A new sequential pneumatic device for the prevention of deep vein thrombosis

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A new sequential pneumatic device for the prevention of deep vein thrombosis

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A new sequential pneumatic instrument for the prevention of deep vein thrombosis (DVT), the Lymphapress, was investigated in neurosurgical patients. In the control group, 50% of patients developed DVT and in the treated group only 4.3% were affected. These results demonstrate the highly beneficial effect of this method of preventing DVT during and after surgery, especially when the use of other preventive methods is precluded.

KEY WORDS • venous thrombosis • phlebothrombosis • postoperative thrombosis

Deep vein thrombosis (DVT) and the consequent thromboembolic phenomena are dangerous complications that threaten some patients after various surgical procedures. The introduction of sophisticated methods for the diagnosis of DVT, such as Doppler sonography, radioactive fibrinogen, and phlebography, has called attention to the fact that DVT is much more common than was previously realized. The percentage of the patients who are affected by DVT following surgical procedures has been reported to be as high as 30% to 50%.3,6,8

Modern preventive treatments, especially prophylactic use of heparin and early ambulation, have significantly decreased the prevalence of this complication.3,8,10 In spite of the general use of these preventive measures, however, clinical evidence of pulmonary embolism will be noted in 1.8% of patients, most of whom will not have been recognized as having DVT. Approximately 0.6% of all patients will die from this cause.11 Late complications of DVT, manifested as chronic venous insufficiency, may appear years after surgery in some patients.

In the last decade, a new preventive method — the intermittent compression method — has been introduced. This method is based on intermittent compression and decompression of the legs by a pneumatic sleeve.1,2,6 The few reports describing the beneficial effect of this technique indicate a significant decrease in the occurrence of DVT during and after surgery. No side-effects have been observed so far.

The present study describes an innovative intermittent sequential pneumatic apparatus, the Lymphapress, which has been used to prevent DVT in patients in a neurosurgical ward. This group of neurosurgery patients was chosen because a substantial percentage of them suffer from limb paralysis of various degrees and the surgical procedures are of relatively long duration. Some of these patients are unconscious, and early ambulation therapy is not possible. Therefore, this group of patients is especially vulnerable to the life-threatening complication of DVT, and suitable for such a study.

Technical Details of the Apparatus

The Lymphapress is an intermittent pneumatic device that is generally used for the reduction of edema of the limbs. A te use os this apparatus in reduction of lymphedema of the upper and lower limbs has been reported elsewhere.11,12

The machine contains a compressor and a distributor which supply pressure to each cell of the sleeve separately. The sleeve is a carpet-like wrapping adapted to each leg. Each sleeve used for preventing DVT contains four independent cells; sleeves used for other purposes contain nine to 12 cells. In order to avoid any gaps between the functioning cells during their inflation phase, the cells overlap one another; the overlapping comprises one-third of each cell, and provides a continuous outflow. The cells are inflated starting from the first distal cell, then the second, and so on. When both sleeves are inflated, all the cells

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empty themselves simultaneously (Fig. 1). Successive inflation cycles generate a milking mechanism on the legs. The duration of each cycle, including an intermission, is 25 seconds, of which the compression period is only 12 seconds. Variation in the compression period can be achieved by using different air supply sources on the machine.

**Summary of Cases**

**Clinical Material**

The preventive effect of the Lymph Press on the development of DVT was investigated on 43 randomly selected postsurgery patients in the Department of Neurosurgery. The patients were separated into two groups: a control group comprised of 20 patients and the treated group of 23 patients, who underwent Lymph Press treatment. Table 1 demonstrates the distribution of the patients in both groups according to age and sex. In the control group, five patients suffered from paresis of one or two limbs, while in the treated group eight patients suffered from these symptoms. The surgical procedures carried out on the patients are demonstrated in Table 2.

Five patients in the control group and six in the treated group suffered from cancer. The average duration of the operative procedure from the induction of anesthesia until the patient was transferred to the ward was 4.6 hours in the control group and 4.7 hours in the treated group.

The diagnosis of DVT was established by the iodine-125-labeled fibrinogen test according to the method described by Kakkar, et al. The method appears to be ideal for the early diagnosis of DVT and can be carried out easily at the patient’s bedside.

The patients in the treated group were connected to the Lymph Press apparatus shortly before surgery. Each leg was inserted into a sleeve constructed of four parallel overlapping cells. The sleeve was snugly adjusted to the leg at an applied pressure of 50 mm Hg, and remained on the patient’s legs during the operation and for 24 hours afterward, until he became ambulant or until conventional prophylactic measures were used (such as physiotherapy or elastic bandages, but not heparin), especially in the paretic patients.

**Results**

Ten of the 20 patients in the control group developed DVT (50%), five of them in both legs and five in one leg (Table 3). From a total of 40 legs investigated, DVT occurred in 15 (37.5%). One of the patients who developed DVT died of massive pulmonary emboli. The pathology of DVT and the massive pulmonary emboli were confirmed at autopsy.

Of the 23 patients included in the group treated with the Lymph Press, DVT was found in one patient only (4.3%). From a total of 46 legs investigated, only one (2.1) was affected by DVT.

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TABLE 1

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Control Group</th>
<th>Treated Group</th>
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<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>30-40</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>41-50</td>
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<td>3</td>
</tr>
<tr>
<td>51-60</td>
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<td>2</td>
</tr>
<tr>
<td>&gt;71</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>total</td>
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<td>13</td>
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TABLE 2

<table>
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<tr>
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</thead>
<tbody>
<tr>
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<td>16</td>
</tr>
<tr>
<td>laminectomy</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>transsphenoidal hypophysectomy</td>
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<td>2</td>
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TABLE 3

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Cases</th>
<th>Cases with DVT</th>
<th>Legs with DVT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Percent</td>
<td>No.</td>
</tr>
<tr>
<td>control group</td>
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<td>10</td>
<td>15</td>
</tr>
<tr>
<td>treated group</td>
<td>23</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

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Discussion

In spite of tremendous efforts to prevent DVT during and after operation by the use of different techniques, including the prophylactic use of anticoagulant drugs, DVT and its complications are still regarded as responsible for serious postoperative mortality and morbidity. Present diagnostic procedures indicate that the rate of DVT in patients undergoing surgery reaches a very high percentage (30% to 50%).

Early ambulation has significantly decreased the high prevalence of DVT but has not solved the problem for patients in whom DVT has already developed during the surgical procedure. Of the 10 patients in our untreated group who developed DVT, seven (70%) developed this complication during the surgical procedure.

The present study was carried out on patients who were particularly disposed to DVT due to limb paralysis of various degrees, long operations, and long hospitalization. These factors may explain the high rate of DVT found in the control group.

A few reports have described the value of the intermittent pneumatic pressure method using a one-cell apparatus. The present study strongly confirms the value of this method as an efficient prophylactic measure in preventing DVT. The main principle of the present apparatus is the prevention of venous stasis by the "milking" effect of the Lymphapress. Other pneumatic methods are based on intermittent compression and decompression of the veins, which is believed to release fibrinolytic substances into the circulation. Those instruments are made of a single pneumatic cell, whereas the Lymphapress, due to its overlapping multiecel structure, adds to the intermittent compression the dynamic "milking" effect, probably explaining the good results obtained in the present study.

The beneficial results achieved by the use of the Lymphapress technique in the treated group are striking. It is strongly recommended that this method should be introduced routinely as an effective measure to prevent DVT in patients undergoing surgical procedures.

References


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