



Efficacy of Acupuncture in the Treatment of Chronic Abdominal Pain

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Abstract

Context: Abdominal pain is a widespread complaint and is one of the common reasons leading patients to seek medical care, either in emergency situations or with their primary providers. While acute abdominal pain is a better defined, usually surgical condition, chronic abdominal pain requires longer, typically lifelong, therapy. Chronic abdominal pain may also present with acute flares and complications. Here we review seminal and novel evidence discussing the use of acupuncture in the treatment of abdominal pain, indications, and conditions that may benefit from this approach.

Evidence Acquisition: Chronic abdominal pain is a common complaint causing significant morbidity and disability and has a hefty price tag attached. Recent studies show it may be prevalent in as much as 25% of the adult population. It is defined as three episodes of severe abdominal pain over the course of three months. Chronic abdominal pain could be the result of chronicity of acute pain or of chronic pain syndromes, most commonly IBD syndromes and IBS. While a plethora of treatments exists for both conditions, these treatments usually fall short of complete symptom control, and there is a need for complementary measures to curb disability and increase the quality of life in these patients. Acupuncture is a form of integrative medicine that has long been used in Chinese and traditional medicine, based on the rebalancing of the patient's Qi, or Ying/Yang balance. It has been shown to be effective in treating several other conditions, and novel evidence may expand its use into other fields as well. Clinical trials studying acupuncture in chronic pain conditions have been promising, and recent evidence supports the use of abdominal pain in chronic abdominal pain conditions as well. Though not curative, acupuncture is a complementary approach that helps reduce symptoms and improved quality of life.

Conclusions: Chronic abdominal pain is a widespread condition, mostly affected by the IBS and IBD spectrum. Etiologies are still being studied for these conditions, and while novel treatment approaches are absolute game changers for these patients, many continue to experience some level of symptoms and disability. Acupuncture may provide further alleviation of these symptoms in select patients, thus improving quality of life, reducing disability, and saving healthcare dollars. It is a largely safe and inexpensive method that may significantly contribute to the quality of life of selected patients.

Keywords: Chronic Pain, Complimentary Medicine, Chinese Medicine, Needling, Healthcare Cost

1. Context

Acupuncture is the practice of applying sterilized needles into specific body points designed to rebalance a patient's qi. Based on the principles of Confucianism and Taoism, health complications are thought to arise when there

is an imbalance in a patient's qi, or equilibrium of ying and yang. In modern medicine, acupuncture is defined as a nonpharmacological option used to treat symptoms ranging from tobacco use to abdominal pain (1).

Abdominal pain is a chief complaint that plagues pa-

tients of all demographics. In 2002, abdominal pain as a chief complaint accounted for over 13.5 million patient visits in primary care clinics (2). Abdominal pain can further be classified into two categories: acute abdominal pain and chronic abdominal pain. Chronic abdominal pain has varying definitions, but the most prevalent definition is three episodes of abdominal pain severe enough to disrupt the daily routine for a patient within a three-month period (3). Common causes for chronic abdominal pain include complications to organs such as gastrointestinal tract organs, digestive organs, and even genitourinary organs. Chronic abdominal pain is sometimes associated with the presence of a functional syndrome (4).

In a meta-analysis, abdominal pain disorders were found to have a prevalence rate of 13.5%. Abdominal pain was reported more frequently in South America (16.8%) and Asia (16.5%) as opposed to Europe (10.5%). Abdominal pain was reported significantly higher in girls (15.9%) than boys (11.5%) (5).

The burden of chronic abdominal pain looms large in healthcare around the world. In the Netherlands, over €623 million is spent yearly on chronic abdominal pain outpatient visits, which equates to over \$720 million (6). GI and digestive tract organ complications are common causes for chronic abdominal pain. These issues burden the United States by accounting for over 200,000 deaths, 10 million ambulance calls, \$140 billion dollars in cost, and 14 million hospitalizations nationally (7). The issue of abdominal pain becomes more urgent as the elderly show a mortality rate of 10% due to abdominal pain (8). In an era in which the population of the elderly (age 65 and older) are growing at a rapid rate with projections of 83.7 million elderly people by 2050 in the United States alone, the healthcare system could soon be overwhelmed (9). This paper aims to investigate the efficacy of using acupuncture methods to treat abdominal pain. This narrative literature review is based on exhaustive search of PubMed-indexed journals as well as Google Scholar publications, as well as the author's expert opinion.

2. Evidence Acquisition

2.1. Abdominal Pain

Abdominal pain is a symptom that is often overlooked but could be a sign of chronic underlying disease with numerous differential diagnoses. There are two common types of abdominal pain: acute abdominal pain and chronic abdominal pain. Acute abdominal pain has varying definitions, but the most widely used definition is non-traumatic abdominal pain that lasts no longer than five days. Acute abdominal pain is near the top of the list of

emergency department (ED) visits chief complaints, accounting for nearly 7 - 10% of all ED visits (10). In contrast, chronic abdominal pain is commonly defined as three episodes of abdominal pain severe enough to alter a patient's daily routine over a three-month period. While data on chronic abdominal pain remains limited, a cross-sectional survey reported that 25% of the adult population admitted to living with abdominal pain. It reported no substantial difference in prevalence when factoring in age and ethnicity but did note a substantial increase in prevalence among women compared to men (11), partly possibly due to inclusion of pelvic pain (12-14)

There are many pathologies that can onset chronic abdominal pain. A key determinant of which pathology is present includes the location of pain. If right upper quadrant pain is present, some common pathologies include gallstones and cholecystitis. In the presence of left upper quadrant pain, splenomegaly or splenic rupture are common possibilities. Some common lower quadrant abdominal pain pathologies include diverticulitis and acute appendicitis. Other common pathologies of abdominal pain include upper acute pancreatitis and acute gastritis. These acute triggers, especially if treated late or left untreated, can be the heralding sign of lifelong chronic pain. In the case of diffuse abdominal pain, irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD) are commonly suspected (15).

2.1.1. Irritable Bowel Syndrome (IBS)

IBS is classified, based on the ROME III criteria, as a gastrointestinal (GI) disorder into three subtypes: (1) IBS with constipation (IBS-C); (2) IBS with diarrhea (IBS-D); and (3) mixed IBS (IBS-M). IBS has variable symptoms that change and are acquired over time, but the most common symptoms reported in IBS cases are abdominal pain, straining, and bloating. IBS affects roughly 9 - 23% of the entire world's population and is the chief complaint for 12% of PCP visits. The pathophysiology of IBS is still not fully understood. Originally thought to be due to visceral hypersensitivity and gastrointestinal motor disturbances that led to abdominal pain and diarrhea/constipation, respectively, IBS is now believed to be the result of multiple causes, including serotonin dysregulation, brain-gut interaction, and organic GI bacterial growth based on new evidence (16).

2.1.2. Inflammatory Bowel Disease (IBD)

Inflammatory bowel disease (IBD) is a term used to commonly denote two diseases: Crohn's disease (CD) and ulcerative colitis (UC). These two pathologies are notable for causing inflammation of the digestive tract. 25% of IBD cases are diagnosed within the first 20 years of a patient's

life, with a higher percentage being diagnosed between ages 13 - 18. IBD is most common in Europe, North America, and Asia. The prevalence rate of Crohn's disease and ulcerative colitis in Europe was 24.3 per 100,000 people and 12.7 per 100,000 people, respectively (17). The pathogenesis and etiology of IBD remains largely misunderstood, but recent research has shown that genetic, environmental, gut microbial, and immune response factors all play a large role in the symptoms of IBD. Recent studies have found the existence of at least 163 susceptibility IBD gene loci that can be implicated in childhood or adulthood to cause the onset of symptoms. Other environmental factors such as smoking, drug use, and diet also play a role. Recent studies have shown that aspirin and other NSAID medications also play a role in triggering IBD symptoms (18).

2.1.3. Risk Factors, Comorbidities, Diagnosis, and Clinical Presentation

Diagnosing abdominal pain pathologies is difficult as there are two nerve fiber complexes that contribute to abdominal pain sensation. Type A-delta fibers are found in the cutaneous structures and terminate in the thalamus, allowing the brain to localize pain from a stimulated location. Conversely, abdominal viscera are innervated by Type C fibers, which terminate before the thalamus, making it difficult for the brain to localize pain, causing the sensation of diffuse abdominal pain. Clinically, if a patient presents with deep abdominal pain that is difficult to localize, organ-based pathologies, such as IBD and IBS, should be considered first. If a patient presents with acute pain that is easily localized, irritation of the parietal peritoneum, especially by blood, bile, pus, or even urine, should be evaluated first, and emergencies ruled out.

Patient history is the best leading evidence in diagnosing abdominal pain, including not only pain description - including location, quality, timing, and previous episodes, but also accompanying symptoms. Nausea, vomiting, constipation, and diarrhea are typical symptoms that should be questioned, especially the timing and activity at the time of onset. Stool composition, especially the presence of blood, should be investigated as it can suggest IBD. Lifestyle choices and habits should also be considered. Excessive alcohol and caffeine usage, as well as cigarette use, are risk factors for chronic abdominal pain. Some symptoms that accompany abdominal pain to consider include fevers, heartburn, weight loss, rectal bleeding, and referred pain in locations such as the back and shoulder. Comorbidities to consider include jaundice, liver disease, stomach ulcers, gastroesophageal reflux (GERD), previous abdominal surgeries, sickle cell disease, and cystic fibrosis (19). Distinct imaging modalities usually aid greatly in making a final diagnosis, either less invasive modes such

as ultrasound or computer-assisted tomography, or imaging methods allowing internal examination of the bowel - endoscopies including upper, lower (sigmoidoscopy and colonoscopy) and pill endoscopy. More advanced methods, such as endoscopic ultrasound and guided biopsies, may also be required.

2.2. Current Treatment Options

Abdominal pain is a common cause of presentation to both emergency and outpatient medical care and represents a significant and increasing burden to the US health-care system (20, 21). It thus requires a robust and appropriate treatment response. Several clinical algorithms have been designed to evaluate the presentation of acute abdominal pain and can help direct treatment strategies (21). When chronic abdominal pain is concerned, the etiologies vary, and so will the possible treatments (22). When non-syndromic pain is diagnosed, different approaches are possible; these include conservative treatments, oral non-opioid pharmacotherapy, opioid-based therapy, continuous infusions, and interventional approaches (14, 23-30). Syndromic pain, including IBD and IBS may require specialized therapy. This section focuses on currently used therapies for the treatment of abdominal pain in patients with IBD and IBS.

2.2.1. IBD Treatment, Immune Suppression, New Treatment Options

Treatment of IBD can be complicated due to the variety of different subtypes and clinical presentations (20). Currently, there is no one best solution, but there is a variety of medication classes that play a role.

Analgesics such as NSAIDs are commonly used in the treatment of extraintestinal symptomology of IBD, such as associated arthropathies. However, their deleterious effects on GI mucosa can exacerbate the abdominal discomfort of IBD (31). Opiate analgesics prescribed for visceral pain in IBD have not been shown to be effective in long-term treatment and have unfortunately imposed complicating factors such as undesirable side effects, the potential for abuse, and even increased mortality in IBD patients (31). Among IBD patients, opioid use was associated with more severe symptoms, and patients who were able to discontinue opioid therapy were also more likely to report their pain was controlled (31). And while opioids may be effective at times, especially for non-visceral, soft tissue pain (29), they carry risks of addiction and use disorder (32).

Biologic therapies targeting tumor necrosis factor (TNF) and anti-integrin agents are recent developments for the treatment of ulcerative colitis and Crohn's disease. These treatments are used in patients whose disease remains uncontrolled with initial medications. There are

currently six approved drugs in these categories: infliximab, adalimumab, golimumab, and certolizumab are all approved anti-TNF agents. Natalizumab and vedolizumab are approved anti-integrins (33). Other new therapeutic strategies include medications to target receptors located in the GI tract, opioid analogs with fewer central side effects, TRP receptor antagonists, and janus kinase (JAK) inhibitors (31).

The use of marijuana for IBD symptom relief has also been a topic of recent interest and investigation. Marijuana and cannabis products have been previously studied in other chronic pain conditions (34, 35) and conditions of widespread pain (25). Several studies have suggested that marijuana may reduce abdominal pain in IBD, but these findings would benefit from additional studies and safety information (36). Finally, non-pharmacologic strategies such as cognitive behavioral therapy have been employed for pain management in IBD (36).

2.2.2. IBS Treatment, Comorbidities Treatment

IBS can be classified based on predominant symptom patterns, referred to as IBS with constipation (IBS-C); IBS with diarrhea (IBS-D); and IBS with mixed presentation (IBS-M), formerly known as IBS with alternation (IBS-A) (20). The varied nature of presentation thus necessitates a diverse arsenal of treatment options. For example, loperamide, an opioid agonist frequently prescribed and efficacious in treating IBS-D was conversely found to increase abdominal discomfort in patients with IBS-C (20). Rifaximin, a broad-spectrum antibiotic, has demonstrated efficacy in reducing bloating in all forms of IBS. Its mechanism of action in this setting is still uncertain. Its ability to reduce abdominal pain was less robust than its efficacy in reducing bloating (37).

The 5-HT₃ receptor antagonist, alosetron, has shown statistically significant reductions in both abdominal and visceral pain as well as diarrhea in several meta-analyses. Its analgesic mechanism is both centrally and peripherally located, in contrast with ramosetron, a 5-HT₃ antagonist with more peripherally-located mechanisms that is not approved yet for IBS in the United States (38).

Antidepressants such as SSRIs and TCAs have both been used for the treatment of IBS, and amitriptyline, a TCA, was found to reduce pain in all subtypes of IBS (20). While numerous studies have demonstrated their efficacy in reducing abdominal pain, there are legitimate concerns about side effects that may limit the feasibility of long-term use of such drugs for this disorder (37). Antispasmodics such as dicyclomine showed improvement in IBS symptoms when used in a short-term study (20). A Cochrane systematic review found that both antispasmodics and antidepressants (SSRIs and TCAs) were effective at reducing abdom-

inal pain and the overall prevalence of symptoms in IBS (39). Pinaverium bromide and trimebutine were the antispasmodics that showed the greatest efficacy in this review.

Food and diet play important roles in the management of IBS. Recognizing and minimizing dietary triggers has been a strategy used for reducing abdominal pain – one touted method is avoiding the FODMAP food group, which may cause increased bloating and pain. There is conflicting evidence regarding the true efficacy of such a diet, and downsides include the restrictions it places on patients and their dietary options (37). The addition of fiber into dietary regimens may also help minimize symptoms of constipation that also contribute to discomfort; however, systematic reviews of fiber supplementations have not found them to be clinically superior to placebo in reducing abdominal pain (37). Probiotic supplements have also gained attention for use in abdominal disorders such as IBS; however, similar to the use of fiber, claims of efficacy have not been proven, and the supplements are not subject to FDA approval or regulation (20).

While is a litany of treatments touted for relief of abdominal pain, none reigns superior, and each has its drawbacks. The current pharmacological options for chronic abdominal pain show benefits mostly for short-term use (36). Additionally, abdominal pain often persists even in patients whose disease process and symptomology is otherwise in remission (31). Overall, evidence levels on pain management are largely limited. Pain reduction may be most aptly achieved with the use of relaxation and/or cognitive strategies that can target the multifactorial nature of symptoms (36).

There are areas of overlap in IBD and IBS diagnoses; indeed, one cohort found that 70% of its IBD patients also met diagnostic criteria for IBS (36). Thus, treatment for abdominal pain has the potential to benefit patients with both conditions.

2.3. Acupuncture

The history of acupuncture begins 3000 years ago in China, but it first gained name recognition in the US in the early 1970s, and it has since been used for analgesic purposes (40). Today it is used most frequently for musculoskeletal and connective tissue complaints, headache and migraines, and chronic pain (41). It has also been explored for the alleviation of side effects from cancer therapies, gastrointestinal complaints, cardiovascular conditions, and allergies (40). It is currently the most commonly practiced form of complementary medicine in the US, and its popularity is on the rise (41).

Acupuncture technique traditionally involves the placement and manipulation of “hair-thin” needles in designated anatomical locations (41). After insertion,

needles remain in place for 10 to 20 minutes. Needles may be manipulated so that their placement and positioning results in a feeling of numbness, which is a normal and often desirable finding (1). Between 5 to 20 needles are placed in a typical acupuncture procedure. Different techniques of acupuncture include electroacupuncture as well as dry needling. When used for the treatment of peripheral neuropathies, acupuncture needles may directly or electrically contact and manipulate nerves and perineurium (1).

The tenets of acupuncture are rooted in traditional Chinese medicine and derive from theories of “de qi,” which refers to the idea of a central energy and interconnection (1, 41). Pain is believed to result in part from a disturbance in an individual’s flow of qi (41). Application and manipulation of the acupuncture needles is intended to adjust and rebalance an individual’s yin and yang, opposing and interconnected forces (41). Traditional acupuncture relies on the placement of needles at specific acupoints throughout the body, at which locations the acupuncturist is able to locate the patient’s qi (41).

Acupuncture needles were approved for sale and use by licensed providers by the FDA in 1996.

2.3.1. Mechanism of Action

Clinical research into acupuncture in the United States significantly increased starting in the late 1990s, when the National Institutes of Health published a statement that supported evidence of acupuncture’s efficacy in the treatment of nausea, vomiting, and post-surgical pain (41). However, basic research into the mechanisms of acupuncture has been conducted in European and Asian countries since the late 1700s (40).

There is evidence suggesting that acupuncture induces the release of neuromodulatory polypeptides in the brain that possess opiate agonist properties (40). A 1987 study found that the administration of Naloxone, an opioid antagonist, effectively blocked the anti-nociceptive effects of acupuncture (41). Additionally, opiate receptor knockout mice were found to have a minimal analgesic response to acupuncture therapy, further supporting an endogenous opiate theory (40). Similar studies have also proposed that the analgesic mechanism of acupuncture could be due in part to its activation of A-delta and C-fibers that communicate with the spinal cord and increase the presence of endogenous opioids that result in a reduction of pain sensation (41). This signaling may travel to the periaqueductal gray and raphe nucleus regions of the mid-brain, where they are able to provide pain suppression (41). In a Cochrane review article, the authors suggested that acupuncture may also decrease overall levels of inflammation (42). Finally, recent studies have suggested that the

analgesic mechanism of acupuncture may involve long-term depression signaling that downregulates the transmission of pain fibers (41). Different methods for acupuncture have been tested; clinical trials have shown efficacy in many fields, including chronic back pain, headache, and recovery time from general anesthesia (43-47).

A study of acupuncture therapy for allergic rhinitis suggested that mechanisms involve the reduction of immunoglobulin, regulation of T-helper cells, and inhibition of inflammatory molecules. In this study, acupuncture was directed at a point near the sphenopalatine ganglion. Action in this region was intended to stimulate sympathetic nerve fibers that would induce vasoconstriction and improve symptoms of nasal congestion (48).

Some benefits of acupuncture are likely able to be attributed to its placebo effect (41). However, as Vanderploeg et al. explained, placebo effects are usually immediate, and acupuncture’s analgesic benefits are often noticeable for many patients for up to two weeks after a procedure (41). Overall, there remains controversy and various theories about the contribution of placebo effects in acupuncture research, which has proven to be a relatively difficult task (40).

There exists still a gap between basic research and clinical applicability when it comes to evidence for acupuncture. Most animal studies have successfully demonstrated positive physiologic effects of acupuncture treatment, but controlled clinical trials of humans have not been as definitive (40). Additionally, clinical research trials have faced challenges of how to effectively provide sham/placebo procedures (40).

2.3.2. Side Effects/Adverse Events

A Cochrane review of acupuncture used in the treatment of hip osteoarthritis did not report any serious adverse events. Minor adverse events included reports of minimal bruising, bleeding, and pain at needle placement sites (42). In a study of acupuncture and its efficacy for the treatment of migraine, patients receiving the acupuncture intervention reported fewer adverse events than those assigned to pharmacologic treatment, and the intervention was therefore qualified as safe (45). In a systematic review of acupuncture in pediatric patients, the most commonly cited adverse events were sedation, needle pain, and neuropathies (49). Only one serious adverse event was reported out of 1865 treatments (49).

2.4. Acupuncture Use in Abdominal Pain

Table 1 summarizes the clinical evidence regarding the use of acupuncture in abdominal pain, which is reviewed

here. Recent evidence points to the utility of acupuncture for the treatment of abdominal pain. Though abdominal pain has many etiologies, typical symptoms, regardless of the underlying cause, include pain, altered defecation habits, and bloating. Traditional treatments for abdominal pain include antispasmodics, fiber supplementation, and antidepressants; however, more recently, acupuncture has been under investigation as an alternative treatment for abdominal pain. Acupuncture treatment is comprehensive and can include acupuncture of the body, scalp, auricular area, and more. Acupuncture has been found to increase gastric motility in patients with low baseline gastric peristalsis, and yet it paradoxically suppresses peristalsis in subjects with high initial gastric motility. It is thought that through combined modulation of visceral sensitivity, gastrointestinal barrier function, and brain-gut axis, acupuncture may help alleviate the clinical symptoms associated with a number of gastrointestinal disorders (50).

Acupuncture has been used to manage a variety of gastrointestinal problems, including irritable gastroparesis, irritable bowel syndrome (IBS), acute pancreatitis, and more. Gastroparesis is characterized by delayed gastric emptying with associated upper abdominal symptoms and is often a complication of diabetes-induced hyperglycemia or surgery (56). A systematic review of acupuncture for the treatment of gastroparesis found preliminary qualitative evidence that acupuncture provided short-term improvement in symptoms of gastroparesis, regardless of etiology (i.e., diabetes, surgery) (57). These findings point to the use of acupuncture to mitigate abdominal pain related to gastroparesis; however, the findings were characterized as low-certainty or very-low certainty evidence and should be interpreted with caution. Additional studies have demonstrated stronger and more quantitative evidence of acupuncture's positive effects in other study populations.

Acupuncture has also been studied in the treatment of functional dyspepsia (FD). A randomized controlled trial (RCT) randomized 56 participants to either receive acupuncture (n = 29) or moxibustion (n = 27). Outcomes were assessed using Leed's dyspepsia questionnaire (LDQ) and Nepean dyspepsia index (NDI) before and after treatment. While total LDQ scores significantly decreased in both groups, upper abdominal pain, early satiety, and epigastric burning in the acupuncture group improved more so than in the moxibustion group ($P < 0.01$). No significant differences in NDI scores were observed before and after treatment (58). These results suggest that acupuncture provided superior relief of FD symptoms compared to moxibustion, though future studies are warranted to better understand the utility of acupuncture for FD. Additionally, a 2015 pilot study of six patients investigated

acupuncture for control of pain and inflammation in pediatric emergency department patients with acute appendicitis. The authors found that acupuncture facilitated a decrease in subjective pain and inflammation as measured by white blood cell counts in pediatric patients with acute appendicitis pain (51). This limited evidence is promising and suggests the need for future studies to investigate this topic more comprehensively.

A randomized clinical trial by Qin et al. (2018) investigated the clinical effect of abdominal acupuncture versus western medication for the treatment of diarrhea IBS. Sixty-one patients were randomly assigned to receive acupuncture once every other day, three times per week, or western medicine involving pinaverium bromide 50 mg, three times per day. Treatment outcomes were measured by IBS symptom severity score (IBS-SSS) and clinical symptom scores (abdominal pain, abdominal distention, diarrhea, poor stool output, defecation urgency, and stool abnormality) immediately following treatment and three months after treatment termination. Results found that acupuncture resulted in significantly larger improvements in IBS-SSS and clinical symptom scores compared with the western medication group at both evaluation time points, though both groups achieved significant improvements overall. No adverse reactions were reported (59). These findings point to the safety, tolerability, and efficacy of acupuncture in managing diarrhea IBS and its superior effectiveness relative to western medication.

Zhao et al. (2015) performed an RCT comparing electroacupuncture (EA) and moxibustion on brain-gut function in patients with diarrhea-predominant IBS. Sixty participants were randomly assigned to EA (n = 30) and moxibustion (n = 30) and were evaluated for changes in gastrointestinal symptoms and psychological symptoms before and after treatment. While both treatment groups had significant improvements in abdominal pain and bloating, those who received moxibustion had significantly increased improvements in defecation emergency, defecation frequency, and stool feature than EA (60). Though moxibustion demonstrated superior outcomes in this study, these results prompted further investigation of the utility of EA for IBS.

A subsequent meta-analysis found different and promising results regarding EA for IBS. This comparative analysis evaluated the effects of acupuncture relative to other controls in the treatment of IBS. A total of 41 RCTs were included in the analysis, including a total of 3,440 participants. Eight of these trials compared acupuncture with sham acupuncture. Acupuncture inclusion criteria included conventional acupuncture, electroacupuncture, and micro-puncture (e.g., auricular acupuncture, scalp acupuncture, or hand acupuncture). Controls were par-

Tables 1. Clinical Efficacy and Safety

Author (y)	Groups Studied and Intervention	Results and Findings	Conclusions
Nager et al. (2015) (51)	A pilot study of six pediatric patients with acute appendicitis was performed to evaluate the efficacy of acupuncture for control of pain and inflammation.	The six patients who received acupuncture all reported decreased subjective pain and were found to have decreased white blood cell counts after treatment.	Acupuncture may be a potential treatment for pediatric patients with acute appendicitis.
Chen et al. (2015) (52)	A total of 229 patients who received colonoscopies were randomly assigned to receive pretreatment with either transcutaneous electric acupoint stimulation (TEAS) (n = 114) or sham treatment (n = 115). Patients were evaluated for post-colonoscopy pain, abdominal distention, and duration of stay in the post-anesthesia care unit (PACU). Additional outcomes evaluated were satisfaction with medical service and acceptance to undergo colonoscopy.	Participants who were pretreated with TEAS had less post-colonoscopy abdominal pain and distention, shorter PACU stays, higher satisfaction with medical service, and greater acceptance to undergo colonoscopy compared to those who received sham treatment.	Pretreatment with TEAS improves post-colonoscopy pain, increases efficiency of medical resource utilization, and increases patient satisfaction.
Yao et al. (2015) (53)	A total of 75 patients undergoing gynecological laparoscopic surgery were randomly assigned to receive either TEAS or control. The participants were evaluated for quality of recovery after treatment using a questionnaire.	Participants who received TEAS had higher quality of recovery scores, higher patient satisfaction scores, and reduced postoperative pain and cumulative opioid use compared with controls at 24 hours postoperative. TEAS additionally reduced postoperative nausea, vomiting, and dizziness, and decreased participants' stay in the PACU.	TEAS provides greater patient satisfaction and improves quality of recovery for patients undergoing gynecological laparoscopic surgery.
Li et al. (2016) (54)	A randomized controlled trial of 140 participants with acute pancreatitis complicated by paralytic ileus were randomly assigned to electroacupuncture (n = 70) or regular treatment (n = 70) involving intensive care, gastrointestinal decompression, and pancreatic exocrine suppression. Outcomes assessed included abdominal pain and distention severity scales before and after treatment.	Participants who received electroacupuncture had significantly improved abdominal pain and distention severity scores compared to those who received regular treatment.	Electroacupuncture is a clinically effective treatment for acute pancreatitis complicated by paralytic ileus.
Li et al. (2018) (55)	A randomized controlled trial of 60 participants with acute pancreatitis were treated with either electroacupuncture of abdominal or limb acupoints. Outcomes of interest included abdominal pain, abdominal distention, and abdominal girth before and after treatment.	On the fifth day of treatment, participants in both the abdominal and limb acupoint groups had significantly decreased abdominal pain, abdominal distention, and abdominal girth. There were no significant differences in efficacy between the abdominal and limb acupoints.	Electroacupuncture is an effective treatment for acute pancreatitis, regardless of location of acupoint.

Participants treated with treatments other than acupuncture such as Chinese medicine (e.g., moxibustion, tuina), sham acupuncture, western medicine (e.g., antispasmodics, antidiarrheal agents, probiotics, cellulose particles), or lifestyle modifications. The main outcomes investigated were total efficacy rates, global IBS symptom scores, and health-related quality of life scores. Acupuncture treatment amounts ranged from six to 28 times, and the most common intervention duration was four weeks. The authors found that true acupuncture improved IBS symptoms better than sham acupuncture treatment; however, there were no significant differences in IBS symptom scores and quality of life scores between acupuncture and sham acupuncture groups. When evaluating acupuncture versus western medicine, the pooled data showed that acupuncture was significantly more efficacious, caused a significant improvement in IBS symptom scores, and

significantly improved quality of life compared with western medicine. One study included in this meta-analysis also found that adjunctive acupuncture in combination with western medicine was significantly better than Western medicine alone when treating IBS symptoms. Data from five studies revealed no difference in efficacy rates between acupuncture versus Chinese medicine yet found that acupuncture significantly improved IBS symptoms relative to Chinese medicine. Acupuncture was no more efficacious than moxibustion or tuina in the treatment of IBS (61). The results of this meta-analysis point to the efficacy of acupuncture relative to alternative treatment modalities for IBS management, yet further research is warranted to better characterize its utility.

An additional meta-analysis further evaluated the clinical efficacy of acupuncture plus Chinese herbal medicine (CHM) for the treatment of IBS. Data was compiled from

a total of 21 RCTs and included studies that used explicit diagnostic criteria for IBS, such as Rome I-IV. CHM therapies included decoction, granules, capsules, pills, tablets, powder, or injection. Of the 20 studies that reported clinical efficacy rates, the comprehensive efficacy index (CEI) was calculated to reflect the efficacy of the treatment regimen. The authors found that acupuncture plus CHM enhanced clinical effectiveness compared with controls treated with western medicine or western medicine plus CHM. Secondary measures of abdominal pain, abdominal distention or discomfort scores, diarrhea, diet conditions, physical strength, sleep quality, safety profile, and long-term observations were also evaluated. Results revealed that acupuncture plus CHM provided significantly greater alleviation of abdominal pain and improvement in diarrhea versus controls and provided favorable effects on abdominal distention or discomfort, though this was not significant. Interestingly, several of the 21 studies found that acupuncture in combination with CHM significantly improved diet conditions compared with control groups, while other studies identified tangential evidence showing that acupuncture with CHM was useful in alleviating physical strength and improving sleep quality compared with controls. No severe adverse events related to acupuncture plus CHM treatment were identified. Long-term observation assessment revealed that acupuncture plus CHM improved IBS symptoms and the psychological status of IBS patients following treatment (62). Though this study did not directly compare acupuncture plus CHM with another IBS treatment modality, the results suggest the relative success of this therapy in alleviating IBS symptoms and improving patients' quality of life.

In addition to its utility in the treatment of abdominal pain, electroacupuncture of abdominal and limb acupoints has shown to be efficacious in the treatment of acute pancreatitis. A 2018 RCT of 60 patients with acute pancreatitis found that abdominal pain and distention symptom scores and abdominal girth levels were significantly decreased on the fifth day of treatment in both abdominal and limb acupoint groups relative to their pretreatment scores. Though there were no differences in abdominal distention symptom scores and abdominal circumference levels between the abdominal and limb acupoint groups, this data indicates that the use of acupuncture is not limited to IBS-related abdominal pain but also may serve to alleviate symptoms of acute pancreatitis (55). An additional RCT investigated the use of electroacupuncture (EA) for severe acute pancreatitis complicated by paralytic ileus. A total of 140 participants were randomly assigned to EA ($n = 70$) versus regular treatment ($n = 70$), which involved intensive care, gastrointestinal decompression, and pancreatic exocrine secretion suppres-

sion. Those who received EA had significantly improved abdominal pain and distention severity scales compared to those in the regular treatment group (54). Data from the aforementioned studies demonstrates the clinical utility of acupuncture in the treatment of acute pancreatitis and acute pancreatitis with paralytic ileus.

Furthermore, a RCT of 229 patients compared post-colonoscopy pain, abdominal distention, and duration of stay in the post-anesthesia care unit (PACU) in patients assigned to receive pretreatment with transcutaneous electric acupoint stimulation (TEAS) ($n = 114$) or sham treatment ($n = 115$). Participants who received TEAS had fewer instances of post-colonoscopy abdominal pain and distention, shorter stays in PACU, higher satisfaction with medical service, and greater improved acceptance to undergo colonoscopy compared with those in the sham group (52). A separate prospective randomized, double-blind, placebo-controlled study examined TEAS in postoperative recovery and analgesia after gynecological laparoscopic surgery. A total of 74 patients undergoing gynecological laparoscopic surgery were randomly assigned to TEAS or control groups and evaluated for quality of recovery after treatment using a questionnaire. The authors found that those who received TEAS reported a higher quality of recovery scores, higher patient satisfaction scores, and reduced postoperative pain, and cumulative opioid use compared with controls 24 hours after surgery (53). These findings suggest that acupuncture may serve to relieve not only pathologic abdominal pain but also postoperative abdominal pain.

Though data exists qualifying the effectiveness of acupuncture for IBS treatment, few studies have investigated its underlying mechanism. The effects of electroacupuncture (EA) on various N-methyl-D-aspartate (NMDA) receptors and behaviors were investigated in rats with IBS. This study found that acupuncture at different acupoints within the colon is associated with differences in expression of NMDA receptors in the anterior cingulate cortex (ACC) and thereby allow for abdominal pain-relief and relief of abnormal pain-related behaviors in IBS rats (63).

3. Conclusions

Abdominal pain is a common complaint and leads to many ED visits, as well as visits with primary care providers. While acute abdominal pain is usually diagnosed with a combination of symptom history, physical examination, and imaging, it may also be the heralding sign of chronic abdominal pain or a flare of such condition. Chronic abdominal pain, unlike its acute counterpart, is usually harder and longer to diagnose and may also present a more

difficult challenge in treatment. While chronic abdominal pain can be the result of acute pain and chronicity of such pain, it is more commonly associated with chronic pain syndromes, most commonly IBD spectrum and IBS.

Traditionally, treatment for chronic abdominal pain was limited due to the side effects of these treatments, commonly exacerbating GI symptoms. More novel approaches, including biologic and non-traditional medicines, have shown promise in the treatment of these conditions. Biologic agents are used in IBD and are targeted therapies aimed at reducing inflammation, either by reducing the abundance of inflammatory cytokines (TNF), reducing leukocyte and monocyte translocation, and more novel approaches, halting the differentiation and maturation of these inflammatory cells. Serotonin receptor antagonists have shown promise in the treatment of IBS. For both spectrum of disease, non-pharmacologic agents, CBT, exercise, and diet also play a significant role. Unfortunately, all of these treatments carry a significant burden of side effects, and most patients continue to experience some level of symptomatology, increasing the need for complementary measures to increase pain and symptom alleviation and reduce disability.

Acupuncture, the practice of introducing thin solid needling into well-specified points in the human body targeting the flow of Qi in a patient, has long been used in traditional Chinese medicine, and recently more and more evidence from clinical trials support its use in several conditions, including those of chronic pain. Modern forms of acupuncture also include dry needling, electropuncture, heat acupuncture, and acupressure. The leading theories regarding the mechanism of action of acupuncture are those of neuromodulation through skin stimulation; the latter leads to the release of neurotransmitters from nearby nerves that are deposited into the plasma and CSF and promote pain alleviation.

The evidence listed above points to the clinical utility of acupuncture in the treatment of abdominal pain. Though future RCTs are needed to better characterize its use, substantial evidence demonstrates both function and psychosocial improvements in abdominal pain when treated with acupuncture. The utility of acupuncture in treating abdominal pain may include IBS, gastroparesis, acute pancreatitis, and beyond. Existing evidence is promising; however, there is a need for larger comparative clinical trials of acupuncture against traditional abdominal pain treatments to better characterize its use.

Footnotes

Authors' Contribution: Study concept and design: AAB, YL, KJ, AK, AW, EMC, ADK, OV, IU; Analysis and interpre-

tation of data: AAB, YL, KJ, AK, AW, EMC; Drafting of the manuscript: AAB, YL, KJ, AK, AW, FI, SHK, GV, OV, IU; Critical revision of the manuscript for important intellectual content: AAB, YL, KJ, AK, AW, EMC, ADK, FI, SHK, GV, OV, IU; Statistical analysis: AAB, YL, KJ, AK, AW, EMC, IU.

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