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Case Report

Magnetic resonance imaging/ultrasound fusion-guided sacroiliac joint corticosteroid injection in patients with axial spondyloarthritis

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ABSTRACT

Local glucocorticoid injections are used in the treatment of isolated sacroiliitis in patients with spondyloarthritis. Sacroiliac joint injections can be performed intraarticularly or periarticularly. Since the accuracy of blind injections is low, fluoroscopy, magnetic resonance imaging, computed tomography, or ultrasonography guidance are used to increase the accuracy of sacroiliac joint injections. Currently, imaging fusion software is successfully used in sacroiliac joint interventions with three-dimensional anatomic information added to ultrasonography. Herein, we present two cases of sacroiliac joint corticosteroid injections under ultrasonography-magnetic resonance imaging fusion guidance.

Keywords: Image fusion technique, intra-articular injection, peri-articular injection, sacroiliitis, spondyloarthritis, ultrasonography.

In axial spondyloarthritis (SpA), sacroiliac joint (SIJ) is one of the areas where the disease starts and typical signs of inflammatory changes are observed. Magnetic resonance imaging (MRI) is a highly useful tool for diagnosis, particularly in the early period before onset of radiological findings.[1] In recent years, biological drugs have led to dramatic improvements in the treatment. However, biologics may not be an option for the treatment in all cases. Besides, during novel coronavirus disease-2019 (COVID-19) pandemic, many patients have attempted to withdraw immunosuppressive drugs due to fear of having the infection more severely.[2] Therefore, local injections may be needed in patients who discontinue biological medications and experience increased disease activity.

Sacroiliac joint corticosteroid (CS) injections can be effectively used in case of active sacroiliitis in patients with SpA.[3-6] Local SIJ CS injections can be performed periarticularly or intraarticularly under the guidance of ultrasound (US), MRI, computed tomography (CT), fluoroscopy (FL), or in a blinded manner.[6] Image fusion techniques are used in interventional procedures with the combination of US and cross-sectional imaging methods such as MRI or CT. Recently, there are studies showing that fusion applications can be used successfully in SIJ injections.[7,8] The fusion technique, which enables the imaging modalities to compensate for each other's disadvantages, provides the following: with MRI/CT, the limited field of view of US is expanded and contrast resolution is not compromised, US provides real-time imaging, color Doppler images can be superimposed on MRI/CT images, and procedure time, costs and radiation exposure can be reduced.[8]

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Herein, we present two cases with axial SpA who underwent CS injection to synovial and ligamentous portion of the SIJ under MRI/US fusion guidance.

CASE REPORT

Case 1- A 36-year-old female patient with axial SpA who was on secukinumab treatment for 18 months presented to our clinic in the early periods of COVID-19 pandemic. She discontinued secukinumab treatment due to fear of being infected and the severity of her back pain and palmoplantar psoriasis increased consequently. Physical examination revealed positive SIJ provocation tests on the left side. The Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) score was 8 and Visual Analog Scale (VAS) score was 10. The SIJ MRI revealed bone marrow edema (BME) in the synovial portion of the left SIJ. We performed CS injection into the synovial part of the left SIJ under MRI/US fusion guidance. A significant pain reduction was achieved after the injection and, during follow-up, the VAS score was 2 at two weeks and six months.

Case 2- A 21-year-old male patient with axial SpA presented with severe back pain unresponsive to non-steroidal anti-inflammatory drugs. Lumbar movements were painful and restricted, and SIJ provocation tests were positive on the left side on physical examination. The BASDAI score was 5.8 and VAS score was 9. Sacroiliac MRI revealed active sacroiliitis on ligamentous parts of left SIJ. The patient was recommended to start a biological drug, but he refused due to the fear of infectious side effects during the COVID-19 period. Therefore, it was planned to perform CS injection to ligamentous portion of SIJs under MRI/US fusion guidance. A significant pain relief was achieved 15 to 20 min after the injection. During follow-up, the VAS score was 1 at two weeks and six months.

Injection procedure

The procedures were performed using a 1-6 MHz curved array transducer (ARIETTA 850, Hitachi, Tokyo, Japan). Both patients were placed in the prone position with a pillow under their belly and arms crossed under their head. Before this procedure, the patients underwent an MRI scan where they were placed in the same position as described above. Previously acquired MRI images in the Digital Imaging and Communications in Medicine (DICOM) format were imported into the US system via CD-ROM. The fusion system, real-time virtual sonography (RVS), is composed of an US scanner, a magnetic sensor linked to the probe, and a magnetic field generator placed close to the area interested (Figure 1a). The RVS can detect the position and angle of the US transducer with these magnetic motion tracking devices.

Figure 1. Real-time virtual sonography system. **(a)** The magnetic sensor (asterisk) linked to the ultrasound probe is shown on the left and the magnetic field generator on the right. The generator should be placed close to the area to be processed. In the magnetic field provided by the generator, the sensor enables the position and angle of the probe to be detected. **(b)** Split-screen view of MRI and real-time US imaging for the registration process; on the left side of the ultrasound monitor, the preselected MRI section is displayed, while on the right side, scanning of the US image matching the MRI section is in progress.

MRI: Magnetic resonance imaging; US: Ultrasound.

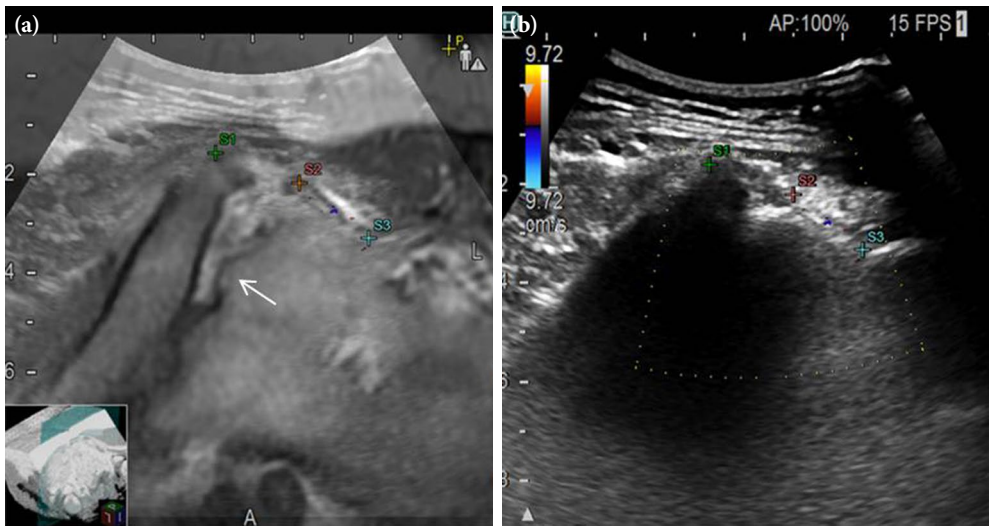

Figure 2. Point registration process for synovial part. The real-time US image is displayed on the right side and the MRI image on the left. This image was taken after matching the same section (plane registration) in both modalities. Anatomical structures that can be easily found on both MRI and US are marked with the same points (S1, S2, and S3). Please note the MRI image, a bony prominence (arrow) on the articular surface, is not detectable on US imaging.

MRI: Magnetic resonance imaging; US: Ultrasound.

Image fusion began with a co-registration process. The MRI images were displayed on the monitor as a split-screen with the real-time US (Figure 1b). For the integration of two sources, we performed plane and point registrations. We selected MRI sections on the axial plane containing the targeted joint region for plane registrations. For plane registrations, sections at the level of the second sacral foramen as described by Klauser et al.,[9] and the level between the first and second sacral foramina as described

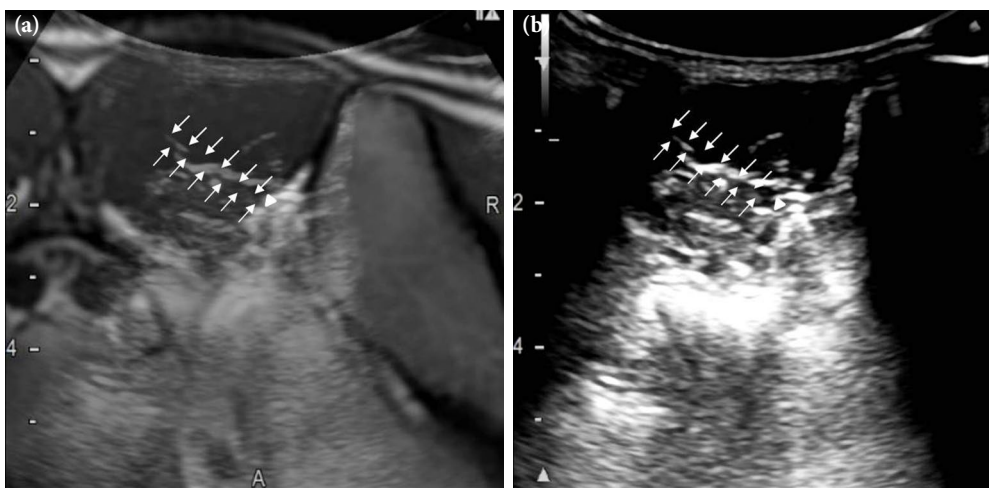

Figure 3. Superimposition of images and injection into the ligamentous part. After the co-registration is complete, the MRI and US images are displayed side by side, and the synchronization of the two images is checked. Real-time US imaging is, then, superimposed on the MRI image (left). The arrows show the course of the needle during the procedure and the arrowhead shows the needle tip (In this image, it can be assumed that the injection was made into the right SIJ. However, since the US operator must be located on the opposite side of the magnetic field generator, the US and MRI images are inverted in the right-left direction for the convenience of the operator).

MRI: Magnetic resonance imaging; US: Ultrasound.

by Saunders et al.[10] were selected for synovial and ligamentous injections, respectively. For an accurate superimposition of images, we performed the process called point registration by marking anatomical landmarks that could be easily found in both imaging methods (Figure 2). Then, the RVS enabled a display of real-time US images simultaneously with the multi-planar rendered images reconstructed from the MRI volume data set. Subsequently, MRI and real-time US images were superimposed. These images were used to guide during needle (23-gauge × 2 1/8"; 0.60 × 80 mm) placement. Betamethasone (1 mL, 3 mg) and lidocaine 2% (1 mL) were injected into each patient. Superimposition and injection process are shown in Figure 3.

DISCUSSION

The SIJ is a complex joint in the structure of diarthrosis/amphiarthrosis, consisting of the synovial part anteriorly, which contains fibrocartilage and hyaline cartilage, and the ligamentous part formed by the intrinsic and extrinsic ligaments surrounding the synovial part posteriorly.[11] In SpA patients with sacroiliitis, inflammation is not only seen in intraarticular (synovial), but also in structures around the joint. Posterior ligamentous structures of SIJ contain nociceptors. Multilocular enthesitis involving this region, also called the retroarticular space, is common in axial SpA.[4] In a study investigating Duplex and color Doppler sonographic findings in active sacroiliitis, of 41 affected sacroiliac joints in 21 patients, three had intraarticular vascularization only, 31 had vascularization only around the joint, and seven had vascularization at both sites.[12] The SIJ injections can be performed intraarticularly (synovial) and periarticularly (ligamentous).[6] Hartung et al.[13] showed that periarticular CS injection is adequate for pain control in patients with active sacroiliitis as similar to intraarticular injections.[13] Conversely, Althoff et al[4] proposed that intraarticular placement of the needle was essential for long-term treatment success; however, the authors suggested that periarticular injections might be beneficial in ankylosed joints or enthesitis in posterior ligamentous structures. In our cases, we determined to perform injection to the site with BME on MRI where the patients' complaints were most intense. Braun et al[5] showed that local CS injection into synovial part of SI joints reduced BME in the patients with SpA. We performed injection into synovial portion of SIJ in one of our patients and into ligamentous portion. Both patients seemed to be asymptomatic in their long-term follow-up.

The SIJ procedures are often performed with CT, MRI, FL, and US guidance. However, all these imaging methods have some inherited disadvantages. For instance, CT and FL are associated with a high radiation exposure, while MRI is expensive and time-consuming[6] Ultrasound is a fast, inexpensive, radiation-free, and readily available modality that is very useful in guiding SIJ injections. Besides, US provides real-time visualization of the injection area and vascular structure with power Doppler mode. In the studies on the accuracy of US-guided SIJ injections, controversial results have been reported ranging from 37.5 to 96%[14] Variation in the accuracy may be due to differences in the technique employed, as well as patient- or operator-related factors. The patient- and disease-related factors such as body mass index, bone spurs, joint space narrowing, and ankylosis are of importance for the success of injection[7] The recent introduction of imaging fusion software may eliminate these disadvantages. Fusion of US with CT or MRI, which were previously used in soft tissue biopsies, have been also used successfully in SIJ injections.[7,8] In particular, for SIJ interventions, superimposition of US scanning on MRI/CT images allows for a better understanding of joint configuration and accurate guidance of the needle into the joint space. By combining the two images, the needle tip, which is normally not visible under US guidance after reaching the hypoechoic cleft of the SIJ, can be oriented at the right angle to the desired part of the joint according to the joint configuration provided by MRI/CT.[7] Klauser et al.[7] achieved successful results in terms of accuracy and pain relief in cadavers and patients, respectively in US-CT fusion-guided SIJ injections. The US-MRI fusion-guided SIJ injections performed by Zacchino et al.[8] were also successful in terms of both pain relief and spatial accuracy, although the number of patients was small. There are also some limitations for multimodal image fusion methods. Experienced operators are needed, as it is necessary to ensure an exact match of the images for spatial accuracy and to stabilize the transducer over the skin until the registration is complete.

In conclusion, both synovial and ligamentous SIJ CS injections seem to be effective methods in patients with spA. The US-MRI fusion guidance is a safe and convenient technique to improve the success of SIJ injection.

Patient Consent for Publication: A written informed consent was obtained from the patients.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

1. Sieper J, Poddubnyy D. Axial spondyloarthritis. Lancet 2017;390:73-84.
2. Ceribelli A, Motta F, De Santis M, Ansari AA, Ridgway WM, Gershwin ME, et al. Recommendations for coronavirus infection in rheumatic diseases treated with biologic therapy. J Autoimmun 2020;109:102442.
3. Luukkainen R, Nissilä M, Asikainen E, Sanila M, Lehtinen K, Alanaatu A, et al. Periarticular corticosteroid treatment of the sacroiliac joint in patients with seronegative spondylarthropathy. Clin Exp Rheumatol 1999;17:88-90.
4. Althoff CE, Bollow M, Feist E, Marticorena-Garcia SR, Eshed I, Diekhoff T, et al. CT-guided corticosteroid injection of the sacroiliac joints: Quality assurance and standardized prospective evaluation of long-term effectiveness over six months. Clin Rheumatol 2015;34:1079-84.
5. Braun J, Bollow M, Seyrekbasan F, Häberle HJ, Eggens U, Mertz A, et al. Computed tomography guided corticosteroid injection of the sacroiliac joint in patients with spondyloarthropathy with sacroiliitis: Clinical outcome and followup by dynamic magnetic resonance imaging. J Rheumatol 1996;23:659-64.
6. Wendling D. Local sacroiliac injections in the treatment of spondyloarthritis. What is the evidence? Joint Bone Spine 2020;87:209-13.
7. Klauser AS, De Zordo T, Feuchtner GM, Djedovic G, Weiler RB, Faschingbauer R, et al. Fusion of real-time US with CT images to guide sacroiliac joint injection in vitro and in vivo. Radiology 2010;256:547-53.
8. Zacchino M, Almolla J, Canepari E, Merico V, Calliada F. Use of ultrasound-magnetic resonance image fusion to guide sacroiliac joint injections: A preliminary assessment. J Ultrasound 2013;16:111-8.
9. Klauser A, De Zordo T, Feuchtner G, Sögner P, Schirmer M, Gruber J, et al. Feasibility of ultrasound-guided sacroiliac joint injection considering sonoanatomic landmarks at two different levels in cadavers and patients. Arthritis Rheum 2008;59:1618-24.
10. Saunders J, Cusi M, Hackett L, Van der Wall H. An exploration of ultrasound-guided therapeutic injection of the dorsal interosseous ligaments of the sacroiliac joint for mechanical dysfunction of the joint. JSM Pain Manag 2016;1:1003.
11. Poilliot AJ, Zwirner J, Doyle T, Hammer N. A systematic review of the normal sacroiliac joint anatomy and adjacent tissues for pain physicians. Pain Physician 2019;22:E247-E274.
12. Arslan H, Sakarya ME, Adak B, Unal O, Sayarlioglu M. Duplex and color Doppler sonographic findings in active sacroiliitis. AJR Am J Roentgenol 1999;173:677-80.
13. Hartung W, Ross CJ, Straub R, Feuerbach S, Schölmerich J, Fleck M, et al. Ultrasound-guided sacroiliac joint injection in patients with established sacroiliitis: Precise IA injection verified by MRI scanning does not predict clinical outcome. Rheumatology (Oxford) 2010;49:1479-82.
14. Zheng P, Schneider BJ, Yang A, McCormick ZL. Image-guided sacroiliac joint injections: An evidence-based review of best practices and clinical outcomes. PM R 2019;11 Suppl 1:S98-S104.