

Review

Use of acupuncture in equine reproduction

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The goal of this review is to provide evidence supporting the physiologic basis for the use of acupuncture as a treatment in equine reproduction, and to discuss current uses of acupuncture for the treatment of anestrus, urine pooling, uterine infection and/or fluid, infertility, maintenance of pregnancy, cryptorchidism, musculoskeletal pain, and poor libido in stallions. The benefits achieved through acupuncture treatment are thought to be a result of hormonal regulation, altered smooth muscle motility, and general stress and/or pain relief from musculoskeletal or environmental conditions.

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1. Introduction

The use of acupuncture in equine reproduction in recent years has shown to be a valuable and legitimate adjunct therapy for many common problems faced by the equine practitioner. Although there is still a limited body of clinical data in horses, research is ongoing, and there are some very convincing studies in various species that provided evidence of a measurable impact

of acupuncture on plasma concentrations of reproductive hormones, including gonadotropin releasing hormone (GnRH), follicle stimulating hormone (FSH), luteinizing hormone (LH), estrogen, testosterone, and progesterone [1–5]. These studies demonstrated that acupuncture can have an effect on the regulation of the hypothalamic–pituitary–gonadal axis. The challenge lies in understanding the relationship between reproductive neuroendocrinology and acupuncture, rigorously investigating acupuncture mechanisms, and determining how to utilize acupuncture effectively for treating equine reproductive conditions.

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2. Physiologic mechanisms of acupuncture

In traditional Chinese medicine, the reproductive system is regulated by the kidney, spleen, liver, triple heater, Ren, and Du meridians. Anatomically, some of these meridians generally run externally and internally through and near the organs of reproduction and related nerves and vessels. Some acupoints used in reproduction may communicate with the nerves derived from the lumbar nerves and from the parasympathetic nerves from the sacral cord area [6]. When these points are stimulated, they may produce a viscerosomatic, or neural feedback response within the reproductive organs and associated structures. It has been postulated that points also correspond with specific anatomic and histological structures, including blood vessels and golgi tendon organs, however this has not been definitively documented with anatomical dissection or histological analysis in the horse [7]. Therapeutically, meridian acupoints as well as other classical Chinese (non-meridian) points are used to treat reproductive disorders.

The most widely accepted scientific theory of the mechanism of acupuncture is the neurohumoral model. This model describes the relationship of acupoint stimulation causing an effect on the cerebral cortex via the peripheral nervous system. Needling activates afferent fibers of peripheral nerves, leading to a central effect in the brain and activating brain nuclei to release modulators (opioid peptides) and neurotransmitters, through a descending pathway. This interaction results in subsequent visceral or cutaneous effects through systemic or local chemical release. An example of this effect might be cutaneous analgesia induced by treatment of select acupuncture points. The neurohumoral model has been supported by studies documenting that the endogenous opiate peptides participated in acupuncture analgesia from the presynaptic level to the receptor sites [8]. Acupuncture has perhaps been evaluated most thoroughly for its use in pain management through measurable increases in plasma concentrations of beta-endorphin and other mediators. Thus, it has been well established that acupuncture can be efficacious for alleviating certain types of pain in human and animal subjects by stimulating opioid and non-opioid analgesic mechanisms [9–11].

Possible physiologic mechanisms of acupuncture-induced effects on the reproductive system include an endorphin-mediated mechanism. In non-equine species, endorphins can inhibit LH secretion, whereas exogenous naloxone, an opioid receptor antagonist, raises LH concentrations [4]. However, subsequent research

questions a direct inhibitory action of exogenously administered beta-endorphin on LH release [12]. Therefore, the action of electroacupuncture on LH release is apparently multifactorial, rather than solely attributable to beta-endorphin concentrations. Electroacupuncture in sows lowered plasma LH concentrations for 1 to 2 h, with a subsequent increase in the frequency and pulsatile release of LH, and an increase in plasma progesterone concentrations 4–6 h after stimulation [5].

As described above, the acupuncture-induced decrease in LH is mediated partially by endorphin release. After a period of depression, the pituitary may be more responsive to GnRH. If there is an imbalance of the hypophyseal–pituitary–gonadal axis, the transient LH depression may allow the system to rebalance [13]. However, in several recent studies performed in rats, the relationship between acupuncture and gonadotropin release was found to be more complex. In one study, GnRH expression was elevated after electroacupuncture treatments in all groups, but degree of expression depended on stage of estrus and point selection. Treatment of a discrete acupuncture point (CV4) significantly increased GnRH and LH concentrations, with the effect being greatest in diestrus and metestrus [3].

Therefore, it is difficult with our current knowledge to consistently interpret or predict whether concentrations of gonadotropins or other hormones will rise or fall with acupuncture treatment. Studies seemed to support a link to an endorphin-mediated mechanism, however responses to acupuncture were variable according to stage of the estrous cycle, point selection, and species evaluated. Considering the potential implications of opioid involvement in the reproductive physiology in other species, the search for related mechanisms in horses is indicated.

Additionally, there is another hypothesis that acupuncture has direct effects on the gonadal paracrine and autocrine control of steroidogenesis by stimulating production and release of epinephrine, catecholestrogens (estrogen-derived metabolites), and growth factors [14]. Elevation of plasma progesterone concentrations in cattle can be induced by norepinephrine, epinephrine, and serotonin, independent of changes in plasma LH concentrations [15]. Furthermore, stimulation of certain acupuncture points significantly elevated plasma cortisol concentrations in horses [16,17], perhaps affecting production of reproductive steroid hormones.

Stress, defined as the inability of an animal to cope with its environment, plays a complex role in subfertility at the endocrine level. There is evidence that stressors interfered with precise timings of

reproductive hormone release [18]. Pain stress associated with acute or chronic conditions in horses such as laminitis, degenerative arthritis, or other musculoskeletal conditions, are commonly encountered in breeding animals. Beta-endorphin release may be one of the pathways in which acupuncture relieved pain in horses [10,19]; in that regard, electroacupuncture significantly elevated beta-endorphin in plasma of horses [10] and decreased catecholamine concentrations in rat stress models [20,21]. Though difficult to quantify, management of stressors, including pain, can have a positive impact on improving reproductive efficiency in the horse.

3. Acupuncture techniques

Although multiple studies have shown that acupuncture can have a quantitative effect on concentrations of certain reproductive hormones, technique and point selection is crucial to providing appropriate therapy. Electroacupuncture may be superior for elevating certain substances than dry needles alone, especially in pain studies [3,4,11], and seems to be the most common acupuncture technique encountered in this review. Aquapuncture, which is injection of a sterile liquid (e.g. drugs, saline, or Vitamin B12) into acupuncture points, is speculated to provide a longer duration or greater stimulation of a chosen point than a dry needle technique. Aquapuncture is often used for points located along or near the spine, rather than in the limbs. Aquapuncture injections of microdoses of therapeutic substances at acupuncture points may enhance effectiveness of a drug or decrease adverse side effects [22,23].

Several studies in horses showed that administering a microdose of prostaglandin $F_{2\alpha}$ in Bai Hui (lumbosacral space) induced luteolysis, while significantly decreasing side effects associated with conventional dosing; however, it was unclear whether side effects were decreased solely due to administration at the acupoint or from the reduced dose [21,24]. Needling CV4 versus PC6 caused a greater response in GnRH expression in rats, emphasizing that stimulation of different points produced different physiologic responses [25]. Consequently, choice of points and technique will potentially dictate the magnitude of therapeutic response.

4. Use of acupuncture in mares

Acupuncture use in ‘problem’ mares is used relatively widely in the central Kentucky Thoroughbred broodmare population. It has anecdotally produced

excellent results for treating mares with uterine fluid and/or urine pooling, especially older, pluriparous mares. A retrospective study involving 44 Thoroughbred mares with a history of uterine fluid and/or urine pooling showed significant resolution of fluid, based on transrectal ultrasonography, on the day following the acupuncture treatment, and a subsequent pregnancy rate of 81% within the group [26]. Acupuncture was initiated after traditional methods had been ineffective; however, mares were simultaneously treated with conventional methods, including oxytocin, uterine lavage, and antibiotic infusions if indicated. Therefore, acupuncture may increase fertility rates in mares with these problems that failed to respond to conventional treatments alone. However, there was no positive control group included in this study. In cattle, aquapuncture for treatment of repeat-breeder dairy cows suggested acupuncture can improve fertility rates [27]. The acupuncture sites used in the dairy study were traditional reproductive points for both equine and bovine systems, and are commonly applied to horses in practice.

Anestrus, transitional, or irregularly cycling mares may also benefit from acupuncture. As discussed previously in this paper, acupuncture may help rebalance or regulate the hypophyseal–pituitary–gonadal axis, thereby helping establish or enhance normal cyclicity. An unpublished acupuncture protocol involves the use of GnRH and prostaglandin $F_{2\alpha}$ injected into select points for three consecutive days to induce follicular development. Anecdotally, most mares will cycle within 2 weeks, or the treatment is repeated. Regimens for lactational anestrus have also been described using acupuncture in addition to conventional therapy, including sulpiride, GnRH, eFSH, increased dietary caloric density, and increased light exposure [28]. Acupuncture has also been used to treat show horse mares with irregular cycles or excessive behavioral estrus, again based on the premise that treatment helps regulate and normalize reproductive hormones.

Acupuncture should be used with care in pregnant mares, and Traditional Chinese medicine (TCM) teaches that certain points are to be avoided. Strong acupuncture stimulation or stimulation of particular points is thought to cause abortion, although consistent evidence is lacking to support this. Treatment with electroacupuncture is typically not used in pregnant mares; in contrast, dry needles, moxibustion, or other external stimulation, may be utilized. It is proposed that acupuncture aids in stimulating uterine blood flow, perhaps decreasing inflammation such as that occurring with placentitis. Acupuncture treatment may also improve general well being in pregnant mares by

relieving subclinical musculoskeletal pain. To this author's knowledge, no specific studies have been conducted or published on pregnant mares.

Acupuncture has also been used to treat a variety of other reproductive conditions in mares, including endometritis, retained placenta, post-partum hemorrhage, systemic endocrine abnormalities such as Cushing's disease, and agalactia. Treatment success will be dependent on technique and case selection, and consistent data are lacking to objectively assess effectiveness for these conditions. As mentioned previously, acupuncture is also used for pain relief, which may enhance fertility in mares suffering from acute or chronic musculoskeletal conditions.

5. Use in stallions

Acupuncture treatment in stallions has not been described as consistently as it has been in mares, however, it is well accepted that existing musculoskeletal pain can have deleterious effects on stallion libido and ability to breed. There are many studies that document acupuncture for its use in pain management and muscle relaxation [29,30]. Reduction of inflammation, relief of myofascial pain, and improved range of motion are benefits of acupuncture utilized commonly in performance horses [30,31]. Treatment of stallions with existing back soreness, orthopedic disease, or neurologic disease is potentially very beneficial for their behavior and libido, purely from an anti-inflammatory perspective. Many of the clinical complaints of stallions that are problem breeders may fall into this group. A comprehensive exam for evidence of pain or inflammation, either related to the reproductive tract or not, can help establish an indication for treatment with acupuncture in breeding stallions.

Unpublished protocols have also been described for treatment of cryptorchid colts with acupuncture alone, as well as injection of human chorionic gonadotrophin (hCG) (5000 IU) injected into Bai Hui and counter-irritant (iodine), injected bilaterally into BL23 and BL52. Multiple doses of hCG (2500 IU) were given to prepubertal colts twice weekly (for eight treatments) to induce descent of a testis retained in the inguinal canal; that plasma testosterone concentrations increased following hCG supported the role of testosterone in testicular descent [32]. A similar study could be conducted using an acupuncture protocol alone to see if the mechanism and efficacy is comparable. If so, acupuncture could provide an advantage over the more conventional study by decreasing the number of treatments and associated cost.

Acupuncture has also been used to treat stallion behavioral issues that may or may not be related to inflammation or pain. Based on the supposition that acupuncture helps reset or regulate the hypophyseal–pituitary–gonadal axis, it may help stallions with libido or aggression issues that may be hormonally based. Assessment of an individual using a TCM examination, along with conventional diagnostics, can help design a treatment plan on a case-by-case basis.

6. Discussion

Although the desire in Western medicine is to correlate a direct cause and effect response, this may be more difficult when assessing the therapeutic value of acupuncture. Despite much evidence that acupuncture produces a response from the body, which can be objectively measured in certain instances, an understanding and ability to consistently predict that response can be elusive. As a practitioner who utilizes acupuncture as an adjunct therapy to Western medicine, I would love to see conclusive data that outlines and defines acupuncture's exact mechanism of action. However, the nature of acupuncture and TCM is more subjective, and fundamentally differs from Western thinking. Therefore, it seems more challenging to design thorough evidence-based Western medicine studies to evaluate the value of acupuncture.

The intent of acupuncture treatment is to address each animal as an individual, assessing and re-establishing balance within the system, so true 'protocols' for group acupuncture studies are somewhat contradictory to TCM philosophy. However, measuring blood concentrations of reproductive hormones, or objectively grading uterine fluid, certainly helps us understand and qualify the value of acupuncture for use in equine reproduction. It should be noted that acupuncture is most successfully used as an adjunct therapy and integrated into a comprehensive approach with Western medicine. Although the two systems have substantial differences in their theoretical basis, they are not incompatible. Although acupuncture physiology and efficacy has yet to be thoroughly defined in a traditional Western medicine sense, current research demonstrates a case for continued use as well as further investigation. This approach should result in successful selection and treatment of certain reproductive conditions in the horse.

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