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Short Report

Use of the Muscle Pump Activator* for Increasing Lower Limb Venous Flow Velocity

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ABSTRACT

Objective: To demonstrate the effect of a newly developed device, the Muscle Pump Activator, on venous flow velocity of the lower limbs.
Design: Prospective study.
Setting: Tertiary-care teaching hospital.
Subjects: A group of 30 healthy volunteers.
Interventions: The Muscle Pump Activator is a self-activated pedal device for use in the sitting position. Venous flow velocity was measured by duplex examination of the femoral vein at rest and during activation by the subject of the device. Subjective reports were also collected.
Results: Venous flow velocity increased from 13.3 (SD 2.4) cm/s at rest to a maximum of 70.3 (SD 14.4) cm/s during 15 s of pedalling ($p<0.01$). This represents an increase in flow of 439 (SD 12.4)%. Ease of use and comfort of the device were reported by all the volunteers.
Conclusions: This Muscle Pump Activator significantly improves venous flow velocity and holds promise as a useful adjunctive modality for the prevention of post-operative deep vein thrombosis. It is easy to use and well tolerated. Studies are now needed in clincial settings with large groups of patients.

Keywords: Deep vein thrombosis; Muscle pump; Prevention

Introduction

Deep vein thrombosis (DVT) is a serious complication of lengthy surgical procedures. The risk is also high in the immediate postoperative period and continues even when the patient is partially ambulant [1–4]. It is often aggravated by the common practice of having post-operative patients sit in a chair near the bed, usually without moving. Venous stasis is probably the major predisposing factor. Despite the introduction of numerous preventative methods, such as anticoagulants, elastic support, intermittent pneumatic compression and electrical stimulation [5–8], DVT and its sequela, pulmonary embolism continue to plague patients and clinicians.

We present a simple new antivenostatic device developed by us, the Muscle Pump Activator (MPA)* (Mego-Afek, Israel), designed to accelerate venous flow return. We believe its use in the early postoperative days can minimise the development of DVT.

Materials and Methods

The MPA is a simple pedal device used in the sitting position (Fig. 1). The pedals are activated by the patient, and placement of the device is adjusted individually. Pressing down on one pedal automatically elevates the other; the patient determines both the height of the pedal and the speed of movement.

We tested the MPA on 30 normal, healthy volunteers, all of whom were medical clerks (four men, mean age 47.6 years, and 26 women, mean age 48.3 years). Venous flow velocity was measured by duplex ultra-

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*Patent pending. Manufactured by Mego-Afek, Israel.

*Patent pending.

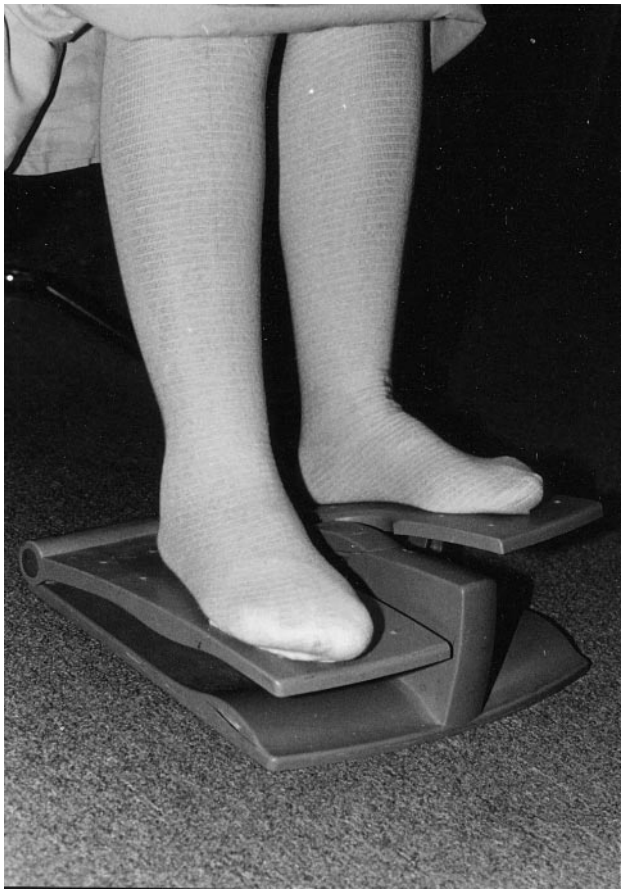

Fig. 1. Patient using the muscle pump activator.

sonography (ATL-3000-HDI) in the common femoral vein at rest, immediately after starting pedalling and continuously during activation of the device. All measurements were made in the sitting position. Maximal flow velocity and the time taken to reach this velocity were noted. After reaching this velocity, the volunteers continued to pedal for a further minute and then rested. The volunteers were questioned regarding ease of use, leg aching or cramps and other observations.

Results are given as the mean and standard deviation (SD). Student's *t*-test was used to detect differences between the velocity at rest and after activation. A *p* value of <0.05 was considered significant.

Results

Mean venous flow velocity increased from 13.3 (SD 2.4) cm/s at rest to a maximum of 70.3 (SD 12.4) cm/s during activation of the device ($p<0.01$) (Table 1, Fig. 2). Maximal velocity was reached at a mean of 3 s after pedalling was started and represented a mean 439 (SD 12.4)% increase in flow velocity.

All volunteers reported ease of use. There were no adverse side-effects, such as leg aching or cramps.

Table 1. Venous flow velocities (cm/s) at rest and after 15 s of the MPA

Volunteer	Venous flow velocity at rest (cm/s)	Maximal venous flow velocity while using MPA (cm/s)	% Velocity augmentation
1	15.7	70.3	348
2	11.2	104	829
3	18.7	97.3	420
4	13.5	80.8	499
5	15	87.5	483
6	18	74.2	312
7	11	69.2	529
8	12	54.6	355
9	11.5	53.1	362
10	12	54.1	351
11	12	49.6	313
12	11	72.2	556
13	9	67.7	652
14	13	54.6	320
15	16.5	60.7	268
16	13	67.7	421
17	13.1	78.2	497
18	14.5	96.1	563
19	18	80.3	346
20	15.3	77.0	403
21	13.6	71.7	427
22	11.6	48.8	321
23	9.9	66.1	568
24	10.2	54.9	438
25	14	58.4	317
26	11.9	86.3	625
27	14.9	77.2	418
28	13	71.3	448
29	11.5	60.4	425
30	14.7	65.7	347
Mean (SD)	31.31 (2.45)	70.33 (14.42)	439 (124)
p value (rest vs. maximal)		<0.01	

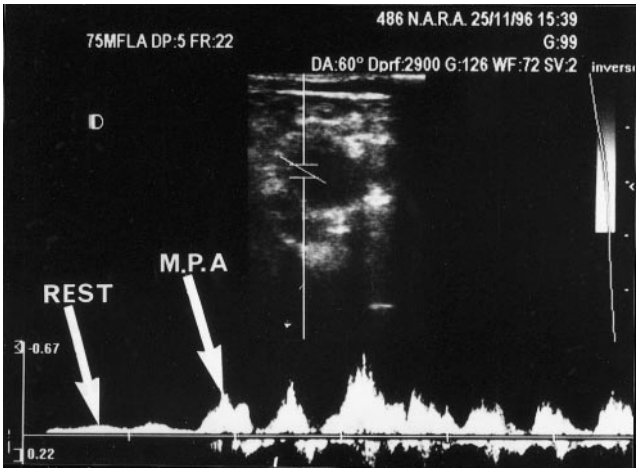

Fig. 2. Venous flow velocity augmentation as recorded by duplex examination of the common femoral vein during activation of the device. Arrows - rest and later MPA initiation.

Discussion

This study indicates that the MPA significantly increases venous flow velocity in healthy volunteers.

This may have significant potential benefits for patients undergoing surgery, in whom postoperative DVT is still a major complication. Patients at risk of developing DVT are those undergoing lengthy operations such as neurosurgery or orthopaedic surgery, where a very high incidence of DVT has been found using various types of diagnostic examinations [1,3,5,6]. Although duration of surgery itself is a major risk factor for the development of DVT, the immediate postoperative period is no less important, in spite of early ambulation and the use of antiembolic stockings or anticoagulants.

This device may be of important benefit as an additional modality for the prevention of DVT in the immediate postoperative and early ambulatory period. It has the double advantage of counteracting venous stasis, probably the major underlying factor of DVT, while not inducing fatigue. We found that the mild extension and contraction of the legs during pedalling activated the muscle pump of the leg, thereby accelerating venous flow velocity. The volunteers found the device easy to use and reported no side-effects.

Although the MPA was designed for the prevention of DVT, it may also have a place in the treatment of patients with chronic venous insufficiency using elastic support who are unable to walk owing to concomitant joint or cardiac diasease. The simple design and low cost of the device will contribute to its widespread use.

In conclusion, the new Muscle Pump Activator significantly improves flow velocity of the femoral vein in healthy individuals. In addition, it is well tolerated and easy to use and therefore we anticipate that patients would be able to use this device properly. Further investigations in clinical settings are now required to verify its potential in postoperative patients.

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