In Brief: Ficat Classification: Avascular Necrosis of the Femoral Head

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History

The earliest attempt at classifying avascular necrosis of the femoral head was proposed by Ficat and Arlet in 1964 [2], before the advent of MRI. The purpose of the classification was to provide prognostic insight and compare treatment options. Ficat modified the classification to include invasive testing procedures and a preclinical, preradiographic stage in 1985 [1]. Since then the system has been modified a few times to include MRI findings, patient symptoms, modify the description of radiographic findings, and exclude the invasive testing procedures originally described [13, 17]. In a systematic review of the literature, Mont et al. [13] identified 16 different classification systems used to classify and describe avascular necrosis. Of these, the Ficat classification [1, 2] was the most frequently

used system (63%), followed by the University of Pennsylvania system [18] (20%), the Association Research Circulation Osseous (ARCO) system [4, 15] (12%), and the Japanese Orthopaedic Association system [7] (5%).

Purpose

An ideal classification system should be practical, valid, reliable, and of prognostic importance. It also would help to choose between different treatment options and facilitate communication between researchers. This would form the basis for uniform reporting of results. There is controversy surrounding the classification of osteonecrosis of the femoral head and indications and success of the various treatment options in preservation of the femoral head [13]. The controversy surrounds the natural history of progression and whether the treatment more frequently preserves the contour of the femoral head than would occur without treatment. Lack of a universally accepted classification system makes it difficult to compare and analyze the data emanating from different centers.

Osteonecrosis of the femoral head typically affects patients with a mean age in the middle thirties [11, 13], and for the majority of patients, leads to collapse of the femoral head if left untreated [13]. Spontaneous resolution of femoral head necrosis also has been reported among patients who have had renal transplants [9, 14, 16, 20]. Hip arthroplasty is not associated with expected longevity (72% 10-year survival in the Finnish registry for patients younger than 55 years) in this younger age group [3, 5, 10, 13]. Thus preservation of the femoral head is the objective of diagnostic and treatment strategies. A useful classification system would outline the criteria of early diagnosis. However, there is no specific radiographic appearance for

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bone necrosis. Every case of bone necrosis should go through an initial preradiographic stage. Thus a useful classification system for avascular necrosis of the femoral head should outline the criteria and methods for early diagnosis in the preradiographic stage.

Ficat Classification

The original classification system was described by Ficat and Arlet in 1964 [2]. It consisted of Stages 1 through 4. Ficat proposed a modification in 1985 [1]. This latter Ficat classification recognized five different stages of bone necrosis from Stage 0 to Stage 4 [1]. We describe here the Ficat classification system presented in 1985 [1]. We shall correlate it with the original Ficat and Arlet classification system [2] and the modified Ficat classification system [17]. The system evolved before the advent of MRI and used a bone scan and “functional exploration of bone (FEB)” for diagnosis of the preradiographic stage [2]. Three stages of FEB were described [2].

Bone Marrow Pressure

Bone marrow pressure is measured through a cannula placed in the intertrochanteric area. The baseline limit was described as 20 mm Hg, with an upper limit being 30 mm Hg. A stress test is done by injecting 5 mL of isotonic saline into the bone and the pressure is recorded 5 minutes after the injection. Normal values for the stress test are described to be within 10 mm Hg greater than the baseline pressure. Ficat recommended repeating both tests by placing the cannula in the head of the femur if both tests are normal in the intertrochanteric area [1].

Intramedullary Venography

Ten milliliters of contrast media is injected through the cannula used to measure bone marrow pressure. Under normal conditions the radiopaque material is easily and quickly cleared. Under pathologic conditions injection is difficult and painful for the patient, with reflux into the diaphysis and intramedullary stasis 15 minutes after the injection.

Core Biopsy

Core biopsy is obtained under image intensification by introduction of a 6-mm or 8-mm diameter trephine into the neck of the femur from an opening in the greater trochanter

and passed toward and into the head of the femur, stopping 5 mm from the articular cartilage. The histologic lesions are classified as: Type 1, disappearance of hematopoietic marrow and presence of foam cells (nondiagnostic for bone necrosis); Type 2, necrosis of the fatty marrow in an eosinophilic reticular pattern and presence of oil cysts; Type 3, complete medullary and trabecular necrosis; and Type 4, complete necrosis with dense medullary fibrosis and new bone formation. All four stages might be present simultaneously. The histologic pattern is reversible at any of the four stages [2, 9].

The classification system also took into consideration the presenting symptoms. Stages 0 to 2 were described as early stages and Stages 3 and 4 were classified as late stages.

Stage 0 is preclinical and preradiographic, ie, a “silent hip” [2]. It initially was described by Hungerford [6]. The diagnosis is suspected in one hip when the other hip has definite disease. Bone marrow pressure studies are abnormal and core biopsy would reveal the histologic patterns described above. This stage was not described in the original classification system [2].

Stage 1 is preradiographic but the patient presents with ischemic pain in the groin with or without radiation down the front of the thigh. All three stages for functional exploration of bone are positive. The description of Stage 1 was retained from the original classification system [2].

A patient with Stage 2 disease presents with radiographic signs of increased density, diffusely increased porosity and/or cystic changes. Although FEB studies are positive in this stage, their role would be minimized in the presence of characteristic radiographic signs. This stage also was described in the same manner as in the original classification system [2].

The radiographs would show flattening of the contour of the head of the femur, the “out-of-round sign” [2], and the classic crescent sign in the head of the femur as the patient’s disorder progresses from the early to late stages. This stage was described as Stage 3 in the original classification system [2].

Stage 3 is characterized by disruption of the normal round contour of the head and accumulation of sequestrum that might increase or maintain the normal joint space.

A patient with Stage 4 disease presents with complete collapse of the femoral head into a flattened contour and decreased joint space. Stages 3 and 4 of the Ficat classification system originally were grouped together in the Ficat and Arlet classification system as Stage 4.

The second most commonly used classification system is the University of Pennsylvania system [18]. This system avoids the use of any invasive diagnostic procedures. It was based on AP and lateral radiographs for later stages of osteonecrosis and technetium bone scan and MRI for the

preradiographic stages. The system describes seven stages, Stage 0 to Stage VI [18]. Stage 0 is suspicion of avascular necrosis although diagnosis cannot be confirmed on radiographs, bone scans, or MR images. With Stage I, the patient has an abnormal bone scan and/or MRI, but radiographs appear normal. Stage II is characterized by cystic and sclerotic changes observed in the femoral head on a plain radiograph. In Stages III through VI, the radiographic signs of progressive worsening of osteonecrosis of the femoral head are seen. The radiographs show subchondral collapse that produces a crescent sign, followed by complete collapse and flattening of the femoral head, followed by a decrease in the joint space with or without acetabular involvement leading to advanced degenerative arthritis [18].

The ARCO system [4, 15] was proposed after a meeting of the association in 1991. Since then several modifications have been made and to date there is no general consensus in support of this system [13]. The Japanese Orthopaedic Association incorporated location in its classification [7], although there is a difference of opinion regarding its use [12].

Reliability

Reliability refers to the precision of the classification system. Kay et al. [8] reported clinically important variability between observers in 10 of 25 hips assessed using the Ficat classification system. Smith et al. [17] reported that the modified Ficat classification system had a low kappa value (0.46) for interobserver reliability and only slightly higher (0.59) intraobserver reliability. However, the modified Ficat classification system was based solely on radiographic findings and the FEB and clinical symptoms were omitted. The omission would make it impossible to diagnose osteonecrosis of the femoral head at an early stage using only the Ficat classification. In another study of the Ficat and ARCO classification systems, Mont and Hungerford reported interobserver and intraobserver reliabilities of 0.39 and 0.52 for the Ficat classification and 0.37 and 0.43 for ARCO classification [11].

The validity of a classification system reveals the accuracy with which it describes the true pathologic process. Validity has not been formally assessed for any of the classification systems for osteonecrosis of the femoral head. However each classification system describes the radiographic signs pathognomonic to osteonecrosis. Modest interobserver and intraobserver reliabilities for the Ficat and other classification systems also raise the question of prognostic importance of the Ficat classification system.

Limitations

The limitations of the Ficat classification system are several. There is a consensus against the use of invasive diagnostic procedures (FEB) [7, 13, 15] and MRI is considered the most specific and sensitive diagnostic method [13]. Moreover, positron emission tomography using the F-18 isotope did not prove useful for early diagnosis of the preradiographic and preclinical stages of osteonecrosis (silent hip) [19]. There is controversy surrounding the inclusion of clinical symptoms in the classification system, as clinical symptoms may vary widely among patient populations, and no prognostic importance has been ascertained [11, 13]. Finally, as outlined above, independent investigations revealed inadequate interobserver and intraobserver reliabilities [8, 17].

Conclusions/Uses

The 1985 Ficat classification system [1] is currently the most widely accepted and used classification system in the literature [7]. However, in view of its limitations, this classification system has not been able to fulfill the requirements in terms of prognostics, reliability, practicality, and communication among researchers. There is a need to reach a consensus regarding adaptation of a new classification system for osteonecrosis of the femoral head.

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