CLINICAL PODIATRY





Objectives

After reading this paper

1) have a greater understanding of the common foot condition of intermetatarsal neuroma.

2) have an increased ability to make a differential diagnosis of the foot

3) be able to describe alternative options for treatment of the foot neuroma.

4) have a greater understanding of the conservative treatment of 4% alcohol injections in the treatment of nerve and keratot-

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By Gary L. Dockery, D.P.M.

ilute solutions of ethyl alcohol may be used to inject several types of lesions found on the foot and ankle region. This solution, usually a 4% dilution of pure ethanol, may be used to reduce or eliminate painful nerve lesions such as intermetatarsal neuromas, traumatic stump neuromas, nerve entrapments and painful scars. The solution may also be used to treat painful keratotic lesions on the foot, such as porokeratosis plantaris discreta, punctate keratotes, Continued on page 118

hemoma dura, heloma molle', pinch calluses and other hyperkeratotic lesions. In this CME article the recommended technique and uses of these injections are outlined.

Nerve Conditions

Intermetatarsal neuroma (also called interdigital neuroma, Morton's neuroma and Morton's metatarsalgia) is a very common condition that is considered by many to be caused by either an entrapment of the intermetatarsal nerve (the plantar proper digital



Figure 1: Pinch Test for intermetatarsal neuroma.

nerve) under the deep transverse intermetatarsal ligament or a mechanical foot imbalance that results in repetitive trauma and eventually in degenerative neuropathy.¹ This condition is often found in the third intermetatarsal space (between the third and fourth metatarsals) and is more frequent in females than in males. Intermetatarsal neuromas are more likely found in the excessively pronated foot but have been reported in both the rectus foot and cavus foot as well.² The author has successfully treated intermetatarsal neuromas with a series of dilute ethyl alcohol injec-

> tions and the results have been well-received by patients and documented to be better than other conservative treatments or surgery for neuromas.

Neuroma Symptoms

Most patients present with similar complaints, which range from numbness in the digital web space (usually between the third and fourth toes) to intense burning pain in the ball of the foot or into the toes with activities. When patients are asked to describe these complaints they use terms, such as 'pins and needles', burning pain, tingling, or a sense of fullness or cramping in the toes, especially with activities or

Direct examination usually locates the point of maximum tenderness (PMT).

when wearing certain shoes. Additionally, they may describe the pain as moving from the ball of the foot into the toes, or radiating into the arch or up the leg. Walking in dress shoes or running in athletic shoes tends to increase the symptoms and removal of the shoes or rest tends to decrease the symptoms being exhibited during activities. Many patients report that when they remove their shoes and massage the ball of the foot and toes, it provides immediate relief of the symptoms. However, in more advanced conditions, taking the shoes off and walking barefoot on hard surfaces may be very uncomfortable.

Diagnosis

The diagnosis of intermetatarsal neuroma is made by a variety of different techniques; however, the clinical history and physical examination of the forefoot is the most reliable method *Continued on page 119*



Figure 2: Lateral Squeeze Test for intermetatarsal neuroma.



Figure 3: Direct Pressure Test for intermetatarsal neuroma.

of making the diagnosis. Direct examination usually locates the point of maximum tenderness (PMT) by reproducing the symptoms during a pinch test involving dorsal and plantar compression of the intermetatarsal space (Figure 1) or with the lateral squeeze test using medial and lateral compression of the forefoot area (Figure 2). Also, direct pressure placed at the plantar distal intermetatarsal space may reproduce the patient's symptoms and identify increased thickness or a nerve enlargement (Figure 3). A combination of the physical examinations of the lateral squeeze test and the pinch test may reproduce an audible and/or palpable click in the involved intermetatarsal space, often referred to as a positive Mulder's sign.³

Other diagnostic techniques may be used to identify intermetatarsal neuromas, such as the anesthetic nerve block injection performed proximal to the suspected neuroma site (diagnostic injection); weight bearing x-rays of the involved forefoot area: computed axial tomography scan (CAT); magnetic resonance imaging (MRI); ultrasonographic imaging (USI); or sensory nerve conduction testing. These diagnostic studies are not well standardized or popular because of increased costs, unreliability of studies due to operator sensitivities, or lack of availability of the equipment. The clinical examination and review of the patient's history of symptoms are still the most common methods for diagnosis of intermetatarsal neuroma.

Differential Diagnosis

Intermetatarsal neuroma may be mimicked by several different clinical findings including any condition that causes forefoot pain, numbness, nerve-like pain, metatarsalgia symptoms or discomfort into the toes. Specific conditions in the differential can be found in Table 1. Most of the conditions listed in the differential diagnosis can be confirmed by careful history and physical examination, as well as with the more sophisti-

cated diagnostic studies mentioned previously.

TABLE 1Differential Diagnosis ofIntermetatarsal Neuromain the Foot

Bursitis

Distal Neuropathy Flexor Tendinopathy Freiberg's Disease Metatarsal Bone Tumors Metatarsal Plantar Plate Rupture Metatarsal Stress Fractures Peripheral Neuritis Plantar Capsulitis Rheumatoid Arthritis Rheumatoid Nodules Soft-tissue Tumors Synovitis Tarsal Tunnel Syndrome Treatment Options

There are numerous treatment options available for intermetatarsal neuroma ranging from leaving it alone with no treatment to conservative methods of treatment or surgical care. The conservative alternatives include tape-strapping of the foot to provide additional support, application of intermetatarsal pads to help separate the metatarsal heads on weight bearing, and the use of functional orthotic devices to help stabilize the foot. Most of these approaches are less

than successful in the long-term correction of the problem. Other conservative treatments involve the injection of vitamin B12,⁴ corticosteroid injections,⁵ and dilute alcohol injections.^{6,7}

Surgical options include a number of different approaches including the most obvious, surgical excision of the involved nerve. Other variations consist of transection of the intermetatarsal ligament with or without neurectomy, external or internal neurolysis, with translocation of the involved nerve, endoscopic decompression or other de-

> All of the surgical techniques have the potential for failures and complications.

structive measures, such as laser ablation or cryogenic denervation.⁸⁻¹²

All of the surgical techniques have the potential for failures and complications. The major problems following the surgical treatments include return of the condition, worsening of the pain, creation of traumatic or stump neuromas, excessive deep or superficial scar formation, damage to adjacent softtissue structures, wound dehiscence and infection. Less serious complications include numbness in the toes or ball of the foot area, a feeling of fullness or swelling, and persistent paresthesias.

Chemical Neurolysis of Intermetatarsal Neuroma

In an unpublished study performed from 1977 through 1985, over 150 patients were evaluated who underwent weekly injections of 0.5-mL of the 4% alcohol solution for clinical symptoms of intermetatarsal neuromas. The results showed that over 80% received resolution of their neuroma symptoms after three or more weekly in-*Continued on page 120*

jections. The compilation of data and format of tracking additional therapeutic measures in this study was faulty and there were so many variables and other treatments provided that the results were not publishable. Many patients had multiple interspace complaints, had undergone previous cortisone injections, were wearing functional orthotic devices or had received some other forms of treatment before or during the study time. In 1986, the technique for mixing the 4% solution and the different clinical conditions responsive to sclerosing alcohol injections was published.6 The mixture was initially composed of 48mL of 2% lidocaine with epinephrine (1:100,000) and 2-mL of dehydrated ethyl alcohol, which resulted in a 4% dilute solution.13 However, I began to note that using 0.5% bupivacaine HCl with epinephrine (1:200,000) combined with the dehydrated ethyl alcohol provided more consistent results and longer-lasting anesthesia after injection. Based upon this experience, this became the mixture of choice for all additional future treatments. Further studies were then developed to help control most of the problems and variables noted in the earlier study design.

From 1986 through 1996, I per-

formed a detailed prospective study to evaluate the treatment results of a conservative technique involving the chemical neurolysis of isolated intermetatarsal space neuromas using a dilute 4% alcohol solution. The patients chosen for the study had clinical symptoms of a single intermetatarsal space neuroma on

> The use of corticosteroid in the mixture is not recommended since it has an anti-inflammatory response.

one foot only. None of the patients had undergone previous therapy for their neuromas and all agreed to refrain from receiving additional alternative treatments while in the study program. The patients all had a minimum of three to a maximum of seven weekly injections composed of 0.5-mL of the 4% ethyl alcohol solution placed proximal to the point of maximal tenderness. The results of this 10-year study involving 100 patients showed that 82 patients reported complete resolution of their symptoms following treatment and another 7 patients reported 60-85% improvement. The results of this study were published in the Journal of Foot and Ankle Surgery in 1999.⁷ Overall, the longterm results of this prospective study of injection therapy for intermetatarsal neuromas appear to be superior to most reported forms of treatment, including cortisone injections and surgical care.

The 4% Dilute Alcohol Mixture

The 4% alcohol solution used for chemical neurolysis in this study and in all subsequent treatments of intermetatarsal neuromas, nerve entrapments, stump neuromas and all keratotic lesions was prepared by mixing 48-ml of 0.5% bupivacaine HCl (Marcaine[™]) with epinephrine (1:200,000) with 2-ml (two 1-ml vials) of dehydrated ethyl alcohol for injection, USP, for a new total volume of 50-mL (Figure 4). The use of epinephrine appears to aid in the results of neuroma injections perhaps due to the fact that it potentiates the local anesthetic agent, confines the sclerosing solution to a smaller area, prevents the rapid absorption of the solution into the adjacent tissues, and may have some neurolytic action on the nerve tissue itself.

The new mixture is kept in the original bupivacaine bottle and re-

labeled to identify the solution as 4% sclerosing, rather than local anesthetic, to prevent inadvertent misuse (Figure 5). The mixture date should also be included on the new label and I recommend replacing the solution after 6 months even though the solution is probably stable for a longer period of time. I also make a bottle of the 4% solution using bupivacaine HCl without epinephrine for use in those patients that have untoward reac-

Continued on page 121



Figure 4: Mixture of two 1 ml. vials of dehydrated ethyl alcohol and 48 ml. of local anesthetic agent.



Figure 5: Placing a new label on the 4% alcohol to clearly identify it.

tions to the epinephrine.

The protocol involves the injection of 0.5-mL of the 4% ethyl alcohol solution proximal to the point of maximum tenderness at the involved intermetatarsal space. Unlike cortisone, I typically give the injection of 4% alcohol about 1/2inch proximal to the tender area. The injection is given from the dorsal aspect of the foot with a 1 1/4inch, 27-gauge needle penetrating deep into the intermetatarsal space below and proximal to the intermetatarsal ligament and neuroma (Figure 6). The needle is then gently and slowly moved around in the deep tissue layers until the patient responds with a sensation of tingling, pins and needles, radiating pain into the toes, or burning into the ball of the foot. This would indicate a relatively close proximity to the nerve and once the sensation is felt by the patient, then the injection is performed. This is done in an attempt to get the 4% diluted ethyl alcohol solution close to the nerve tissue, but proximal to the actual neuroma.



Figure 6: Placement of the injection proximal to the point of maximum tenderness.

It is not necessary to try to enter the nerve itself, but to be as close to it as possible. It is thought that the nerve in this proximal area is smaller, without surrounding perineural fibrosis or adjacent thickened tissues, making it easier to destroy at this level with the chemical solution than it would at the actual

The solution

should be mixed

by the physician's

office to maintain

quality control

and consistency.

neuroma or entrapment site. Furthermore, it is not necessary nor recommended to perform a local anesthetic nerve block prior to the injection of the 4% ethyl alcohol solution, since this will cause anesthesia to the area, making it very difficult to

locate the involved nerve and could potentially dilute the 4% alcohol solution even further. Also, the use of corticosteroid in the mixture is not recommended since it has an anti-inflammatory response and will decrease the neurolysis effect of the alcohol solution, thereby de-

creasing its effect on the nerve tissue.

Results of Original Study

The results of the 10-year prospective study showed that, in 100 patients, there were 73 females and 27 males ranging from 20 to 75 years of age (average 51 years). There were 62 left feet and 38 right feet involved. Fifty percent of the patients had 6 or 7 injections. The third intermetatarsal space was involved in 81 cases. Follow-up evaluation was performed for each patient from 6 months to 2 years (average of 13 months) following completion of treatment. As was stated previously, the final results showed that 82 patients reported 100% improvement of their symptoms and 7 patients reported from 60-85% improvement, giving an overall success rate of 89%. Eleven patients had continued pain or other symptoms at the end of the study and elected to proceed with surgical neurectomy. It was interesting to note the appearance

of the tissues around the neuroma in the eleven patients that failed the injection treatment. In seven patients the tissues around the neuroma were atrophic and thin in appearance, even though the neuromas were enlarged and dis-

tinct. It gave the impression that additional injections of the alcohol solution may have eventually succeeded in destroying the proximal nerve. The other four patients had what appeared to be coagulation and melting of the adjacent adipose tissues and the neuromas were more difficult to remove discretely. The surgeries were all successful with no major complications or delayed healing noted.

Complications of Alcohol Injections

The complications with this 4% alcohol injection technique appear to be minimal and include failure to relieve the original symptoms, recurrence of symptoms, increased symptoms after the first, and possibly the second, injection (postinjection neuritis), and, finally, a postinjection lymphatic reaction has been reported. The failure to work and recurrence of symptoms is not truly a complication, but something that happens with most forms of treatment. The increase in symptoms following the first or second injections appears to be relatively common and occurs in the first 48 hours after the injection and then the intensity decreases rapidly. By the subsequent clinical visit all patients reported that the 'new' pain had decreased significantly and were now absent in most patients. Continued on page 122

Very few patients had similar increased pain after the third or subsequent injections due to the increasing neurolysis effect and subsequent numbness of the previous injections.

I have never actually seen the peri-lymphatic irritation in the past 25 years of doing this injection; however, a few podiatric physicians have contacted me in the past several years to report having seen it following the injection of the 4% alcohol solution. They report that the symptoms include increased pain, intense redness with streaking from the injection point proximally up the foot and blistering in a few cases. It is my opinion that the 4% ethyl alcohol solution was picked up by the dorsal superficial lymphatic system and the irritation is subsequently seen soon after the injection. Deep injections of the solution do not appear to have this secondary effect and therefore, one can avoid this complication by being certain not to inject the solution until the needle is deep within the tissues and to refrain from performing additional injection while withdrawing the needle through the superficial tissues. This reaction is probably very similar to the condition reported by Kravette with cortisone injections, termed peri-lymphatic atrophy.¹⁴

Discussion

The primary component of the 4% sclerosing solution discussed in



Figure 7: Injection of the painful medial pinch callus digital nerve.

this article is dehydrated alcohol injection, USP, which is also termed absolute alcohol. pure ethyl alcohol for injection, desiccated alcohol, and ethanol. Dehydrated alcohol consists of not less than 98% by volume of ethyl alcohol (ethanol) and is distributed in sterile 1

ml, glass vials, ready for injection. Ethvl alcohol is a clear, colorless liquid that is miscible with local anesthetic agents. Once the ethanol is diluted to 4% by the method described earlier, it produces neuritis and Wallerian nerve degeneration or chemical neurolysis when absorbed into nerve tissue. Repeated injections of this dilute solution in close proximity to nerve tissue, on a weekly basis, presumably causes selective degeneration or neurolysis until the nerve completely ceases nerve function or is directly destroyed. The volume needed to produce therapeutic neurolysis involves amounts too small to produce systemic side-effects related to ethanol.15,16

The dehydrated alcohol may be ordered from the local pharmacist and is also available from a variety of medical supply companies, including Moore Medical and Surgical Supply Service. Dehydrated alcohol is usually purchased in 1-ml glass vials in quantities of 10 vials per box. My recommendation is that the materials be ordered and the solution mixed by the physician's office to maintain quality control and consistency.

Other Nerve Conditions

The treatment of other nerve conditions is performed in a similar fashion as described for the intermetatarsal neuroma17. When there is nerve damage, nerve entrapment, or painful scars, it is necessary to find the point of maximum tender-*Continued on page 123*



Figure 8: Painful scar nerve entrapment may be injected with a 4% alcohol solution.



Figure 9: Injection for medial calcaneal heel nerve pain.

ness by clinical examination. Once the area has been identified, then the injections of 0.5-ml of the 4% alcohol solution may be injected proximal to the maximum point of tenderness on a weekly basis until the symptoms resolve. It has been my experience that a minimum of three injections is necessary to assess the improvement of the condition. If the condition is not responding after the third injection, the treatment is discontinued. If, however, there has been an improvement, the injections are continued for the full treatment of seven injections.18

Painful nerve entrapment at the medial pinch callus of the hallux can successfully be treated with a series of the 4% alcohol injections (Figure 7). Painful scars with dermal nerve entrapments may be injected in a similar fashion (Figure 8). Moreover, many patients that complain of heel pain may have symptoms secondary to entrapment of the medial calcaneal nerve branch rather than true medial plantar fasciitis symptoms. If I can reproduce their heel or arch pain by palpating along the medial aspect of the heel, rather than at the plantar calcaneal tubercle, then I will perform a series of injections proximal to the point of maximum tenderness on the medial heel (Figure 9).

Painful Keratotic Lesions

There are a number of keratotic and painful lesions that form on the weight bearing and pressure areas of the foot. Many of these conditions are difficult to treat and often do not respond to simple debridement and padding. Abnormalities in keratinization may represent thickenings referred to as corns, calluses, helomas, hyperkeratoses, or tylomas.

In general, hyperkeratosis indicates an increased keratinocyte activity in which the hyperkeratosis is due to stimulation of the epidermis by intermittent or increased pressure. Hyperkeratoses that are diffuse and generalized are usually referred to as calluses or tylomas. If the hyperkeratoses are more distinct and isolated, they are commonly referred to as corns or helomas, especially on the toes.19

Several unrelated keratotic-like lesions have similar appearances to corns and calluses and these conditions include arsenical keratosis, eccrine poroma, keratodermas, plantar verrucae, and porokeratosis plantaris discreta.

Diffuse hyperkeratotic tissue is generally found on the weight-bearing surface of the sole of the foot and is usually asymptomatic. This diffuse type is seen more often in patients who regularly go barefoot and in patients who have a form of posterior equinus. The more discrete types of hyperkeratosis are frequently painful and are often found on the ball of the foot. Close evaluation of these lesions may show a central conical core of keratin at the point of greatest pressure.²⁰

Discrete isolated lesions may

After several injections the nerve will stop sending pain signals to the central nervous system.

also be similar to cutaneous horns, but unlike skin horns, careful debridement of hyperkeratotic lesion will lift the superficial keratin plug off completely, leaving visible skin lines underneath. Other distinct areas of pressure hyperkeratosis formation may be seen under individual metatarsal heads. These lesions are frequently resistant to regular conservative care of debridement and protective padding. These lesions may be seen under any or all of the lesser metatarsal heads and are referred to as intractable plantar keratoses (IPK's).²¹

Other lesions that may be visibly similar to corns and calluses should be identified to obtain the most beneficial results from treatment. These conditions include:

Arsenical Keratoses

These are discrete hyperkeratotic lesions found on the soles of the feet and palms of the hands secondary to arsenic exposure. These lesions may mimic discrete intractable plantar keratoses, seed corns (heloma milliare) or plantar verrucae. This condition is usually very difficult to treat but many will respond completely to injections of 4% alcohol solution.

Eccrine Poromas

Slow-growing, painless, superficial, smooth-surfaced, and partially flattened, these lesions may resemble pyogenic granulomas, dermatofibromas, or foreign-body granulomas. Eccrine poromas may appear rubbery to firm and can reach 3 cm. in diameter. Eccrine poromas are commonly found in women during the fourth decade and typically are found on the heel or ball of the foot.

Keratodermas

These are localized forms of keratodermas may be similar to diffuse, generalized or isolated forms of hyperkeratosis. Most types of keratodermas are inherited as autosomal dominant traits and may also be associated with systemic manifestations. Diffuse hyperkeratosis of the plantar skin may become so thick that it tends to form cracks or fissures and may become very painful for the patient to walk on. The punctate form of palmoplantar keratoderma looks very similar to arsenical keratoses with the exception that a central translucent center is commonly present in each lesion. These keratodermatous conditions are all persistent and difficult to treat.

Porokeratosis Plantaris Discreta

This lesion is represented by small (1- to 3-mm diameter) punctate lesions usually found on the weight-bearing aspect of the ball of the foot. The porokeratosis is probably developed by direct pressure on the plantar surface of the skin but is not usually associated with an underlying bony condition. There is still some debate as to whether the underlying ducts of sweat glands are involved. These distinct lesions appear as white or yellow-white lesions that *Continued on page 124*

are most tender with side-toside pressure.

Injection Therapy for Keratotic Lesions

It may be worthwhile to treat certain keratotic lesions or conditions, such as the intractable plantar keratosis, porokeratosis, fibroma, or keratodermas with intradermal or subdermal injections to create a neurolysis and therefore reduce the pain associated with these lesions(21). In many cases, the lesions themselves will resolve following a series of three or more 4% alcohol injections. Unlike with neuroma injections, local infiltrative nerve block with a local anesthetic agent may be necessary prior to giving a sublesional injection on the plantar foot. Because injections into the plantar aspect of the foot may be extremely painful, a posterior tibial nerve block may be given prior to any other injection on the sole area of the foot. The use of skin coolants, such as ethyl chloride, will greatly decrease the per-



Figure 11: Injection of painful porokeratosis plantaris discreta. A. Pre-injection. B. After three injections. Note the reduction in size.

ception of pain from the needle penetrating through the skin.

Additionally, some plantar foot lesions may actually be injected from a dorsal approach if a long needle passing between the metatarsals can be placed at the level of the lesion. In many cases, the patients report that this is somewhat less painful than injecting directly into the plantar lesion from below.

Painful bursae, with or without overlying callus formation, and other cystic lesions may be injected with 0.25 to 0.5 ml. of 4% alcohol sclerosing solution, depending upon its size

(Figure 9). This may be repeated up to seven times at weekly intervals. The sac or bursal cyst tends to shrink in the following weeks, with a dramatic decrease in painful symptoms and callus formation which may last as long as one year and in many instances never recur.

Plantar fibromas are injected

with 0.5 ml. to 1.0 ml. of 4% alcohol sclerosing solution directly into the central portion of the mass. Subsequent injections may be infiltrated throughout the mass and the injection is followed by a 5-to 10minute ultrasound treatment. This is repeated weekly for up to seven visits and additional softening and shrinking of the fibroma may be expected to be seen for several months after the final injections. In almost all cases, the pain of the lesion will resolve completely.

Painful porokeratosis plantaris discreta and other punctate or deeply nucleated plantar lesions respond extremely well to 4% alcohol sclerosing injections.²²⁻²⁵ A total of 0.25 ml. to 1.0-ml., depending upon the size of the



Figure 10: Injection of painful bursa with 4% alcohol solution.

lesion, of 4% sclerosing solution is injected at a 45-degree angle to the lesion with a 5/8 inch, 25gauge needle, using a 1 ml. tuberculin syringe (Figure 10). This injection procedure is repeated at weekly intervals for up to seven injections. Larger punctate lesions will also respond to a similar injection process of weekly intervals (Figure 11). Usually there is dramatic change by the third injection and, if the lesion has responded, no further treatment is performed. If, however, after three injections there has been poor or no response, the program is terminated and alternative treatments are recommended. The weekly intervals seem to be relatively important and longer intervals between injections may delay the end-results.

Once the local anesthesia wears off there may be considerable burning or pain at the injection site that may last for several hours. This discomfort may be reduced by the application of cool foot soaks or ice to the area. Analgesics, especially aspirin, may also help reduce the pain.

The remarkable thing about this treatment is that not only do the lesions become asymptomatic in nature, presumably due to the chemical neurolysis that occurs following the alcohol injections, but also the lesions frequently go away. Over the past 25 years I have seen *Continued on page 125*

very few recurrences of lesions once they have responded to the injection process.

Conclusions

The use of a dilute 4% ethyl alcohol solution for the chemical neurolysis of intermetatarsal neuroma provided 89% improvement of symptoms with 82% of all patients reporting total relief of their nerve-like symptoms after completing a series of weekly injections. The 4% ethyl alcohol solution injection has less reported side-effects than cortisone injections. A complete series of seven 4% ethyl alcohol solution injections has less reported complications than surgery. Most patients are extremely pleased with this conservative treatment program and refer other patients with similar problems for the same treatment. This would indicate that the treatment of neuromas with a conservative injection of dilute 4% alcohol is a good alternative to other conservative treatments, cortisone injections, and surgical

treatment. And even if this approach is unsuccessful, other treatments can still be performed at a later date.

There are numerous painful keratotic and punctate skin le-

If the time between injections is prolonged then the nerve can recover significantly and this will delay the chemical neurolysis response that is being sought.

sions on the feet and many of these can be treated with changes in shoe styles, local tissue debridement, padding and strapping, accommodative shoe inserts and surgical intervention. In some of the cases, the painful le-

sions continue to be a problem even after extensive treatment. Some patients may not be good surgical candidates, but still need additional therapy for their painful lesions. In these cases, the addition of injection therapy with a dilute 4% alcohol solution may greatly improve or even totally resolve these painful conditions.

Coding Issues

The proper diagnostic codes for nerve conditions should be used, which include, but are not limited to the following: neuroma 355.6; neuritis, peripheral 355.8; nerve entrapment 355.9; amputation neuroma 997.61; nerve injury, skin/sensory 956.4; nerve injury, unspecified 956.9; and, pain, lower extremity 729.5. The correct CPT-2004 code is 64640: Chemical neurolysis by chemical methods. This is not prolotherapy or an experimental injection technique and should not be recoded by the insurance company for this treatment. Podiatric physicians are qualified to provide this service and should not allow insurance companies to dictate that this procedure only be performed by anesthesiologists or pain clinics.

Additional Considerations

Why Inject Proximal to the Neuroma?

As explained previously, the nerve tissue that is proximal to the neuroma should be thinner, smaller and more susceptible to chemical neurolysis than the thicker, fibrosed or enlarged neuroma itself. Therefore, it should be destroyed much faster in this area.

Why Not Use a Much Stronger Percent of Alcohol Instead of the 4% Solution?

The ethanol solution of 4% alcohol has a strong affinity for nerve tissue, but is not toxic to the adjacent tissue unless injected directly intravascular. Some nerve specialists inject a pure solution to destroy nerves. At a greater concentration, the alcohol may cause damage to both blood vessels and tendon sheaths and is much more reactive with muscle tissue. Why increase your risks if you can achieve greater than 80% improvement with the 4% solution with very few, if any, complications?

What About After the 7th Injection?

If there are still symptoms after the 7th injection, but the patient has had some improvements, I suggest that you reschedule the patient for 2-3 months for a follow-up visit. In many cases, the symptoms will have totally resolved by the next visit indicating that the neurolysis progressed after completion of the last injection. If there are still symptoms after the delay time then I suggest another series of 4% ethyl alcohol injections, cortisone injections or surgery. The patient and *Continued on page 126*



Figure 12: Large punctate plantar keratotic lesions may respond favorably to 4% alcohol injections. A. Large punctate lesion before injection. B. Appearance after several injections.



the doctor can now explore other options that are suitable for that particular patient.

Why is There Pain After the 1st or 2nd Injections?

The dilute ethanol solution has a strong affinity for nerve tissue and it is absorbed almost immediately. The alcohol starts to irritate the nerve tissue and the nerve symptoms may increase at this point due to the damage that is occurring. Subsequent injections cause additional chemical neurolysis to occur and after several injections the nerve will stop sending pain signals to the central nervous system.

Why Not Inject a Local Anesthetic Into the Area Before Injecting the Alcohol?

The local anesthetic agent would cause numbness to the area making it more difficult to locate the nerve and therefore make it more difficult to get into close proximity to the nerve. The local anesthetic would also potentially dilute the 4% alcohol solution even further and possibly decrease the neurolysis effects.

Why Not Add Corticosteroid to the Solution?

The goal of the injections with 4% alcohol solution is to cause a chemical neurolysis effect on the involved nerve. The alcohol solution is irritating to the nerve tissues and the steroid would, by its nature, decrease the desired effect of the alcohol and therefore, decrease the neurolysis. The steroid also adds potential side-effects of tissue atrophy, discoloration of the skin, telangiectasia and damage to the soft tissues not seen with the dilute alcohol solution alone.

Why Is It Important to Inject the Dilute Alcohol Every 5 to 10 Days?

Nerve tissue is relatively dynamic and can begin repairing itself soon after minor injury occurs. If the time between injections is prolonged then the nerve can recover significantly and this will delay the chemical neurolysis response that is being sought.

What If the Insurance Company Does Not Allow the Billing of CPT 64640?

My suggestion is to contact the medical advisor of the insurance company and explain that this is a series of injections and how the process works. If there is not a favorable consideration following this technique, I suggest writing a letter of justification for treatment and sending copies of current references on this treatment program to the principle decision maker of the company in question. It may be necessary to talk to the insurance commissioner of your state to obtain assistance in this manner.

How Long Does the Solution Last Once it is Mixed?

It is my opinion that the mixed alcohol and local anesthetic solution is viable for a minimum of 6 months as long as it is not exposed to direct sunlight or air and is kept in the multi-dose vial during usage. I suggest dating the mixture once it is made and then replacing it after 6 months.

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Dr. Dockery is author of Cutaneous Disorders of the Lower Extremity, W.B. Saunders Co. (1997) and Founder and Director of Scientific Affairs of the



Northwest Podiatric Foundation for Education & Research, USA, Seattle, WA.

EXAMINATION



1) Intermetatarsal neuroma formation is most likely caused by:

A) repetitive trauma to the nerve

B) wearing incorrect sized shoes

- C) athletic activities
- D) poor nutrition

2) Foot neuromas are commonly found:

A) between the 1st and 2nd metatarsals
B) between the 2nd and 3rd metatarsals
C) between the 2nd and 4th

C) between the 3rd and 4th metatarsals

D) between the 4th and 5th metatarsals

3) The most accurate assessment

of foot neuromas is made by: A) x-rays of the foot

B) clinical examination of the foot

C) computed axial tomography of the foot

D) posterior tibial nerve block

4) Intermetatarsal neuromas appear to be:

A) more common in menB) more common in womenC) equally common in men and womenD) uncommon in men and women

5) The alcohol described for neurolysis is:

- A) isopropanol
- B) methanol
- C) ethylene glycol
- D) ethanol

6) The mixture recommended to obtain a 4% solution is:

A) 2 ml. alcohol plus 48-mL

See answer sheet on page 129.

local anesthetic agent B) 1 ml. alcohol plus 49-mL local anesthetic agent C) 4 ml. alcohol plus 46-mL local anesthetic agent D) 2 ml. local anesthetic agent plus 48-mL alcohol

7) The recommended dosage of 4% alcohol per injection is:

- A) 2.0 ml.
- B) 1.0 ml.
- C) 0.5 ml.
- D) 0.1 ml.

8) The recommended interval between injections of 4% alcohol is:

- A) 1 month
- B) 2 weeks
- C) 1 week
- D) 2 days

9) The injection of 4% alcohol for intermetatarsal neuroma is placed:

A) distal to the maximum point of tenderness
B) directly into the maximum point of tenderness
C) deep to the maximum point of tenderness
D) proximal to the maximum point of tenderness

10) Which of the following is recommended when injecting 4% alcohol:

A) adding corticosteroid to the solution to reduce the discomfort
B) mixing the solution with phenol to increase tissue reaction
C) injecting as close to the involved nerve as possible

D) pre-injecting the area with local anesthetic before using 4% alcohol 11) In the prospective study discussed in the article, what percent of patients had 100% improvement of their symptoms:

A) 82%
B) 74%
C) 50%
D) 26%

12) Complications of the 4% alcohol injections include all of the following except:

A) failure to relieve original symptoms

B) ulceration formation

C) recurrence of nerve symptoms

D) perilymphatic irritation

13) Other names for pure ethanol include all of the following except:

A) dehydrated alcohol

B) desiccated alcohol

C) absolute alcohol

D) rubbing alcohol

14) Which of the following lesions is not injected with 4% alcohol solution:

A) plantar warts

B) porokeratosis plantaris discreta

C) eccrine poromas

D) arsenical keratoses

15) When injecting painful plantar fibromas with 4% alcohol what additional treatment is recommended:

A) topical cortisoneB) oral anti-inflammatory drugs

- C) ultrasound massage
- D) ice massage

Continued on page 128



(cont'd)

16) After three consecutive injections of 4% alcohol and there has been no response it is recommended to:

A) continue with four additional weekly injections

B) discontinue treatment and recommend other options

C) continue treatment with the addition of cortisone

D) discontinue treatment and do surgery

17) The increased pain after the first or second injection of dilute alcohol is due to:

- A) the needle touching the nerve tissue
- B) the flare from the steroid additive
- C) the pressure from fluid injection
- D) the inflammatory reaction

18) Delaying the intervals between injections of4% alcohol may:

- A) allow the nerve to repair itself
- B) cause the patient increased discomfort
- C) damage the nerve too much
- D) decrease the treatment time

19) Mulder's sign is:

A) pain with plantarflexion of the toes

B) tingling into the toes with tight shoes

C) an audible or palpable click between the metatarsals

D) reproducible in all patients

20) Which of the following statements about 4% alcohol injections is true:

A) it is the only conservative treatment that is successful

B) it is the only treatment that has no sideeffects

C) it is recommended for all patients

D) it is a good alternative treatment for cortisone injections or surgery

See answer sheet on page 129.

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