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Review Article

**A REVIEW OF GENICULAR ARTERY EMBOLIZATION IN
THE MANAGEMENT OF KNEE OSTEOARTHRITIS:
CURRENT EVIDENCE, CLINICAL OUTCOMES, SAFETY,
AND FUTURE PERSPECTIVES****Arshapogu Usha^{1*}, Mulla Taiba Anjum², Dr. S. Rajesh Raja³**^{1,2} Pharm D Students, Department of Pharmacy Practice St. Johns College of Pharmaceutical Sciences.³ Assistant Professor Department of Pharmacy Practice, St. Johns College of Pharmaceutical Sciences.**Abstract:**

Knee osteoarthritis (KOA) is one of the most common causes of chronic pain and physical disability worldwide, significantly affecting patients' mobility and quality of life. Conventional treatment options, including lifestyle modification, pharmacological therapy, intra-articular injections, and surgical interventions, may not provide adequate symptom relief for all patients and can be associated with limitations or adverse effects. Genicular Artery Embolization (GAE) has emerged as a promising minimally invasive treatment for patients with symptomatic knee osteoarthritis who have persistent pain despite conservative management. The procedure involves selective embolization of abnormal neo vessels supplying the inflamed synovium, thereby reducing inflammation and alleviating pain. Recent clinical studies have demonstrated encouraging outcomes, including significant reductions in pain scores and improvements in knee function and patient-reported quality of life. GAE offers the advantages of a relatively short recovery period, outpatient feasibility, and a favourable safety profile when performed in appropriately selected patients. Although early and mid-term results are promising, long-term efficacy data and standardized treatment protocols remain areas of ongoing investigation. This review summarizes the current understanding of GAE, including its mechanism of action, procedural techniques, patient selection criteria, clinical outcomes, safety considerations, and future prospects in the management of knee osteoarthritis.

Keywords: Knee Osteoarthritis, Genicular Artery Embolization, Chronic Knee Pain, Interventional Radiology, Synovial Inflammation, Minimally Invasive Therapy, Pain Management, Quality of Life.

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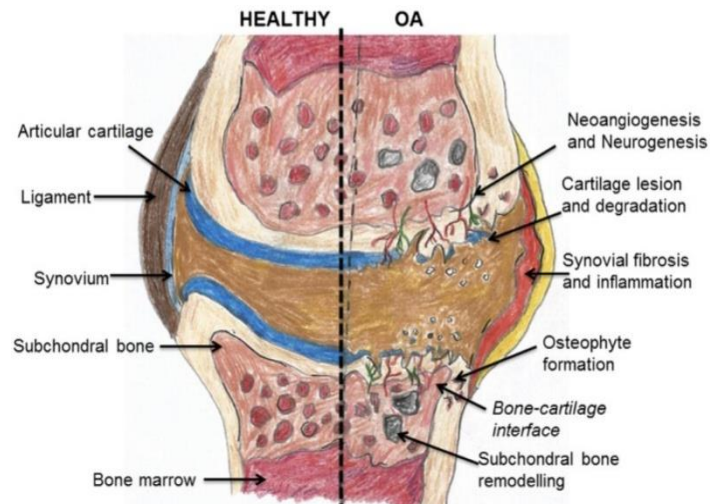


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1. INTRODUCTION:

Knee osteoarthritis (KOA) is a common degenerative joint disease that causes cartilage loss, inflammation, pain, stiffness, and reduced mobility, especially in older adults. Conventional treatments such as lifestyle changes, medications, physiotherapy, injections, and surgery may not provide adequate relief for all patients. Genicular Artery Embolization (GAE) is a novel minimally

invasive procedure that reduces pain by blocking abnormal blood vessels responsible for synovial inflammation. Early clinical studies have shown promising improvements in pain, knee function, and quality of life with a good safety profile. This review discusses the mechanism, procedure, patient selection, clinical outcomes, safety, and future potential of GAE in managing knee osteoarthritis



2. Pathophysiology of Knee Osteoarthritis

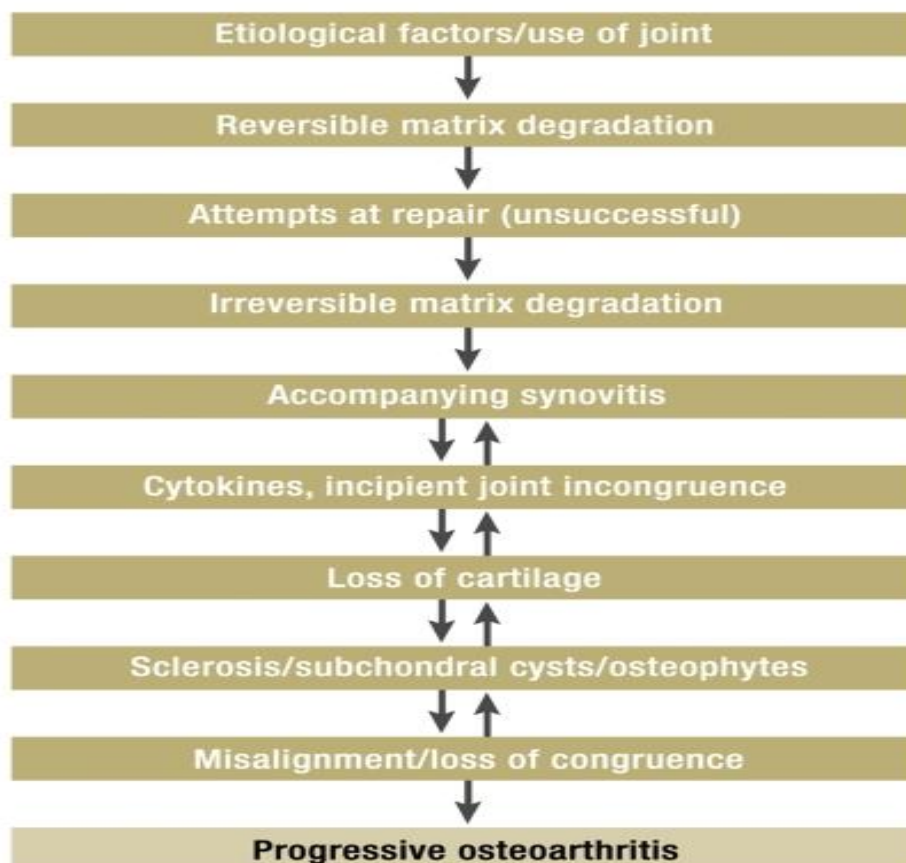


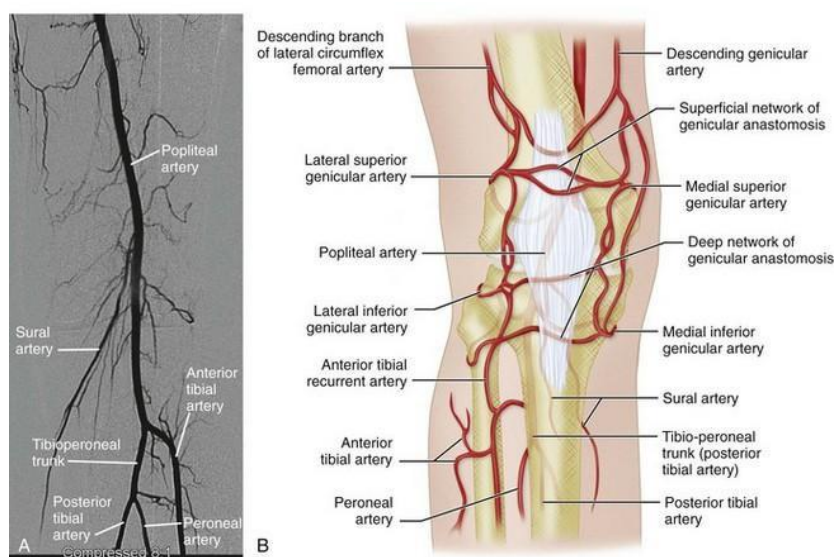
Fig.1: Pathophysiology of Knee Osteoarthritis

3. Principle and Mechanism of Genicular Artery Embolization

Genicular Artery Embolization (GAE) is a minimally invasive interventional radiology procedure used to treat chronic knee pain in osteoarthritis. It works by selectively blocking abnormal blood vessels that develop in the inflamed synovium, reducing inflammation, pain, and abnormal nerve stimulation. The procedure is performed under fluoroscopic guidance using selective angiography and microcatheters to deliver embolic agents while preserving normal blood supply. Clinical studies have shown that GAE improves pain, knee function, and quality of life with a short recovery period and a favourable safety profile. It serves as a promising alternative for patients who do not respond to conservative treatment or are unsuitable for surgery.

4. Procedure and Technique of Genicular Artery Embolization

Genicular Artery Embolization (GAE) is a minimally invasive outpatient procedure performed under local anesthesia to treat chronic knee pain caused by osteoarthritis. After careful patient evaluation using clinical assessment and imaging (X-ray/MRI), a catheter is inserted through the femoral or radial artery. Using fluoroscopic guidance and selective angiography, abnormal blood vessels supplying the inflamed synovium are identified and blocked with embolic agents while preserving normal blood flow. Patients are usually discharged the same day, with pain relief and improved knee function often seen within a few weeks. The success of GAE depends on proper patient selection, precise technique, and advances in imaging and embolization technology.



GENICULAR ARTERY EMBOLIZATION (GAE) – PROCEDURE STEPS

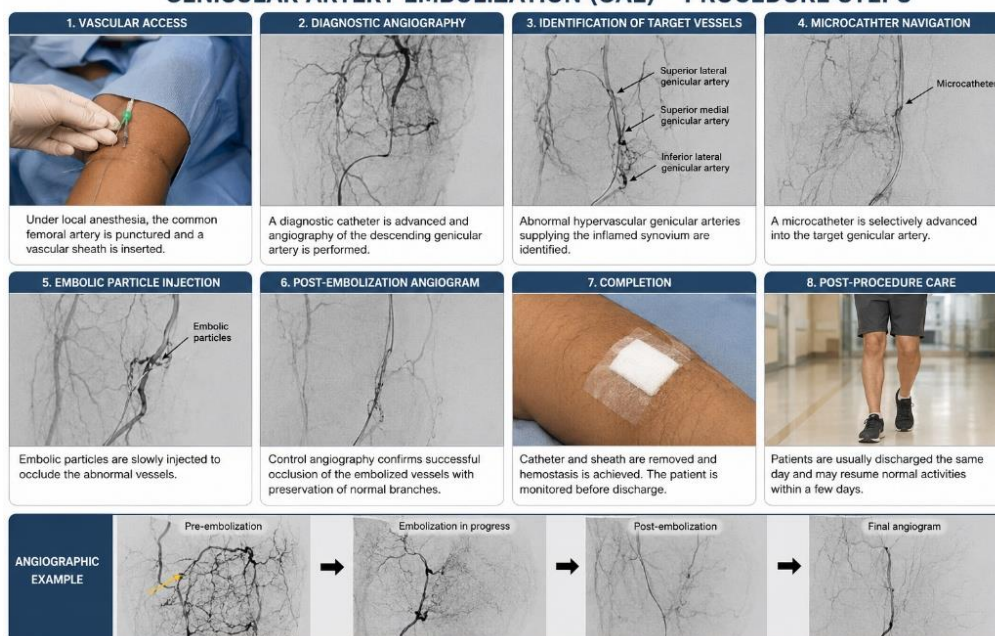


Fig.2: Procedure and Technique of Genicular Artery Embolization**5. Patient Selection Criteria for Genicular Artery Embolization**

Successful Genicular Artery Embolization (GAE) depends on careful patient selection. It is most suitable for patients with mild-to-moderate symptomatic knee osteoarthritis who continue to experience pain despite conservative treatments such as physiotherapy, weight loss, NSAIDs, and intra-articular injections. Clinical evaluation includes assessment of pain severity, functional limitations, and imaging (X-ray/MRI) to confirm synovial inflammation and disease severity. GAE is particularly beneficial for patients seeking a minimally invasive alternative or those who are not suitable candidates for surgery. However, it is contraindicated in patients with active infections, severe peripheral arterial disease, bleeding disorders, severe renal dysfunction, or advanced end-stage osteoarthritis. Appropriate patient counselling and shared decision-making help ensure safe treatment and better clinical outcomes.

6. Clinical outcomes of Genicular Artery Embolization

Genicular Artery Embolization (GAE) has shown promising clinical outcomes in patients with symptomatic knee osteoarthritis, especially those who do not respond to conservative treatment. The procedure significantly reduces pain, improves knee function, mobility, and quality of life by decreasing synovial inflammation and abnormal blood vessel growth. Most patients experience pain relief within a few weeks, with benefits lasting from several months to a few years. Better outcomes are seen in patients with mild-to-moderate osteoarthritis and careful patient selection. GAE also preserves future treatment options, including total knee replacement, although larger long-term studies are still needed to confirm its effectiveness.

7. Evidence from Clinical Studies

Clinical studies indicate that Genicular Artery Embolization (GAE) is a safe and effective minimally invasive treatment for symptomatic knee osteoarthritis. It significantly reduces pain, improves knee function, mobility, and quality of life, especially in patients with mild-to-moderate osteoarthritis who have not responded to conservative treatment. Most reported complications are mild and temporary, while advances in imaging and embolization techniques have improved procedural safety. However, current evidence is based mainly on small studies, and larger randomized controlled trials with long-term follow-up are needed to confirm its long-term effectiveness and establish standardized treatment protocols.

Outcome	Findings
Pain	Significant reduction
WOMAC	Improved
KOOS	Improved
Mobility	Improved
Daily Activities	Improved
Quality of Life	Improved
Recovery	Usually within weeks
Future Surgery	Still possible

Table.1. Evidence from Clinical Studies**8. Complications and Safety Profile of Genicular Artery Embolization**

Genicular Artery Embolization (GAE) is considered a **safe and well-tolerated minimally invasive procedure** for treating symptomatic knee osteoarthritis, particularly in patients who do not respond to conservative therapy or are unsuitable for surgery. Most reported complications are **mild, temporary, and self-limiting**, including skin discoloration, localized pain, tenderness, swelling, bruising, or small hematomas at the catheter insertion site. Serious complications such as non-target embolization and tissue ischemia are rare due to advances in angiographic imaging, selective microcatheter techniques, and careful embolization procedures.

Current clinical evidence has not shown any significant long-term damage to the knee joint or accelerated cartilage degeneration after GAE, and the procedure does not interfere with future treatments such as total knee arthroplasty. Careful patient selection, identification of contraindications, and proper pre-procedural counseling further improve safety and treatment outcomes. Overall, GAE has a favourable safety profile when performed by experienced interventional radiologists, although long-term studies are still needed to further confirm its safety and optimize procedural protocols.

9. Comparison of Genicular Artery Embolization with Other Treatment Modalities

Knee osteoarthritis is managed using lifestyle modifications, medications, physiotherapy, injections, minimally invasive procedures, and surgery. While conservative treatments and intra-articular injections provide symptom relief, their benefits are often temporary and may be associated with side effects. Radiofrequency ablation (RFA) relieves pain by interrupting nerve signals, whereas

Genicular Artery Embolization (GAE) targets the underlying synovial inflammation and abnormal blood vessel formation responsible for pain. Compared with total knee arthroplasty (TKA), GAE is a minimally invasive outpatient procedure with faster recovery that preserves the native joint and does not limit future surgical options. Although long-term evidence and standardized protocols are still needed, GAE is a promising complementary treatment for patients who fail conservative therapy or are unwilling or unsuitable for surgery.

10. Advantages, Limitations, and Future Perspectives of Genicular Artery Embolization

Genicular Artery Embolization (GAE) is a promising minimally invasive treatment for symptomatic knee osteoarthritis that targets synovial inflammation and abnormal blood vessel formation. It offers several advantages, including outpatient treatment, rapid recovery, and preservation of the native joint, significant pain relief, improved physical function, and a favourable safety profile. GAE is particularly beneficial for patients with mild-to-moderate osteoarthritis who continue to experience pain despite conservative treatment.

However, current evidence is mainly based on small clinical studies, and there is a lack of standardized treatment protocols and long-term efficacy data. Treatment outcomes also depend on careful patient selection, with limited benefits seen in advanced end-stage osteoarthritis. Future research, including large randomized controlled trials, improved imaging techniques, better embolic materials, and long-term follow-up studies, is needed to establish the role of GAE.

11. CONCLUSION:

Genicular Artery Embolization (GAE) is a promising minimally invasive treatment for symptomatic knee osteoarthritis, especially in patients who continue to experience pain despite conservative therapy or are unsuitable for surgery. By targeting abnormal synovial blood vessels and inflammation, GAE effectively reduces pain, improves knee function, and enhances quality of life while preserving the native joint. It offers advantages such as a favourable safety profile, short recovery time, and outpatient feasibility. However, further large-scale randomized studies and long-term follow-up are needed to standardize treatment protocols and confirm long-term efficacy. With continued research and appropriate patient selection, GAE has the potential to become an important bridge between conservative treatment and knee replacement surgery.

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