New is the well-forgotten old: The use of dry cupping in musculoskeletal medicine

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Received 30 August 2015; received in revised form 6 October 2015; accepted 30 October 2015

KEYWORDS
Cupping; Musculoskeletal pain; Dry cupping

Summary  Cupping is an ancient technique used in treating pain and various disorders. Different techniques have been developed over time, however, applying a cup to create suction over a painful area, is common to all. Dry or fire cupping, used on the intact skin, leaves bluish circular hematomas. Recently, interest in cupping has re-emerged and subsequently, several studies have begun to investigate the mechanisms of cupping therapy. Mechanically, cupping increases blood circulation, whereas physiologically it activates the immune system and stimulates the mechanosensitive fibers, thus leading to a reduction in pain.

There is initial scientific evidence that dry cupping is able to reduce musculoskeletal pain. Since cupping is an inexpensive, noninvasive and low-risk (if performed by a trained practitioner) therapeutic modality, we believe that it should be included in the arsenal of musculoskeletal medicine. It is essential to perform additional studies clarifying the biological mechanism and clinical effects of cupping.

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History: cupping therapy in different cultures

Cupping has been practiced in most cultures in one form or another throughout history but the true origin of cupping therapy remains uncertain. Although it is believed that cupping therapy dates back to as early as 3000 B.C.E., the earliest record describing cupping as the removal of “foreign matter” from the body was found in the Egyptian Ebers Papyrus in 1550 B.C.E. (Nickel, 2005). Subsequently, cupping was introduced to the Greeks and eventually spread to many other countries in Europe and America. Cupping was practiced by many famous physicians such as Galen (131–200 C.E.), Paracelsus (1493–1541) and Ambroise Pare (1509–90), in addition to other practitioners including barber surgeons and bath house attendants.

http://dx.doi.org/10.1016/j.jbmt.2015.11.009
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Cupping was widely used into the late 1800’s by European and American physicians (Turk and Allen, 1983). In the Soviet Union, cupping was in practice until the late 20th century (Pokrovski, 1991).

The clinical efficacy of cupping was confirmed by a joint research project between Chinese and Russian acupuncturists (Chirali, 1999). Since 1999, cupping has been accepted as an official therapeutic practice in Chinese hospitals. A Korean survey in 2006 showed that 93.5% of 6708 oriental physicians used cupping treatments in their clinical fields (Han et al., 2006).

Although cupping is practiced in Eastern and Western cultures, the theories and basis for its application differ. Eastern medicine believes that diseases are caused by stagnant or blocked Qi, the life force; cupping is able to unblock and correct imbalances in the flow of Qi, thereby, leading to a greater well-being (Tham et al., 2006). Galen’s teachings regarding four basic body fluids (humors) were used as a theoretical background for cupping. Greek physicians believed that the cupping drew pathogenic features to the surface, thus, facilitating their elimination (Kose et al., 2006). Medieval European practitioners used cupping as a means of expelling evil spirits. In 1920, Epstein proposed a “counter-irritation” explanation, referring to cupping as a process of transferring discomfort and pain from one site to another thereby curing the original site (Epstein, 1920). A psychosomatic theory advocated by several researchers hypothesized that the therapeutic effect of cupping could be attributed purely to a placebo effect (Kouskoukis and Leider, 1983; Yoo and Tausk, 2004).

Although cupping was used to treat pain and a variety of other complaints for thousands of years, it nearly disappeared from the therapeutic spectrum of Western medicine during the late 20th century. Nevertheless, during the past few years, interest in cupping has increased and new clinical trials suggest that cupping may be effective in managing painful conditions (Farhadi et al., 2009; Kim et al., 2011; Lüdtke et al., 2006).

Numerous investigations and review papers have begun studying wet cupping (that including small incisions made on the skin to cause bleeding). This method is invasive and cannot be performed by most practitioners who deal with musculoskeletal disorders (physical therapists, osteopaths, massage therapists, etc.). Our review concentrates on dry cupping, a noninvasive procedure, that if found effective can be easily included in the arsenal of therapies focusing on musculoskeletal disorders.

**Methods of cupping**

Cupping is traditionally performed by using a small round cup made of thick glass with a rolled rim to ensure uniform and air-tight contact with the skin in order to preserve a vacuum effect (Kravetz, 2004). Cups are also made of bamboo, earthenware and other materials. Negative pressure is created by heating the air within the cup, then allowing it to cool and contract while in contact with the skin. The air is heated either by swabbing the interior of the cup with alcohol then setting it aflame or by igniting an alcohol-soaked cotton ball or other flammable materials held inside the cup (Kravetz, 2004; King and Davis, 1983; Kouskoukis and Leider, 1983; Look and Look, 1997). Just before the flame is extinguished, the mouth of the cup is positioned firmly against the skin at the desired location. The suctioning effect produced by the vacuum anchors the cup onto the skin, drawing it upwards into the cup. Today, cupping is frequently carried out using plastic cups and a manual hand-pump to create the vacuum. To cover a wider area, lubricants can also be used to move the cup around once placed on the skin (Turk and Allen, 1983).

The most common sites of application are the back, chest, abdomen and buttock — areas of abundant muscle (Yoo and Tausk, 2004). Traditionally, cupping is performed in sets of four, six or 10. The cups are typically left in place for 5–20 min or more. The longer a cup is left on the skin, the more of a circular mark is created (Kouskoukis and Leider, 1983).

The after-effects of cupping include erythema, edema, and ecchymosis in a characteristic circular arrangement. These bruises may take several days to several weeks to diminish (Yoo and Tausk, 2004; Manber and Kanzler, 1996). Cupping has unique morphologic features. Family physicians and dermatologists should be made aware of this technique as it is becoming more and more widespread.

**Mechanical effects of cupping**

Tham et al. (2006) demonstrated in a soft tissue model that the soft tissue directly under the rim of the cup compresses, while the periphery tenses. The tensile stresses appear to be greater in the bulb-shaped region under the center of the cup, extending down to the muscle layer. However, these forces reach their maximum on a very small area of the skin layer near to and just inside the cup’s rim. This is probably caused by the stretching of the skin and the underlying soft tissue layers when drawn into the cup by the applied vacuum.

The cups typically used for cupping, range in diameter from approximately 38 mm–50 mm. Tham et al. (2006) observed that maximum stress was found in a larger cup and minimum stress in a smaller cup, located along the axis passing through the center of the cup. Therefore, it may be assumed that a small cup will not be able to exert the force required to make any difference. For constant vacuum pressure, a larger cup is able to exert a higher stress at the interface between the fat and muscle layers. These results are consistent with the experimental data reported by Hendriks et al. (2006) in a study describing the mechanical behavior of the skin using different diameter suction devices. Hendriks’s data clearly show that increasing the diameter of the suction device leads to larger skin-surface displacements, resulting in a correspondingly larger uplift and resulting stress at the underlying tissue layers.

The larger compressive stresses were found associated with a sharper cup rim which caused more pain and discomfort to the patient (Kravetz, 2004). It was therefore, recommended that cups with more rounded rims should be used (Kravetz, 2004). This rounded rim is commonly referred to as a rolled rim or rolled edge.
Zhao et al. (2009) studied the effects of time and negative pressure on the cupping mark color. Cupping was performed on 12 sites on the back of a healthy subject. Thirty-four persons were included and the amount of time the cup was in place was recorded. The cupping mark color at each site was assessed 24 h after the procedure using a cupping mark color atlas as a reference. The amount of time the cup was in place, either 10 min, >30 min, >20 min, had a statistically significant effect on the cupping mark color. The effect of −700 hPa, >−600 hPa, >−500 hPa, >−400 hPa pressure on the cupping mark color was also significant. The application for 10 min and a pressure of −400 hPa, produced a marked ecchymosis on the cupping site, which became darker and darker along with increased stimulation intensity.

Huber et al. (2011) compared four methods of producing a vacuum: a 2 cm lighter flame, a 4 cm lighter flame, an alcohol flame and mechanical suction with a balloon. They found that all methods yielded consistent pressures, however, large differences in magnitude were observed between methods (mean pressures: 200 ± 30 hPa with a 2 cm lighter flame; 310 ± 30 hPa with a 4 cm lighter flame; 560 ± 30 hPa with an alcohol flame; and −270 ± 16 hPa with a balloon). Mechanical suction with a balloon showed the best reproducibility.

Physiological effects of cupping

There are various hypotheses, both traditional and scientific, that have endeavored to explain the effects of cupping. Nevertheless, there is still no reliable scientific data clarifying the exact mechanism which can determine the therapeutic effect of cupping.

One theory inferred by several authors is that cupping increases the circulation surrounding the treated area, thus enabling toxins trapped deep in the soft tissue layers to rise to the body surface (Kouskoukis and Leider, 1983; Look and Look, 1997; Yoo and Tausk, 2004). The consequences of the cupping treatment are a direct result of the stress developed within the skin layers (Tham et al., 2006). The skin has a very rich blood supply (Gawkrodger, 2002) and the arteries in the subcutaneous tissue layer branch upwards into the dermal layer to form a superficial network, very close to the skin’s surface (at the papillary-reticular dermal boundary). The existence of high tensile stresses inside the cup is believed to cause a severe dilation of the capillaries, leading to rupture (Tham et al., 2006; Zhao et al., 2009). The tension stresses also cause ecchymosis produced by the escape of blood into the tissues after the rupture of the blood vessels.

In traditional Chinese medicine (TCM), the principles of acupuncture and acupressure are very similar to that of cupping therapy. For this reason, TCM practitioners will occasionally apply cupping to acupoints. Of all the hypotheses suggested to-date attempting to explain the pain-relief effects of acupuncture analgesia in scientific terms, the most comprehensive is the neural mechanism theory (Pomeranz, 2001) which states that acupuncture analgesia is prompted by the stimulation of the small diameter nerves in muscles, which then send impulses to the spinal cord. The three neural centers — spinal cord, mid-brain and pituitary — are subsequently activated, releasing chemical transmitters, such as monoamines and endorphins, thus blocking the pain messages. In addition, Schulte demonstrated that acupressure and acupuncture analgesia can elicit the release of morphine-like substances (endorphins), serotonin or cortisol which can lead to pain relief in addition to changing the physiological state of the individual (Schulte, 1996). It was found that acupressure and acupuncture work by stimulating or activating: 1. vasoconstriction and dilation; 2. a neurotransmitter release; 3. enkephalin secretion; 4. the immune system and 5. the pain gates (according to the gate control theory) in the central nervous system which interpret pain sensation (Anon, 1998; Schulte, 1996). TCM, including acupressure and acupuncture, have proven useful in pain management (Schulte, 1996; Cadwell, 1998; Hinze, 1988). The effect of dry cupping apparently can be explained by activation of the same pathways.

It has been proposed that cupping can affect the immune system in two ways: by irritating the immune system thus causing local inflammation, which subsequently activates the complement system and increasing the level of the tumor necrotizing factor (TNF) and interferon; or by increasing the lymph flow (Ahmadi et al., 2008).

Cupping is a form of treatment by which somatic structures such as skin, subcutaneous tissue, fascia, etc. are favorably influenced by manipulation. Cupping has been hypothesized to improve performance at all neurophysiological levels (spinal cord, changes of milieu, environment and performance of the nociceptor) (Musial et al., 2013). It is likely that this manipulation of the skin and deeper tissue layers will stimulate the inhibitory receptive fields of cortically projecting multi receptive dorsal horn neurons or provoke diffuse nocuous inhibitory controls (Le Bars, 2002; Ji and Woolf, 2001; Woolf and Salter, 2000).

Deep relaxation, induced by cupping is an additional desirable effect, probably contributing to the general reduction of stress and directly affecting the motivational-affective pain processing network (Musial et al., 2013).

By generating a vacuum, cupping causes local edema, ecchymosis or minor bleeding from the capillary vessels (Tham et al., 2006; Zhao et al., 2009), therefore, it is logical to assume that the effect of cupping is, in some way, similar to autohemotherapy (Klemparskaya et al., 1986) (subcutaneous reinjection of freshly drawn autologous blood).

Treatment for musculoskeletal pain

Cupping is used for neuralgia or myopathy, headaches, stomach aches, insect bites, infections, etc., but one of the main complaints treated by cupping is pain, primarily musculoskeletal pain. According to a Korean survey, cupping is primarily used by physicians for treating musculoskeletal diseases (96%). The most frequently applied points are the neck and shoulders (94%) (Lee et al., 2008). Recent studies examining the efficacy of cupping treatment for various musculoskeletal disorders showed good results (Lauche et al., 2011; Cramer et al., 2011; Kim et al., 2012; Markowski et al., 2014; Teut et al., 2012).
Pulsatile dry cupping was examined on patients with osteoarthritis of the knee and found to relieve symptoms of knee osteoarthritis compared to no intervention. The researchers concluded that further studies comparing cupping with active treatments are needed (Teut et al., 2012).

We found no studies on no-effect of negative effect of dry cupping. It is possible that this is due to a publication bias effect, where only positive results are published.

Complications of cupping

Cupping is considered a safe therapy with minor side effects such as erythema, edema, and ecchymosis which are directly caused by cupping. Because cupping encourages blood flow to the cupped region (hyperemia), the patient may feel warmer and/or hotter as a result of vasodilatation taking place. Slight sweating may occur.

There are a few contraindications for cupping such as pregnancy or menstruation, cancer (metastatic) and bone fracture. Also, cupping cannot be applied to a site of deep vein thrombosis, arteries or areas where a pulse can be felt, i.e. an area where the dermis or flesh is injured or compromised as in sunburn, abrasion, rash or contusion (Chirali, 1999). Some complications may ensue due to a long duration of cupping therapy (more than 20 min) or a high vacuum pressure which may cause separation of the epidermal layer from the dermal base of skin.

In a case report by Ling and Wang, a man who had received cupping therapy while aboard his private airplane, presented to the emergency department with tingling and a painful sensation felt on his back. Multiple blisters within circular marks of differing sizes and varying shades of redness, petechiae, and ecchymosis were found. Upon further observation, it was deduced that these symptoms were a result of changes in atmospheric pressure related to the unexpected descent of the plane which had increased the negative pressure in the cups (Lin et al., 2009).

In another case report, a woman reported that cupping had been performed on her lower back two weeks previously in order to relieve her back pain. However, the cup was held on her skin for over 40 min. She experienced intense pain soon after the procedure. Bullae and crusting subsequently developed over the area within the ensuing week (Tuncez et al., 2006).

Another complication that can occur due to cupping is a skin burn. Despite several documented single case reports of burn injuries caused by cupping (Iblisher and Stark, 2007; Kose et al., 2006; Sagi et al., 1988), no systematic reviews of this complication have been published.

According to Zhao et al. (2014), burn injuries occurring during cupping therapy are usually a result of one of the following: 1) the practitioner uses an excessive amount of alcohol to moisten the inner surface of the cupping vessel (this is the most common reason for patients presenting to the author’s department with burns); 2) the container holding the alcohol was accidently knocked over during cupping therapy; 3) the materials used to start the fire needed to produce a vacuum effect, caused the burn injury. Practitioners usually use a piece of paper or cotton soaked with alcohol to heat the air before an application. In
Some cases, a hasty practitioner applies the cupping vessel to the treatment site before the alcohol has burned away which subsequently results in a burn; 4) therapy may continue for too long (i.e., more than 30 min) or the skin is very sensitive to heat (e.g., in some older people the skin is thin and vulnerable, while in some children the skin is too tender to tolerate the hot cups). Treatment, complications and residual effects of burns sustained from cupping do not differ from other burns.

Additional complications may occur as a result of contamination. Nowadays, cups are made of glass or plastic. While cupping, blood may be drawn into cups. Small amounts of blood or fluid may express into the cups and may or may not be related to excessive suction force, skin fragility or hydration. Blood-borne pathogens may not be visible to the naked eye and therefore, there may be a risk of transfer of these pathogens (Nielsen et al., 2012).

Although a Medline and Chinese language database search revealed no reported cases of blood-borne pathogen transmission through cupping devices, disease transmission may be unidentified because the possibility has not been considered. When cupping, blood or body fluids may contaminate the cup and the skin area. The re-use of contaminated cups without decontamination can expose other patients to blood-borne pathogens.

Complications as well as transmission of infection have been documented as originating from cupping. Factual panniculitis and herpes simplex virus have been reported secondary to cupping demonstrating that transmission of blood-borne pathogens can occur (Lee et al., 1995; Jung et al., 2011). As a result of this report, there is a need for caution in removing cups containing blood or body fluids with respect to the potential for splash or aerosol formation upon the release of suction. Cups used for dry cupping should be cleaned, washed (immediately after use) and disinfected with a high level, registered hospital-grade disinfectant before reuse or disposal (Nielsen et al., 2012).

There is a greater risk for epidermal separation when using pumping cupping rather than a vacuum caused by a flame; on the other hand the risk for acquiring a burn is much greater during the second method. Taking into consideration all the aforementioned data, we recommend that cupping therapy be performed by practitioners with training in the art of cupping. The training should include the intensive practice of cupping application, as well as information on contraindications and precautions.

Conclusions

The existence of high tensile stress inside the cup causes severe capillary dilation leading to its rupture. Capillary rupture, the cause of ecchymosis, typically remains after cupping therapy. In a larger cup, the stress forces are greater than in a smaller cup; therefore in order to achieve maximal results, the largest cup possible should be used.

The physiological effect of cupping expressed in the activation of the immune system by causing local inflammation and activation of the complement system, also affects the thymus and increases the lymph flow. Cupping also stimulates the mechanosensitive Aβ fibers which reduce nociceptive input. More intense stimulation activates the C and Aδ fibers in the affected areas, thereby raising the inhibitory receptive fields of cortically projecting and provoking diffuse noxious inhibitory controls. In addition, cupping probably strongly impacts relaxation and may serve as a social, comforting interaction. Further investigations of these mechanisms of action are necessary.

As was found in several studies (Cramer et al., 2011; Hong et al., 2006; Lauche et al., 2011, 2012), cupping application seems to be effective in treating various musculoskeletal pain conditions. However, further studies are necessary to confirm these results and evaluate the effectiveness of cupping compared to standard treatments. Studies investigating the effects of repeated interventions in different intervals and long-term observations are needed as well.

Complications of cupping are rare and in most cases result from the therapist’s incompetence (Cao et al., 2012, 2010; Cramer et al., 2011; Kim et al., 2011; Teut et al., 2012). On the other hand, some complications can be serious, such as a skin burn and contamination (Iblher and Stark, 2007), we, therefore suggest that cupping be employed only by practitioners who have undergone specific, supervised training.

The results of reviewed studies and patients’ experiences with cupping therapy support the assumption that cupping is a safe and effective treatment for musculoskeletal pain conditions and can be used as a therapeutic technique in musculoskeletal medicine.

Financial sources

None.

Conflicts of interests

None.

Acknowledgments

The authors thank Mrs Phyllis Curchack Kornspan for her editorial services.

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