The Efficacy of the Cardio-Synchronous Pulsator or Syncardon in Severe Peripheral Ischemia

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The Efficacy of Cardio-Synchronous Pulsator or Syncardon in Severe Peripheral Ischemia

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ABSTRACT

Various methods of increasing the blood flow to the extremities of patients suffering from peripheral arterial disease are discussed. The probable order of effectiveness of these methods is: (1) Arterial surgery, (2) Proper position, (3) Local warmth, (4) The Cardiosynchronous Pulsator (CSP) or Syncardon, (5) Suction and pressure, (6) Vasodilator drugs, (7) Sympathectomy. A particular attempt is made to determine the clinical efficacy of the CSP. It is demonstrated that during this procedure the blood flow to the skin of the toes is increased. Increments in blood flow are monitored by photoplethysmography. The difficulty of obtaining statistically significant clinical results is stated. Reasons for expression of clinical impressions are given.

Data acquired by photoplethysmography and clinical experience leads us to believe that the CSP is a useful adjunct to the treatment of patients with severe peripheral arterial disease, who do not have phlebitis, and in whom surgery is not feasible.
INTRODUCTION

The mission of the blood flowing to the extremities is to nourish muscle, skin, nerves, bones, blood vessels, connective and possibly other tissue. Very little reduction of flow to muscle is necessary to make itself manifest by intermittent claudication, as contracting muscle has much greater metabolism and demands a far greater blood supply than do all other organs. Ischemia of bone, blood vessels and connective tissues is a rare extreme. Ischemic pain is a sign of severe deprivation of blood flow to nerves. The most dangerous form of ischemia, however, is cutaneous. This may eventually result in gangrene.

The primary object, therefore, of any therapeutic procedure in peripheral arterial disease must be to increase the blood flow to the skin of the feet where gangrene usually starts.

Prophylactic by avoiding trauma, infection, cold and tobacco must always be the most foremost consideration.

Presently available methods if increasing blood flow to the skin of the feet, particularly the toes, include, probably in order of effectiveness: (1) Arterial surgery, when feasible; (2) Position; (3) Warmth; (4) The cardioc synchronous pulsator (CSP), or Syncardion; (5) Suction and pressure; (6) Vasodilator drugs; (7) Sympathectomy.

When dealing with ischemic toes, surgery, when feasible, is usually most effective. Warmth and proper dependent position are easily obtained and should always be part of the treatment. CSP, as has been previously documented, and as we will demonstrate, will almost invariably increase the blood flow to the toes. The suction and pressure technique works on a similar principle and, although not synchronous with the cardiac cycle, is occasionally effective. Vasodilator drugs have, at best, been disappointing in the treatment of peripheral arterial disease. Sympathectomy is seldom helpful except in cases of severe
vasospasm.

Judging the effectiveness of any procedure in the treatment of peripheral arterial disease by clinical results ranges from difficult to almost impossible, with the exception of arterial surgery and application of warmth and proper position. The blood flow to a pedal digit ranges from 0.1 cc per 100 cc of tissue per minute, to 100 cc of blood per 100 cc of tissue per minute, in patients with or without peripheral arterial disease.\(^{(10)}\) In ischemic toes the flow may range from 0.1 cc per 100 cc of tissue per minute to 3.0 cc per 100 cc of tissue per minute. Obviously even this represents a wide range and equally obviously, the patient with the greater flow has the best chance of a satisfactory therapeutic result. Therefore, only by selecting and comparing the therapeutic results in patients and controls with practically identical flows can significant results be expected. Finding an adequate number of such patients, to say nothing of the tediousness of such a quest, makes the undertaking prohibitive to any sane mortal.

Only arterial surgery and establishment of collateral blood flow are known to influence the course of intermittent claudication.\(^{(11)}\) We have come to rely upon skin temperature studies\(^{(12)}\) and photoplethysmography to detect alterations in the blood flow to the tips of the toes.

We chose the photoelectric approach to monitor the effects of CSP in this study.\(^{(13,14,15,16)}\)
METHOD AND PROCEDURE

Photoplethysmography is a technique for measuring pulsatile blood flow by sensing light reflected or transmitted from the vascular bed. The instrument used operates with reflected light and thus, measures flow in tissue to a depth of approximately 1 mm. The sensing probe, Figure 1, contains a grain-of-wheat lamp and a cadmium selenide photocell side by side in a rectangular assembly 9 x 6 x 4 mm. When the sensor is placed gently on the skin, light reflected by the skin and underlying tissue is registered by the adjacent photocell as a change in resistance. The pulsing of the arterial blood is the only rapidly changing reflector. AC coupling the photocell into an amplifier and recorder eliminated the effects of long term drift, skin pigmentation and other artifactogenid phenomena.

Although the technique is not capable of absolute calibration, there is a straight line relationship of recorded pulse height plotted against pulsatile flow.

For peripheral vascular studies, particularly of the skin of the toes of the lower extremities, this appears to be the simplest technique for measuring increments in flow. The sensor can be quickly and easily moved from one site to another. Skin temperature measurements and occlusion plethysmography lend themselves to calibration in terms of cc per 100 cc of tissue per minute but both of these methods are cumbersome and possibly less accurate since photoplethysmography yields instant and reliable data concerning relative change. It is for this reason that this latter method was employed in this study.
QUOTING FROM DILTS:

(5)

"Maurice Fuchs (6,7) introduced the principle of Syncardial Massage. This is a method by which the pressure of the pulse may be increased. The pressure pulse is augmented by the compression of a cuff as the pulse passes under the cuff. Compression is indexed by the R wave of ECG, giving the process the descriptive name of Heart Synchronized Pulse Compression (HSPC), and more correctly Heart Synchronized Pulse Augmentation by Compression. The Syncardion, employs electronic circuitry which uses self-contained ECG electrodes and permits the determination of the arrival time of the pulse beneath the cuff. The cuff can be placed on the extremity as determined by the operator. The timing of the compression and the amount and duration of pressure are all accurately controlled.

Several concepts of mechanical massage therapy for peripheral vascular diseases have been promoted over the past 40 years or so. As a group they have included application of positive pressure to the entire limb or sections of it, application of negative pressure, and even sequential use of these pressures. However, only this method used the R wave to index the compression of the pulse."

With the CSP in position around the patient's calf and the photoplethysmograph on a digital pad, the following maneuvers were carried out:

1. Recording of pulse height with and without CSP operating, figure 2a.
2. Recording of pulse height with CSP operating, with CSP not operating and with manual manipulation of the calf stimulating CSP operation, figure 2b.
3. Recording of present pulse height without CSP operating, with blood pressure cuff above CSP cuff and apparatus operating, it is inflated to 200 mg HG, noting pulse height and pulsatile flow, figure 2c.
The subjects had varying degrees of peripheral arterial disease and were not hypertensive. These procedures were carried out on eleven (11) consecutive subjects.

The purpose of the procedures was to demonstrate that the increments of pulse height were attributable to the activity of CSP and were not artifactual.

RESULTS
Operation of the CSP increases the pulse height, figure 2a.
Manipulation of the calf manually does not alter the pulse height, figure 2b.
Operation of the CSP below the level of occlusion of arterial flow by sphygmomanometer does not increase the pulse height, figure 2c.

Since the pulsatile flow varies directly with the pulse height, and since the similar results persisted in all eleven (11) subjects, it may be stated that the CSP appreciable increases the blood flow to the skin of the toes.

DISCUSSION
It is now established that the CSP or Syncardion is definitely capable of increasing the blood flow to the skin of the toes during the time that it is in operation. The questions then present themselves as to whether or not this is of therapeutic value and assuming that it is, how often and how long the CSP should be operated. We encountered two patients, both of whom had diabetes, both of whom had severely limited capacity for blood flow to the toes, as measured by the vasodilation test. In neither patient, was arterial surgery feasible, but proper warmth and position had been applied. One had ischemic ulcers on the toe and heel, the other, rubor on dependency and rest pain. Both had suffered these symptoms and signs for months. Both improved within a week
after CSP had been administered for one half hour, twice daily. Our impression was that these two patients, both in the seventh decade, had unquestionably benefited from this treatment.

As mentioned above, one must rely in judging therapeutic procedures for this disease upon blood flow measurements and/or clinical impressions. It is our belief based upon criteria that the CSP is useful in the treatment of severe peripheral arterial disease which is not amenable to and/or does not respond to arterial surgery.

CSP therapy is contraindicated in the presence of local active venous thrombosis.

There are various possible mechanisms to account for long term beneficial effects from CSP therapy. We know that the pulse height and pulsatile flow are increased. Therefore, the increased pulse pressure can open up the smaller vessels, on a moderately permanent basis. We also know that in situations in which there is very severe ischemia small increments of blood flow may make the difference between preserving or not preserving viable tissue. We also know that such small increments can be produced by the CSP.
REFERENCES


