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Recent Advances in Acupoint Stimulation for Pain Relief after Transvaginal Oocyte Retrieval

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Abstract: This review focuses on recent advances in the application of acupoint stimulation for postoperative analgesia following transvaginal oocyte retrieval (TVOR). In recent years, studies have demonstrated that acupuncture, electroacupuncture (EA), transcutaneous electrical acupoint stimulation (TEAS), and auricular acupoint therapy can effectively relieve postoperative pain, potentially through the modulation of neurotransmitters, activation of the endogenous opioid system, and regulation of inflammatory responses. This review summarizes the clinical use of these acupoint stimulation techniques in managing pain after TVOR and analyzes their mechanisms of action, therapeutic efficacy, and research progress. Although current evidence suggests that acupoint stimulation has certain analgesic benefits, further high-quality randomized controlled trials (RCTs) are still needed to confirm its effectiveness and to optimize treatment protocols for standardized clinical implementation.

1. Introduction

With the increasing prevalence of infertility and the advancement of reproductive medicine, assisted reproductive technologies (ART) have been widely adopted to help infertile couples fulfill their desire for childbearing [1]. In vitro fertilization and embryo transfer (IVF-ET) is one of the most used ART procedures, and transvaginal oocyte retrieval (TVOR) is a crucial step involving ultrasound-guided puncture to obtain oocytes via the vaginal route [2]. Currently, most medical institutions in China perform TVOR under intravenous anesthesia to reduce intraoperative pain and improve procedural success. However, patients may still experience varying degrees of postoperative discomfort, such as lower abdominal pain, pelvic distension, or lumbosacral soreness [3], which may negatively affect recovery, reduce treatment compliance, and potentially impact reproductive outcomes.

Pharmacologic analgesia remains the mainstay for postoperative pain management. However, concerns regarding drug-related side effects and tolerance have prompted growing interest in safer, non-pharmacologic alternatives—such as acupoint stimulation. Thus, safe and effective non-drug analgesic strategies have garnered increasing clinical attention. As a non-pharmacologic approach,

acupoint stimulation has been investigated for the management of various types of postoperative pain. Its analgesic effects are thought to involve multiple mechanisms, including modulation of the endogenous opioid system, inflammatory pathways, and neuroregulatory networks. This review aims to explore the clinical applications and potential mechanisms of acupoint stimulation in managing pain following TVOR, with the goal of informing clinical practice.

2. Mechanisms of Postoperative Pain Following Transvaginal Oocyte Retrieval

Postoperative pain after transvaginal oocyte retrieval (TVOR) is multifactorial, arising not only from puncture-induced injury and traction pain due to negative pressure aspiration of follicular fluid, but also from factors such as the type of anesthesia used and the patient's preoperative psychological state.

During TVOR, a puncture needle penetrates the vaginal wall under ultrasound guidance to access the ovarian follicles. This process may cause trauma to the vaginal mucosa, ovarian capsule, and surrounding tissues, which activates nociceptive nerve endings and triggers acute pain [4]. In addition, the aspiration of follicular fluid—especially when multiple follicles are involved—generates a negative pressure that pulls on ovarian tissue, resulting in traction-type pain [3]. In some cases, accidental injury to blood vessels or adjacent organs such as the bladder or intestines may occur, leading to more severe pain or, in rare instances, life-threatening complications [5].

The ovaries are innervated primarily by the autonomic nervous system, with pain signals transmitted via the celiac plexus [6]. Visceral pain is typically dull or cramping in nature, poorly localized, and often radiates to other areas, which makes pain perception more complex. When ovarian or adjacent structures are stimulated intraoperatively, nociceptive signals travel along visceral afferent pathways. Puncture near anatomically sensitive regions such as the uterosacral ligament or the rectouterine pouch (Douglas pouch) can stimulate the pelvic nerve plexus, eliciting deep, radiating pain [7].

The intensity of postoperative pain is also influenced by intraoperative techniques. Repeated punctures or the use of large-diameter aspiration needles can exacerbate tissue damage and increase pain levels [8]. Additionally, prolonged procedure duration may lead to local edema and congestion, further contributing to discomfort and pain during the postoperative period [9].

Anesthetic strategy also plays a role in postoperative pain outcomes. Different anesthesia protocols vary in the degree of intraoperative analgesia they provide and may influence postoperative pain intensity and duration. The choice and dosage of analgesic drugs can affect pain relief and potential side effects, which should be considered when optimizing perioperative pain management [10].

Moreover, psychological and emotional factors can significantly influence pain perception. Preoperative anxiety, tension, and fear may lower the pain threshold and amplify the perception of pain through central sensitization mechanisms [11]. Patient expectations regarding surgery and previous experiences with pain also contribute to postoperative pain perception. Negative expectations or a history of distressing procedures may worsen subjective pain intensity. Emotional factors not only affect pain sensitivity but also alter individual responses to pain through psychological mechanisms [12].

3. Analgesic Mechanisms of Acupoint Stimulation in the Management of Postoperative Pain After TVOR

The analgesic effects of acupoint stimulation are primarily mediated through the endogenous opioid system, neural regulation, and modulation of inflammatory responses. Studies have shown that acupuncture activates endogenous analgesic pathways through multiple mechanisms, including

the promotion of β-endorphin and enkephalin release in the spinal cord, pituitary, and plasma, activation of opioid receptors to inhibit nociceptive signal transmission, and downregulation of substance P and calcitonin gene-related peptide (CGRP) in the spinal dorsal horn [13]. Furthermore, acupuncture and transcutaneous electrical acupoint stimulation (TEAS) may enhance pain inhibition by increasing levels of serotonin (5-HT), norepinephrine (NE), and γ-aminobutyric acid (GABA) [14]. Functional magnetic resonance imaging (fMRI) studies have also demonstrated that acupuncture can modulate the default mode network and pain-related brain regions (e.g., anterior cingulate cortex, insula, thalamus), strengthen descending inhibitory pathways (PAG–RVM–spinal dorsal horn), and reduce the transmission of pain signals [15].

In terms of neural regulation, acupuncture and related techniques can modulate the autonomic nervous system and the hypothalamic–pituitary–adrenal (HPA) axis, suppressing excessive sympathetic activity and lowering cortisol levels, thereby alleviating postoperative anxiety and pain [16]. Additionally, acupuncture may promote the release of GABA and enhance the functional connectivity of brain regions involved in emotional regulation, such as the amygdala and prefrontal cortex. This may help reduce anxiety-related neural activity and improve the perception and emotional processing of pain [17].

Ovarian puncture during TVOR may elicit a mild inflammatory response, making inflammatory modulation another important mechanism underlying acupuncture-induced analgesia. Both animal and clinical studies have shown that acupuncture and electroacupuncture can reduce the expression of inflammatory cytokines, alleviate tissue edema, and thereby attenuate pain related to postoperative inflammation [18].

4. Clinical Evidence of Acupoint Stimulation for Pain Relief After TVOR

In recent years, the application of acupoint stimulation in relieving postoperative pain following transvaginal oocyte retrieval (TVOR) has received growing attention. Results indicate that body acupoints such as Hegu (LI4), Zusanli (ST36), Neiguan (PC6), and Sanyinjiao (SP6), as well as auricular points including Uterus, Shenmen, and Endocrine, play significant roles in alleviating postoperative discomfort. Various stimulation techniques—including manual acupuncture, electroacupuncture (EA), transcutaneous electrical nerve stimulation (TENS), and auricular acupressure—have all shown promising analgesic effects. These methods may also help reduce the need for postoperative analgesic drugs and enhance patient comfort.

In terms of body acupoint stimulation, randomized controlled trials (RCTs) have confirmed that acupuncture at bilateral Hegu points can significantly reduce postoperative pain scores following oocyte retrieval ($P < 0.01$) [19]. Moreover, EA combined with analgesics such as pethidine has been shown to enhance analgesic efficacy and reduce the incidence of abdominal pain within 1 to 5 hours postoperatively ($P < 0.01$) [20]. Additionally, TENS has been found to significantly decrease visual analogue scale (VAS) scores within 60 to 90 minutes post-surgery and increase patients' pressure pain threshold (PPT), further supporting the analgesic role of acupoint-based therapies after TVOR [21].

As a non-invasive or minimally invasive approach, auricular stimulation is associated with high patient compliance. Studies have demonstrated that auricular acupressure can reduce the dosage of propofol required during the procedure and lower VAS scores 30 minutes after surgery ($P < 0.05$) [22]. Auricular embedding techniques, which provide continuous stimulation to auricular points such as Uterus, Ovary, Shenmen, and Heart, have also been reported to significantly reduce immediate postoperative scores for the Pain Rating Index (PRI), VAS, and Present Pain Intensity (PPI) ($P < 0.05$) [23].

In addition to these single-modality approaches, the role of acupoint stimulation as part of

multimodal analgesia has attracted increasing interest. One study found that transcutaneous electrical acupoint stimulation (TEAS), when combined with sedative and analgesic regimens, could significantly reduce VAS scores at 2, 4, 8, and 24 hours after surgery and decrease opioid consumption ($P < 0.05$) [24]. These findings collectively suggest that acupoint stimulation may serve as an effective strategy for postoperative pain relief following TVOR and holds potential value within enhanced recovery after surgery (ERAS) protocols.

In summary, commonly used body acupoints include Hegu, Neiguan, Zusanli, and Sanyinjiao, while frequently selected auricular points include Uterus, Shenmen, and Endocrine. Various acupoint stimulation techniques have demonstrated beneficial effects in alleviating postoperative pain and reducing the need for analgesics to varying degrees.

5. Conclusion and Future Directions

Compared with inpatient procedures, postoperative management in outpatient surgeries is often overlooked. For example, although transvaginal oocyte retrieval (TVOR) is minimally invasive and associated with rapid recovery, postoperative pain still affects the patient experience. Current studies suggest that acupoint stimulation—including acupuncture, electroacupuncture, TENS, and auricular acupressure—can effectively relieve postoperative pain following TVOR, reduce the need for analgesic medications, and enhance patient comfort. However, existing research is limited by small sample sizes in randomized controlled trials (RCTs), heterogeneity in intervention protocols, and insufficient optimization of acupoint selection and electroacupuncture parameters.

Additionally, individual differences such as pain thresholds and hormonal fluctuations have not been adequately considered in postoperative pain management. Future research should aim to conduct large-scale, multicenter RCTs to generate more robust evidence. Optimization of acupoint stimulation should focus on acupoint combinations and stimulation parameters. While commonly used acupoints include Hegu (LI4), Neiguan (PC6), Zusanli (ST36), and Sanyinjiao (SP6), the most effective combinations—especially those integrating body and auricular acupoints—require further investigation. Furthermore, the frequency, waveform, intensity, and duration of electroacupuncture and TEAS may influence analgesic efficacy and should be examined systematically.

In the future, acupoint stimulation holds great promise as a component of multimodal analgesia. When combined with pharmacological therapies or regional nerve blocks, and optimized through personalized acupoint combinations and dose adjustment, it may help achieve the goal of “minimal drug exposure and maximal pain control,” offering new strategies for perioperative pain management.

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