Cardiovasc Intervent Radiol (2022) 45:1710–1715
https://doi.org/10.1007/s00270-022-03253-5

SHORT COMMUNICATION EMBOLISATION (ARTERIAL)

6-Month Follow-up of Lateral Femoral Circumflex Artery Embolization to Control Pain Related to Hip Osteoarthritis and Greater Trochanteric Pain Syndrome

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Received: 20 January 2022 / Accepted: 6 August 2022 / Published online: 24 August 2022

Abstract

Purpose To present the preliminary results of a cohort of 13 patients with hip osteoarthritis (OA) and great trochanteric pain syndrome (GTPS) refractory to conservative management or physical therapy and no indication for surgery treated with embolization of the lateral femoral circumflex artery.

Material and Methods This is a single-center prospective cohort from July 2019 to September 2020. Visual analogue scale (VAS) and Western Ontario and MacMaster Universities (WOMAC) were used to compare the symptoms before and after 6-month follow-up. Technical success was considered when at least one artery responsible

This cohort is approved in the Ethic Committee of University of Passo Fundo with number CAAE: 52368120.7.0000.5342.

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Table 1 Magnetic resonance imaging changes in hip osteoarthritis and greater trochanter pain syndrome

Hip osteodegenerative changes
Changes in morphology and signal intensity of the chondral lining
Reduced joint interline amplitude
Subchondral bone sclerosis
Subchondral fibrocystic changes
Marginal osteophytosis
Reactive osteitis (translated by high signal in the sequences sensitive to fluid and enhancement after intravenous administration of paramagnetic contrast)
Musculotendinous structures
Tendinopathy—alteration of intratendinous morphology and signal intensity
Peritendinopathy—high signal in the fluid-sensitive sequences, post-contrast enhancement around the tendinous insertions
Bursopathies—fluid distension and peripheral post-contrast enhancement in the subgluteal and pretrochanteric bursae

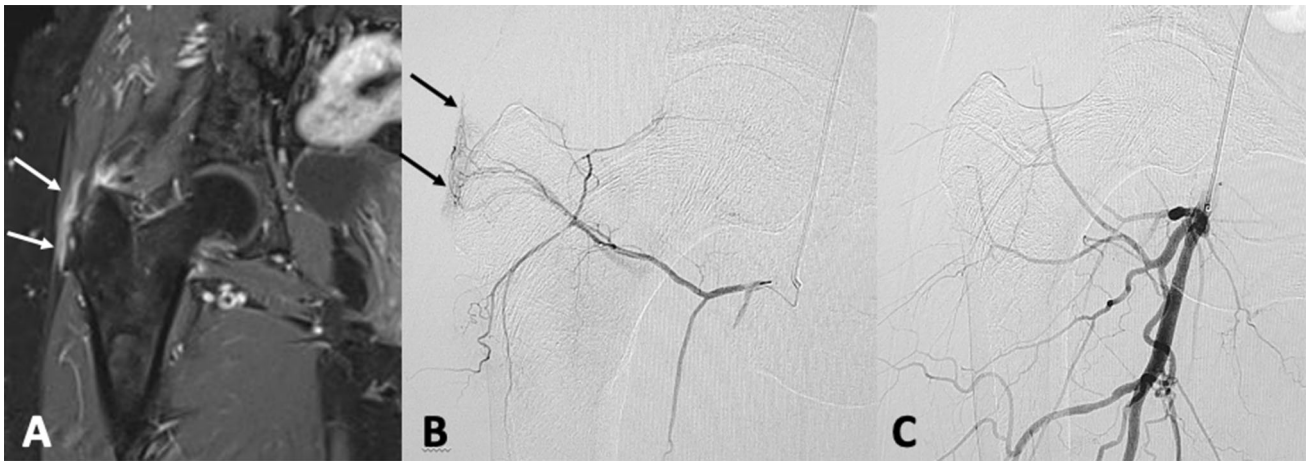

Fig. 1 **A** Coronal magnetic resonance imaging (MRI) of the right hip joint. Pre-embolization post-contrast T1W-weighted image with tissue saturation presenting with moderate prethrocanteric bursitis (white arrows). **B** Superselective angiography of the ascending branch of the lateral femoral circumflex artery with a 2.1Fr microcatheter. The "inflammatory blush" was found in a similar pattern as the MRI (black arrows). **C** Control angiogram not demonstrating hiperemic areas

for the hyperemic synovium was embolized. Complications and adverse events were noted.

Results In total, 13 patients were included; mean age was 62.4 (± 11.0) years. 10 (76.9%) patients were treated for GTPS and 3 (23.1%) for hip OA. Nine patients were treated with imipenem/cilastatin (I/C) alone. Microsphere 100–300 μm and I/C were combined in 4 patients. The WOMAC Index had a statistically significant decrease in the total from 77 to 27 points ($p = 0.001$). Pain, rigidity and physical activity have also significantly reduced (19 to 5, $p = 0.001$; 6 to 2, $p = 0.002$ and 53 to 22, $p = 0.001$, respectively). VAS score had a significant decrease (10 to 2, $p = 0.002$). Two patients present posterior tight numbness, spontaneously improved within 30 days.

Conclusion In this cohort, lateral femoral circumflex artery embolization was a safe and effective treatment for patients with hip pain due to OA and GTPS.

Introduction

Symptomatic Hip OA has a lifetime-estimated risk of 25% in people who live to age 85 and a 10% risk of hip replacement [1]. In addition, greater trochanteric pain syndrome (GTPS) describes a source of trochanteric pain derived from pathology of the trochanteric bursae, gluteus medius and minimum tendons and iliotibial band with an annual incidence of 1.8 per 1000 adults [2].

Traditionally, treatment is based in pain management with surgery in end-stage disease for both OA and GTPS [1–5]. In this setting, transcatheter embolization has emerged as an alternative in reduction in pain in patients with OA [6], and there are new reports of hip osteoarthritis embolization [7].

This paper reports the results of the 6-month follow-up of the cohort of 13 patients with hip inflammatory diseases

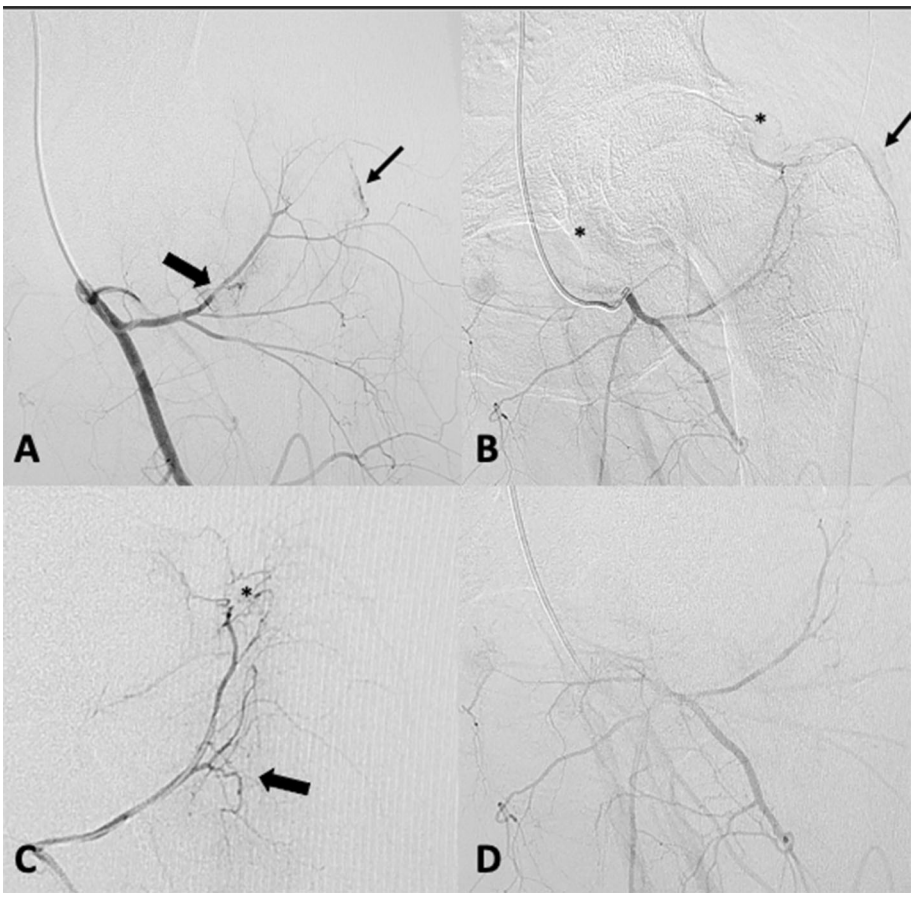

Fig. 2 **A** Early (**A**) and late (**B**) superselective angiogram of the medial branch of the left lateral femoral circumflex artery with a JIM 5Fr catheter and 2.1Fr micro catheter (**C**) in a patient with hip osteoarthirtis. Note the areas of trochanteric bursitis (thin arrow) and corkscrew-like neovascularization (large arrow) at the small trochanter. Also note the subtle hyperemic synovia at the femoral head (*). **D** Control late angiogram of the left lateral femoral circumflex artery with a JIM 5Fr catheter with no evidence of blush or neovascularization

treated with lateral circumflex femoral artery embolization (LCFAE).

Material and Methods

This is a prospective cohort started in June 2019, approved by the Ethical Committee of Universidade de Passo Fundo, CAAE: 52368120.7.0000.5342. Informing consent was achieved prior to procedure in all patients. Patients presenting with a history of at least 6-month of hip pain refractory to conservative management or physical therapy and no indication to total hip replacement (THR) or surgery were referred to interventional radiology team. Inclusion criteria were a visual analogue scale of pain (VAS) $> 6/10$, acute pain or tenderness during palpation and maneuvers of the hip and MRI findings listed in Table 1 [8]. Patients with infection, malignancy, peripheral artery disease, prior hip surgery or coagulopathy were excluded from this study. Follow-up was performed in 30 days and every 3 months. VAS and the Western Ontario and MacMaster Universities (WOMAC) scores were performed prior to the procedure and after 6 months. In patients where the sixth month of follow-up was during the COVID-19 pandemic, WOMAC score was answered by a telephone call [9, 10].

Technique

Procedure was performed under local anesthesia. No sedation was used in order to maintain full collaboration of patients. Contralateral femoral access was achieved for access of the ipsilateral profunda femoral artery using a JIM 5Fr catheter with a 2,4Fr Progreat (Terumo, Japan) or 2,1Fr Maestro (Merit, USA) microcatheter inserted coaxially to access the branches of the ascending branch of the LFCA, according to the areas identified in the preoperative MRI (Fig. 1A) and areas of reported pain in physical examination. The hyperaemic synovium area was found (Fig. 1B), and embolization was performed using preferentially Imipenem/Cilastatin (I/C) diluted 1 g:10 ml with contrast media, injected every 0.3 cc until total occlusion of the blushes (Fig. 1C). 100-300 µm microspheres—embosphere (Merit, USA)—or bead block microspheres (BTG Farnhan, UK) were used in GTPS cases if there was a *fistulae-like* pattern of the blush, depending on the availability at the hospital.

Table 2 Magnetic resonance imaging (MRI) findings of the cohort

	Patient, age	Side	MRI OA findings	MRI GTPS findings
1	Female, 76	right	Mild coxarthrosis	Insertional tendinopathy of the gluteus medius (chronic aspect) Tendinobursopathy at the origin of the hamstrings
2	Female, 68	right	Mild coxofemoral synovitis. Mild coxarthrosis	Tendinopathy with peritendinitis at the origin of the hamstrings Pretrochanteric bursitis
		left	Mild coxofemoral synovitis. Mild coxarthrosis	Tendinopathy with peritendinitis at the origin of the hamstrings Pretrochanteric bursitis
3	Female, 56	Left	Moderate coxarthrosis. Labral tear	Mild Insertional tendinopathy with peritendinitis of the gluteus minimus and medius Mild pretrochanteric bursitis
4	Female, 84	Right	Mild coxarthrosis	Insertional tendinopathy of the gluteus medius (chronic aspect) Tendinobursopathy at the origin of the hamstrings
5	Female, 64	Left	Moderate coxarthrosis. Labral tear	Moderate Insertional tendinopathy with peritendinitis of the gluteus minimus and medius Moderate pretrochanteric bursitis
6	Female, 74	Right	Coxarthrosis. Moderate coxofemoral synovitis	None
7	Female, 55	Left	Mild coxofemoral synovitis. Mild coxarthrosis	Tendinopathy with peritendinitis at the origin of the hamstrings
8	Female, 58	Left	None	Moderate pretrochanteric bursitis
9	Male, 49	Left	Severe coxarthrosis. Moderate coxofemoral synovitis	None
10	Female, 57	Right	Paralabral cyst	Insertional tendinopathy with peritendinitis of the gluteus minimus. Right pretrochanteric bursopathy
11	Female, 64	Right	Advanced coxarthrosis. Massive joint effusion with synovitis	Nonspecific signal alteration in the gluteus maximus muscle belly
		Left	Advanced coxarthrosis. Massive joint effusion with synovitis	Pretrochanteric bursitis
12	Male, 60	Left	Mild coxarthrosis. Mild joint effusion with synovitis	Mild insertional tendinopathy with gluteus medius peritendinitis
13	Female, 43	Left	Labral tear	Mild pretrochanteric bursitis

OA osteoarthritis, *GTPS* great trochanter pain syndrome

Patients 6, 9 and 11 were treated for hip OA

Statistical Analysis

Categorical variables were described by frequencies and percentages. The normality of the quantitative variables was evaluated by the Shapiro–Wilk test. Quantitative variables with normal distribution were described by the mean and standard deviation, and those non-normal distributed variables were described by the median, minimum and maximum and compared using the Wilcoxon test. A significance level of 0.05 was considered for the established comparisons.

Results

Between June 2019 and September 2020, 13 patients were evaluated, 10 (76.9%) were female. The mean age was 62.4 (± 11.0) years; 10 (76.9%) patients were treated for GTPS and 3 (23.1%) for hip OA (Fig. 2). MRI findings are listed in Table 2. Pre-procedure VAS and WOMAC scores are listed in Table 3. Two patients had fibromyalgia and one patient had rheumatoid arthritis. Nine patients were treated with I/C alone. Microsphere was used in 4 patients. Bead block was used in one patient [7] and embosphere in three patients. Two patients had bilateral hip embolization at the

Table 3 Comparative table of *Western Ontario and MacMaster Universitites* (WOMAC) scale and Visual analogue scale of pain (VAS) before and after 6 months

	Pre	6 months	*p*
WOMAC			
A	19 (15–20)	5 (0–14)	0.001
B	6 (4–8)	2 (0–7)	0.002
C	53 (36–68)	22 (0–34)	0.001
Total	77 (61–96)	27 (0–49)	0.001
VAS	10 (8–10)	3 (0–10)	0.002

Data presented by the median (minimum–maximum) and compared by the Wilcoxon test. The WOMAC scale has questions about pain (A), rigidity (B) and physical activity (C) in the last 72 h

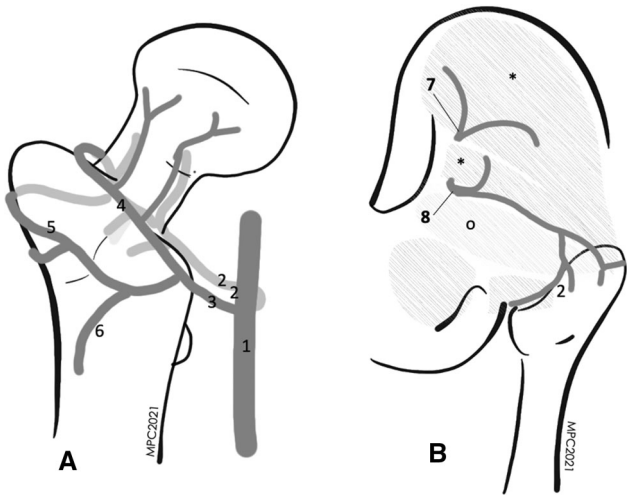

Fig. 3 Illustrative image of anterior (**A**) and posterior (**B**) vascularization of the hip. 1—deep femoral artery, 2—medial circumflex femoral artery, 3—lateral circumflex femoral artery, 4—superior branch of the lateral circumflex femoral artery, 5—transverse branch of the lateral circumflex femoral artery, 6—inferior branch of the lateral circumflex femoral artery, 7—superior gluteal artery, 8—inferior gluteal artery. *—Gluteus minimus muscle, o—piriformis muscle

same procedure. In two patients, ipsilateral embolization of inferior gluteal branches was necessary, since embolization of the ascending branch of the LFCA was not enough to reduce symptoms. Mean procedure time was 32′42″.

One obese patient presented with a small groin hematoma, spontaneously resolved in 15 days, and two patients treated with I/C had mild posterior tight numbness, spontaneously resolved with no additional medication or treatment in 21 and 30 days, respectively. Both were back to work 10 days after the procedure. No major adverse events were found in this cohort. In the 6-month follow-up contact, 3 patients were examined, and the others were reached by phone.

The median WOMAC Index had a statistically significant decrease in the total value from 77 pre-procedure to 27 points after six months ($p = 0.001$). The pain score has a median decrease of 14 points (19 to 5, $p = 0.001$). The rigidity score has a reduction of 6 to 2 points ($p = 0.002$), and the median physical activity score has also significantly reduced from 53 to 22 points ($p = 0.001$). VAS median score had a significant decrease from 10 to 2 points after 6 months, $p = 0.002$.

Discussion

There are technical points in the hip embolization that must be highlighted. First, in patients where pain and inflammation are more prominent in gluteal muscles, ascending embolization of superior and/or inferior gluteal arteries may be necessary. In this cohort, two patients needed this approach, since embolization of regular branches was not enough to relief their pain. The embolization of gluteal branches was not pre-planned and was performed in the same session, and the decision-making was based by patient symptoms, which were not improving during the embolization. For this reason, we believe the full collaboration of patient is extremely necessary and is that why the procedures were performed under local anesthesia without sedation. In most patients, however, there are several collaterals in this area, and catheterization of the ascending branch of the LFCA is adequate to relief all areas of pain (Fig. 3).

Second, in contrast with genicular artery embolization, the tumor-like blush is not as common as expected, and corkscrew-like arteries were found. Third, LCFAE favors the use of imipenen/cilastatin, since this embolic agent has the theoretical advantage of preventing ischemia, as demonstrated by Woodhams et al. [11] In this territory, there is a particular concern of the orthopedic team, since there is an unknown risk of aseptic hip necrosis (AHN). In this short-term cohort, we do not have any clinical sign of osteonecrosis or AHN, and no patient was submitted to hip replacement due to worsening of the symptoms following embolization. Just one MRI was performed before one year [7], with no sign of osteonecrosis. These findings so far are similar of GAE, where no osteonecrosis was found [12]. There were two posterior tight numbness, probably due to inadvertent embolization of sciatic nerve branches. Both had spontaneous improvement, with no additional complications. After this first two events, the authors did not have any similar complication.

This study has limitations. In addition to the small sample size and short-term follow-up, MRI was not performed in most patients after 6 months, compromising information about osteonecrosis. In addition, despite that

hip OA and GTPS are vastly associated, the analysis of both treatments in this study may be a confounder. Multiple embolic agents used and the lack of information of medications used before and after the first patients can also be cofounders of the results.

Conclusion

LFCA embolization is feasible and has been demonstrated as an option to pain relieve in patients with hip OA and GTPS refractory to clinical treatment. More studies are needed to corroborate the initial impressions of the technique.

Acknowledgements We like to thank Daniela Benzano for the statistical analysis of the paper and both the Orthopedic Teams of the hospitals of Passo Fundo, Brazil, for the support in improving data of musculoskeletal embolization.

Author Contributions MPC, RCP, RM, JNS, RSN, JCB performed the procedures; MPC, RM, JSD performed follow-up; EBJ performed magnetic resonance analysis; MPC, JMMLF, RCP, EBJ, RM, JNS, RSN, JCB written and performed critical review of the paper; MPC took part in overall responsibility.

Funding This study has no funding.

Availability of Data and Material Not applicable.

Declarations

Conflict of Interest The authors declare that they have no conflict of interest.

Consent for Publication All participants have signed the informed consent.

Ethical Approval This is a retrospective study from a prospective cohort.

Informed Consent Informed consent was created and approved at the University of Passo Fundo ethical committee. Study was approved by the ethical committee with number 52368120.7.0000.5342.

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