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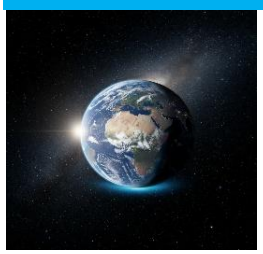

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Dextrose as an effective agent in the treatment of entrapment neuropathies by Hydrodissection

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Abstract

Background. Entrapment neuropathies are a diverse group of peripheral nerve disorders caused by the compression and irritation of nerves at structurally narrow areas. More recently, interest has grown in the novel minimally invasive ultrasound-guided method in the treatment of entrapment neuropathies: nerve hydrodissection. This emerging procedure involves the injection of various substances around the nerve to separate it from surrounding tissues in order to allow for decompression and healing. Among injectable agents, 5% dextrose in water (DW) has gathered much interest because of its favorable properties. **Aim.** The objective of this study was to describe potential mechanisms of action, efficacy and safety of 5% dextrose in water in the management of entrapment neuropathies via hydrodissection based on recently published studies. **Materials and methods.** This study is a narrative review. Articles related to nerve hydrodissection with 5% dextrose in water published from 2020 (past 5 years) were included. **Results.** Hydrodissection by 5% dextrose in water significantly improves both symptoms and functions in various neuropathies. The application of 5% dextrose and water solution appears to have been explored extensively as a treatment for carpal tunnel syndrome. Compared to other treatments, including corticosteroids and local anesthetics, this solution shows a more sustained response and a good safety profile, with no adverse reactions reported. However, the true mechanism of action of 5% dextrose and water remains unclear. Proposed mechanisms include modulation of TRPV1 receptors, thereby playing a role in the attenuation of neuropathic pain. **Conclusions.** Hydrodissection using 5% dextrose and water solution can be considered an effective modality of therapy for entrapment neuropathies, with its efficacy best proved in the treatment of carpal tunnel syndrome.

Key worlds: nerve hydrodissection, entrapment neuropathy, 5% dextrose in water, ultrasound-guided

1. Introduction

Entrapment neuropathies are a diverse group of peripheral nerve disorders caused by the compression and irritation of nerves at structurally narrow areas. These disorders usually manifest in patients as pain, paresthesias, and sensory changes, and eventually proceed to muscle weakness and atrophy in the advanced stages [1,2]. These disorders may occur in the athletic population, as intense physical activity may lead to chronic compression of neural structures in the upper and lower limb [3,4]. Although their incidence is also relevant in the general population. Among the entrapment neuropathies, the most widely distributed disorder is the carpal tunnel syndrome (CTS), and other disorders of the ulnar nerve at the elbow [5,6,7]. CTS incidence alone varies between 5% and 16% of the population, depending on region [1]. Conservative treatment for entrapment neuropathies typically includes modifications of physical activity, bracing, non-steroidal anti-inflammatory drugs, physiotherapy, and patient instruction. While a number of patients benefit from these measures when the neuropathy is in its early stages or milder in presentation, many eventually need to undergo decompressive surgery after failed conservative treatment when symptoms persist or escalate [8]. In CTS, 57–66% of patients require surgical treatment after unsuccessful conservative therapy within up to three years of its initiation [9]. In cubital tunnel syndrome, only 44–66% of patients experience resolution of symptoms within one year after conservative treatment [10]. On the other hand, decompressive surgery carries the risks of the perioperative complications and is not effective in every case [11, 12]. Thus, with limited effectiveness in the treatment of entrapment neuropathies, a new therapeutic technique could prove to be beneficial.

More recently, interest has grown in the minimally invasive ultrasound-guided method in the treatment of entrapment neuropathies: nerve hydrodissection (HD). This emerging procedure involves the injection of various substances around the nerve to separate it from surrounding tissues in order to allow for decompression and healing. Several injectable agents have been suggested for the purpose of HD. These range from the use of normal saline, steroids, platelet-rich plasma, hyaluronic acid, hyalase, to 5% dextrose in water [13]. Of these, 5% dextrose in water (DW) has gathered much interest because of its favorable properties and promising clinical outcomes. Therefore the objective of this study was to describe potential mechanisms of action, efficacy and safety of 5% dextrose in water in the management of entrapment neuropathies via hydrodissection.

2. Materials and Methods

This study is a narrative review of the recent literature on the effectiveness of hydrodissection by 5% dextrose in water in the treatment of entrapment neuropathies of different anatomical locations. We searched PubMed, BioMedCentral, and ScienceDirect databases in September 2025 with the phrase “nerve hydrodissection“ or “nerve hydro dissection“. Studies that referred to nerve hydrodissection with 5% dextrose in water, as injectate were included. Articles published from 2020 (past 5 years) were included in this study. We focused on reviews and RTCs, as they represent the highest level of evidence, although studies with lower hierarchy were also included, especially when we reported on less common entrapment neuropathies with less incidence.

3. Results

3.1 Mechanism of Action

The presumed clinical benefits DW in hydrodissection (HD) are thought to be related to both mechanical and biochemical processes. Firstly, on mechanical principles, the injected fluid agent produces a mechanical separation between the nerve and the surrounding tissues, reducing intraneural pressure along with breaking adhesions and increasing neural mobility. Mechanical decompression therefore promotes enhanced blood flow and nerve regeneration [13,14]. This purely HD-related process is not specific to dextrose solutions. However, a potential advantage exists with the use of DW as it is considered to possess its own biochemical properties. It is hypothesized that DW acts on nociceptive pathways by reducing nerve sensitization via inhibition of the transient receptor potential vanilloid 1 (TRPV1) receptor, which is involved in neuropathic pain [15]. A study by Bertrand et al. demonstrated that mannitol - a structurally similar substance to DW is capable of reducing capsaicin induced pain, triggered by TRPV1 activation [16]. Moreover, there is another potential mechanism confirmed in animal study. Han et al. found out that genetic deletion of ion channel 1a (ASIC1a), is associated with abolished DW-induced antinociception in mice with chronic hyperalgesia [17]. This channel may also be responsible for DW induced pain reduction in humans. While the precise action in human studies still remains incompletely confirmed, evidence from human studies illustrate that DW has better effect in HD than normal saline (NS), which has no active pharmaceutical agent [18,19]. Taking this into account, DW is likely to exert a unique pharmacological effect which, in combination with the mechanical effect of HD, appears to be

cumulative, resulting in superior outcomes compared with NS. Future studies should directly define the specific receptors and signaling molecules responsible for the attenuation of neuropathic pain in humans mediated by DW.

3.2 Effectiveness

It is appropriate to begin with the most recent meta-analysis on the topic of HD for carpal tunnel syndrome (CTS), which compared the efficacy of various injectates. Lee et al. conducted a comprehensive study of nine RCTs involving 458 participants, where experimental and control arms were administered distinct agents, including normal saline (NS), 5% dextrose in water (DW), corticosteroids (CS), platelet-rich plasma (PRP), and hyaluronidase. The primary endpoint was the Boston Carpal Tunnel Questionnaire (BCTQ), encompassing the Symptom Severity Scale (SSS) and Functional Status Scale (FSS). Treatment rankings were determined using the surface under the cumulative ranking (SUCRA) curve. DW exhibited the top SUCRA score for SSS (99.9 at week 4), while PRP led at weeks 12 and 24 (95.7 and 93.9, respectively). For FSS, DW ranked highest across all timepoints (99.9, 89.8, and 88.8 at weeks 4, 12, and 24) [20]. These results align with prior systematic reviews highlighting DW and PRP as superior for VAS (Visual Analogue Scale) and BCTQ improvements, offering more sustained benefits than CS or other substances [21,22]. Supporting retrospective evidence, confirms superior short-term (1 month) and mid-term (6 months) outcomes for DW and PRP relative to NS or hyaluronic acid (HA) [19].

Evidence for ulnar neuropathy remains sparse compared to CTS, likely due to its lower prevalence [6,7]. Building on CTS findings, Chen et al. performed a double-blind RCT in 33 patients with ulnar neuropathy at the elbow (UNE), comparing 5 mL DW against 3 mL CS (10 mg/mL triamcinolone acetonide) with 2 mL NS. No significant VAS differences emerged at 1, 3, 4, or 6 months, though DW outperformed from month 3, without the pain recurrences seen in the CS arm [23]. This parallels, previously mentioned meta-analysis data, as Wu et al. reported significant pain and disability reductions in DW versus steroid groups across 54 wrists from months 4 to 6 [24]. Potential reasons for non-significance in Chen et al. study include limited sample size or anatomical/pathophysiological differences between carpal and ulnar canal disorders. Hooper et al. 's case series of three UNE patients further endorsed DW-based HD, using perineural mixture containing: platelet lysate, 50% dextrose, 0.5% ropivacaine to create 5% DW solution. Baseline VAS scores (6/10, 6/10, 3/10) improved to 0/10, 0/10, and 1/10 at 18, 22, and 67 months post-HD [25].

Robust data for meralgia paresthetica (MP) stem from a landmark study—the first RCT and largest cohort to date. Shi et al. evaluated ultrasound-guided HD with 10 mL DW versus CS in 56 patients. Both reduced VAS pain and enhanced quality-of-life VAS scores, but DW yielded superior relief, clinical success (85.7% [24/28] vs. 50.0% [14/28] at 6 months), and zero adverse events (versus six in CS) [26]. Su et al. corroborated this in a 35-year-old with refractory 20-year MP. Seven ultrasound-guided 10 mL DW sessions over two months produced marked symptomatic, electrophysiological, and ultrasonographic improvements (reduced nerve swelling), advocating repeated injections for chronic cases [27].

For sciatica, Yoon et al. described a 51-year-old woman with progressive left-sided symptoms, sacrospinous ligament calcification, and sciatic nerve enlargement on imaging. Three ultrasound-guided HD sessions (4 mL 10% DW + 1 mL 2% lidocaine without epinephrine) plus rehabilitation reduced sitting/walking VAS from 10 to 2 within one month, normalized provocation tests, and restored function [28].

The mechanisms underlying DW's functional superiority are not fully elucidated, though it yielded the greatest sensory nerve conduction velocity (SNCV) gains [20,22]. CTS often impairs manual dexterity via sensory and proprioceptive deficits [39,30]. Therefore DW may uniquely restore these via enhanced conduction. Conversely, PRP's regenerative effects—driven by growth factors modulating phased inflammation (with repair in later stages)—explain its delayed SSS dominance at mid term follow-up after injection [31].

3.3 Safety

Procedures involving injections performed under ultrasonographic guidance, such as HD allow for real-time monitoring of needle placement. As a result, potential complications such as damage to critical structures, including blood vessels and nerves, which are also visible on imaging, can be minimized. An additional potentially beneficial feature of ultrasound-guided techniques is that imaging enables precise delivery of the medication to the target site, which is difficult to achieve when performing blind procedures. [32,33]. The adverse event profile related to DW in HD showed to be favorable based on recently published studies. In a systematic review gathering 10 studies about over 569 patients with entrapment neuropathy treated by different injectates, only one paper reported adverse events related to HD. Although these cases were related to corticosteroids and NS, not DW use. These included swelling at the injection site, pain at the injection site, swollen hand, and depigmentation at the injection site [22]. Sveva et al. in another systematic review confirmed these findings and concluded that

complications related to HD are generally very rare. Only 11 out of 923 patients included in their study had collateral or side effects after the procedure. Similarly, these were reported only in corticosteroid injection studies. Among these were long-lasting medial nerve injury with pain and sensory changes for more than 48 h after HD. Some patients reported mild discomfort during and after the procedure [34]. Accordingly, in a study by Shi at al. about meralgia paresthetica treated by either DW or corticosteroids, no patient in the DW group experienced an injection-related adverse effect. Six incidences (out of 28 patients) of adverse effects were reported in the steroid group, including 3 incidences of vasomotor symptoms, one incidence of local pain, and 2 incidences of menstrual disorders [26].

The above-mentioned studies conducted in large patient cohorts indicate that DW is a very safe substance when used for HD. Available data show that adverse events occur only in the group treated with corticosteroids. This is not surprising, as it is well known that locally administered corticosteroid agents may lead to complications such as post-injection flare, local infection, hypopigmentation, and skin atrophy, as well as tendon rupture and systemic adverse effects [35]. However, it must be remembered that for HD using DW to be considered safe, the procedure must be performed by an appropriately trained operator who is familiar with the technique. HD does not belong to simple interventions. During the procedure, the physician must simultaneously manipulate the ultrasound transducer with one hand while advancing and controlling the needle with the other. This requires adequate hand–eye coordination, dedicated training, and a thorough knowledge of sonoanatomy. Safety during HD is therefore determined not only by the type of substance used, but also by the experience and technical skills of the operator [13].

4. Discussion

Dextrose hydrodissection has cumulative evidence supporting its use in treatment for entrapment neuropathies. Its benefits appear to exist in CTS to a significant degree with the less data in other entrapment neuropathies. This agent is capable of improving both symptoms and function. Its proposed mechanism of action is probably a combination of mechanical effects and possibly influencing neurogenic inflammation or nerve sensitization [15]. It has advantages over CS, as it represents higher therapeutic efficacy with better safety profile. DW hydrodissection is probably more cost-effective than PRP and CS although it has not been investigated directly. We know that CS has low and unfavorable cost effectiveness in neuropathies [36]. On the other hand, PRP requires specialized equipment and trained personnel

which increases cost of procedure [37]. A 5% dextrose bag (500ml) is widely available for a few dollars. Therefore, it is the most favorable option from a cost perspective. The ideal volume of DW during HD procedure needs to be explored in future. Although based on available evidence volume between 4 to 10 mL should be recommended. Moreover, as for the current level of evidence, short-axis and long-axis HD methods have proven effective, with the short-axis technique being simpler for the beginner to perform [13,38]. Though the vast majority of the literature pertains to mild to moderate neuropathies, the exact role of DW hydrodissection in the advanced stages is yet to be established. In the setting of severe disease with extensive axonal degeneration, surgical decompression should be considered [8,39]. Furthermore, despite the evidence from randomized studies that DW is superior to both CS and NS, the possibility of a true placebo effect should not be ignored and there is a need for more placebo-controlled trials. Additional limitation of currently existing data include length of follow-up, which is a maximum of 6 months. Despite these limitations in existing data, it appears that DW in HD is safe and should be considered in conservative treatment for entrapment neuropathies.

5. Conclusions

5% dextrose based hydrodissection is a well-tolerated, minimally invasive, and effective method of managing compressive neuropathies, with the highest level of evidence for CTS. The action of this method combines mechanical pressure relief with a possible impact on pain pathways. It has a low complication risk and cost compared with other contrast agents. In the future, it is important to conduct large-scale randomized clinical trials with various types of neuropathies in order to better understand its role in clinical practice.

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