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Sonography-guided trigger point injections in abdominal myofascial pain syndrome

Hye Chang Rhim, MD[a], Jae Hyun Cha, MD[a], Jaehyung Cha, PhD[b], Dong Hwee Kim, MD, PhD[c,*]

Abstract

Even though chronic abdominal pain is 1 of the most common reasons for hospital visits, diagnostic testing is often time-consuming and treatment is inadequate. Abdominal myofascial pain syndrome (AMPS) is usually not included as a differential diagnosis, but it should be considered in cases of chronic abdominal pain. The purpose of this study was to investigate the clinical characteristics of AMPS and to assess the effect of sonography-guided trigger point injections (TPI).

A total of 100 patients with AMPS from 2012 to 2018 were retrospectively evaluated for clinical characteristics and TPI effects. AMPS was diagnosed using Srinivasan and Greenbaum's criteria, and the TPIs were performed at intervals of 2 to 4 weeks. The Visual Analog Scale (VAS) ratio was calculated by subtracting the final VAS from the initial VAS score and dividing it by the initial VAS score after injections, and the patients were divided into 4 groups: non-responders, mild, moderate, and good responders.

The median duration of pain was 12 months, and the median number of hospital visits before TPI was 2. Of the 100 patients, 66 (66%) were categorized as good responders, 11 (11%) as moderate responders, 7 (6.9%) as mild responders, and 16 (15.7%) as non-responders. When the initial and final VAS scores were compared, the sonography-guided injections were found to be effective in alleviating pain ($P < .001$). Moreover, patients who received the injections 2 or more times tended to have more significant pain reduction than those who received a single injection ($P < .001$).

Patients with AMPS suffer from long-term pain and undergo many hospital visits and diagnostic tests. TPI with lidocaine can be an effective and safe treatment for patients with chronic AMPS.

Abbreviations: AMPS = abdominal myofascial pain syndrome, CAWP = chronic abdominal wall pain, CT = computed tomography, Onabot A = onabotulinumtoxinA, PET-CT = positron emission tomography-computed tomography, TPI = trigger point injections, VAS = visual analog scale.

Keywords: abdomen, injections, myofascial pain syndrome, pain, treatment, trigger points, ultrasonography

1. Introduction

Although chronic abdominal pain is a common cause of hospital visits, it often results in inappropriate diagnostic testing and poor treatment. It has been reported that 10 to30% of chronic abdominal pain cases develop from abnormalities in the abdominal wall.[1] In previous studies of patients who were ultimately diagnosed with abdominal wall pain, 100 had gone through 418 diagnostic procedures,[2] and 30 had gone through 67 diagnostic procedures, including 4 laparoscopies.[3] Owing to the lack of physician awareness of abdominal wall pain and its association with low mortality, diagnosis and treatment may be delayed, leading to considerable costs.[4,5]

Chronic abdominal wall pain (CAWP) resulting from trigger points in the abdominal musculature is termed abdominal myofascial pain syndrome (AMPS).[6] Trigger points are spots of extreme tenderness and hyperirritability in the muscles.[7] Nazareno et al. found that 89% of patients with abdominal wall pain showed either complete or incomplete symptom improvement with trigger point injections (TPI) using local anesthetics, and that 77% of patients achieved long-term symptom alleviation.[5] Since prompt and appropriate treatment can result in a high success rate, it is crucial to be aware of abdominal wall pain. However, blind injection into abdominal muscles can be difficult because of individual differences in the thickness of subcutaneous tissue and abdominal muscles. Furthermore, unless a twitch response is evoked, it is impossible

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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to judge whether the injection is precisely targeted to abdominal muscles.[8] In addition, injecting into the intraperitoneal space or subcutaneous fat may lead to undesirable consequences.[9] In these circumstances, an ultrasound can be used for guidance to ensure the safety and accuracy of injections.

This study aimed to evaluate the effect of sonography-guided TPI on AMPS and identify clinical characteristics of AMPS and significant predictors of TPI responses.

2. Materials and methods

2.1. Patient selection

A total of 100 patients who were referred for the evaluation and treatment of AMPS between 2012 and 2018 were eligible for inclusion in this study. The clinical characteristics of abdominal pain and the effects of sonography-guided TPI were analyzed by retrospective chart review. AMPS was diagnosed using Srinivasan and Greenbaum criteria,[2] which included the following: localized pain or unchanging location of tenderness without intra-abdominal pathology, superficial tenderness, point tenderness diameter of no more than 2.5 cm, and positive Carnett sign (increased point tenderness on abdominal wall during muscle testing). Treatment with TPI was performed at the initial visit if the patients met the above criteria, and the severity of pain was recorded using the visual analogue scale (VAS). The patients were followed-up at intervals of 2 to 4 weeks. If the pain persisted or the symptomatic area changed during the follow-up visit, additional injections were performed at the pain site. Patients were excluded if they had neurological pain, an infection, drug or alcohol abuse problems, rheumatologic disease, pregnancy, psychiatric disease, postoperative abdominal pain, or if their abdominal pain was caused by fibromyalgia. The institutional review board of our institution approved this study (IRB No.2019AS0073).

2.2. Procedure and intervention

Physical examinations and TPIs were performed by the corresponding author of this study. The pain locations in the abdomen were divided into 12 areas horizontally by subcostal and transtubercular planes and vertically by central and midclavicular lines (lateral border of the rectus abdominis muscle) (Fig. 1). Tender points with positive Carnett sign were isolated by palpation to ensure reproducibility of symptoms. If the pain was localized in the central areas (area 2R, 2L, 5R, 5L, 8R, 8L), 1 mL of 0.5% lidocaine (SAMJIN, Seoul, Korea) was injected once into the rectus abdominis muscle, and if the pain was located in the lateral areas (1, 3, 4, 6, 7, 9), 2 ml of lidocaine was injected into the external oblique and internal oblique muscles. All the injections were performed parallel to the direction of muscle fibers with sterile 23G-diameter needles using high-resolution ultrasonography (Accuvix V20 system; Samsung Medison, Seoul, Korea) interfaced with a 5 to13 MHz linear array transducer. Ultrasound was used to ensure the safety and accuracy of the injections. If the pain site changed during the follow-up period, tender points with positive Carnett's sign were reinjected under sonography guidance.

2.3. Outcome measures

During their initial visits, patients completed questionnaires eliciting demographic information, history of pain (duration, location, severity, characteristics), associated symptoms, history of previous hospitalizations and management, and history of systemic disease. Pain duration was defined as the period between the initial onset of pain and the last follow-up visit with pain resolution. Pain severity was measured by the VAS score on a scale from 0 ("no pain") to 10 ("extreme pain"). The associated symptoms included distension, pressure, nausea, vomiting, diarrhea, constipation, menstrual pain, and others. Any special diagnostic tests for abdominal pain, including upper and lower endoscopy, abdominal computed tomography (CT), ultrasonography, and positron emission tomography-CT (PET-CT), performed at previous hospitals were investigated. Diagnoses from previous hospitals, which included gastritis, irritable bowel syndrome, functional gastrointestinal disorder, diverticulum, post-operation symptoms, and myofascial pain syndrome, were also recorded.

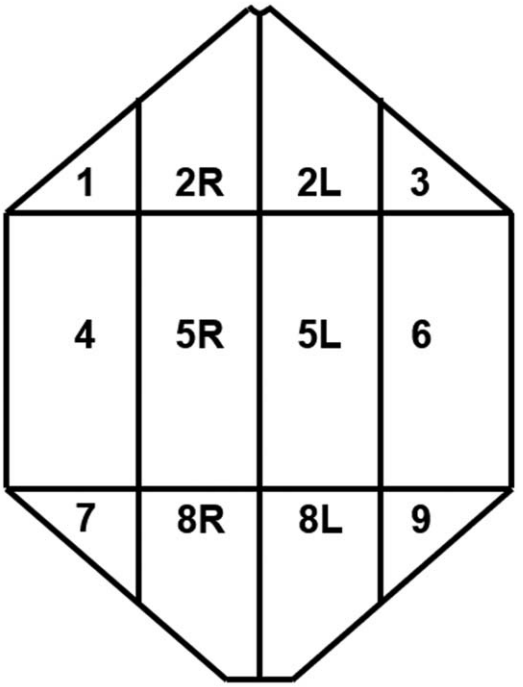

Figure 1. Abdominal pain sites were divided into 12 areas by horizontal planes (subcostal and transtubercular planes) and vertical lines (central and midclavicular lines).

After the initial injection, patients were followed up at 2- to 4-week intervals and asked to complete another questionnaire, which including pain prognosis, percent of improvement, and VAS score. VAS ratio was calculated by "(initial - final VAS score)/initial VAS score", and the patients were divided into 4 groups: non-responders (if the ratio was negative to zero), mild responders (if the ratio was 1% to 24%), moderate responders (if the ratio was 25% – 49%), and good responders (if the ratio was higher than or equal to 50%). This categorization was similar to that from a previous study on chronic migraines, in which patients with 30% or 50% pain reduction were identified after the treatment.[10] Any change in the pain location and adverse events associated with injections were noted.

The primary outcome was the efficacy of TPI in treating chronic abdominal pain. Regardless of the number of injections patients received, the final and initial VAS scores were used to assess the efficacy. The secondary outcomes were to investigate

whether sex, total number of injections, total lidocaine dose, number of injections received during the initial visit, changes in injection site, presence of associated symptoms, and duration of pain could be significant predictors of treatment response to TPI.

2.4. Statistical analysis

All statistical analyses were performed with SPSS, version 25.0 (IBM Corp, Armonk, NY). The significance level was set at $P < .05$. Mann-Whitney U test was used to analyze the efficacy of TPI by comparing initial and final VAS scores. χ^2 trend analysis (Cochran-Armitage) was used to investigate whether the number of injections was associated with better treatment response. Furthermore, we analyzed the differences in categorical variables of baseline and clinical characteristics among the 4 types of responders using χ^2 trend test or Kruskal-Wallis test and performed post-hoc pairwise comparisons using Bonferroni correction for statistically significant results.

3. Results

3.1. Patient demographics

This retrospective analysis included 46 male and 54 female patients. The median age of the patients was 51 years (range 16 – 88). The median duration of pain was 12 months (range 1 – 360), and the median number of hospital visits before the TPI was 2 (range 0 – 50). Twenty-six patients had previous diagnoses, which included 13 patients with gastritis; 4 with irritable bowel syndrome; 8 with AMPS; and 1 with diverticulum. The other 74 patients were not previously diagnosed with any diseases.

The median number of special tests performed previously for each patient was 2. In total, however, patients underwent 60 CTs, 58 endoscopies (53 gastroscopies and 47 colonoscopies, some patients receiving both), 48 ultrasounds, and 2 PET-CTs. Of the 100 patients included, 66 (66%) were categorized as good responders, 11 (11%) as moderate responders, 7 (7%) as mild responders, and 16 (16%) as non-responders. The clinical characteristics of the patients are summarized in Table 1.

The most common injection site at the initial visit was the right middle column of the upper abdomen (area 2R, 16.6%), followed by the right middle abdomen (area 4, 15.1%) and the left middle column of the upper abdomen (area 2L, 15.1%) (Fig. 2A).

3.2. Primary outcome: response to TPI

The median initial VAS score was 6, and the median final VAS score was 2. Comparing the initial and final VAS scores, TPI was significantly associated with alleviating pain regardless of the number of injections ($P < 0.001$) (Fig. 3).

3.3. Secondary Outcomes: predictors of good response to TPI

There was no difference between males and females in terms of treatment response ($P = .605$). Patients who received 2 or more injections showed significantly more pain reduction than those who received only 1 injection ($P < .001$) (Fig. 4). Additionally, the total dose of lidocaine was associated with a difference in response ($P = .026$), and the post-hoc analysis showed that good responders received higher doses than non-responders ($P < .05$). However, there was no difference in treatment response depending on the number of injections received during the initial visit ($P = .250$). Injection site changes were significantly associated with response to treatment. If the injection site did not change between the initial and final injections, patients seemed to have a better treatment response ($P = .002$). The number of associated symptoms at the initial visit did not significantly affect treatment response ($P = .512$), and the duration of pain was not associated with treatment response ($P = .729$).

3.4. Adverse event

After the injections, the injection sites were compressed for more than 30 seconds. None of the patients reported any adverse events, such as bleeding or bruising, after the injections.

4. Discussion

CAWP should be suspected in patients presenting with chronic abdominal pain and negative diagnostic results from tests such as endoscopies, imaging, and lab results. Failure to diagnose CAWP can lead to frustration for both the patients and clinicians. Additional hospital visits and testing only increase costs and confer additional risks.[11,12] The median number of diagnostic tests for patients included in this study was 2, though we limited the diagnostic tests to endoscopy (gastroscopy and colonoscopy),

Table 1

Demographic and clinical characteristics of patients.

	Non-responder	Mild responder	Moderate responder	Good responder	Total	*P-value*
Number of Patients	16	7	11	66	100	
Sex (M/F)	8/8	3/4	7/4	28/38	46/54	.605
Age (yr)*	50.5 (16, 83)	49 (25, 81)	51 (22, 70)	53 (19, 88)	51 (16, 88)	.548
Number of associated symptoms*	1 (0, 6)	2 (0, 3)	1 (0, 3)	1 (0, 5)	1 (0, 6)	.512
Hospital visit*	2 (0, 10)	4 (1, 10)	2 (1, 4)	2 (0, 50)	2 (0, 50)	.449
Diagnostic tests*	2 (0, 4)	2 (1, 4)	2 (0, 4)	2 (0, 4)	2 (0, 4)	.860
Pain duration (mo)*	12 (3, 72)	24 (1, 96)	12 (2, 120)	12 (1, 360)	12 (1, 360)	.729
Initial VAS score*	7 (1, 10)	6 (4, 10)	7 (3, 10)	6 (2, 10)	6 (1, 10)	.988
Number of injections*	2 (1, 4)	3 (2, 6)	2 (1, 7)	3 (1, 6)	2 (1, 7)	.023
Number of injection sites at initial treatment*	2 (1, 4)	3 (2, 4)	2 (1, 4)	2 (1, 4)	2 (1, 4)	.250
Injection site change between initial and final (yes/no)	12/4	2/5	6/5	17/49	37/63	.002
Total dose of lidocaine*	2 (1, 7)	9 (1, 11)	3 (1, 19)	4 (1, 21)	3.5 (1, 21)	.026

VAS = visual analog scale.

* These data are presented in median. (Minimum, Maximum).

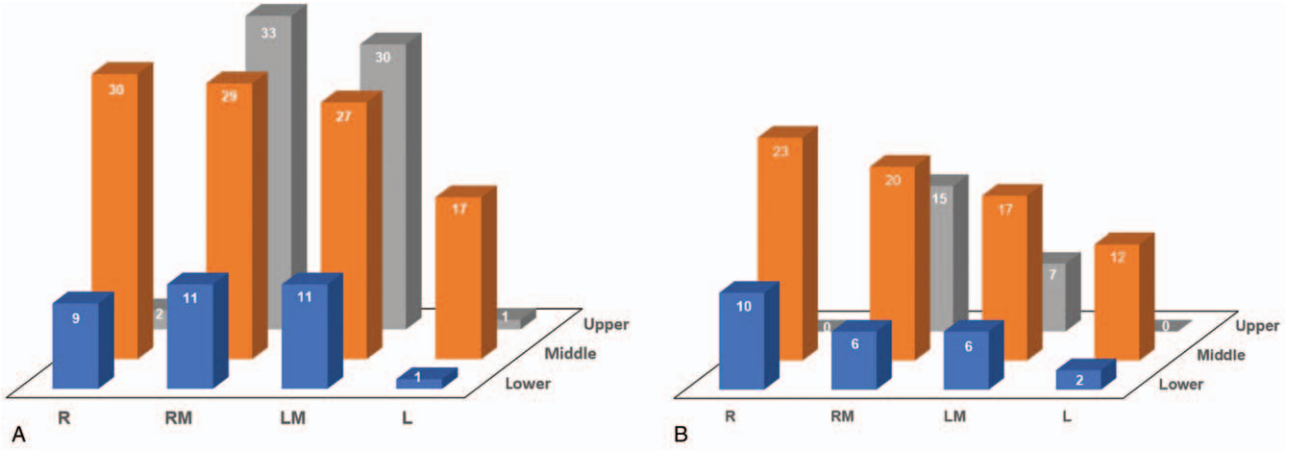

Figure 2. Frequency of different injection sites on the initial visit (number of total injection sites, 201) demonstrated that the most common injection site was the right middle column of the upper abdomen (area 2R, 16.4%), followed by the left middle column of the upper abdomen and the right middle abdomen (area 2L and 4, 15.0%), and then the right middle column of the middle abdomen (area 5R, 14.4%) (A). The frequency of different injection sites on subsequent visits (number of total injection sites, 118) decreased but the patterns were similar to the initial visit except the area 2R and 2L. Upper: upper abdomen, Middle: middle abdomen, Lower: lower abdomen, R: right column of the abdomen, RM: right middle column, LM: left middle column, and L: left column. The numbers located at the upper portion of each column designate the total number of injections in each area.

CT, ultrasound, and PET. Despite this, 16% of patients underwent 4 diagnostic tests, and if we had broadened the range of diagnostic tests, the median might have increased. This result is similar to the findings of Nazareno et al[5] and Hershfield et al,[2] which demonstrated that patients underwent 4 diagnostic tests on average before the diagnosis of abdominal wall pain. Moreover, 1 patient reported that he had visited 50 hospitals prior to his initial assessment and treatment, but ultimately showed good response after 2 injections. Despite the importance of a timely diagnosis and treatment, the pathophysiology and management of CAWP currently remains ambiguous in the literature.

Previous studies have reported that anterior cutaneous nerve entrapment syndrome appears to be the most common cause of CAWP.[1,13–15] However, a recent prospective study showed that anterior cutaneous nerve entrapment syndrome was diagnosed in 12% of patients presenting with chronic abdominal pain.[6] The author of this study distinguished between anterior cutaneous nerve entrapment syndrome and AMPS based on the presence of anterior cutaneous nerve irritation signs such as cutaneous allodynia or hypoesthesia near the lateral border of the rectus muscle.[6] Clinically, it is difficult to differentiate the etiology of CAWP, but substantial pain relief after anterior cutaneous nerve block or TPI can be confirmatory.[1] In our study, we did not divide CAWP patients into either anterior cutaneous nerve entrapment syndrome or AMPS through physical examination. However, since 84% of the patients showed some degree of response after TPI injections, we speculated that most of our patients suffered from AMPS rather than anterior cutaneous nerve entrapment syndrome.

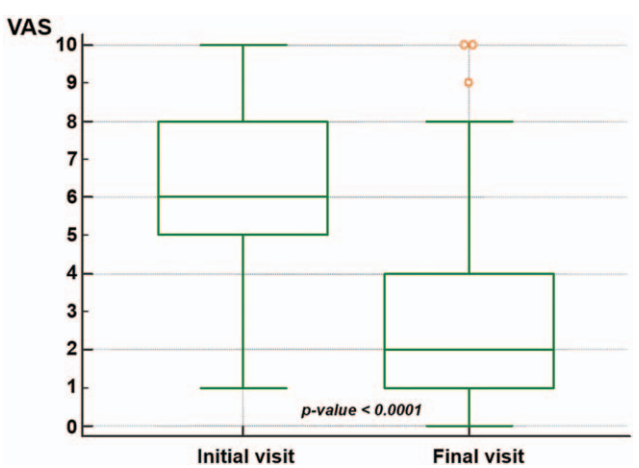

Figure 3. Pain intensity on the initial visit decreased significantly after trigger point injection administration compared with the final visit ($P < .001$).

In previous studies, injections with local anesthetics were shown to be effective in treating CAWP.[5,16–18] Gallegos et al demonstrated that 16 of the 20 patients who were treated with local anesthetics and steroids were symptom free or improved at a median follow-up period of 29 months.[16] On a larger scale, Kuan et al. found that the injection of 2 ml of 0.5% bupivacaine, 3 mL of 2% lidocaine, and 1 ml of betamethasone 4 mg/1 mL allowed 115 out of the 140 patients to remain symptom-free after 3 months.[17] Similarly, Nazareno et al. found that 89% of their 89 patients showed either complete or incomplete symptom improvement with TPI using local anesthetics, and that 77% of patients achieved long-term symptom alleviation.[5] For abdominal pelvic pain syndrome, local anesthetics also achieved successful responses in 89.3% of 131 patients.[18] Consistent with these results, our retrospective analysis demonstrated that TPI with lidocaine can be an effective and safe treatment for alleviating CAWP. Of the 100 patients included, 84 showed some degree of response to treatment, and 66% reported more than a 50% reduction in pain after their final TPI. Unlike the previous studies, we used sonography-guided TPI rather than blind injection because the thickness of subcutaneous fat can range from 6.5 to 27.1 mm and abdominal muscle from 5.6 to 15.2 mm, indicating significant individual differences.[19] Moreover, the thickness of subcutaneous fat and abdominal muscles can vary depending on the pressure applied. By using an ultrasound for

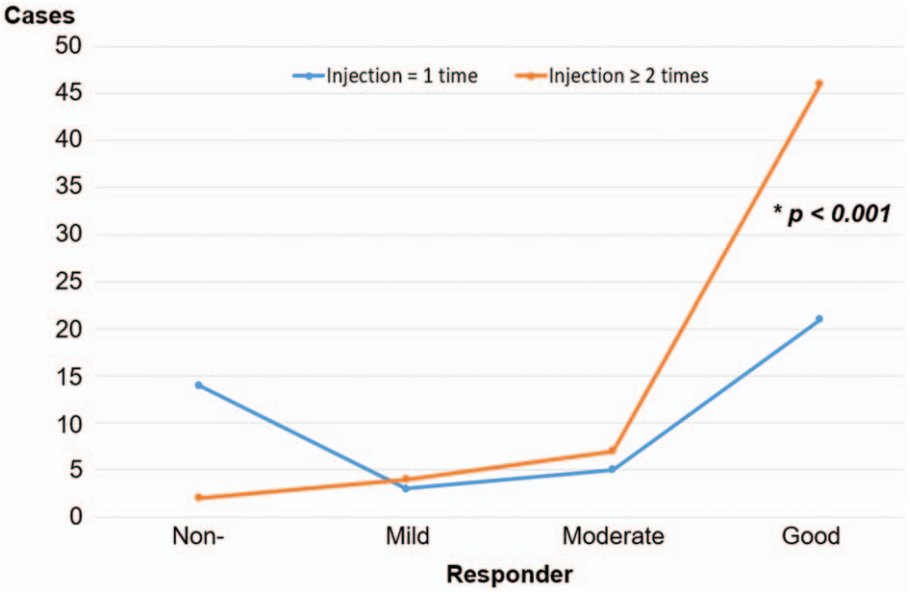

Figure 4. There were fewer non-responders and more good responders among those who received 2 or more injections than those who received one injection ($P < .001$).

guidance, we confirmed that TPI was correctly applied to the abdominal muscles.

One of the novel findings of our study was that 37% of patients had a different pain location during the final visits compared with the initial visit. This change may be explained by lateral inhibition during nociceptive processing. Lateral inhibition refers to the suppression of nearby neurons by stimulated neurons, thereby sharpening sense perception.[20] It was originally described in vision processing, wherein lateral inhibition increases edge perception and contrast in visual images,[21] though it has been known to be an important process in multiple sensory systems, including pain.[22] Quevedo et al showed that during 8 cm 2-point stimulation, subjects could distinguish between 2 points, but they could not do so during 4 cm stimulation.[22] Since the abdomen was divided into 12 areas in our study, there may have been areas where nearby neurons were inhibited by the neurons that perceived the strongest pain. When this pain was resolved by TPI, other areas with lateral inhibition were disinhibited, and patients began to perceive changes in the pain location. This presumption is partly supported by the finding that a lack of change in the pain location was associated with a better treatment response. A change in pain location may indicate that there were initially multiple pain sites which were suppressed by lateral inhibition but were manifested after initial injection. However, more research is required to fully understand why pain locations changed after the initial injections.

Moreover, patients who received more than 1 injection seemed to have a better response, and the good responders received a higher total dose of lidocaine than the non-responders. Of the patients who received injections only once, 33% did not respond to treatment, while 49% showed good response. On the other hand, 3% of patients who received injections 3 times or more did not respond to the treatment while 78% showed good response. This finding is similar to the treatment response that onabotulinumtoxinA (Onabot A) had on chronic migraine pain.[23] In 1 study, even when Onabot A was not effective during the first cycle, 15% of patients began to respond to the second cycle.[23] Therefore, in chronic migraine patients, a second cycle of Onabot A is always recommended for patients unresponsive to the initial treatment, and this effect is thought to potentially be cumulative.[24] AMPS and chronic migraine are 2 very distinct entities; yet, they are linked in terms of chronic pain. The mechanisms of how TPI and Onabot A mediate chronic pain are also different; however, our results suggest that additional TPI may be necessary to elicit a better clinical response, which is similar to Onabot A with chronic migraine. Patients who did not respond to the initial injection may have benefitted from additional injections.

4.1. Limitations

Our study has several limitations. First, owing to the retrospective design, some patients' data were missing and could not be included in this analysis. These missing data might have affected our results. Second, there was no control group receiving blind injections without ultrasound guidance, placebo injections, or other medical treatments. Owing to the lack of a control group, we could not determine how effective sonography-guided TPI was compared to other treatments or no treatments. Therefore, prospective randomized controlled trials are needed to further confirm the efficacy of TPI on CAWP.

5. Conclusion

Even though CAWP may be a rare cause of chronic abdominal pain, physicians need to be aware of it, because patients with CAWP suffer from long-term pain and many hospital visits and diagnostic testing. Although more high-quality randomized controlled trials are required to confirm efficacy, our study shows that sonography-guided TPI with lidocaine may be an effective and safe treatment option for patients with CAWP. When there is limited response to the initial treatment, further injections are recommended because this may lead to better outcomes. Furthermore, identifying changes in pain location is

essential since new locations of pain may indicate poor prognosis and the need for further care.

Author contributions

Conceptualization: Dong Hwee Kim.
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Investigation: Jaehyung Cha.
Methodology: Jae Hyun Cha.
Software: Jaehyung Cha.
Supervision: Dong Hwee Kim.
Writing – original draft: Hye Chang Rhim.
Writing – review and editing: Dong Hwee Kim.

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