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Acupuncture in critically ill patients

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ABSTRACT

Acupuncture has been used in Eastern medicine for thousands of years for a variety of conditions and illnesses. However, there is very little literature on the use of acupuncture in intensive care. In this review, we examine the role of acupuncture in intensive care, pain, stress, anxiety, sleep quality, treatment support, reduction of side effects, respiratory problems, circulatory shock, immune system and nutritional support, and functional recovery after critical illness.

Keywords: Acupuncture, critical care, critically ill, traditional Chinese medicine, review

INTRODUCTION

Acupuncture has been used in traditional Chinese medicine for more than 2000 years.[1] According to this traditional approach, health is maintained by the regular flow of energy in the body, and disease is caused by the internal imbalance of Yin and Yang. The mechanism of action of acupuncture is not clear. It is accepted that there are 12 primary and 8 secondary meridians in the human body, and when internal imbalance occurs, the flow of Qi (life energy) along the meridians is blocked. It is believed that there are more than 400 acupuncture points on the meridians and by stimulating them, the blood flow to certain parts of the body increases and the imbalance improves.[2,3]

While the Chinese often use traditional Chinese medicine and western medicine together, combined use is less common in Europe, America and in our country.[4] Many published studies have demonstrated the efficacy of acupuncture in critical or non-critical diseases.[5-8]

Research on the use of acupuncture in intensive care unit (ICU) patients is still scarce. In this review, we aimed to summarize the use of acupuncture in critically ill patients.

The use of acupuncture in critically ill patients was evaluated under 8 main topics.

1-Pain Management

Patients in the ICU often experience severe pain. Acupuncture can help reduce this pain and minimize the use of medication.[6]

2-Anxiety and Stress Relief

Intensive care is associated with high levels of stress and anxiety for patients. Acupuncture can help alleviate these conditions by providing relaxation.[6]

3-Improving Sleep Quality

Critically ill patients in the ICU patients often experience insomnia. Acupuncture can improve sleep patterns and help patients to rest better.[6]

4-Supportive Treatment andReduction of Side Effects

Acupuncture can help treat some diseases and accelerate the healing process.[9-11] Acupuncture can reduce medications and minimize the risk of side effects.[12]

5-Respiratory Problems

Intensive care patients often experience respiratory problems. Acupuncture can help improve respiratory function.[7,8]

6-Treatment of Circulatory Shock and İmmuneSystem Support

It has been suggested that it can be used in the treatment of hypertension, cardiovascular failure, chronic cardiovascular diseases. The immune systems of intensive care patients may be weakened. Acupuncture can also be used to support the immune system.[13_15]

7-NutritionalSupport

Acupuncture may be effective in regulating nutrition by facilitating gastric emptying and preventing nausea and vomiting.[13]

8-Functional Recovery After Critical İllness

It can be used in the treatment of Intensive Care Unit Acquired Weakness (ICUAW) that may develop after critical illness.[13]

PAIN MANAGEMENT

Research shows that acupuncture has potential benefits in pain management. The insertion of an acupuncture needle stimulates pain receptors, which are free nerve endings, causing the release of endogenous opioids known to be involved in pain control. The pain control system is activated. Neurotransmitters such as beta endorphins, enkephalins and serotonin are involved in the analgesic system. Enkephalins are released from most of the fibers originating from the periaqueductal gray matter and periventricular nuclei and terminating in the nucleus raphe magnus. Enkephalins have a high affinity for mu1 and delta receptors among opioid receptors[16] and enkephalins released by painful stimuli bind to mu1 receptors to produce supraspinal analgesia and to delta receptors to produce spinal analgesia. The painful stimulus causes the release of serotonin from nerve fibers originating in the raphe nuclei and terminating in the dorsal horn of the spinal cord, and of enkephalins from local spinal cord neurons. The released enkephalins are thought to cause presynaptic and postsynaptic inhibition where C and A-delta nerve fibers synapse in the dorsal horn.[17]

It has been reported that the analgesic effect of electroacupuncture (EA) may be due to the secretion of beta endorphin from the pituitary gland[18] and the increase in its concentration in plasma and the central nervous system.[19,20] An increase in the secretion of beta endorphin and ACTH from the anterior lobe of the pituitary by EA application[21] and an increase in plasma levels have been observed.[22] In particular, it has been observed that the analgesic effect induced by EA is associated with beta endorphin concentration in brain tissue, and EA application is more effective than needle acupuncture application in terms of analgesic effect.[23]

Acupuncture has been shown to be effective in reducing pain,especially in conditions such as chronic pain, migraines, andlow back pain. Intensive care patients can also experiencesevere pain, so acupuncture may be an option for pain relief. Acupuncture may be used in certain types of patients to treatpain in the ICU.

Treatment of Postoperative Pain

Acupuncture can be used to treat postoperative pain. Postoperative pain can be severe, and acupuncture, in addition to traditional pain management methods, can help reduce pain. Acupuncture points commonly used in the treatment of postoperative pain:

- **Hegu (LI-4)**: This point is located between the thumb and forefinger of the hand. It is effective in relieving pain such as headache and facial pain.[24]
- **Zusanli (ST-36)**: This point is located on the front of the leg, just below the knee. It can help2 relieve generalized pain and strengthen the immune system.[25]
- **Sanyinjiao (SP-6)**: This point is located on the inside of the leg, just above the ankle. It is used to relieve abdominal and pelvic pain.[24,25]
- **Quchi (LI-11)**: This point is located on the outside of the elbow, just above the elbow crease. It can help relieve inflammation and muscle pain.[25]
- **Fengchi (GB-20)**: This point is located on both sides of the neck, in the nape of the neck. It is used to treat headache and neck pain.[15]
- **Taichong (LV-3)**: This point is located on the foot, between the big toe and the second toe. It is used to relieve pain associated with the liver.[26]
- **Huantiao (GB-30)**: This point is located on the outside of the hip, just above the hip bone. It is effective in treating hip and leg pain.[27,28]

Treatment of Chronic Pain

Acupuncture may be preferred in chronic pain conditions, especially in cases such as migraines, low back pain, and fibromyalgia. Acupuncture can be effective in relieving such pain.

Acupuncture Points for Migraines

- Yintang (EX-HN3): Located in the center of the forehead, this point can help relieve migraines.[25]
- Taiyang (EX-HN5): May be effective in relieving pain around the eyes.[25]
- Hegu (LI4): May be used to relieve headache.[25]

Acupuncture Points for Back Pain

- Weizhong (BL40): Helps relieve lower back pain, this point can reduce tension in the legs and lower back.[28]
- Shenshu (BL23): May be effective in relieving low back pain.[28]

Acupuncture Points for Fibromyalgia

- Ashi points: Points applied to the most sensitive areas for common aches and pains such as fibromyalgia.
- Sanyinjiao (SP6): May help relieve muscle pain.[24,26]

Sensitivity to Pain Medications

Some patients may be sensitive or unable to take pain medication. In this case, acupuncture may be an alternative for pain management.

Combined Treatment

Acupuncture can be used in combination with other treatments. Treatment plans for ICU patients usually include multiple approaches, so acupuncture can be used in combination with other treatments.[15,24]

ANXIETY AND STRESS RELIEF

Acupuncture can help manage stress and anxiety in the ICU. Intensive care patients have a high tendency to experience stress and anxiety because the treatment processes are stressful and worrisome. Serotonin and enkephalin levels in the central nervous system and plasma are increased with acupuncture causing regulation of the mental and psychological state. Acupuncture can contribute to the treatment of stress, anxiety and depression in these patients.[15]

Some studies show that acupuncture reduces stress and anxiety levels in intensive care patients. In particular, it is thought that acupuncture may help patients sleep better and experience a general sense of well-being due to its relaxing effects.[6]

Zheng et al.[29] showed that EA can reduce the dose of midazolam required for sedation in mechanically ventilated patients, while Feeney et al.[30] reported that acupuncture provided benefits in pain and anxiety and a significant reduction in morphine use after treatment.

Delirium is recognized as a common and serious problem in the ICU, as it is strongly associated with ICU length of stay, organ dysfunction, and mortality.[31] Although there is insufficient evidence to support the routine use of non-pharmacological strategies for the treatment and prevention of delirium, acupuncture has been reported in the literature as an alternative approach to delirium prevention. Compared with standard care in hospitalized patients, acupuncture has been shown to achieve faster remission of delirium and significantly more delirium-free days in those who received acupuncture.[32] In conclusion, acupuncture appears to be an effective part of a non-pharmacologic strategy to manage agitation, pain, and delirium in the ICU.

Some important acupuncture points used for this purpose include**:**

- **Yin Tang (Third Eye)**: Located in the center of the forehead, this point can help reduce stress and anxiety with its calming effect.[26]
- **Shen Men (Spirit Gate)**: Located in the ear, this point has the potential to bring calm and relaxation. It can help reduce stress.[26]
- **Neiguan (Gate of Insight)**: Located on the wrist, this point can help relieve stress and reduce anxiety.[26]
- **Zusanli (Three Mile Stone)**: Located below the knee, this point can help balance energy and promote tranquility.[26]
- **Sanyinjiao (Three Yin Combination)**: Located on the inside of the legs, this point can help reduce stress and promote relaxation.[26]
- **Hegu (Open Passage)**: Located on the wrist, this point can help calm and reduce anxiety.[26]
- **Taixi (Great Stream)**: Located on the ankle, this point has the potential to bring calm and relaxation.[26]
- **Fengchi (Wind Pool)**: Located on the back of the neck, this point can help reduce stress.[15]

IMPROVING SLEEP QUALITY

54 pressure points are used to alleviate sleep problems. The Shen Men point, the 7th acupuncture point (HT7) of the heart meridian, is one of the most commonly used points.[34,35] Studies have shown that acupuncture improves sleep quality in people with sleep problems.[36-39]

In the ICU patient, acupuncture reduces stress, anxiety, and pain; increases blood circulation; contributes to healing and relaxation in the body; and provides relaxation by increasing the release of endorphins, a natural painkiller. All of these effects help to improve sleep quality by reducing sleep disturbances.[6,24]

SUPPORTIVE TREATMENT AND REDUCTIO OF SIDE EFFECTS

Acupuncture can help treat some diseases and speed up the healing process. When acupuncture is used as a supportive treatment in addition to standard treatments, it can positively contribute to the treatment and healing process by reducing symptoms such as pain, nausea and vomiting.[9-11]

Acupuncture can reduce dependence on medications and minimize the risk of side effects. It has been shown to reduce side effects such as nausea, pruritus, dizziness, sedation, urinary retention, and delayed gastric emptying that can occur with postoperative opioid use. It has been shown to reduce the need for narcotic use in the perioperative and intensive care settings.[9-12]

RESPIRATORY PROBLEMS

Critical care patients often have respiratory problems and may require mechanical ventilation. These patients may be difficult to wean from mechanical ventilation. Prolonged mechanical ventilation can lead to morbidity and mortality due to ventilator-associated pneumonia and muscle weakness.[40,41]

Acupuncture may help improve respiratory function. In particular, patients with respiratory problems such as lung disease, asthma or chronic obstructive pulmonary disease have been reported to experience beneficial effects of acupuncture. These beneficial effects are thought to be clinically related to a decrease in dyspnea, an increase in respiratory muscle strength, functional respiratory indices, improvement in chest wall mobility, and an increase in beta endorphin levels. The number of articles investigating the effects of acupuncture in critically ill patients on mechanical ventilation in the ICU is still insufficient.

Matsumoto-Miyazaki et al.[8] retrospectively evaluated the effect of acupuncture on respiration in intensive care patients undergoing long-term MV. They found that respiratory rate, heart rate, and rapid shallow breathing index decreased significantly immediately after acupuncture, while tidal volume and dynamic compliance of the respiratory system increased significantly. They also found that the increase in dynamic compliance was greater in the successful weaning group.

Two studies compared the effect of acupuncture with conventional therapy in the treatment of pneumonia. One study showed that acupuncture plus the classic herbal formula Da Cheng Qi decoction (Da Huang 12 g, Mang Xiao 8 g, Hou Pu 24 g, Zhi Shi 5 g) was effective in improving clinical symptom scores, shortening mechanical ventilation times, and reducing antibiotic use. Patients were randomly divided into an acupuncture treatment group and a control group. In this investigation, ST36 (Zusanli) was selected bilaterally for the patients in the treatment group. The needles were manipulated using the Ping Bu Ping Xie (mild tonifying and attenuating) technique. Another study showed how the administration of conventional drug therapy with acupuncture and herbs increased the rate of favorable patient outcomes. The treatment group received acupuncture at CV10 (Xiawan), ST25 (Tianshu), RN4 (Guanyuan), ST36 (Zusanli). The study found that patients who received acupuncture plus drug therapy had significantly better outcomes than patients in the drug monotherapy control group.[42]

In conclusion, the addition of acupuncture to standard care can positively regulate respiratory parameters and support successful weaning from long-term mechanical ventilation in patients followed in the ICU.[7,8]

Acupuncture is thought to help regulate the flow of energy in the body and can relieve spasms in the airways. Here are some common acupuncture points used to improve respiratory function:

- **Renzhong (GV26)**: Located at the junction of the upper lip and nose, this point can help relax the airways and facilitate breathing.[43,44]
- **Fengchi (GB20)**: This point is located on the back of the head, just above the neck. It can be used to relieve breathing problems15.
- **Feishu (BL13)**: Located in the middle of the back, this point is associated with the lungs and can relieve respiratory problems.[45]
- **Pishu (BL20)** and Shenshu (BL23): These points can help strengthen the kidneys and the immune system, which can have a positive effect on breathing.[46]
- **Tiantu (CV22)**: Located in the center of the throat, this point can be used to relieve respiratory problems.[47]
- **Quchi (LI11)**: This point is located on the outside of the arm near the elbow. It can help relieve breathing problems.[48,49]

TREATMENT OF CIRCULATORY SHOCK AND IMMUNE SYSTEM SUPPORT

Although complementary therapies for shock resuscitation and intensive care remain current, acupuncture is still not included in standard treatment protocols for cardiovascular failure.[50] The number of studies on this topic is small and based on animal experimental results. One of these is the animal study by Li et al.[51] in which EA stimulated the median nerve to increase cardiac oxygen demand via the sympathetic pathway and decrease regional myocardial ischemia. Despite these studies, it is still unclear whether acupuncture can be beneficial in shock. The results of only one case report suggest the hypothesis that acupuncture may be useful in shock resuscitation. The hypothesis in this case was that LR3 (Taichong) stimulation would affect peripheral artery and ST36 (Zusanli) stimulation would affect macrocirculatory hemodynamics and have a beneficial effect.[52]

Another mechanism of action is that acupuncture prevents sepsis by acting on the immune system, thereby ameliorating sepsis-induced shock. This has been demonstrated in experimental studies by showing that electrical stimulation of ST36 improves the functions of natural killer cells and macrophages, and increases lymphocyte counts and T-cell functions.[52-57]

The effect of acupuncture on the immune system is thought to be due to the effects of the endogenous opioids beta endorphin, leucine enkephalin and methionine enkephalin on this system. It has been shown that leukocytes possess proopiomelanocortin mRNA and can therefore synthesize ACTH and beta endorphins from these precursors. Endogenous opioid receptors have also been found on B lymphocytes, T lymphocytes, natural killer cells, granulocytes, monocytes, platelets, and the terminal complex of complement. It has been reported that there are biochemical and physical similarities between opioid receptors of the neuroendocrine system and opioid receptors of the immune system.[15]

In a prospective randomized controlled trial, 60 patients with sepsis were divided into two groups. The control group received conventional treatment, and the other group received bilateral EA at ST36 (Zusanli) and RN4 (Guanyuan) in addition to conventional treatment. The combined treatment group showed a decrease in sepsis score and an increase in lymphocyte count, but no difference in mortality was found. As a result, it was concluded that the combined treatment was much more effective and had positive results.[58]

NUTRITIONAL SUPPORT

Compared to Western medicine, acupuncture is a traditional Chinese medical practice that also aims to regulate nutrition. Its main goal is to achieve balance and harmony in the body through nutrition. Early enteral nutrition is recommended in intensive care patients to reduce the severe catabolic process. Especially in mechanically ventilated patients, nutritional difficulties may occur due to delayed gastric emptying. There are few studies on the effect of acupuncture on nutrition. It has been reported that acupuncture may regulate gastric emptying by affecting both lower esophageal sphincter relaxation and gastric myoelectric activity by acting on autonomic nervous system activity. Zou et al.[59] showed that stimulation of the electrical acupuncture point at PC6 (Neiguan) inhibited the frequency of lower esophageal

sphincter relaxation in healthy subjects. Acupuncture has also been shown to regulate gastric motility in experimental animal studies.[60,61] However, there are not many studies evaluating the effects of acupuncture on gastric emptying in ICU patients. Pfab et al.[62] reported an effective protocol for the treatment of delayed gastric emptying in critically ill patients. Kao et al.[63] also showed that transcutaneous electrical stimulation of bilateral PC6 (Neiguan) points was more effective in gastric emptying than traditional motility agents in critical neurosurgical patients. They also showed that electroacupuncture combined with prokinetic drugs is an effective treatment for gastric emptying in adult critically ill patients. They reported that the gastric residual volume gradually decreased until the fourth day and decreased below 200 ml/day on the fifth day when electroacupuncture treatment was combined with intravenous metoclopramide. In this study, electrical stimulation was applied to bilateral points PC6 (Neiguan), TE8 (Sanyanglou), ST36 (Zusanli) and SP3 (Taibai). In addition, ST37 (Shangjuxu) and ST39 (Xiajuxu) points were needled only without electrical stimulation. Another double-blind randomized controlled trial reported that postoperative feeding intolerance could be reduced in patients with hypopharyngeal cancer. In this study, patients in the treatment group received acupuncture at ST36 (Zusanli), ST37 (Shangjuxu), ST39 (Xiajuxu), PC6 (Neiguan) and LI4 (Hegu) points in the first three days in addition to routine intensive care. Patients in the treatment group reached 80% of target energy intake significantly earlier than the control group. This was associated with higher caloric intake in the first postoperative week. It was also highlighted that the treatment group required less prokinetics.[64,65]

FUNCTIONAL RECOVERY AFTER CRITICAL ILLNESS

Another pathological condition that occurs after recovery from critical illness is intensive care unit acquired weakness (ICUAW).[66] This condition includes critical illness myopathy and polyneuropathy or a mixture of both (myopathy is usually more predominant). It is most commonly seen in mechanically ventilated patients. The incidence of 25-60% has been reported in patients on MV for more than 7 days.[67] There is no specific treatment yet, but acupuncture has been found to correct muscle wasting and mass by increasing nerve function.[68-70] In one study, acupuncture was found to be effective against muscle wasting by increasing IGF-1 levels and stimulating muscle regeneration. This study suggested acupuncture points such as LI15 (Jianyu), LI11 (Quchi), ST36 (Zusanli), GB34 (Yanglingquan), and ST31 (Biguan).[69]

There may be conditions that prevent the use of acupuncture in the ICU. These conditions may vary depending on the specific health status and needs of the patient. Here are some conditions that prevent the use of acupuncture in the ICU[62-67]

- **Skin problems**: Inserting acupuncture needles into the skin can be risky if the skin has an infection, open wound, or skin disease.
- **Bleeding disorders**: Patients with blood clotting problems may be at risk for bleeding from acupuncture.
- **Drug Interactions**: Acupuncture may interact with some medications, so the patient's medications should be taken into account.
- **Immune problems:** Acupuncture may not be recommended for patients with immune system problems because of the risk of infection.
- **Mental state**: Patients with mental health problems or under extreme stress may require special attention as acupuncture can have a relaxing effect.
- **Fear of needles**: For patients with a fear of needles, acupuncture may be uncomfortable and therefore not preferred.
- **Tissue damage**: Patients in the ICU may have tissue damage or deformities in their bodies that can make it difficult to insert needles accurately.

Each patient is different, and the appropriateness of acupuncture should be determined by a healthcare professional based on the patient's assessment. Treatment plans for critical care patients often involve multiple approaches, and acupuncture may be used in combination with other treatment modalities or, in some cases, excluded. Therefore, a professional's opinion and assessment is necessary to determine whether acupuncture is appropriate for a patient in the ICU.[62-67]

CONCLUSION

This review shows that acupuncture in the ICU is an acceptable and feasible treatment modality for the management of various aspects of critical illness. The fact that acupuncture can be used in relatively common patient populations suggests that acupuncture can be used in critically ill patients in the ICU, taking into account the balance of benefits and harms. However, more randomized controlled trials are needed to investigate the efficacy of acupuncture as an adjunct to standard care in critically ill patients.

ETHICAL DECLARATIONS

Referee Evaluation Process

Externally peer-reviewed.

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The authors have no conflicts of interest to declare.

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES:

1. Lu AP, Jia HW, Xiao C, Lu QP. Theory of traditional Chinese medicine and therapeutic method of diseases. *World J Gastroenterol.* 2004;10(3):1854. doi: 10.3748/wjg.v10.i13.1854
2. Lu A, Jiang M, Zhang C, Chan K. An integrative approach of linking traditional Chinese medicine pattern classification and biomedicine diagnosis. *J Ethnopharmacol.* 2012;141:549-556. doi: 10.1016/j.jep.2011.08.045
3. Xutian S, Zhang J, Louise W. New exploration and understanding of traditional Chinese medicine. *Am J Chin Med.* 2009;37(03):411-426. doi: 10.1142/S0192415X09006941

4. Xue CCL, Zhang AL, Greenwood KM, Lin V, Story DF. Traditional Chinese medicine: an update on clinical evidence. *J Alternative Compl Med*. 2010;16(3):301-312. doi: 10.1089/acm.2009.0293

5. Unsal N, Akcaboy ZN, Soyal OB, Akcaboy EY, Mutlu NM, Gogus N. Effectiveness of intraoperative laser acupuncture combined with antiemetic drugs for prevention of postoperative nausea and vomiting. *J Altern Complement Med*. 2020;26(1):67-71. doi: 10.1089/acm.2019.0181

6. Carlos L, Cruz LAP da, Leopoldo VC, Campos FR de, Almeida AM de, RC de CP Silveira. Effectiveness of traditional Chinese acupuncture versus sham acupuncture: a systematic review. *Rev Lat Am Enfermagem*. 2016;24:e2762. doi: 10.1590/1518-8345.0647.2762

7. Yeh GY, Horwitz R. Integrative medicine for respiratory conditions: asthma and chronic obstructive pulmonary disease. *Med ClinNorth Am*. 2017;101(5):325-941. doi: 10.1016/j.mcna.2017.04.008

8. Matsumoto-Miyazaki J, Ushikoshi H, Suzuki K, et al. Efficacy of acupuncture treatment for improving the respiratory status in patients receiving prolonged mechanical ventilation in intensive care units: a retrospective observational study. *J Alternative Compl Med*. 2018;24(11):1076-1084. doi: 10.1089/acm.2017.0365

9. Patil S, Sen S, Bral M, et al. The role of acupuncture in pain management. *Curr Pain Headache Rep*. 2016;20(4):22. doi: 10.1007/s11916-016-0552-1

10. Yuan SC, Cao WJ, Huang Y, Hua SY, Zhou YH, Cai R. Effect of acupuncture on analgesia and sedation in elderly patients with severe pneumonia during invasive mechanical ventilation. *Zhongguo Zhen Jiu=Chinese Acupunct Moxibust*. 2021;41(9):971-978. doi: 10.13703/j.0255-2930.20200903-k0004

11. Lee A, Done ML. Stimulation of the wrist acupuncture point P6 for preventing postoperative nausea and vomiting. *Cochrane Database Syst Rev*. 2004;(3):CD003281. doi: 10.1002/14651858.CD003281.pub2

12. Acar HV. Acupuncture and related techniques during perioperative period: a literature review. *Complement Ther Med*. 2016;29:48-55. doi: 10.1016/j.ctim.2016.09.013

13. Formenti P, Piuri G, Bisatti R, Pinciroli R, Umbrello M. Role of acupuncture in critically ill patients: a systematic review. *J Tradit Complement Med*. 2023;13(1):62-71.

14. Jankovic B. Neuroimmunomodulation from phenomenology to molecular evidence. In: Fabris N, Markovic B, Spector N, Jankovic B, eds. Neuroimmunomodulation: The state of the art. The New York Academy of Sciences: 1994:1-38.

15. Cabıoğlu MT, Ergene N. The effect mecanism of acupuncture and clinical applications. *Genel Tıp Derg*. 2003;13(1):35-40.

16. Chen Z, Hendner J, Hedner T. Substance P induced respiratory excitation is blunted by delta-receptor specific opioids in the rat medulla oblongata. *Acta Physiol Scand*. 1996;157(2):165-173.

17. Guyton AC, Hall JE. Textbook of medical physiology. WB Saunders: 2001.

18. Takeshige C, Nakamura A, Asamoto S, Arai T. Positive feedback action of pituitary beta-endorphin on acupuncture analgesia afferent pathway. *Brain Res Bull*. 1992;29(1):37-44.

19. Jin HO, Zhou L, Lee KY, Chang TM, Chey WY. Inhibition of acid secretion by electrical acupuncture is mediated via beta endorfin and somatostatin. *Am J Physiol*. 1996;271(3):G524-G530.

20. Fu H. What is the material base of acupuncture? The nerves! *Med Hypothes*. 2000;54(3):358-359.

21. Pan B, Castro-Lopes JM, Coimbra A. Activation of anterior lobe corticotrophs by electroacupuncture or noxious stimulations in the anaesthetized rat, as shown by colocalization of fos protein with ACTH and β-endorphin and increased hormone release. *Brain Res Bull*. 1996;40(3):175-182.

22. Malizia E, Andreucci G, Paolucci D, Crescenzi F, Fabbri A, Fraioli F. Electroacupuncture and peripheral beta endorphin and ACTH levels. *Lancet*. 1979;314(8141):535-536.

23. Wang JQ, Mao L, Han JS. Comparison of the antinociceptive effects induced by electroacupuncture and transcutaneous electrical nerve stimulation in the rat. *Int J Neurosci*. 1992;65(1-4):117-129.

24. Cevik B, Tascı S. Effect of acupressure applıcatıon on pain management. *J Health Sci*. 2017;26(3):257-261.

25. Tekin A, Çevik C. Akupunktur Uygulaması Kitabı. TR Ministry of Health General Directorate of Health Services: 2021.

26. Karakus Z, Yangoz ST, Ozer Z. The effect of acupressure on the management of cancer-related pain and anxiety: a systematic review. *J Hacettepe Univ Fac Nurs*. 2022;9(1):63-72.

27. Shao XM, Shen Z, Sun J, et al. Strong manual acupuncture stimulation of "Huantiao" (GB 30) reduces pain-induced anxiety and p-erk in the anterior cingulate cortex in a rat model of neuropathic pain. *Evidence-Based Complement Alternat Med*. 2015;2015:235491. doi: 10.1155/2015/235491

28. Chen MR, Wang P, Cheng G, Guo X, Wei GW, Cheng XH. The warming acupuncture for treatment of sciatica in 30 cases. *J Tradit Chin Med*. 2009;29(1):50-53. doi: 10.1016/s0254-6272(09)60031-5

29. Zheng X, Meng J-B, Fang Q. Electroacupuncture reduces the dose of midazolam monitored by the bispectral index in critically ill patients with mechanical ventilation: an exploratory study. *Acupunct Med*. 2012;30(2):78-84. doi: 10.1136/acupmed-2011-010095

30. Feeney C, Bruns E, LeCompte G, Forati A, Chen T, Matecki A. Acupuncture for pain and nausea in the intensive care unit: a feasibility study in a public safety net hospital. *J Alternative Compl Med*. 2017;23(12):996-1004. doi: 10.1089/acm.2016.0323

31. Frontera JA. Delirium and sedation in the ICU. *Neurocrit Care*. 2011;14(3):463-474. doi: 10.1007/s12028-011-9520-0

32. Joo C, Lee S, Kang JW, Lee JD. Acupuncture for postoperative delirium (POD): a systematic review and meta-analysis protocol. *Medicine*. 2021;100(3):e23822. doi: 10.1097/MD.0000000000023822

33. Levy I, Gavrieli S, Hefer T, et al. Acupuncture treatment of delirium in older adults hospitalized in internal medicine departments: an open-label pragmatic randomized-controlled trial. *J Geriatr Psychiatr Neurol*. 2021;35(3):333-343. doi: 10.1177/0891988721996804

34. Sun JL, Sung MS, Huang MY, Cheng GC, Lin CC. Effectiveness of acupressure for residents of long-term care facilities with insomnia: a randomized controlled trial. *Int J Nurs Stud*. 2010;47(7):798-805. doi: 10.1016/j.ijnurstu.2009.12.003

35. Hmwe NTT, Subramaniam P, Tan LP. Effectiveness of acupressure in promoting sleep quality. *Holistic Nurs Pract*. 2016;30(5):283-293.

36. Kim WI, Youn HM. The effects of self-acupressure of wan-gol (G12), shinmun (H7), samumgyo (SP6) on clinical nurses' sleep pattern disturbance and fatigue. *Korean J Acupunct*. 2004;21(2):81-93.

37. Arab Z, Shariati AR, Asayesh H, Vakili MA, Bahrami-Taghanaki H, Azizi H. A sham-controlled trial of acupressure on the quality of sleep and life in haemodialysis patients. *Acupunct Med*. 2016;34(1):2-6. doi: 10.1136/acupmed2014-010369

38. Abbasi Tadwwi S, Saberi M, Akbari H. Effect of acupressure at shenmen acupoint on the sleep quality of nurses in emergency departments and intensive care units. *Complement Med J*. 2021;10(4):380-395. doi: 10.32598/cmja.10.4.1025.1

39. Huong HTX, Alex M, Wan CC, Anh VH, Phuc BT. Pilot randomized sham-controlled trial of self-acupressure to manage the symptom cluster of insomnia, depression, and anxiety in cancer patients undergoing chemotherapy. *Sleep Breath*. 2021;26(1):445-456. doi: 10.1007/s11325-021-02370-8

40. Funk GC, Anders S, Breyer MK, et al. Incidence and outcome of weaning from mechanical ventilation according to new categories. *Eur Respir J*. 2010;35(1):88-94. doi: 10.1183/09031936.00056909

41. Jia X, Malhotra A, Saeed M, Mark RG, Talmor D. Risk factors for ARDS in patients receiving mechanical ventilation for> 48 h. *Chest*. 2008;133(4):853-861. doi: 10.1378/chest.07-1121

42. Quan A, Cai G, Liu K, Zhong J, Shang L. Therapeutic observation of acupuncture for gastrointestinal dysfunction in severe pneumonia. *Shanghai J Acupunct Moxibust*. 2017;(12):287-290.

43. Chen CH, Hsieh CL. Effect of acupuncture on oxidative stress induced by cerebral ischemia-reperfusion injury. *Antioxidants*. 2020;9(3):248. doi: 10.3390/antiox9030248

44. Hu XY, Trevelyan E, Chai QY, et al. Effectiveness and safety of using acupoint Shui Gou (GV 26): a systematic review and meta-analysis of randomized controlled trials. *Acupunct Relat Therap*. 2015;3(1):1-10. doi: 10.1016/j.arthe.2014.12.001

45. Zhang XF, Zhu J, Geng WY, et al. Electroacupuncture at Feishu (BL13) and Zusanli (ST36) down-regulates the expression of orexins and their receptors in rats with chronic obstructive pulmonary disease. *J Integr Med*. 2014;12(5):417-424. doi: 10.1016/S2095-4964(14)60040-6

46. Umemoto K, Hayashi T, Fukushige K, et al. Specific acupuncture stimulation of Shenshu (BL23) affects sympathetic nervous activity-associated plasma renin concentration changes. *J Tradit Chinese Med*. 2022;42(2):250-255.

47. Wu Z, Zheng Y, Chen Y, et al. The role of acupoint application of herbal medicine for asthma: meta-analysis of randomized double-blind placebo-controlled trials. *Evidence-Based Complement Alternat Med*. 2022;2022:5589433. doi: 10.1155/2022/5589433

48. Zhang WP. Effects of acupuncture on the pulmonary function and heart rate variability in different state of bronchial asthma. *Zhen Ci Yan Jiu=Acupunct Res*. 2007;32(1):42-48.

49. Jiang LH, Li PJ, Wang YQ, et al. Anti-inflammatory effects of acupuncture in the treatment of chronic obstructive pulmonary disease. *J Integr Med*. 2023;21(6):518-527. doi: 10.1016/j.joim.2023.11.005

50. Moore FA, McKinley BA, Moore EE. The next generation in shock resuscitation. *Lancet*. 2004;363(9425):1988-1996. doi: 10.1016/S0140-6736(04)16415-5

51. Li P, Pitsillides KF, Rendig SV, Pan HL, Longhurst JC. Reversal of reflex-induced myocardial ischemia by median nerve stimulation: a feline model of electroacupuncture. *Circulation*. 1998;97(12):1186-1194. doi: 10.1161/01.cir.97.12.1186

52. Hsu C, Hua Y, Jong G, et al. Shock resuscitation with acupuncture: case report. *Emerg Med J*. 2006;23(3):e18. doi: 10.1136/emj.2004.023218

53. Choi GS, Oha SD, Han JB, et al. Modulation of natural killer cell activity affected by electroacupuncture through lateral hypothalamic area in rats. *Neurosci Lett*. 2002;329(1):1-4. doi: 10.1016/s0304-3940(02)00551-7

54. Sato T, Yu Y, Guo SY, Kasahara T, Hisamitsu T. Acupuncture stimulation enhances splenic natural killer cell cytotoxicity in rats. *Jpn J Physiol*. 1996;46(2):131-136. doi: 10.2170/jjphysiol.46.131

55. Rho SW, Choi GS, Ko EJ, et al. Molecular changes in remote tissues induced by electro-acupuncture stimulation at acupoint ST36. *Mol Cell*. 2008;25(2):178-183.

56. Kim SK, Lee Y, Cho H, et al. A parametric study on the immunomodulatory effects of electroacupuncture in DNP-KLH immunized mice. *Evid Based Complement Alternat Med*. 2011; 2011: 389063. doi: 10.1093/ecam/nep166

57. Chen L, Xu A, Yin N, et al. Enhancement of immune cytokines and splenic CD4þ T cells by electroacupuncture at ST36 acupoint of SD rats. *PLoS One*. 2017;12(4):e0175568. doi: 10.1371/journal.pone.0175568

58. Yang G, Hu R, Deng A, Huang Y, Li J. Effects of electro-acupuncture at Zusanli, Guanyuan for sepsis patients and its mechanism through immune regulation. *Chin J Integr Med*. 2016;22(3):219-224. doi: 10.1007/s11655-016-2462-9

59. Zou D, Chen WH, Iwakiri K, Rigda R, Tippett M, Holloway RH. Inhibition of transient lower esophageal sphincter relaxations by electrical acupoint stimulation. *Am J Physiol Gastrointest Liver Physiol*. 2005;289(2):G197-G201. doi: 10.1152/ajpgi.00023.2005

60. Tabosa A, Yamamura Y, Forno ER, Mello LEAM. A comparative study of the effects of electroacupuncture and moxibustion in the gastrointestinal motility of the rat. *Dig Dis Sci*. 2004;49(4):602-610. doi: 10.1023/b: ddas.0000026305.20852.41

61. Jin HO, Zhou L, Lee KY, Chang TM, Chey WY. Inhibition of acid secretion by electrical acupuncture is mediated via beta-endorphin and somatostatin. *Am J Physiol*. 1996;271(3):G524-G530. doi: 10.1152/ajpgi.1996.271.3.G524

62. Pfab F, Winhard M, Nowak-Machen M, et al. Acupuncture in critically ill patients improves delayed gastric emptying: a randomized controlled trial. *Anesth Analg*. 2011;112(1):150-155. doi: 10.1213/ANE.0b013e3181fdfac8

63. Kao ML, Chen YL, Lee SC, Huang SY, Lin PY. Electroacupuncture improves gastric emptying in critically ill neurosurgical patients: a pilot study. *Evid Based Complement Alternat Med*. 2017;2017:1892161. doi: 10.1155/2017/1892161

64. Ben-Arie E, Kao PY, Ho WC, Lee YC. Acupuncture effect on digestion in critically ill postoperative oral and hypopharyngeal cancer patients. *Medicine*. 2019;98(35):e16944. doi: 10.1097/MD.0000000000016944

65. Ben-Arie E, Wei TH, Chen HC, et al. Digestion-specific acupuncture effect on feeding intolerance in critically ill post-operative oral and hypopharyngeal cancer patients: a single-blind randomized control trial. *Nutrients*. 2021;13(6):2110. doi: 10.3390/nu13062110

66. Schefold JC, Bierbrauer J, Weber-Carstens S. Intensive care unit-acquired weakness (ICUAW) and muscle wasting in critically ill patients with severe sepsis and septic shock. *J Cachexia Sarcopenia Muscle*. 2010;1(2):147-157. doi: 10.1007/s13539-010-0010-6

67. Babb T, Levine B, Philley J. ICU-acquired weakness: an extension of the effects of bed rest. *Am J Respir Crit Care Med*. 2012;185(2):230-231. doi: 10.1164/ajrccm.185.2.230

68. Song J, Li H, Cao Y, et al. Electroacupuncture improves survival in rats with lethal endotoxemia via the autonomic nervous system. *Anesthesiol*. 2012;116(2):406-414. doi: 10.1097/ALN.0b013e3182426ebd

69. Su Z, Hu L, Cheng J, et al. Acupuncture plus low-frequency electrical stimulation (Acu-LFES) attenuates denervation-induced muscle atrophy. *J Appl Physiol*. 2016;120(4):426-436. doi: 10.1152/japplphysiol.00175.2015

70. Zhou X, Xing B, He G, Lyu X, Zeng Y. The effects of electrical acupuncture and essential amino acid supplementation on sarcopenic obesity in male older adults: a randomized control study. *Obes Facts*. 2018;11(4):327-334. doi: 10.1159/000491797