Clinical Appraisal of Intra-arterial Priscoline Therapy in the Management of Peripheral Arterial Diseases

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Priscoline can be given intra-arterially without difficulty. Untoward reactions are infrequent even in older patients. Intra-arterial administration was often effective in patients who did not respond to oral Priscoline. Although maximal vasodilatation may not be achieved by giving Priscoline intra-arterially, the degree of vasodilatation obtained is often adequate for a clinical effect. Results in 250 patients indicate that intra-arterial Priscoline is most useful in the treatment of ischemic rest pain resulting from organic vascular disease. Improvement in exercise tolerance was infrequent. Causalgia, delayed wound healing and ulceration in Raynaud’s disease responded favorably in some instances.

One of the major objections to the use of chemical sympathetic blockade to produce vasodilatation in the management of peripheral arterial disease has been the inability to confine the effects of the medication to the local vascular bed where vasodilatation is desired. Despite the fact that maximal skin flow can be achieved following the use of intravenous blocking agents,\(^1\)\(^2\) these drugs often produce annoying side effects because of their “generalized” effects, especially in the elderly patient. This, and the repeated failure to obtain a maximal rise in skin temperature following the use of Priscoline by the usual routes of administration, seemed to indicate that there might be a use for the drug when given intra-arterially. This approach has been used for other drugs to a limited extent for many years and intra-arterial Priscoline has been employed by several observers during the past six years.\(^3\)\(^-\)\(^10\) While we know from personal communications that many clinicians have followed this therapeutic technic, the method is not widely known. The exact role of intra-arterial Priscoline in the therapy of vascular disease has not as yet been clearly defined, especially since the introduction of other effective blocking agents.

Priscoline (2-benzyl-4,5-imidazoline hydrochloride) exerts its adrenergic blocking effect in the periphery. In addition to blocking responses produced by stimulation of the sympathetic nerves or injection of epinephrine, Priscoline appears to have some direct dilating effect on the vessel wall. The drug is neither necrotizing to tissue nor is it irritating to the vascular endothelium.\(^11\)\(^-\)\(^19\)

The peripheral site of action, absence of irritation to the vessel wall, probable local dilating effect, and practical freedom from serious side effects, with proper precautions, makes Priscoline particularly suitable for intra-arterial administration.

Method of Administration

The method of injection into the femoral, radial, or brachial artery is simple, but the technic must be learned in order to avoid technical difficulties, especially since it is one not commonly used by the average physician. Intra-arterial administration is to be carried out with the patient lying down.

The basic technic of injection is as follows: a skin wheal is raised with Novocaine, and through this a finely sharpened 22-gauge needle is inserted into the artery at right angles. The color of the arterial blood, plus pressure transmitted into the syringe, will make clear that the artery has been entered. Good injection sites, where the respective arteries are nearly always readily palpable are: Femoral Artery, immediately below Poupart’s ligament; brachial artery, at superior angle of antecubital fossa just medial to biceps tendon; and radial artery at usual wrist site of palpation of pulse.

In our experience, local vasodilatation has been obtained only if Priscoline is injected slowly into the artery over a period of three to five minutes. Because of “spill” into the general circulation, rapid administration produces more generalized effects quite comparable to those following intravenous...
administration. We have found that 2 cc. (50 mg.) is most effective in the majority of cases.

Administration of Priscoline intra-arterially is followed by visible changes in the injected extremity; these occur 15 to 90 seconds after starting the injection. The upper extremity responds considerably faster than the lower, with intense flushing of the forearm and palm occurring within 15 seconds. In the injected lower extremity, piloerection and erythema are usually patchy in the proximal portion of the thigh and become diffuse from the lower third of the thigh distally. Appearance of goose flesh and erythema is followed by visible distention of the superficial veins. Skin temperature and oscillometric excursions may increase, decrease, or remain unaltered, depending upon the patency of the peripheral vessels and the degree of vasoconstriction in the limb being injected. It is of interest to note that intense erythema of the injected extremity may occur without a significant rise in skin temperatures above control levels; likewise, in some of the instances to be cited, pain was relieved by the injection even though skin temperature and pulse amplitude remained unaltered. It is therefore apparent that surface temperature and oscillometric criteria, even under well-controlled conditions, do not necessarily reflect accurately the clinical response. Duration of effect is from one to three hours.

The "adrenolytic" action of Priscoline given intra-arterially can be demonstrated as follows: a wheal in the skin raised with 1:100,000 epinephrine causes the surrounding area to blanch over a diameter of 1 to 1.5 cm. The same amount of epinephrine injected into the skin after 50 to 75 mg. of intra-arterial Priscoline either fails to blanch the skin or the development of the marginal zone of pallor is prevented. Priscoline given in 50 to 75 mg. doses orally or intravenously does not prevent epinephrine-induced blanching.

Since 1948 observations upon the effects of intra-arterial Priscoline have been extended to a group of over 250 patients with known or suspected peripheral vascular disease. Their ages ranged from 18 to 81 years, and many of them had concurrent cardiac and renal disease, diabetes, hypertension, or malignancy.

Over 2,000 intra-arterial injections of Priscoline have been given in this group without serious mishap. Most of the patients have received up to a dozen such injections, often while receiving anticoagulants. One received a mixture of Priscoline and heparin intra-arterially at 24-hour intervals for seven successive days. Six patients have received from 30 to 250 injections each.

The only adverse local effect has been occasional ecchymosis. Bleeding at the injection site has never been troublesome and is readily controlled by simple pressure for one to three minutes. Occasionally periartrial thickening occurred near the site of injection after prolonged therapy. This made repeated injections difficult.

Side effects included mild orthostatic vertigo in about 15 per cent of the patients over 60 years of age. Transient tachycardia and, occasionally, a slight rise or fall in blood pressure were observed in some patients, but these showed no consistent association with vertigo.

Two patients (under treatment for arteriosclerosis obliterans) who had antecedent myocardial infarctions, experienced anginal pain after unduly rapid injection of the drug. Pain began within a few minutes and lasted from 30 minutes to three hours, with complete recovery. Electrocardiographic evidence of myocardial ischemia was obtained during the period of substernal pain in one of these patients. Other patients having known coronary or myocardial disease have tolerated intra-arterial Priscoline, given slowly, without adverse effects.

Four patients developed multiple premature ventricular contractions following rapid injection of Priscoline; none of these, nor the two preceding cases, showed significant hypotension during these episodes. All six are living and are apparently unharmed by these events 14 months after their occurrence.

RESULTS

Normal Individuals

Fifty to 75 mg. of Priscoline given intra-arterially to 10 normal patients produced rises in skin temperatures equal to that following procaine block of a peripheral mixed nerve (table 1).

The rise in skin temperature is accompanied

| Table 1.—Summary of Results in Ten Normal Fasting Subjects under Standard Conditions |
|---------------------------------|-------------------------------|-------------------------------|
| Change from control temperature | Priscoline intra-arterially   | Peripheral nerve block (procaine) |
| Range +5.4 to +10 C.            | Range +6 to +9.8 C.          |
| Average +7.6 C.                 | Average +7.0 C.              |
| Maximal digital temperature attained | Range 30.5 to 33.2 C.     | Range 30.2 to 33.6 C.      |
| Average 32.2 C.                 | Average 32.5 C.              |

Room temperature 23 C. ±1.
by an increase in the volume of pulsations distal to the point of injection. This increase ranges from 50 per cent to 200 per cent and in many instances equals that elicited by procaine block of a peripheral nerve. Studies utilizing the portable venous occlusion plethysmograph to measure skin blood flow demonstrated that intra-arterial Priscoline did not increase blood flow to the same extent as intravenous hexamethonium. The degree of increase, however, was significant although not maximal. These observations have been published elsewhere.²

Although slow intra-arterial injection will confine most of the effect to the single extremity, some of the drug reaches the general circulation and measurable skin temperature increases occur in contralateral extremities and elsewhere. Table 2 demonstrates this as well as compares changes in surface temperature when the drug is given intravenously.

It is noted that following intra-arterial administration, the first toe on the injected side shows a 2.9 C. greater rise than with intravenous injection. Likewise, contralateral digits demonstrated significantly less rise following intra-arterial as opposed to intravenous injection, indicating better localization of effect.

**Neurovascular Arterial Disease**

**A. Raynaud’s Disease.** In seven patients with Raynaud's disease and two with acrosclerosis, severe blanching of the fingers produced by exposure to cold prior to administration of intra-arterial Priscoline could not be produced after its administration.

Indolent ulcers of the fingertips in five of these cases healed after three to five weeks of combined oral and intra-arterial Priscoline therapy, and the intense pain associated with digital ulceration was relieved for progressively longer periods during therapy.

One of the patients in this group had undergone bilateral sympathectomy in 1949; digital ulcers developed two years later. These were associated with intense burning, stinging pain. Oral Priscoline in 150 mg. doses had been administered without improvement, but intra-arterial administration immediately provided relief. Pain disappeared completely as the lesions healed, and such scarring as ultimately resulted was not painful.

All of these patients have been followed for from 6 to 18 month periods, subsequent to intra-arterial therapy, and have remained on oral Priscoline or oral Dibenzyline. There have been some recurrences of blanching following exposure to cold, but there has been no recurrence of ulcers.

Although intra-arterial Priscoline is effective in these cases, most patients with this disease are young, relatively healthy, and without heart disease. They may be treated with other agents such as Hexamethonium during the period when ulceration is present. This drug can be given subcutaneously or intravenously (35 to 50 mg. twice daily). The necessity for intra-arterial administration is thus eliminated and, although a more “generalized” effect is produced by Hexamethonium, the local therapeutic effect is also obtained. If the physician is not fully aware of the effects of Hexamethonium it is much safer to use Priscoline even by the intra-arterial route. Dibenzyline is also effective in some of these cases. This drug may be given orally (10 to 30 mg. four times daily). In the milder cases of Raynaud's disease without ulcerations, oral Dibenzyline, or even oral Priscoline, may produce good results.

**B. Painful Neurovascular Disorders.** Thirty-

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**Table 2.—Summary of Skin Temperature Changes in Ten Normal Fasting Subjects under Standard Conditions**

<table>
<thead>
<tr>
<th></th>
<th>1st Toe</th>
<th>1st Toe</th>
<th>3rd Finger</th>
<th>Umbilicus</th>
<th>Forehead</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P</strong></td>
<td>+7.1 C.</td>
<td>+1.6 C.</td>
<td>+1.3 C.</td>
<td>+0.4 C.</td>
<td>+0.9 C.</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>+4.2 C.</td>
<td>+4.2 C.</td>
<td>+3.0 C.</td>
<td>+0.6 C.</td>
<td>+0.9 C.</td>
</tr>
</tbody>
</table>

Room temperature 23 C. ±1.

P, digits on injected side; C, contralateral digits.
eight patients with painful neurovascular disorders of the "causalgic type" received Priscoline injected into the appropriate artery proximal to the site of pain. Doses ranged from 25 to 75 mg, given over a five-minute period.

This group included eight patients with "minor causalgia" complicating chronic venous insufficiency, six with painful postphlebitic ulcer, six with painful scars, three with meralgia paresthetica, four with posttraumatic pain syndrome following spinal cord injuries, two with shoulder-hand syndrome, two with causalgia of the upper extremities following cerebral vascular accidents, three with postherpetic neuralgia, one with Sudeck's atrophy, and three with residual cold injury.

The results obtained with intra-arterial Priscoline in these patients are difficult to evaluate for several reasons. First, there is some degree of functional overlap in the majority, and as a result it is impossible to determine how much of the improvement represented a response to medication and how much was a response to suggestion. Second, Priscoline administered intra-arterially produces definite sensory effects (warmth and piloerection) and no satisfactory placebo could be found to permit control studies. Lastly, many of the patients were receiving compensation, and it was therefore to their advantage to deny improvement. All these factors must be considered in interpreting the following results. If no relief was obtained, or if severity of symptoms were diminished for only 30 to 60 minutes following injection, the treatment was considered to have failed.

Eighteen patients obtained complete relief of discomfort comparable to the effects of procaine block of the lumbar or stellate ganglia. In eight patients temporary partial relief was obtained; after repeated relapses two had surgical sympathectomies and obtained lasting relief.

Among these patients, relief of longstanding discomfort was occasionally dramatic. One patient with a painful scar of the lower extremity of three years' duration could not tolerate the weight of bedclothes on her leg; Etamon, oral Priscoline, and local infiltration of the scar with procaine had been tried unsucessfully. After intra-arterial Priscoline, the discomfort disappeared completely and did not return. Another patient, 70 years of age, suffered from a crippling causalgia of her right upper extremity which had persisted for six months after a cerebral vascular accident. Here again, pain was completely and lastingly relieved after one intra-arterial injection of 50 mg. of Priscoline. In all but one case, the pain associated with postphlebitic ulcers (which in some instances had been present as long as six months) disappeared after one or two treatments.

Postherpetic neuralgia responded promptly in one case but was completely unaffected in two others.

The five patients who had antecedent spinal cord injuries obtained no significant degree of relief.

One of the patients with shoulder-hand syndrome was completely asymptomatic after two treatments while the other was unimproved.

The majority of the patients who obtained only partial temporary relief returned at varying intervals for treatment, usually during severe exacerbations of their discomfort, and occasionally obtained some measure of relief.

Many of the patients regarded as failures in this group of 38 were so classified because of variation in, rather than absence of, response to treatment; relief appeared to follow some of the injections but did not occur consistently enough to permit accurate appraisal. It is to be noted that even when relief of pain was not obtained in these patients, intra-arterial Priscoline consistently produced erythema, piloerection, increase in volume of pulsations and skin temperature in the treated extremities.

In comparing the results obtained with intra-arterial Priscoline in causalgic states with those obtained in "post-traumatic causalgia" treated with Hexamethonium and Dibenzyline by other observers, it would appear that these latter agents produce relief of symptoms more consistently. We would agree that these agents appear to be superior to Priscoline in the treatment of "causalgic states." In the occasional patient who cannot tolerate Hexa-
methonium or Dibenzyline, intra-arterial Priscoline therapy certainly should be tried.

**Organic (Occlusive) Arterial Disease**

One hundred thirty-one patients with organic arterial disease have received Priscoline intra-arterially, either as a diagnostic or therapeutic procedure. Not a single adverse effect of repeated arterial puncture occurred in this group. There were 65 patients with arteriosclerosis obliterans, 51 with thrombangiitis obliterans, and 12 with sudden arterial occlusion caused by thrombosis or embolism.

A. **Arteriosclerosis Obliterans.** These patients ranged from 39 to 81 years of age. Twenty-two had concurrent coronary heart disease, four had diabetes mellitus, and four had malignant neoplasms.

The change in the skin temperature of the toe which followed the intra-arterial injection of Priscoline in this group showed the following variations:

In 24 patients, skintemperatures attained almost complete vasodilatation levels of 31 to 33 C. Twenty others attained a somewhat limited increase (1 to 6 C.), with the final temperatures ranging between 22 to 28 C. In 12 patients there occurred no change in skin temperature, even though the foot became pink and the veins visibly distended. Nine others showed a paradoxic fall in skin temperature of the foot. In the proximal portions of these latter extremities, there was unquestionable dilatation of the skin vessels and increase in skin temperature, even though the toes became cooler and paler. Two of the patients in whom this paradoxic response occurred initially showed an elevation of skin temperature of the foot ranging from 3 to 5 C. after several months of intensive treatment with intra-arterial Priscoline.

The most gratifying results following administration of Priscoline intra-arterially occurred in patients with ischemic rest pain. Twenty-five of the patients with arteriosclerosis obliterans were suffering from this type of pain of varying severity. In all instances the pain was of sufficient intensity to interfere with the patient’s sleep and to require analgesics, and over two-thirds of these individuals required narcotics at two to four-hour intervals. Eighty per cent of the group obtained permanent relief of rest pain after multiple intra-arterial injections of Priscoline. In many, pain was promptly lessened and requirements for sedation and analgesics diminished after the first injection. Some slept without medication for the first time in several weeks following the initial dose. However, pain frequently returned and repeated injections were necessary before it was completely abolished.

Temporary intensification of pain occasionally followed by relief was noted when the paradoxic lowering of skin temperature occurred after the injection. Relief of pain was not contingent upon a significant rise in skin temperature and was even obtained in patients with areas of superficial gangrene.

Increase in exercise tolerance was attained in only a few of these patients. Even in these it was difficult to ascribe the improvement to the intra-arterial Priscoline. The degree of relief of ischemic rest pain obtained with intra-arterial Priscoline is actually greater than that obtained with hexmethonium and Dibenzyline. This occurs despite the fact that skin blood flow may not be increased to as great a degree by Priscoline.

B. **Thromboangiitis Obliterans.** Fifty males and one female with thromboangiitis obliterans were studied. They ranged in ages from 18 to 39 years. Disease had been present from one to eight years, and therapy, consisting of postural exercises, reflex heat, vasodilators or sympathectomy, antibiotics, ointments, and soaks had been employed. All had received oral Priscoline. Some of these patients had pain which was so intense and so resistant to treatment that they had consented to undergo amputation to secure relief. Gangrene was present in 26 patients. It involved over 25 per cent of the foot in eight of these, and in the remainder it was confined to one or more digits.

Tobacco was interdicted routinely in all patients with thromboangiitis obliterans. Some of the patients were already abstaining from tobacco when they came under the author’s observation. Over one third of the group however, “broke training” with varying frequency
after tobacco was prohibited. Attempts at rigid enforcement of the prohibition met with little success. As a rule, response to treatment was more rapid and gangrene less frequent in the patients who discontinued smoking.

Fourteen patients, including four who had previous sympathectomies, obtained complete lasting relief from pain after intra-arterial Priscoline therapy. These patients required intensive therapy, receiving from one to two injections of 50 to 75 mg. daily over periods from two to four weeks. Ten patients received partial relief. Nine obtained temporary relief ranging from 2 to 36 hours in duration.

Eighteen others in this group had pain of unusual severity, requiring morphine in 16 mg. doses every three to four hours. In the authors' experience only a very small percentage of patients so afflicted could be expected to escape major amputation. Nevertheless, in the group that received intra-arterial Priscoline, only three required subsequent major amputations. Two had transmetatarsal and five had digital amputations. In eight cases gangrenous lesions involving the soft tissues healed completely without surgical intervention. Healing appeared to be accelerated and the duration of hospital stay was shortened by the use of intra-arterial Priscoline.

In the patients with thromboangiitis obliterans, as in those with arteriosclerosis obliterans, there was partial relief of ischemic pain at rest as well as a diminution in the requirements for narcotics. Exercise tolerance, however, was only occasionally increased to a significant degree.

Three patients experienced return of their discomfort several weeks after intra-arterial Priscoline was discontinued despite the fact that the drug was being taken by mouth. Pain was again relieved following the institution of intra-arterial Priscoline therapy.

Results in another group of patients with thromboangiitis obliterans who were treated with hexamethonium and Dibenzyline have been reported elsewhere. Although the degree of release of vasomotor tone and vasodilatation produced by these agents is often greater than that produced by intra-arterial Priscoline, only rarely is a more significant increase in exercise tolerance or pain relief obtained. In some instances, intra-arterial Priscoline produced a more significant increase in blood flow than did oral Dibenzyline. In all cases tested, intravenous hexamethonium produced the most significant increase in skin temperature and blood flow.

C. Sudden Arterial Occlusion (Thrombosis and Embolism). Priscoline by the intra-arterial and oral routes, together with anticoagulant therapy, was employed in the management of 12 patients with sudden arterial occlusion. Sudden closure of the artery was caused by embolism (blood clot) in three, traumatic thrombosis in two, simple thrombosis in three, and sudden thrombosis superimposed on old arteriosclerosis obliterans in the remaining five.

Nine of these patients were not subjected to surgery because they were not presented to us within the period felt to be “optimal” for surgical results. In the remaining three, the initial response to intra-arterial Priscoline was so favorable that conservative, nonsurgical management was continued. In nine patients the initial injection was accompanied by a paradoxic reduction in blood flow to the lower leg and foot which was demonstrated by a fall in skin temperature and development of cadaveric pallor of the injected extremity. Vasodilatation, as shown by redness, increased warmth and visible dilatation of the superficial veins occurred in the proximal portion of the extremity despite the changes in the distal areas. In most cases, vasodilatation of the distal portion of the extremity occurred after repeated injections.

A sustained paradoxic response of the type described above may be elicited by sympathectomy. If sufficiently protracted, it can cause gangrene of the already ischemic tissues and loss of the extremity. Reactions of this kind occurring in patients with extensive arterial occlusion following sympathectomy have been reported by Atlas, Freeman and others. Although the paradoxic response to intra-arterial Priscoline was evoked repeatedly during the early phase of treatment of these patients, in no instance was it sustained for a period long enough to produce complete devitalization of the distal tissues. Priscoline administration appears to be of value, there-
fore, in unmasking the “paradox response” in patients for whom sympathectomy is contemplated and in whom it would increase already existing damage.

Although gangrene occurred in seven extremities in this group of 12 patients, only two digits and one forefoot required amputation; all other gangrenous areas healed under treatment. Maintenance of adequate anticoagulant therapy caused no significant problems during the course of repeated arterial injections.

**DISCUSSION**

Priscoline has now been in use for the treatment of peripheral vascular disease for many years. Numerous reports have confirmed the observations that the drug is an effective vasodilating agent. Its use, as well as the use of other presently available vasodilating agents is, however, definitely limited. Priscoline is effective orally, intravenously, or intraarterially, but even when given by the latter route does not increase blood flow or prevent vasoconstriction following exposure to cold to as great a degree as some of the newer autonomic blocking agents (Dibenzyline and hexamethonium).21

Blood flow, as measured by skin temperature and plethysmographic studies, does not necessarily correlate, however, with clinical results. This may be due to the fact that these measurements reflect total blood flow which includes arteriovenous shunt flow, plus so-called “nutritional blood flow.” “Shunt flow” may increase to a great degree in patients with organic vascular disease while nutritional flow is not greatly increased. Consequently, measurements may show an excellent increase in blood flow while little or no improvement occurs clinically. The converse may also be true; only a slight rise in skin temperature or blood flow may occur while a marked clinical improvement results. Therefore, it would appear that flow measurements by the presently available means do not always accurately predict the expected clinical results of any therapy.

There is some evidence to suggest that tolerance to drug effect develops after a prolonged period of therapy regardless of the drug used. For this reason, the long-term management of peripheral vascular disease with presently available drugs is not always satisfactory. The results are encouraging, however, in some cases where an increase in vasoconstrictor tone is present; namely, acrocyanosis, Raynaud’s disease, and thromboangiitis obliterans. In causalgic states or in patients with ischemic pain excellent results have also been achieved.

Studies with Priscoline given by the intraarterial route have indicated that this method of administration often produces better results than when the drug is used orally or intravenously. Side effects and reactions are minimal even in the older age groups.

Results indicate that intra-arterial Priscoline is often effective in the treatment of ulcerations or delayed wound healing secondary to diseases with increased vasoconstrictor tone and Raynaud’s disease. Relief in various “causalgifc” and pain states is also obtained. Treatment of these entities with hexamethonium and/or Dibenzyline is, however, quite satisfactory and, in many instances, the results are better with the latter drugs.21 The use of these agents by conventional methods will relieve the physician of the necessity of using intraarterial therapy with Priscoline. In the occasional case where a marked reaction to hexamethonium or Dibenzyline occurs, or in instances where these drugs are not available, or the physician is not acquainted with their action, intra-arterial Priscoline should be used.

Priscoline has proved to be most effective in providing relief of ischemic rest pain in patients with organic arterial disease. There is evidence of an increased “local” effect and the occasionally serious side effects noted after the use of other “general” blocking agents are rarely noted after intra-arterial Priscoline. This consideration is especially important when one considers that most patients with organic vascular disease are treated in a semi-Fowler’s (foot down) position. If drugs such as hexamethonium, which produce marked postural hypotension, are used in these patients, there is a real danger of syncope and cerebral anoxia. If hypotension occurs and the patient must be placed in the head down position to prevent serious cerebral difficulties, the ischemic extremity is rendered more ischemic by being elevated. For this reason intra-arterial Pris-
Priscoline used in this study was supplied through the courtesy of Drs. F. Yonkman and J. Graeme of Ciba Pharmaceutical Products, Inc.

SUMARIO ESPAÑOL

La Priscolina se puede administrar intra-arterialmente sin dificultad. Reacciones no deseadas ocurren infrecuentemente aún en pacientes de avanzada edad. La administración intra-arterial fue frecuentemente efectiva en pacientes que no respondieron a la administración oral de la Priscolina. Aunque vasodilatación máxima no se obtuvo mediante la administración de Priscolina intra-arterial, el grado de vaso-dilatación obtenida es frecuentemente adecuado en cuanto al efecto clínico. Resultados en 250 pacientes indican que la Priscolina intra-arterial es de mayor beneficio en el tratamiento de dolor isquémico durante el descanso producido por enfermedad vascular oclusiva. Mejora a la tolerancia al ejercicio fue infrecuente. Causalgia, cicatrización tardía y ulceración en la enfermedad de Reynaud's respondieron favorablemente en algunos casos.

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