Cystic Lesions in Femoral Head Necrosis: A Dual Role as Both Bone Repair Indicator and Collapse Risk Factor

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Disclosures:

INTRODUCTION: Femoral head necrosis (FHN) is a progressive condition that leads to the collapse of the femoral head, often requiring hip-preserving treatments. Recent imaging studies have revealed a high prevalence of cystic lesions within the femoral head, particularly visible on CT scans. These cystic lesions are commonly associated with changes in bone structure, but their role in the disease's progression is not fully understood. This study aims to explore the pathological characteristics of cystic lesions in FHN and examine their potential role both as markers of bone repair and as predictors of femoral head collapse. We hypothesize that cystic lesions may represent a paradoxical phenomenon—indicating repair while simultaneously contributing to mechanical instability and collapse.

METHODS: This was a retrospective study involving 138 patients (245 hips) diagnosed with FHN. CT imaging was used to identify and analyze cystic lesions in the femoral head, noting the incidence, distribution, and their association with femoral head collapse. A subset of 66 patients (112 hips) was followed up for an average of 26 months to assess the long-term outcomes of cystic lesions. Histopathological analysis was performed on 42 femoral head samples to further examine the morphological characteristics of the cystic lesions and surrounding bone tissue. Statistical analysis was performed to evaluate the correlation between cystic lesions and femoral head collapse, using chi-square tests and logistic regression models. The study was approved by the Institutional Review Board (IRB) of our institution, and informed consent was obtained from all participants.

RESULTS: Among the 245 hips, 108 (44%) exhibited cystic lesions on CT scans, with 72.22% of these lesions located in the anterolateral region of the femoral head. In the follow-up cohort, cystic lesions were found to increase the risk of femoral head collapse by 4.43 times, particularly when located in the anterolateral region. Pathological analysis revealed a variety of changes in the trabecular bone surrounding the cystic lesions, including fractures, resorption, sclerosis, and calcification. The cysts were predominantly filled with fibrous tissue and soft tissue, with occasional colloid substance observed. Osteoblasts, osteoclasts, and capillaries were noted around the lesions, indicating ongoing bone remodeling. These findings suggest that cystic lesions may serve as a focal point for both bone repair and pathological changes that contribute to femoral head collapse.

DISCUSSION: The findings of this study highlight the dual nature of cystic lesions in FHN. On one hand, these lesions may represent an attempt at bone repair, with evidence of osteogenesis, vascularization, and fibrous tissue formation. On the other hand, the structural instability caused by cystic lesions, particularly in the anterolateral region, increases the risk of femoral head collapse. The presence of osteoclasts and resorption changes around the cysts further supports the idea that these lesions contribute to the mechanical instability of the femoral head. Limitations of this study include its retrospective design and relatively short follow-up period. Future studies with larger sample sizes and longer follow-up are needed to further clarify the long-term implications of cystic lesions in FHN. In conclusion, cystic lesions in FHN serve as both a potential indicator of bone repair and a predictor of collapse, posing a complex challenge in the management of this condition.

SIGNIFICANCE/CLINICAL RELEVANCE: (1-2 sentences): This study provides crucial insights into the paradoxical role of cystic lesions in femoral head necrosis, highlighting their potential as both markers of bone repair and risk factors for femoral head collapse. These findings have important clinical implications for improving diagnosis, monitoring disease progression, and tailoring more effective treatment strategies for patients with FHN.

IMAGES AND TABLES:

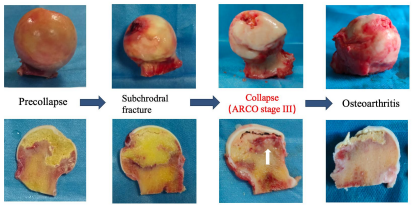

Figure 1 The nature history of FHN and the appearance of cystic lesions (white arrow)

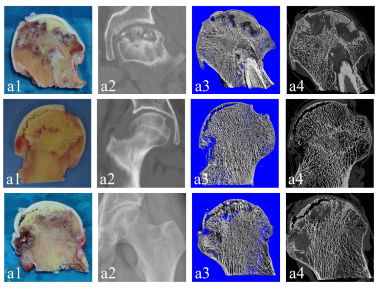

Figure 2 Representative images of femoral head samples with cystic lesions. (a1) Macroscopic appearance of femoral head samples showing different stages of cystic lesions. (a2) X-ray images illustrating the presence of cystic lesions. (a3-4) Micro-CT scan images showing detailed trabecular structure around the cystic lesions.

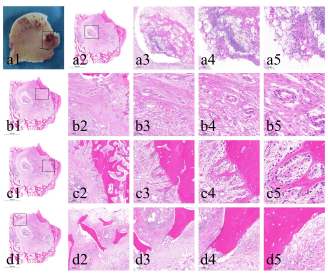

Figure 3 Histological images of cystic lesions. (a) Necrotic tissue within the cystic lesion. (b) Formation of new blood vessels in the cystic area. (c) Osteoblasts and newly formed trabeculae in the surrounding bone tissue. (d) Bone resorption in the necrotic bone regions.