Retrospective Evaluation

Factors Associated with the Outcome of Ultrasound-Guided Trochanteric Bursa Injection in Greater Trochanteric Pain Syndrome: A Retrospective Cohort Study

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Background: Trochanteric bursa injections of corticosteroids and local anesthetics have been shown to provide pain relief for the treatment of greater trochanteric pain syndrome (GTPS). However, symptom recurrence and incomplete symptom relief are common. The reason for the variation in response is unclear but may be related to disease-, treatment-, or patient-related factors.

Objective: To determine whether there are factors related to patient, treatment, or disease that can predict either the magnitude or duration of response to ultrasound-guided trochanteric bursa injections for GTPS.

Study Design: Retrospective evaluation.

Setting: A university hospital outpatient center.

Methods: Potential study participants were patients who underwent ultrasound-guided trochanteric bursa injection at an outpatient rehabilitation department. Follow-up interviews were performed in a hospital visit at 1, 3, and 6 months after injection. The Harris Hip Score and the Verbal Numeric Pain Scale were used to evaluate clinical effectiveness of pain reduction and functional improvement at baseline, 1, 3, and 6 months after treatment. Clinical data and ultrasound findings were obtained to assess the possible predictive factors for a good and durable response to ultrasound-guided trochanteric bursa injection.

Results: Patients receiving ultrasound-guided trochanteric bursa injections had a statistically significant improvement in pain and hip function at 1, 3, and 6 months after the last injections. Of the 137 patients, 110 (80.3%), 95 (64.9%), and 77 (56.2%) patients achieved successful outcomes according to their 1, 3, and 6-month follow-up evaluations, respectively. Univariate analysis showed that patients with knee osteoarthritis and lumbar facet joint or sacroiliac joint pain experienced less therapeutic effect than those without the conditions at 6 months post-injection. Logistic regression analysis showed that the significant outcome predictors at the 6-month follow-up were facet joint or S-I joint pain (odds ratio = 0.304, $P = .014$) and knee osteoarthritis (odds ratio = 0.329, $P = .021$). Age, gender, body mass index, and pain duration were not independent predictors of a clinically successful outcome. There was no statistically significant association between effective treatment and the ultrasound findings of tendinosis, bursitis, partial or full-thickness tear, and enthesopathic changes.

Limitations: Retrospective chart review without a control group.

Conclusions: This study suggests that knee osteoarthritis and lower back pain might be associated with a poor outcome of ultrasound-guided trochanteric bursa injection for GTPS. Assessment of these clinical factors should be incorporated into the evaluation and counseling of patients with GTPS who are candidates for ultrasound-guided trochanteric bursa injection.

Key words: Bursa injection, corticosteroid, greater trochanteric pain syndrome, knee osteoarthritis, lower back pain, lumbar facet joint, ultrasonography, S-I joint pain

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Greater trochanteric pain syndrome (GTPS) refers to pain in the lateral aspect of the hip joint (1,2). Although the disorder is often attributed to greater trochanteric bursitis, other diagnoses—such as gluteus medius or minimus tendinosis, tear, or both, and abnormalities of the adjacent iliotibial band—have emerged as more likely causes (2-4). The incidence of GTPS is reported to be approximately 1.8 patients per 1000 annually (5,6). The prevalence is 3.5 – 4.0 times higher in women, typically occurring in their fifth to seventh decades of life, and in patients with coexisting obesity, lower back pain (20 – 35% correlation), hip and spine osteoarthritis, and iliotibial band tenderness (7).

Initial treatment of GTPS includes non-steroidal anti-inflammatory drugs (NSAIDs), ice, weight loss, physical therapy, and behavior modification strategies that aim to improve flexibility, muscle strength, and joint mechanics (8-10). When these conservative treatments fail, trochanteric bursa (TB) injections of corticosteroids and local anesthetics have been shown to provide pain relief (10,11). However, symptom recurrence and incomplete symptom relief are common (8,12-14). In one study, 33% of patients treated with a minimum of 2 corticosteroid injections experienced improvement but incomplete symptom resolution (12). Of the patients who showed improvement, 25% reported a recurrence (12). The reason for variation in response is unclear but may be related to disease-, treatment-, or patient-related factors. If factors consistently associated with response to corticosteroids could be identified, corticosteroid injections might be better targeted to those most likely to respond.

Because incorrect placement can cause discomfort and reduce treatment efficacy significantly, it is important that injections be administered at the correct site. In a study by Cohen and colleagues (15), the authors found that intra-bursal spread of contrast material occurred in only 45% of landmark-guided TB injections and concluded that fluoroscopic guidance is necessary to ensure needle placement within the bursa. However, contrast media are costly and sometimes cannot be mixed with other substances for injection, and repeated injections under fluoroscopy should be avoided because of excessive radiation exposure (16). Ultrasound guidance recently has been described as an alternative method for targeted TB injections (17,18). This noninvasive technique allows continuous monitoring of the needle position, thus facilitating safe and precise corticosteroid injections (17).

The purpose of this retrospective cohort study was to determine whether there are patient-, treatment- or disease-related factors that predict either the magnitude or duration of response to ultrasound-guided TB injections for GTPS.

Methods

Study Design

The study is a retrospective cohort study of chart data. Approval from the Institutional Review Board of the corresponding author's affiliated university was obtained. The approval included a waiver of informed consent, because the study did not include direct contact with the study population, and all patient identifiers were removed from the dataset on initial collection.

Patients

Potential study participants were patients who underwent ultrasound-guided TB injection at our outpatient rehabilitation's department between July 2012 and July 2014. On the day of the procedure—prior to the injection—and at a subsequent follow-up appointment, patients who underwent ultrasound-guided TB injection were requested to fill out self-assessment questionnaires regarding their baseline information (e.g., pain level, functional status). The electronic clinical records and the questionnaire responses were reviewed retrospectively to gather data and to determine inclusion criteria compliance. GTPS was diagnosed when the patient complained of pain persisting for more than 3 months in the lateral region of the hip, and when tenderness to palpation of the greater trochanter was found on physical examination, reproducing the patient's pain, and after diagnostic ultrasonographic evaluation (19-22).

The inclusion criteria were defined as any patient (a) whose primary indication for ultrasound-guided TB injection was symptomatic of GTPS; (b) who underwent ultrasound of the hip lesion before injection; (c) who had not responded to conservative management, including NSAIDs, analgesics, and physical therapy performed for at least 4 weeks before injection; and (d) whose self-assessment questionnaire responses were complete, both before injection and at follow-up. The exclusion criteria applied were patients who were administered any type of steroids within 3 months; significant comorbidities (rheumatologic disease, inflammatory, or autoimmune diseases); pain of 3 months due to a hip or joint-related incident, fracture, tumor, avascular necrosis, or total hip arthroplasty; and a neurologic disorder (e.g., lumbar radiculopathy, Parkinson's disease, stroke).

Ultrasound Examination and Guided Trochanteric Bursa Injection

Patients received detailed information about the procedure and its expected benefits and risks and were asked to provide consent. Ultrasound examination of the greater trochanteric region and procedures were performed by a physician with more than 7 years' experience in the musculoskeletal ultrasound field. All examinations and procedures were performed on an Accuvix XQ® (Samsung-Medison, Seoul, Korea) with a linear probe at 6 – 12 MHz. Patients lay in the lateral position with the symptomatic hip facing upward and hips and knees gently flexed in a comfortable position (17,18). Gel was applied, and the probe was moved over the gluteal muscles, tendons, and greater trochanter, ensuring that the ultrasound beam remained at a 90° angle to the tissues being examined. Confirmation of anatomy was achieved by having the patient perform appropriate resisted movements. Tears were confirmed by injecting a small amount of normal saline between the tendon planes (2,23). Ultrasound images included transverse and longitudinal views of the anterior facet of the greater trochanter at the gluteus minimus tendon insertion, the lateral and superoposterior facets at the gluteus medius tendon insertions, the iliotibial band, and the greater TB at the level of the posterior facet.

Patients were positioned in lateral decubitus position on the side opposite to the symptomatic side with both hips slightly flexed (Fig. 1A) (17,18). The injection site was disinfected with betadine and alcohol and covered with a porous sterilization wrap to expose only the applicable site. The procedure was performed while wearing aseptic gloves. The transducer was positioned in an oblique coronal plane, and a 23-gauge needle fixed to a 10-mL syringe filled with 0.5% lidocaine (9 mL) + triamcinolone 40 mg (1 mL) was inserted via a posterolateral approach in plane with transducer, free-hand technique (Fig. 1B,C) (24). The accuracy of injection into the TB was checked during the procedure, and bursal distension was checked in appropriate cases (Fig. 1D). Because all the patients did not have significant improvement through analgesics or physiotherapy treatment for least 4 weeks before injection, investigators reasoned that such conservative treatments would have very limited effects on results during follow-up periods; therefore, no limitation was set on the continuation of previous analgesics or physiotherapy treatment. There were no specific additional interventions.

Clinical and Radiographic Data Collection

Follow-up interviews were performed by nursing personnel who were not involved in the procedure and conducted in a hospital visit at 1, 3, and 6 months after injection. All data collection and analyses were performed by an independent reviewer. The Harris Hip Score (HHS) as well as Verbal Numeric Pain Scale (VNS) were used to evaluate the clinical effectiveness in terms of pain reduction and functional improvement. The HHS, which was originally developed in 1969 to help evaluate the results of hip replacement, has become widely used as a means of evaluating results and hip pathology (25,26). Patients are scored up to a maximum of 100. Factors assessed are pain (total score of 40); function (total score of 47); range of motion (total score of 5); and absence of deformity (total score of 8). Function is further broken down into daily activities (14 points) and gait (33 points) (25,26). Harris defined 90 – 100 points as excellent, 80 – 90 as good, 70 – 80 as fair, and below 70 as poor (25,26).When using VNS, patients were asked to rate their pain on a scale from 0 – 10, with a higher score indicating more pain (27).

An effective outcome was defined as a > 50% improvement in the VNS score and > 20 points improvement in the HHS score (27,28). Patients who failed to meet these criteria or who underwent ultrasound-guided intra-articular injection or surgical treatment during the follow-up period were considered to have an ineffective outcome. Independent variables such as age, gender, body mass index, pain duration, ultrasound findings, lower back pain, lumbar facet joint or sacroiliac joint pain, and knee osteoarthritis (OA) were documented in the medical charts and prompted review of radiographic evaluation. Diagnosis of degenerative knee osteoarthritis was based on the clinical and radiologic criteria issued in 2000 by the American College of Rheumatology (29). Based on the medical history, image findings, physical examinations, and diagnostic block, the patients were diagnosed with lumbar facet joint or sacroiliac joint pain.

Patient age was classified into 3 groups: 50 – 59, 60 – 69, and > 70. Pain duration was treated as a potential predictive variable and classified as acute or subacute (< 6months) or chronic (> 6 months). Body mass index was classified as normal (< 25 kg/m2), overweight (25 – 30 kg/m2), or obese (> 30kg/m2).

The images obtained at the time of the procedure were retrospectively reviewed by an experienced mus-

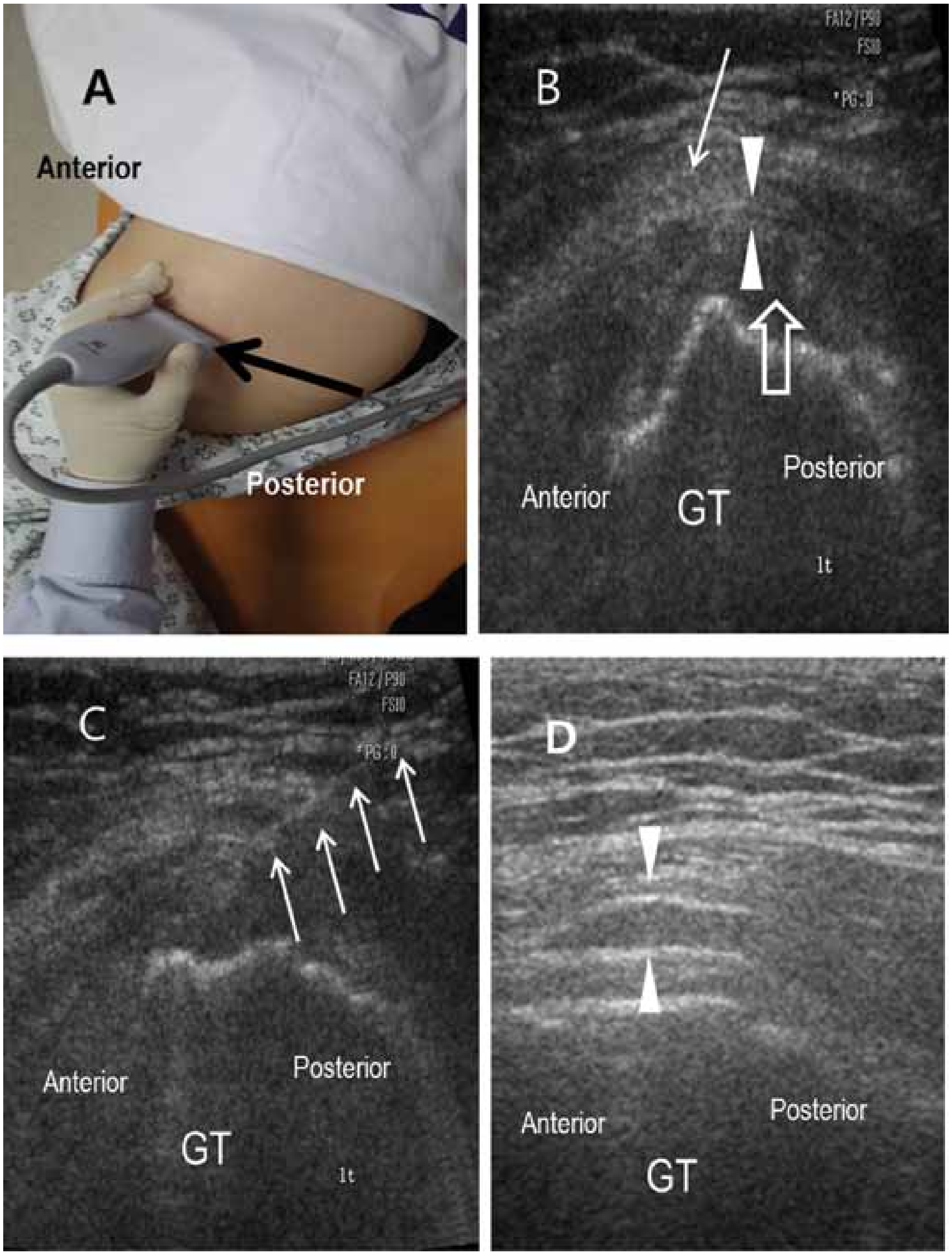

Fig 1. *Ultrasound-guided trochanteric bursa injection.*
(A) Patients lay in lateral position with the symptomatic hip facing upward and hips and knees gently flexed in a comfortable position. Linear transducer is positioned in short axis view perpendicular to long axis of femur at level of greater trochanter. Injection is performed from posterolateral approach in plane with transducer (arrow). (B) Ultrasound image over the greater trochanter (GT) shows a trochanteric bursa (arrowhead) within the gluteus medius tendon (open arrow), and deep to the gluteus maximus muscle (arrow), greater trochanter (asterisk), gluteus medius muscle (open arrow), fascia lata femoris (arrow). (C) Ultrasound-guided trochanteric bursa injection with needle tip (arrow). (D) After ultrasound-guided trochanteric bursa injection with bursal distension (arrowhead).
GT, greater trochanter

culo-skeletal radiologist who was blinded to outcomes. Based on ultrasound findings described by previous studies, tendinosis was deemed to be present if there was a hypoechoic change but the fibrillar pattern was preserved (30,31). Bursitis was defined as an anechoic fluid collection in the expected location of the TB (18). A partial tear was defined as a focal anechoic area with no intact fibers or a discrete irregular hypoechoic band traversing either longitudinally or horizontally within the tendon (18,30-32). A full-thickness tear was defined as a distinct interval extending through the full width of either the gluteus medius or minimus tendon with or without tendon retraction (18,30-32). Enthesopathic changes were defined as irregularity of the echogenic bone surface over the lateral or anterior facet of the greater trochanter or closely adjacent echogenic foci of calcification within the gluteus medius or minimus tendon (Fig. 2) (18).

Statistical Analysis

At each time point, VNS and HHS were compared by repeated measure analysis of variance (ANOVA). Univariate analysis was performed using the χ^2 test to evaluate the relationship between possible outcome predictors and therapeutic effect. Logistic regression analysis also was performed to evaluate the relationship between possible outcome predictors and their therapeutic effects. A data analysis software program (SAS Enterprise Guide 4.1 [4.1.0.471]) was used. A *P* -value of < .05 was considered significant.

Results

Of the 189 ultrasound-guided TB injections performed during the interval encompassed by this study, 137 met inclusion criteria; 107 (78%) of injections were performed in women, and 30 (22%) were performed in men. Among exclusions, 31 (16%) of prospective patients were excluded because they did not return the follow-up survey, 10 (5%) were excluded because exclusion criteria were met, and 9 (4%) were excluded because the precise injection site could not be determined during retrospective review of the post-procedure ultrasound images. One injection was excluded due to femur neck fracture, and one was excluded because of recent greater trochanter bursectomy.

Demographic and radiologic characteristics of the study population are shown in Table 1. The mean duration of pain prior to injection was 6.9 ± 2.4 months. The ultrasound findings were tendinosis (21.2%), bursitis (9.5%), partial tear (21.9%), full thickness tear (19.0%), and enthesopathic changes (10.2%). Of 137 patients, 74 (21.9%) patients had concurrent knee osteoarthritis and 58 patients had concurrent lower back pain (lumbar facet joint or S-I joint pain).

Patients receiving ultrasound-guided TB injections had a statistically significant improvement in VNS and HHS at 1, 3, and 6 months after the last injections (Table 2). Treatment was considered successful when patients obtained significant pain relief (as measured by > 50% improvement in VNS score and > 20% improvement in HHS after the injections). Of the 137 patients, 110 (80.3%), 95 (64.9%), and 77 (56.2%) patients achieved successful outcomes according to their 1-, 3-, and 6-month follow-ups, respectively (Fig. 3).

Univariate analysis showed that patients with knee osteoarthritis and lower back pain (lumbar facet joint or S-I joint pain) experienced less therapeutic effect at the 6-month follow-up than those without the conditions (Table 3). Logistic regression analysis showed that the significant outcome predictors at the 6-month follow-up were facet joint or S-I joint pain (odds ratio = 0.304, *P* = .014) and knee osteoarthritis (odds ratio = 0.329, *P* = .021). Age, gender, body mass index, and pain duration did not independently predict a clinically successful outcome (*P* > 0.05). Similarly, there was no statistically significant association between effective treatment and ultrasound findings of tendinosis, bursitis, partial or full thickness tear, and enthesopathic changes (Table 4).

At one month follow-up, there were 27 patients considered to have an ineffective treatment. From those, 22 patients received TB reinjection, one patient received ultrasound-guided aspiration and steroid injection, and 4 patients received arthroscopic surgical treatments. At 3 months follow-up, 10 patients were considered to have an ineffective treatment, 5 patients received arthroscopic surgical treatment from 15 ineffective treatment patients. At 6 months follow-up, 14 patients received TB reinjection, and 4 patients received arthroscopic surgical treatment from 18 ineffective treatment patients. Surgical treatments included arthroscopic bursectomy, arthroscopic escision of calcified tendon, and iliotibial band release.

No systemic adverse events were observed. Six local adverse events were reported; these were described as a mild, transient sensation of pain and heaviness in the injected joint. These complications lasted for an average of 2 – 4 days; no medication was required and daily activity was unaffected. No septic complications were reported.

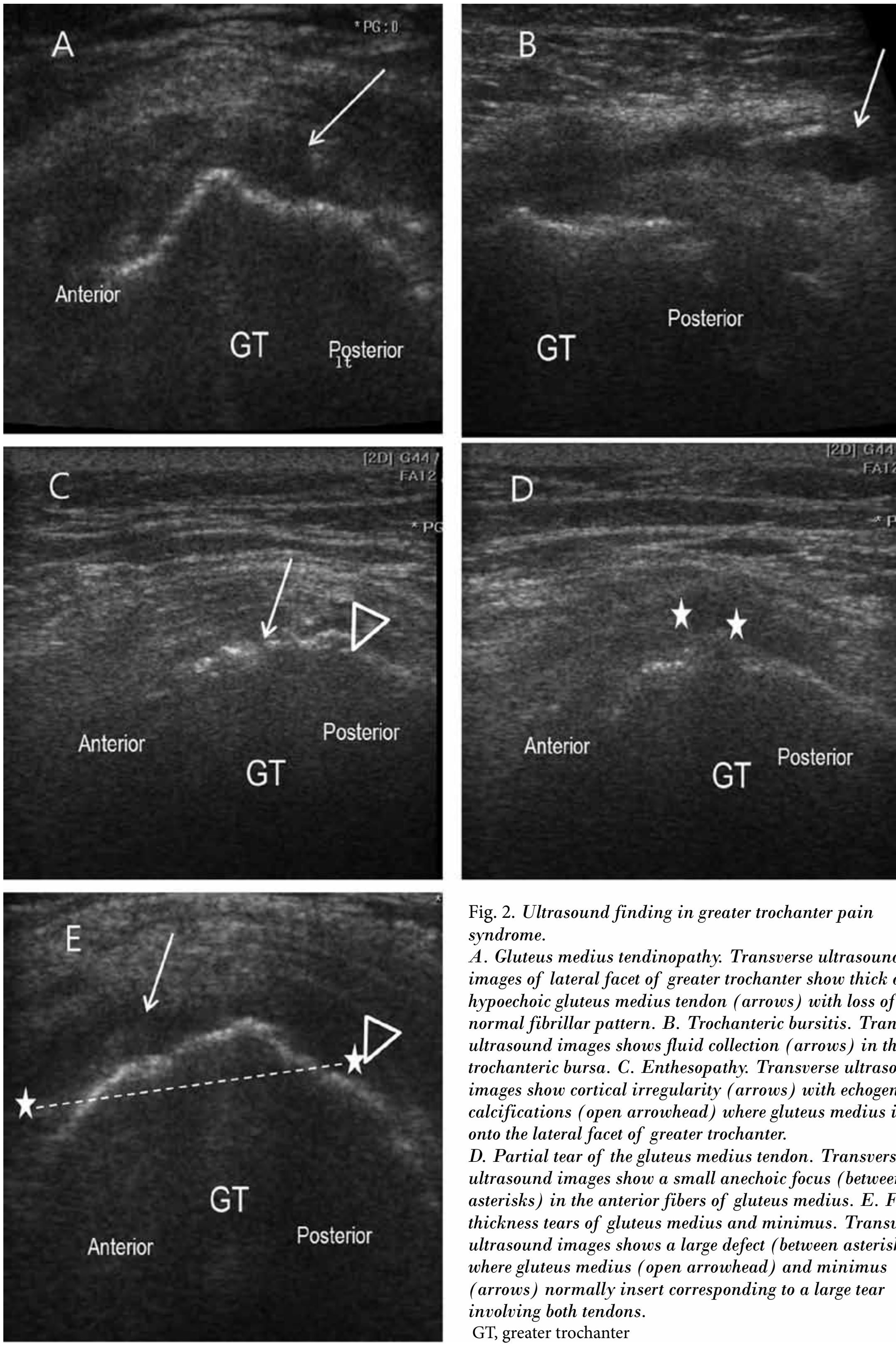

Fig. 2. *Ultrasound finding in greater trochanter pain syndrome.*
A. Gluteus medius tendinopathy. Transverse ultrasound images of lateral facet of greater trochanter show thick and hypoechoic gluteus medius tendon (arrows) with loss of normal fibrillar pattern. B. Trochanteric bursitis. Transverse ultrasound images shows fluid collection (arrows) in the trochanteric bursa. C. Enthesopathy. Transverse ultrasound images show cortical irregularity (arrows) with echogenic calcifications (open arrowhead) where gluteus medius inserts onto the lateral facet of greater trochanter.
D. Partial tear of the gluteus medius tendon. Transverse ultrasound images show a small anechoic focus (between asterisks) in the anterior fibers of gluteus medius. E. Full-thickness tears of gluteus medius and minimus. Transverse ultrasound images shows a large defect (between asterisks) where gluteus medius (open arrowhead) and minimus (arrows) normally insert corresponding to a large tear involving both tendons.
GT, greater trochanter

Table 1. *Demographic, clinical, radiologic, and procedural information for patients (N = 137).*

Demographic Factor	**Value**
Age (years)	65.4 ± 6.75
Gender	
Male	22.6 (31)
Female	77.4 (106)
Pain duration (Month)	6.9 ± 2.4
Body mass index (kg/m^2)	25.30 ± 3.54
Knee osteoarthritis	74 (54%)
Lumbar facet joint or sacroiliac joint pain	58 (42.3%)
Ultrasound Finding	
Tendinosis	29 (21.2%)
Bursitis	13 (9.5%)
Partial tear	30 (21.9%)
Full-thicknesstear	26 (19.0%)
Enthesopathic changes	14 (10.2%)

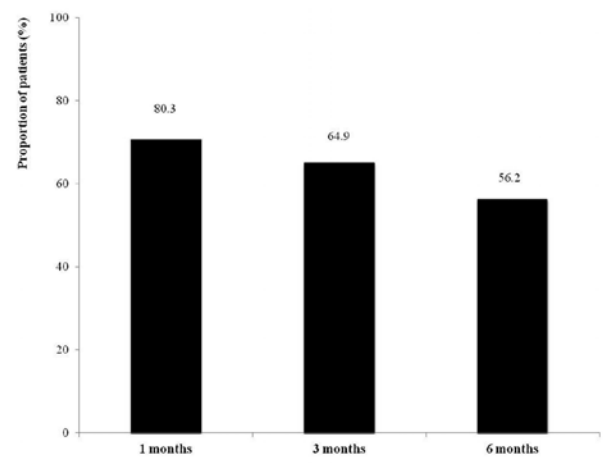

Fig 3. *Illustration of significant pain relief (≥ 50% reduction in Verbal Numerical Scale from baseline), functional improvement (≥ 20-point reduction in Harris Hip Score from baseline).*

Table 2. *Comparison of VNS(1) and HHS(2) at baseline and after the corticosteroid injections.*

	Before injection	**1 month after last injection**	**3 months after last injection**	**6 months after last injection**
VNS	6.13 ± 0.95	2.07 ± 1.49 *	2.53 ± 1.34*	2.78 ± 1.45*
HHS	50.46 ± 7.01	74.20 ± 11.06 *	73.15 ± 7.72*	70.12 ± 10.03*

Values are means ± standard deviations.
*$P < 0.05$ comparison of verbal numerical scale score with baseline.
VNS: Verbal Numeric Pain Scale
HHS: Harris Hip Score

Discussion

Predictors of treatment outcomes are necessary not only to inform the patient about his or her individual prognosis but also to select the most appropriate treatment strategy. In this retrospective cohort study, investigators found that knee osteoarthritis or lower back pain (S-I joint or facet joint pain) were associated in GTPS with poor treatment outcomes following ultrasound-guided corticosteroid TB injection. In addition, treatment effects of ultrasound-guided TB injection showed clinically meaningful and significant improvement in all parameters and successful treatments (≥ 50% improvement in the VNS score and ≥ 20 point improvement in the HHS) in 56.2% (n = 77) of patients at the end of the 6-month follow-up.

The reported response to corticosteroid–local anesthetic mixture injections ranges from 60 to 100% (5,8,10,11). Rasmussen and Fano (12) evaluated 36 patients after corticosteroid injections for simple trochanteric bursitis; 24 patients reported excellent results after one or 2 local corticosteroid injections, and improvement was observed in the remaining cases (12). Shbeeb and colleagues' (5) observational study evaluated the short- and long-term effects of a single local corticosteroid injection for GTPS; 20, 32, and 22 patients received 6, 12, and 24 mg of betamethasone, respectively, mixed with 4 mL of 1% lidocaine. Pain improvement at weeks 1, 6, and 26 were reported in 77.1%, 68.8%, and 61.3% of responding patients, respectively (5). Labrosse et al (17) reported that ultrasound-guided injections into the TB are effective in the treatment of patients with gluteus medius tendinopathy. McEvoy et al (18) found that ultrasound-guided injection of corticosteroid–local

Table 3. *Univariate analysis for possible outcome predictors for injection effectiveness at follow-up.*

Characteristic	Effective (N = 77)	Not effective (N = 60)	*P*-value
Age			0.661
50 – 59	21 (27.3%)	13 (21.7%)	
60 – 69	33 (42.9%)	30 (47.6%)	
70	23 (29.9%)	17 (28.3%)	
Gender (female)	61 (79.2%)	45 (75%)	0.558
Body mass index			0.172
Normal (< 25 kg/m2),	38 (49.4%)	21 (35.0%)	
Overweight (25 – 30 kg/m2)	32 (41.6%)	29 (48.3%)	
Obese (> 30kg/m2)	7 (9.1%)	10 (16.7%)	
Pain duration			0.187
< 6 month	19 (24.7%)	21 (35.0%)	
> 6 month	58 (75.3%)	39 (65.0%)	
Knee osteoarthritis	29 (37.7%)	45 (75.0%)	0.0001
lumbar facet joint or sacroiliac joint pain	20 (26.0%)	38 (63.3%)	0.0001
Ultrasound finding			0.787
Tendinosis	14 (18.2)	15 (25.0)	
Bursitis	7 (9.1)	6 (10.0)	
Partial tear	17 (22.1)	13 (21.7)	
Full-thickness tear	15 (19.5)	11 (18.3)	
Enthesopathic changes	7 (9.1)	7 (11.7)	

Table 4. *Multiple logistic regression analysis for possible outcome predictors for injection effectiveness at follow-up.*

Characteristic	OR	95% CI	*P* value
Gender	0.839	0.317 – 2.218	0.723
Age	0.998	0.941 – 1.058	0.942
Body mass index	1.039	0.931 – 1.161	0.492
Pain duration	1.011	0.849 – 1.204	0.902
Knee osteoarthritis	0.329	0.128 – 0.848	0.021
lumbar facet joint or sacroiliac joint pain	0.304	0.118 – 0.783	0.014
Ultrasound finding			0.420
Tendinosis	3.167	0.885 – 11.331	0.076
Bursitis	4.204	0.869 – 20.333	0.074
Partial tear	2.944	0.795 – 10.896	0.106
Full-thickness tear	3.273	0.848 – 12.637	0.085
Enthesopathic changes	3.821	0.809 – 18.033	0.090

OR, Odds ratio; 95% CI, 95% Confidence interval

anesthetic mixture into the TB conferred more effective pain reduction compared with injection into the sub-gluteus medius bursa. Although GTPS is a complex entity that can be caused by pathologic changes at the tendon attachments, bursa, and iliotibial band (18), ultrasound-guided corticosteroid TB injection may be an effective treatment for patients with GTPS.

Results of the present study agree with the results of previous studies that found no statistically significant association between treatment outcome and ultrasound findings of tendinopathy, bursitis, partial or complete tear, and enthesopathy (17,18). Although GTPS is regarded as a clinical diagnosis, several authors have described a limited role for imaging in confirming this diagnosis (33-35). Calcification adjacent to the greater trochanter has been reported on radiographs of patients with GTPS, but this finding is nonspecific (33,34). McEvoy et al (18) studied 65 consecutive patients with GTPS and found that tendinopathy was revealed in 19 of 65 (29%) ultrasound examinations, bursitis in 17 of 65 (26%), and enthesopathy in 32 of 65 (49%). Fourteen of 65 (22%) patients had normal findings at ultrasound evaluation of the greater trochanter. These findings are congruent with current thought that the syndrome may be associated with myriad other causes such as tendinitis, muscle tears, trigger points, iliotibialband disorders, and general or localized pathology in surrounding tissues (35). Therefore, ultrasound findings may not be predictive of response to treatment with corticosteroid injections.

The prevalence of GTPS in adults with lower back pain has been reported to range between 20% and 35% (4,11,35). In a large, multicenter, cross-sectional study involving 3,026 middle-aged to elderly adults, Segal et al (4) found GTPS prevalence to be 17.6%; prevalence was higher in women and in patients with coexisting lower back pain, osteoarthritis, iliotibial band tenderness, and obesity. In a retrospective analysis of 247 patients referred to an orthopedic spine center for lower back pain, Tortolani et al (35) found that 62.7% of patients with GTPS had been evaluated previously by a spine surgeon for suspected radicular symptoms. The higher reported incidence in patients with leg length discrepancies, lower back pain, and knee pain suggest that altered lower-limb biomechanics and abnormal force vectors across the hip may predispose patients to GTPS (4,11). In a retrospective cohort study of 164 patients, Lievense et al (7) reported that patients with osteoarthritis in the lower limbs had a 4.8-fold risk of persistent symptoms after one year, compared to patients without osteoarthritis. The prognostic value of corticosteroid injection could not be determined in that study because patients had received various treatments such as corticosteroid injection of the greater trochanter, paracetamol, NSAIDs, physiotherapy, and operative treatment. They found that patients who had received a corticosteroid injection had a 2.7-fold chance of recovery after 5 years, compared with patients who had not received an injection.

The results of this study revealed that mid-term pain relief and functional improvement following ultrasound-guided TB injection of local anesthetic with corticosteroid correlated negatively with knee osteoarthritis and lower back pain with facet joint or S-I joint pain. This may provide indirect evidence that the treatment effect of ultrasound-guided corticosteroid injection is low for GTPS patients with knee osteoarthritis or lower back pain with facet joint or S-I joint pain, and that additional treatment for the concurrent problem is needed to achieve treatment effectiveness. Knee or back pain could be related to GTPS as a consequence of compensatory movements from musculoskeletal problems, thus causing symptoms at additional locations through the kinetic chain. It was thought in this study that, although corticosteroid injection might improve GTPS symptoms caused by TB inflammation, unresolved knee or back pain still could influence symptoms.

Female gender and obesity are known risk factors for GTPS due to altered biomechanics associated with differences in the size, shape, and orientation of the pelvis (gynecoid vs android), as are combined effects of increased stress on the hip joint, hip, and knee from osteoarthritis and lower back pain (4,11). However, gender and obesity were not significant prognostic factors for the treatment effectiveness in this study. These results correspond to the results of previous studies, which showed no association between treatment effectiveness and demographic variables (gender, body mass index, age) (17,18).

Most patients with GTPS can be effectively treated through conservative treatment including rest, stretching, physical therapy, and NSAIDs medication. When these conservative treatments fail, TB injection with corticosteroid and local anesthetics have been shown to provide pain relief, with response rates ranging from 60% to 100% (11). However, a certain percentage of patients will have a recurrence of symptoms in spite of several injections (5,12). In patients who fail conservative treatment and/or repeated injection treatment, surgical intervention has been advocated. The recalcitrant TB can sometimes be addressed with arthroscopic bursectomy and/or iliotibial band release (ITB) release (36). In the case of gluteus medius and minimus tears, endoscopic tendon repair can be a treatment option (6). Many successful treatment options have been described for calcific tendinitis, including extracorporeal shockwave lithotripsy, needle aspiration and steroid injection, and surgery (37-39). In our study, 46 patients out of 60 patients who did not respond to TB corticosteroid injection received reinjection. Nine patients received arthroscopic bursectomy with concomitant ITB. Three patients received arthroscopic repair of gluteus medius tendon tears. In the case of 2 acute calcific tendinitis patients, one received arthroscopic excision and the other did needle aspiration and steroid injection.

Certain limitations hampered the study. First, this study was retrospective in design. Out of 189 charts reviewed, complete data were available for 158 patients, with 31 charts omitted, amounting to a 16% loss to follow-up. One major cause for an incomplete dataset was failure to show up for the follow-up appointment one month after the final injection. It is difficult to assess the degree to which this reflects beliefs of patients who felt that their medical experience was not beneficial and thus decided against subsequent visits versus those who benefited to such an extent that they considered further evaluation to be unnecessary. In addition, investigators could not control for other treatments (e.g., medication, physical therapy) during follow-up. Though patients refractory to these treatments were included in this study, these treatments might have influenced study results. Secondly, the 6-month follow-up period was relatively short. However, because the procedure was not repeated during the follow-up period, results reflect the clinical efficacy of a single treatment and exclude the influences of repetition and the cumulative effects of multiple procedures. Thirdly, the treatment procedures were performed by the same physician, thus reflecting that practitioner's experience and potentially limiting generalization of the findings. Fourth, ultrasound findings were not confirmed by surgical or pathologic findings and not validated by another imaging modality (e.g., magnetic resonance imaging). Other imaging modality supplementation can help to overcome some of the limitations of sonographic finding reliability (i.e., sonography is an operator-dependent modality). Further large-scale longitudinal prospective studies are required to better understand these findings.

Conclusion

This study suggests that knee osteoarthritis and lower back pain (S-I joint pain or lumbar facet joint pain) may be associated with, or predictive of, a poor outcome of ultrasound-guided TB injection. Assessment of these clinical factors should be incorporated into the evaluation and counseling of patients with GTPS who are candidates for ultrasound-guided TB injection. Additionally, ultrasound-guided TB injection may be effective for pain reduction and functional improvement in patients with GTPS who do not respond to other conservative treatments.

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