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Discography: Over 50 Years of Controversy

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ABSTRACT

Low back pain is estimated to affect 80% of the general population at least once in their lifetime. It is the fifth leading cause of medical clinic visits and the leading work-related disability. Lumbar discography has been used to diagnose the source of low back pain when noninvasive imaging, such as magnetic resonance (MR), does not reveal morphologic abnormality consistent with symptoms. Controversy regarding the usefulness of discography has been ongoing for over 50 years. Modern advancements with imaging and technique still have not been sufficient to justify the practicality of this procedure for standard use. Based on review of current literature, pain provoked by discography of normal appearing discs on MR were likely due to internal disc disruption, increased pain sensitivity, and false positive result with chronic pain, psychological state, central hyperalgia, and technical difficulty of the procedure. These causes of positive pain provocation are not amendable to invasive treatment. In these cases, an invasive diagnostic procedure to identify problems best treated with conservative management is not practical. The conclusion of this review found no clear evidence-based purpose for discography in the diagnosis and treatment of low back pain.

INTRODUCTION

Provocation discography is an invasive diagnostic procedure to identify pain originating within the intervertebral disc. Radiopaque contrast is injected into the nucleus pulposus to visualize specific morphological changes within the disc. Provocation of concordant pain that coincides with the patient's original complaint is used to identify the symptomatic disc.

Discography has been controversial since its beginning over 50 years ago. At that time, 3 major areas were defined as a cause of controversy. The first is difficulty with the technique. Much of this difficulty was attributed to relatively poor quality of imaging available at that time. Today, with modern imaging, this is much less of a concern. Current literature reveals that needle insertion and injection pressure variables are a major factor in reproducibility and validity of results, even with defined criteria regarding injection pressure relating to unequivocal discogenic pain.

The second controversy is regarding the disc itself. Not all damaged discs cause pain and not all pain is related to damage. Substantial research in this area has led to better understanding of the mechanical and biochemical causes of disc degeneration. Current studies show many derangements in the correlation of damage and pain. Discograms are based on anatomical findings and pain subjectivity, not biochemistry, on which the basis of certain disc diseases such as internal disc disruption (IDD) has more recently been described.

The third controversy deals with symptom interpretation. Traditionally, diagnostic studies with greater objectivity are considered to be most valid. Greater knowledge of neuropathic and psychologic causes of pain has done little to give some objectivity to pain provocation. We now realize that pain is multimodal and individuals without anatomically defined defects can have real pain. Therefore, objectivity cannot be infused into a subjective response by validating a pain scale or pain drawing criteria.

The purpose of this paper is to briefly describe the history of discography, describe the current use of discography, and explore the 3 historic areas of controversy with a modern literature review.

HISTORY

Doctor Knut Lindblom reportedly was the first to demonstrate discography by injecting red lead to visualize cadavaric discs. In 1948, he published the first description, stating, "Diagnostic disc puncture with injection of opaque medium demonstrates disc ruptures and protrusions, and tells if the patient's symptoms originate from

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the punctured disc. The method seems to be of great value."[1] More than 50 years ago, Lindblom reported that discography had not been popular in European countries due to (1) difficulty with technique, (2) too many ruptured discs with or without pain, and (3) difficulty interpreting produced symptoms.[1]

CURRENT USE

Discography is most commonly used to assist in finding the cause of low back pain (LBP). In many cases of LBP with suspected discogenic origin, discography was found to be the most sensitive diagnostic modality.

A study performed at the Medical College of Wisconsin by Yu et al concluded that MR cannot be used as effectively as discography to visualize radial tears.[2] Although the accuracy of determining high intensity zone (HIZ) and reactive end-plate (modic) change in disc degeneration on magnetic resonance (MR) are relatively specific, MR is not always sensitive enough to identify symptomatic disc levels.

Conversely, it is obvious that every radiographic abnormality does not cause pain. Discography can be a valuable tool when MR findings are too numerous; it helps narrow the diagnosis to what is clinically significant.

Therefore, lumbar discography is most commonly used to (1) identify symptomatic discs prior to possible lumbar fusion, (2) evaluate discs adjacent to spondylolisthesis, (3) confirm the identity of the symptomatic disc prior to percutaneous therapy, and (4) assist in cases complicated by prior surgeries. Discography has also been used to evaluate painful scoliosis and Schmorl's nodes, painful incompletely healed end-plate fracture, and established non-union vertebral fracture.

CONTROVERSY #1: TECHNIQUE

Misplaced needles are a cause of false-positive discography results. Needles placed or injection of contrast into the annulus instead of the nucleus pulposus may induce back pain. The error in needle placement is often seen as an asymmetrical accumulation of contrast localized to 1 side of the disc and not crossing the mid-line. A misplaced needle into the vertebral end-plate can cause false-positive results when injecting a normal disc.

Urasaki et al assessed the effect of needle tip placement on discograms from the same patient at different intervals of time. They found that if the second needle placement was different, the appearance of the injected disc differed significantly. These differences were less likely to be seen if the needle tip placement was consistent between the 2 discograms.[3]

Injection pressure is also a source of spurious results. Derby et al studied the prevalence of positive pain response in asymptomatic volunteers by using different injection pressures. They concluded that normal discs can become painful at higher pressure. Criteria extrapolated from their data would require the stimulation of the target disc to produce 6/10 concordant pain intensity at a pressure <15 psi above the opening pressure to diagnose true discogenic pain.[4]

CONTROVERSY #2: THE DISC

Normal discs have been shown to produce pain with discography. Abnormal discs will produce pain with stimulation, but not all abnormal discs are painful when stimulated.

Derby et al compared discography results of normal appearing discs of chronic LBP patients to normal appearing discs of asymptomatic subjects. Pain tolerance was shown to be significantly lower in the LBP patients. They postulated that chemical mediators, such as the enzyme phospholipase A2 may increase nociceptive sensitivity at the disc.[5]

The clinical characteristics of IDD are in part based on chemical mediators as well. IDD is a condition characterized by derangements in internal structure and metabolic function of the disc. In most cases of IDD, a specific episode of spinal trauma, such as unexpectedly assuming a heavy load of short duration, has occurred. After the injury, patients describe a deep-seated ache developing gradually over time. Their back pain becomes worse over several months and may coincide with feelings of heaviness or weakness in effected limbs. The pain may resolve only slowly with rest, and is problematic while lying in bed. They also may present with decreased energy and weight loss, and psychological problems. Depression is more often associated with IDD than any other spinal disorder.[6] The neurologic exam is usually normal, as well as plain films and computed tomography (CT) scans. MR may show signs of degeneration such as loss of nuclear signal. In the past, operation for suspected disc prolapse exacerbated their pain and led to greater disability.

The clinical characteristics of IDD are thought to arise from toxic catabolites of the affected disc entering the vascular system.[6] These products cause irritation of nerves in and around the disc, and possibly stimulate the immune system causing constitutional symptoms.

The catabolic products act as nociceptors on intradiscal and spinal nerves surrounded by thin-walled veins of the intervertebral plexus leading to spinal and limb pain. Therefore, pain produced by IDD is worsened by activities that force more irritant fluid out of the disc. This

may account for the observation of chronic LBP patients having pain with discography of normal appearing discs.

CONTROVERSY #3: SYMPTOM INTERPRETATION

Pain is a complex, individual, multi-faceted phenomenon that has cast the greatest shadow of controversy in discography interpretation. Several studies have been done to determine the relationship between pain provocation at discography and the subject's psychologic status. Black et al evaluated a series of patients with the Minnesota Multiphasic Personality Inventory. They found that patients with significant score elevations for hypochondriasis, hysteria, and depression were more likely to report pain during injection of normal discs. They concluded that pain production at discography is not only a function of disc pathology but also related to personality.[6]

Carragee et al studied pain response to disc injection in 26 patients with no history of LBP. Of these, 10 were asymptomatic, 10 had chronic arm or neck pain, and 6 had primary somatization disorder. Significant positive pain responses and pain-related behavior were found in 10% of the asymptomatic group, 40% of the chronic cervical pain group, and 83% of the somatization disorder group.

Carragee et al studied a group of patients without previous LBP who had undergone posterior iliac bone graft harvesting 2-4 months previously. A significant number of disc injections resulted in pain considered to be either similar to, or exactly the same as, pain experienced at the iliac graft site. This observation can be attributed to central hyperalgesia.[6]

Central hyperalgesia is a physiologic phenomenon in which a normally painless structure may feel painful when stimulated (the disc) if the actual source of pain (graft site) is innervated by the same or an adjacent spinal cord segment. Therefore, false positive and incongruent discography results can also be caused from previous non-related injury.

Various techniques have been reported to attempt to increase specificity of provoked pain response. These include visual pain scales, videotaped reactions, and patient pain diagrams. It was found that patients with pain drawings depicting a non-anatomic pain pattern were more likely to report concordant pain production during injection of non-disrupted discs.

CONCLUSION

Current literature regarding the 3 historic areas of controversy with discography—the technique, the disc, and symptom interpretation—has done little to prove that discography is more acceptable now than 50 years ago despite the many advances that have been made. An objective, technically talented physician will incur fewer false-positive results. Our imaging technology has improved. We have a greater understanding of disc pathology that explains how metabolic derangements produce a painful, normal appearing disc. Damage to nerves, self-limited, or varied degrees of metabolic dysfunction can explain painless discs that appear abnormal. We understand that depression and other psychologic and personality factors contribute to pain sensation. Psychometric testing is commonly done before discography. A careful history can describe the pain of IDD as well as unrelated pain from previous injuries.

Discography is not a benign procedure. It is painful, and has potential for complications. The simplest question to ask when considering lumbar discography is, "Will intervention relieve the symptoms?" If there is no indication for surgical or percutaneous treatment, discography has little purpose. Based on review of current literature, pain provoked by discography of normal appearing discs on MR are due to either IDD, increased sensitivity and false positive rate with chronic pain, psychological state, central hyperalgia, or technical difficulty of the procedure, all of which are not amendable to invasive treatment. Surgical intervention for IDD has been shown to exacerbate pain and lead to greater disability. Invasive diagnostic procedures to identify problems best treated with conservative management do not seem feasible in these instances. The conclusion of this review found no practical purpose for discography using an evidenced-based approach regarding the diagnosis and proper treatment of LBP.

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