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Opinion

Glucopuncture: Series of Regional Multiple Glucose 5% Injections

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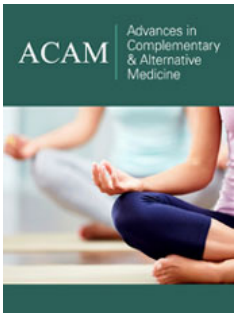

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Definition

Glucopuncture is an injection-based therapy for the management of musculoskeletal conditions. It consists of multiple local injections with glucose or dextrose in low concentrations. These injections of G5W (Glucose 5% in Water) or D5W (Dextrose 5% in Water) seem to have a favorable effect on the repair mechanisms of damaged or inflamed tissues such as muscles, tendons, ligaments, cartilage, and peripheral nerves. The exact mechanism of action is not well understood and is likely multifactorial. Large randomized controlled trials are warranted to make specific recommendations regarding ideal protocols and indications. The introduction of a new term to describe these injections might give more exposure to its possible benefits among both patients and professional health care providers.

Keywords: Glucopuncture; Injection; Dextrose; Protocols; TRPV1 receptor; Scar tissue; Osteoarthritis; Glucose; Prolotherapy; Aerobic respiration; Cell metabolism; ATP-based theory; Primary sensory axons; Neurogenic inflammation; Chronic rotator

History

Glucose and dextrose injections have been used for decades in prolotherapy [1-26]. Prolotherapy - also known as proliferation therapy - is an injection technique which uses high concentrations of dextrose (more than 10% net concentration). Lidocaine is added to make the injections less painful. One of the aims of such hypertonic injections is to create an inflammatory reaction and / or stimulate formation of scar tissue in ligaments [27]. It is postulated that these dextrose injections stimulate tissue repair through growth factors and modulate pain modulation through agonism of TRPV1 receptor. As an increased matrix metalloproteinase (MMP) activity plays a major role in degradation of articular cartilage in patients with osteoarthritis, it is interesting to realize that glucose decreases IL-1β-induced MMP-1 expression in chondrocytes [28].

In prolotherapy, injections are given mainly into joint cavities, entheses, tendons and ligaments. It is suggested that prolotherapy can be as efficient as corticosteroid injections in the treatment of, for example, lateral epicondylosis [29,30], failed rotator cuff repair surgery [31] and chronic rotator cuff lesions [32]. It is also an interesting treatment modality in the treatment of osteoarthritis [33,34].

Over the last decade, low concentrations of dextrose 5% have become more popular [35-38]. These injections are administered into muscles, in the epidural liquid, near peripheral nerves [39], around tendons and in the skin. As the clinical effect is usually temporary, the sessions need to be repeated on a regular basis to achieve clinical effect. Although treatment protocols vary a lot, most physicians are using series of weekly injections of glucose 5% without adding local anesthetics in the treatment of osteoarthritis, carpal tunnel syndrome, back pain, sports injuries, whiplash, failed back surgery syndrome, regional pain syndrome and neuropathic pain.

The ATP Hypothesis

Glucose is a monosaccharide which functions as a precursor for many carbohydrates found in organisms. It is considered as the prime energy source for cellular health. One glucose molecule result in 38 ATP molecules during the aerobic respiration. The conversion of ATP into ADP releases 30.6kJ/mol energy to the cells. In other words, glucose can be considered as a provider of energy to the cell metabolism.

When tissues are damaged because of trauma, overuse or other causes, the cells need to regenerate as quickly as possible. This tissue regeneration requires an additional amount of energy. When energy supply is limited, complete recovery of the tissue may be slow or even impossible, leading to poor tissue healing. It is postulated that injecting glucose in the extracellular space of the damaged tissue may enhance ATP supply to the cells and as a result support and speed up local recovery. However, there is no strong evidence for this hypothesis so far. Only one study seems to support (partially) this ATP-based theory. In this recent study the authors have illustrated that injecting ATP in the spinal cord stimulates regeneration of primary sensory axons [40].

In the last decade, more findings about injections of low concentrations of glucose have been published. A prospective, randomized, double-blind, controlled trial illustrated a six-month efficacy of perineural dextrose for carpal tunnel syndrome [41]. Dextrose 5% injections also seem to be beneficial for patients with chronic low back pain (failed back surgery syndrome) [42]. Epidural injection of 5% dextrose is reported to reduce pain temporary, but a waning pain control at 2 weeks suggests the need to assess the effect of serial dextrose epidural injections [43]. Caudal epidural injection of 10mL of D5W (without anesthetic) every 2 weeks for 4 treatments and then as needed for 1 year resulted in a consistent pattern of post injection analgesia [44]. This suggests a potential sensorineural effect of serial dextrose injections on neurogenic pain, probably by targeting the peptidergic nociceptors. One proposed mechanism of action suggests that dextrose binds to presynaptic calcium channels and inhibits the release of substance P and CGRP, thereby decreasing neurogenic inflammation [37].

These observations generate the idea that glucose 5% injections (without anesthetic) might be an inexpensive and safe option in the treatment of sports injuries, carpal tunnel syndrome, musculoskeletal pain, whiplash, regional pain syndrome and osteoarthritis. In contrast to cortisone, longer series of such injections every week or every two weeks have little or no side effects. The downside of Glucopuncture is that more sessions are needed to attain symptom resolution when compared to cortisone injections or to PRP injections [45,46], although one study showed that intraarticular glucose injections in the sacroiliac joint produced longer lasting effects than those of steroid injections [47]. In other words, steroid injections provide probably better results on the short run while glucose injections may be superior when it comes to long term results.

Clinical Application of Glucopuncture

Glucose in a five percent water solution (G5W) is a sterile liquid which can be injected without adding a local anesthetic. Adverse reactions are not well documented but appear to be extremely rare (e.g., itching, allergic dermatitis). Temporary injection site tenderness and bruising are the most frequently reported side effects. Injections are given intracutaneously, subcutaneously, in joints and into muscles. Glucose 5% can also be injected around tendons, ligaments, and peripheral nerves. Usually multiple injections (5 to 10 injections) are given in the zone of tissue repair or in the pain zone (the zone which the patient points out as the painful area). Needles frequently used are 30G (1/2"), 27G (3/4" or 1 1/2") and 23G (3"). The total volume injected varies from 5 to 15ml in each treatment zone. In acute cases, injections are given once or twice a week, and one to five sessions might be necessary. In chronic cases, five to ten sessions (first once a week and then every two weeks) might be needed to attain tissue repair and / or lasting pain relief.

When glucose (or dextrose) is injected in normal healthy tissue, the influence on cell metabolism is minimal. But it is hypothesized that when glucose is injected in tissues which lack energy supply, the added extracellular glucose may lead to more ATP production in the cell and thus support the natural repair processes in those damaged cells. When injected into a muscle tear, the muscle fibers seem to heal quicker and better [48]. As a result, it seems an interesting option to use injections of G5W in trigger points for the treatment of myofascial pain. Glucose injections are also applied in peripheral nerves. Especially chronic inflamed nerves seem to react well to Glucopuncture. Even the peripheral nerve endings in the skin and under the skin recover quicker from neural inflammation when injected with glucose 5%. More clinical research might illustrate the hypothesis that chronic regional pain syndrome [49] might be treated successfully and safely with subcutaneous (SC) or intracutaneous (IC) glucose injections.

Conclusion

Glucopuncture is a new term to describe regional multiple injections with glucose 5%. It is hypothesized that a series of sessions of multiple injections of glucose 5% supports the repair of damaged tissue such as muscles, tendons, ligaments, cartilage, and peripheral nerves. This injection technique can be applied as a single or as an adjuvant modality in the treatment of sports injuries, posttraumatic pain, osteoarthritis, neuropathic pain, and myofascial pain. More clinical and fundamental research in this area is necessary to verify the mechanism of action, safety, and long-term results of this technique.

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