistency of data collection, all assessments were performed by trained research personnel who were blinded to the clinical information of the patients. Patients completed the HADS questionnaire independently, while the HHS was assessed by experienced orthopedic surgeons or physical therapists.

Statistical analysis

Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. Continuous variables are presented as mean ± SD, while categorical variables are presented as frequencies and percentages. The normality of the data was assessed using the Shapiro-Wilk test.

Dynamic changes in the HADS-D, HADS-A, and HHS scores over time were analyzed using repeated measures ANOVA with Bonferroni *post-hoc* tests. The sphericity assumption was assessed using the Mauchly's test, and the Greenhouse-Geisser correction was applied when the assumption was violated. The prevalence of depression and anxiety at each time point was calculated based on the HADS subscale scores and presented as percentages.

Pearson's correlation analysis was used to examine the relationship between HADS-D/HADS-A scores and HHS at each time point. The strength of the correlation was interpreted as follows: Weak ($0.1 \leq |r| < 0.3$), moderate ($0.3 \leq |r| < 0.5$), and strong ($|r| \geq 0.5$). Scatter plots were generated to visualize the relationships between variables.

All statistical analyses were performed with SPSS version 25.0 (IBM Corp., Armonk, NY, United States). Statistical significance was defined as a two-tailed P value < 0.05.

RESULTS

Demographic and clinical characteristics

A total of 93 patients with FHN (mean age, 52.7 ± 11.3 years; 58.1% male) were included in the study. The mean duration of symptoms before surgery was 18.5 ± 9.2 months and 61.3% of the patients underwent THA, while 38.7% underwent core decompression. The demographic and clinical characteristics of the participants are summarized in Table 1.

Dynamic changes in HADS-D, HADS-A, and HHS scores

Mean HADS-D and HADS-A scores improved significantly over time ($P < 0.001$). HADS-D scores decreased from 7.2 ± 3.8 at baseline to 3.1 ± 2.6 at 3 years postoperatively, while HADS-A scores decreased from 7.8 ± 3.5 at baseline to 3.5 ± 2.8 at 3 years postoperatively (Table 2). Bonferroni *post-hoc* tests revealed significant differences between all time points for both the HADS-D and HADS-A scores ($P < 0.01$, all pairwise comparisons).

The prevalence of depression and anxiety decreased from 36.6% and 41.9% at baseline to 10.8% and 12.9%, respectively, at 3 years postoperatively. The prevalence of depression and anxiety showed a significant decreasing trend over time ($P < 0.001$ for trend).

The mean HHS increased significantly from 52.3 ± 10.5 at baseline to 88.1 ± 7.2 at 3 years postoperatively ($P < 0.001$; Table 2). Bonferroni post-hoc tests showed significant differences between all time points ($P < 0.001$ for all pairwise comparisons).

Relationship between HADS-D/HADS-A scores and HHS

Significant negative correlations were found between HADS-D/HADS-A scores and HHS at all time points (r = -0.35 to -0.58, $P < 0.05$; Table 3).

Table 1 Demographic and clinical characteristics of the participants (*n* = 93)

Characteristic	Value
Age (years), mean ± SD	52.7 ± 11.3
Sex, *n* (%)	
Male	54 (58.1)
Female	39 (41.9)
BMI (kg/m²), mean ± SD	24.6 ± 3.2
Duration of symptoms (months), mean ± SD	18.5 ± 9.2
Type of surgical treatment, *n* (%)	
Total hip arthroplasty	57 (61.3)
Core decompression	36 (38.7)

BMI: Body mass index.

Table 2 Dynamic changes in hospital anxiety and depression scale-depression, hospital anxiety and depression scale-anxiety, and Harris hip scores over time

Time point	HADS-D	HADS-A	HHS
Baseline	7.2 ± 3.8	7.8 ± 3.5	52.3 ± 10.5
6 months	5.4 ± 3.2	5.9 ± 3.1	68.7 ± 9.3
1 year	4.3 ± 2.9	4.7 ± 2.9	78.2 ± 8.5
2 years	3.6 ± 2.7	4.0 ± 2.8	84.6 ± 7.8
3 years	3.1 ± 2.6	3.5 ± 2.8	88.1 ± 7.2
P value	< 0.001	< 0.001	< 0.001

Data are presented as mean ± SD. HADS-D: Hospital anxiety and depression scale-depression; HADS-A: Hospital anxiety and depression scale-anxiety; HHS: Harris hip score.

Table 3 Correlations between hospital anxiety and depression scale-depression/hospital anxiety and depression scale-anxiety scores and Harris hip score at each time point

Time point	HADS-D *vs* HHS	HADS-A *vs* HHS
Baseline	r = -0.53, P < 0.001	r = -0.48, P < 0.001
6 months	r = -0.58, P < 0.001	r = -0.51, P < 0.001
1 year	r = -0.49, P < 0.001	r = -0.44, P < 0.001
2 years	r = -0.41, P < 0.001	r = -0.38, P < 0.001
3 years	r = -0.35, P = 0.001	r = -0.36, P < 0.001

HADS-D: Hospital anxiety and depression scale-depression; HADS-A: Hospital anxiety and depression scale-anxiety; HHS: Harris hip score.

DISCUSSION

This longitudinal study demonstrated significant improvements in depression, anxiety, and functional recovery in patients with FHN over a three-year postoperative period. The prevalence of depression and anxiety decreased considerably and functional recovery, measured using HHS, showed steady improvement over time. These findings suggest that surgical treatment, along with appropriate postoperative rehabilitation, can effectively alleviate psychological burden and improve functional outcomes in patients with FHN.

The high prevalence of depression and anxiety at baseline in this study was consistent with the findings of previous studies on psychological distress in patients with chronic musculoskeletal conditions[8,9]. The prolonged duration of

symptoms, functional limitations, and the need for surgical intervention can contribute to the development of depression and anxiety in patients with FHN[10]. Moreover, the uncertainty surrounding the postoperative recovery process and potential for complications may exacerbate psychological distress[18].

The significant improvements in depression and anxiety observed in this study highlight the importance of addressing psychological factors in the management of patients with FHN. Previous studies have shown that psychological interventions such as cognitive behavioral therapy and mindfulness-based stress reduction can effectively reduce depression and anxiety in patients with chronic pain conditions[19,20]. Incorporating these interventions into postoperative care plans can further improve psychological well-being and functional recovery of patients with FHN.

Strong negative correlations between HADS-D/HADS-A scores and HHS at all time points underscore the bidirectional relationship between psychological status and functional recovery. Depression and anxiety can adversely affect patient motivation, adherence to rehabilitation, and the overall recovery process[21]. Conversely, poor functional outcomes and persistent pain may contribute to the development or exacerbation of psychological distress[22]. Therefore, a comprehensive approach that addresses both the physical and psychological aspects of recovery is essential to optimize the outcomes of patients with FHN.

The findings of the present study have important clinical implications. Healthcare professionals involved in the care of patients with FHN should be aware of the high prevalence of depression and anxiety in this population and should routinely screen for these psychological comorbidities. Early identification and management of psychological distress can improve the adherence of patients to treatment, improve their coping strategies, and ultimately lead to better functional outcomes[23]. Moreover, the integration of psychological interventions into the standard care plan for patients with FHN may provide additional benefits in terms of pain reduction, functional improvement, and overall quality of life[24].

The strengths of this study include its longitudinal design, which allowed the assessment of dynamic changes in depression, anxiety, and functional recovery over a relatively long period. The use of well-validated outcome measures (HADS and HHS) and blinding of the assessors to patients' clinical information further enhanced the reliability and validity of the findings. Furthermore, the inclusion of patients who underwent different surgical treatments (THA and core decompression) increased the generalizability of the results to a larger population of patients with FHN.

However, this study had some limitations that should be acknowledged. First, the single-center design can limit the generalizability of our results to other healthcare settings and patient populations. Second, the study did not include a control group of patients who did not undergo surgical treatment, which could have provided additional information on the natural course of FHN and the effectiveness of surgical intervention. Third, we did not assess other factors that can influence psychological status and functional recovery, such as pain intensity, social support, coping strategies, or comorbidities. Future studies should address these limitations by conducting multicenter studies with larger sample sizes, including control groups, and assessing a broader range of potential confounding variables.

Additionally, future studies should aim to include a more diverse sample in terms of demographic characteristics such as age, sex, and socioeconomic status to enhance the generalizability of the findings to broader patient populations.

Another important consideration is the possible impact of the coronavirus disease 2019 (COVID-19) pandemic on psychological well-being and functional recovery of patients with FHN. The pandemic has led to increased levels of stress, anxiety, and depression in the general population[25], and patients with chronic conditions may be particularly vulnerable to these psychological effects[26]. Furthermore, the pandemic has disrupted healthcare services and limited access to rehabilitation programs, which may have negatively affected the patients' functional recovery[27]. Future studies should investigate the long-term impact of the COVID-19 pandemic on the psychological and functional outcomes of patients with FHN and develop strategies to mitigate these effects.

In addition to psychological interventions, future studies should focus on identifying other modifiable factors that may influence the outcomes of patients with FHNs. Previous studies have suggested that lifestyle factors, such as smoking and alcohol consumption, may be associated with an increased risk of FHN and poor outcomes after surgical treatment[28,29]. Addressing these modifiable risk factors through patient education and behavioral change interventions can further improve the long-term outcomes of patients with FHN.

Finally, the development and validation of prediction models for psychological distress and functional recovery in patients with FHN could help healthcare professionals identify people at high risk for poor outcomes and tailor interventions accordingly. Such models can incorporate a variety of demographic, clinical, and psychosocial variables and can be used to inform personalized treatment plans and follow-up strategies[30]. Machine learning techniques, such as artificial neural networks and support vector machines, have shown promise in predicting outcomes in various healthcare settings[31] and can be applied to the field of FHN research.

CONCLUSION

This longitudinal study demonstrated significant improvements in depression, anxiety, and functional recovery in patients with FHN over a three-year postoperative period. The severity of depression and anxiety was negatively correlated with functional recovery, highlighting the importance of psychological interventions in the management of patients with FHN. A comprehensive approach that addresses both the physical and psychological aspects of recovery is essential to optimize patient outcomes. The findings of this study have important implications in clinical practice and future research. Healthcare professionals should routinely screen patients with FHN for depression and anxiety and provide appropriate psychological interventions to improve their well-being and functional recovery. Future research should focus on developing and evaluating targeted psychological interventions, identifying modifiable risk factors, and creating predictive models to inform personalized treatment plans for patients with FHN. By addressing the psycho-

logical aspects of FHN and implementing evidence-based interventions, healthcare professionals can help patients achieve better results and improve their overall quality of life. Integrating psychological care in the management of patients with FHN represents a crucial step towards a more holistic and patient-centered approach to the treatment of this debilitating condition.

FOOTNOTES

Author contributions: Fang GZ was the guarantor and designed the study; Fang GZ and Yang L participated in the acquisition, analysis, and interpretation of the data, and drafted the initial manuscript; Cao LH, Liu TS, Ma YH, and Lin J critically revised the article for important intellectual content; all authors participated in this study and jointly reviewed and edited the manuscript. Fang GZ and Lin J, as the first authors, made equal contributions to this work. After discussion among all the authors, Fang GZ and Lin J as the first authors for three main reasons. First, this study was conducted as a collaborative effort and it is reasonable to designate the author as a joint first author. The author accurately reflects on the distribution of responsibilities and burdens related to the time and effort required to complete the research and the final manuscript. Designating two co-first authors ensures effective communication and management of post-submission matters, thereby improving the quality and reliability of the paper. Second, the co-first authors of the research team possessed diverse professional knowledge and skills from different fields, and their appointments best reflected this diversity. It also promotes the most comprehensive and in-depth exploration of research topics, ultimately enriching the readers' understanding by providing various expert perspectives. Fang GZ and Lin J made substantial and equal contributions throughout the study. Choosing these researchers as first co-authors and acknowledging and respecting their equal contributions demonstrates the spirit of collaboration and teamwork. We believe that designating Fang GZ and Lin J as co-first authors is suitable for our manuscript, as it accurately reflects the collaborative spirit, equal contribution, and diversity of our team.

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