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## **Venous Hemodynamic Alteration Induced by the Venopress (A New Intermittent Compression Pneumatic Device for Prevention of Deep Vein Thrombosis)**

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### **ABSTRACT**

The hemodynamic effect of general anesthesia on the venous velocity of the lower limbs was investigated in 20 patients who volunteered to undergo venous compression with the use of a new pneumatic device, the Venopress. Venous velocity in the common femoral vein was monitored by a duplex device before and after induction of general anesthesia. Results indicated that prior to general anesthesia, venous velocity was increased two- to fourfold by the Venopress and when anesthesia was induced, a further augmentation of 10 to 30% was achieved. We conclude that, the Venopress is a very efficient device for venous velocity augmentation, especially during general anesthesia.

### **INTRODUCTION**

Postoperative deep vein thrombosis (DVT) remains an important medical problem which continues to endanger patients despite the use of such prophylactic methods as anticoagulants, pneumatic devices, elastic support, and electrical stimulation [1].

The use of pneumatic devices is based on the assumption that intraoperative augmentation of venous velocity in the lower limbs will prevent the formation of DVT. There are also reports indicating an elevation in fibrinolytic activity due to the release of fibrinolytic substances from the compressed venous wall during pneumatic compression [2]. However, no information on variations in compressed venous velocity under general anesthesia has been published.

Thirteen years ago, we reported our findings on the preoperative prevention of DVT in neurosurgical patients with the Lymph-Press device, designed for reduction of lymphedema [3]. Using marked fibrinogen to monitor DVT, we noted a reduction in the frequency of DVT in the control group from 50% to 4.3% [4]. These excellent results, together with the introduction of the

noninvasive vascular duplex device, prompted us to develop a new pneumatic device the Venopress (manufactured by Mego Afek, Israel), for the prevention of postoperative DVT. The present work investigates the affect of the Venopress on the compressed venous blood velocity before and after induction of general anestesiã.

### OPERATION OF THE VENOPRESS

The venopress has two parts:

1. **The sleeve** consists of five independent overlapping cells, connected to form a boot. Each cell is fed independently by an air tube from the pneumatic machine. Two sleeves are used, one for each leg, during operation of the device.
2. **The pneumatic machine** consists of a compressor and distributor. Air pressure may be set at 50 or 60 mmHg. The distributor divides the air sequentially among the ten cells of the two sleeves, at 2 seconds per each pair of cells. When all ten cells are full, they are emptied simultaneously. The air insufflation cycle lasts 10 seconds, followed by a 1-minute pause.

### PATIENTS AND METHODS

#### Patients

Twenty patients (12 men, 8 women, mean age 64 years) undergoing surgery unrelated to the lower limbs (cholecystectomy, hemicolectomy, gastrectomy) gave their informed consent for this study.

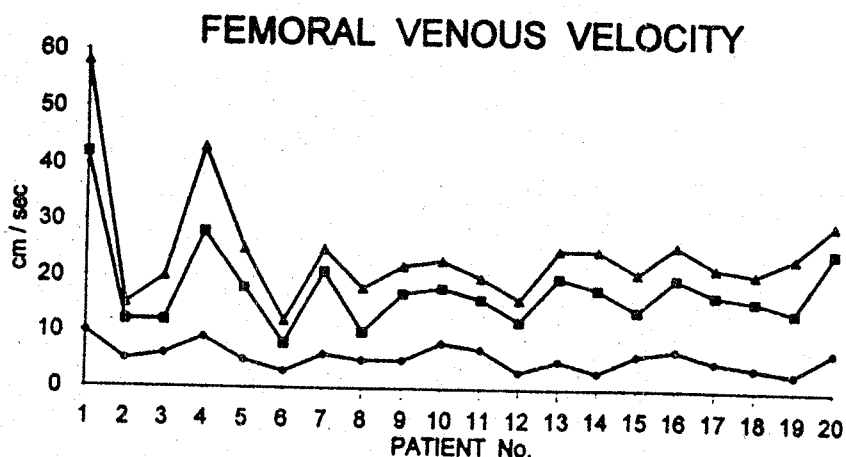
#### Methods

- Each patient was investigated in three stages while on the operating table:
1. Prior to undergoing anesthesia, baseline venous velocity was measured using a duplex device (Elscent, Israel) placed on the common femoral vein (6.5 MHz probe, 60° angle).
  2. With the duplex device still monitoring venous velocity in the same place and at the same angle as in stage 1, the Venopress was applied to both legs.
  3. Five minutes after general anesthesia was induced venous velocity in the common femoral vein was again measured.

Twenty-four hours after surgery all patients underwent investigation of the deep vein in the lower limb for the presence of postoperative DVT.

### RESULTS

The results can be seen in Figure 1.



The mean baseline venous flow velocity in the lower limbs in all patients was 6.6 cm/sec. After application of the Venopress, venous velocity increased to a mean of 17.8 cm/sec. When general anesthesia was induced, a further augmentation was noted, to a mean of 24.5 cm/sec. In addition, the duplex device indicated a 30% enlargement of the common femoral vein after general anesthesia was induced [5]. Twenty-four hours after surgery, a control deep vein duplex examination revealed no DVT in any of the patients.

## DISCUSSION

Of the many methods used today to prevent DVT, the pneumatic devices are the safest and, in the long run, have the highest cost-benefit ratio. We tested a new pneumatic device, the Venopress, before and after induction of anesthesia, and found it to be much more effective during general anesthesia, presumably because of the attendant muscle relaxation, which, in turn, led to enlargement of the veins. This factor most probably contributes to the reduction in venous flow during anesthesia and the consequent of intraoperative DVT. Since the enlarged veins contain a greater amount of venous blood in the lower limbs, their compression was more prominent during general anesthesia, as shown by the increase in the velocity wave detected over the common femoral vein.

In high risk patients, i.e., those with a past history of DVT, or a hypercoagulation state, undergoing long operations (neurosurgery) or with contraindications to prophylactic heparin, the pneumatic compression device is the best method for prevention of DVT [6].

The Venopress proved to be a very efficient device for augmentation of intraoperative venous blood flow velocity.

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