

MECHANICAL PROPHYLAXIS AGAINST DEEP VEIN THROMBOSIS IN CHARNLEY HIP ARTHROPLASTY

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A retrospective study of 521 Charnley hip replacements involving 471 patients is presented, assessing the effect of mechanical prophylaxis against deep vein thrombosis. During the operation venous flow was stimulated in all cases by passive movement at the ankle joint. In addition, all patients used Flowtron leggings – a non-invasive, intermittent pneumatic compression device – on the unoperated leg during the operation and on both legs during the first 24 hours after the operation. The patients were mobilized as soon as possible with weight-bearing on the operated leg from the second postoperative day.

As indicated by the results, the above combination of early mobilization, peroperative stimulation of the venous flow and the use of Flowtron leggings lowered the incidence of thromboembolic complications to 3.6 per cent.

Key words: deep vein thrombosis; pulmonary embolism; thromboembolic complications; total hip replacement arthroplasty

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Thromboembolic complications present one of the major problems in hip surgery. In an endeavour to arrive at an effective method of avoiding thromboembolic complications two fundamentally different principles have been used. In the light of biochemical knowledge, an attempt has been made to interfere with the clotting mechanism, and from the physiological point of view venous stasis in the lower limbs has been counteracted by purely mechanical means.

The effect of prophylactic anticoagulant medication varies with the method used (Soreff et al. 1975, Jennings et al. 1976, Stamatakis et al. 1978), and opinions are divided concerning its effect and relative safety (Coventry et al. 1973, Hampson et al. 1974, Sakai & Amstutz 1976, Rogers et al. 1978, Moskovitz et al. 1978).

Mechanical prophylaxis has received less attention, although it is a cheap method and devoid of side effects (Pedegana et al. 1977, Roberts 1977).

The present paper reports our experiences of an active attitude to mobilization, combined with peroperative stimulation of venous flow by passive movements of the ankle joint and the use of Flowtron leggings. The leggings, which exert intermittent compression on the calf, with a compression cycle of 2 minutes obtaining a maximum pressure of 40 mmHg, were used on the unoperated leg during the operation and on both legs during the first 24 hours after the operation (Calnan et al. 1970, Hills et al. 1972, Clark et al. 1974).

PATIENTS AND METHODS

The material comprises 521 total hip replacement arthroplasties on 471 patients, all of whom had the Charnley operation. Table 1 gives the sex ratio and age distribution. The operations were performed during the period May 1974 to May 1978. Since October 1974 the arthroplasties have been performed in a Charnley-Howorth sterile box.

Table 1. Sex ratio, age distribution and number of operated hips

| | No. of hips | Age, mean | Range |
|---------|-------------|-----------|-------|
| Males | 268 | 62.9 | 31-76 |
| Females | 253 | 61.0 | 28-78 |

The material is a selected one. Patients having an increased thromboembolic risk were not subjected to surgery unless the risk factors could be eliminated or sufficiently minimized. For instance, patients with varicose veins were operated on for this condition prior to a hip replacement, and patients with heart diseases or hypertension were not subjected to operation if the risk was deemed to be appreciably enhanced.

A diagnosis of deep vein thrombosis was made clinically on the basis of a combination of the signs: calf tenderness, oedema, a positive Homans' sign, fever, increased pulse rate and venous distension. The diagnosis was made according to the current procedures in our department; I^{126} fibrinogen test and phlebography were not used.

A diagnosis of pulmonary embolism was based upon the symptoms and signs: a stitch in the side, dyspnoea and haemoptysis, and was confirmed by ECG, chest X-rays, arterial puncture and lung scintigraphy.

Patients in whom deep vein thrombosis or pulmonary embolism was diagnosed received treatment with heparin and dicoumarin for a period of 3 months. Heparin was discontinued when the therapeutic prothrombin level was reached. In other cases this medication was not given.

During the operation venous flow was stimulated in all cases by passive movements of the operated leg at the ankle joint, about 30 times every 10 minutes. After waking up, all the patients were encouraged to actively move their ankle and knee joints.

Flowtron leggings (Flowtronaire P.V.C. inflatable leggings) which exert intermittent compression on the calf, with a compression cycle of 2 minutes and a maximum compression lasting for 5 seconds (maximum pressure of 40 mmHg), were used in all patients on the unoperated leg during the operation and on both legs during the first 24 hours after the operation (Figure 1).

The Flowtronaire system was developed in the Royal Postgraduate Medical School and Hammersmith Hospital, London. It has gained ground especially within urology, gynaecology, and abdominal surgery, while in orthopaedic surgery it has received little attention.

During the whole period the operated leg was bandaged with elastic bandage from toes to pelvis until the stitches were removed. The foot of the bed was raised about 20 centimeters.

All patients were mobilized as soon as possible. Walking with weight-bearing on the operated leg was allowed from the 2nd postoperative day, with the use of

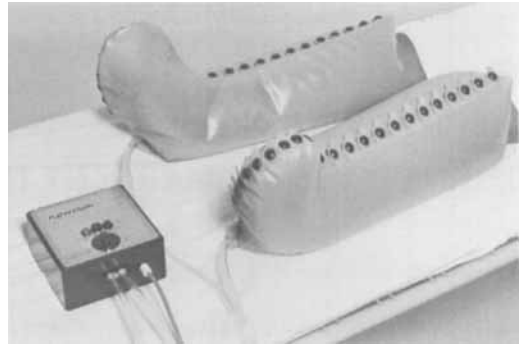


Figure 1. Motorunit and Flowtron leggings, of which the right is deflated and the left inflated.

two crutches. All the patients were examined 12 weeks after the operation in our outpatient department.

RESULTS

Thirteen of the 521 patients developed clinical signs of deep vein thrombosis and were treated with anticoagulants for 3 months. The thromboembolic complications are listed in Table 2. In nine cases the deep vein thrombosis affected the operated leg and in four cases the contralateral leg. In no case were both legs affected. Of these 13 patients two developed symptoms and signs of pulmonary embolism.

Another six patients developed symptoms and signs of pulmonary embolism without previous signs of deep vein thrombosis.

One patient, a 66-year-old male, who developed deep vein thrombosis affecting the operated leg on the 11th postoperative day, died at home 75 days after the operation and no autopsy was made. In the other cases with throm-

Table 2. Thromboembolic complications after total hip replacement

| | |
|---------------------------------|-----------|
| Number of operations | 521 |
| Deep vein thrombosis (DVT) | 11 = 2.1% |
| Pulmonary embolism (PE) | 6 = 1.2% |
| DVT + PE | 2 = 0.4% |
| Thromboembolic complications | 19 = 3.6% |
| Total PE (with and without DVT) | 8 = 1.5% |

Table 3. Thromboembolic complications (TEC) divided according to age

| | No. of patients | No. of TEC |
|--------------------|-----------------|------------|
| Age below 60 years | 186 | 7 = 3.8% |
| Age over 60 years | 335 | 12 = 3.6% |

Table 4. The incidence of thromboembolic complications (TEC) in patients with previous deep vein thrombosis (DVT) or a prior operation for varicose veins

| | Total series | Pts with TEC |
|---------------------------------------|--------------|--------------|
| Earlier DVT | 21 = 4.0% | 4 = 21.0% |
| Previous operation for varicose veins | 62 = 11.9% | 1 = 5.2% |

boembolic complications there were no further problems and no sequelae.

The deep vein thrombosis was detected from 2 to 35 days postoperatively, mean 14 days. The pulmonary embolism appeared from 2 to 90 days postoperatively, mean 35 days.

Table 3 demonstrates that patients over 60 years of age did not have a higher incidence of thromboembolic complications, and from Table 4 it is apparent that there was a greater risk for patients with previous deep vein thrombosis to develop this condition again, whereas in patients

previously operated on for varicose veins the risk of thromboembolic complications was not increased.

The patients who developed thromboembolic complications did not differ from the others as regards, sex, age, body weight, preoperative haemoglobin level, peroperative blood loss, number of transfusions, duration of anaesthesia, or preoperative and peroperative mobility of the hip joint.

DISCUSSION

Hills et al. (1972) demonstrated a significantly higher frequency of thromboembolic complications in patients over 60 years, and in patients operated on for gastrointestinal and urological diseases. In agreement with Salvati & Lachiewicz (1976), however, we were not able to find a higher incidence of thromboembolic complications in patients over 60 years, and could not confirm the findings of Coventry et al. (1973) that obesity predisposes to thromboembolic complications. Again in agreement with Salvati & Lachiewicz (1976) we found that patients with previous deep vein thrombosis run a greater risk of developing this condition again.

Prophylactic anticoagulation is difficult to administer, and wound complications, especially bleeding, and subsequent infection can be very serious. Bleeding from the gastrointestinal tract

Table 5. The incidence of thromboembolic complications (TEC) after total hip replacement with various prophylactic regimens (A-C = anticoagulation)

| | Method of A-C | No. of hips | TEC | Fatal PE | A-C complications |
|-----------------------------|---------------|-------------|------|----------|-------------------|
| Coventry et al. (1973) | Warfarin | 1950 | 3.5% | 1 | 4.2% |
| Sakai & Amstutz (1976) | Warfarin | 415 | 3.9% | 0 | 5.8% |
| Jennings et al. (1976) | Aspirin | 528 | 7.8% | 0 | ? |
| Salvati & Lachiewicz (1976) | Dextran | 427 | 7.0% | 1 | 15% |
| | + Aspirin | | | | |
| Salvati & Lachiewicz (1976) | Dextran | 197 | 5.1% | 0 | 24% |
| | + Warfarin | | | | |
| Present series | | 521 | 3.6% | 1 | 0 |

or genito-urinary tract has been reported as well as bleeding from the central nervous system (Sakai & Amstutz 1976, Salvati & Lachiewicz 1976, Rogers et al. 1978).

Mechanical prophylaxis against deep vein thrombosis has attracted less interest although it is a method which is easy to control and devoid of risk. It has been demonstrated by several investigators that passive movements at the ankle joint and intermittent compression of the calf constitute effective prophylaxis (Hills et al. 1972, Roberts 1977, Pedegana et al. 1977).

In Table 5 we have compared our own findings with other published reports on the frequency of thrombotic complications and complications following prophylactic anticoagulation after total hip replacement. The frequency of thromboembolic complications found in the present series corresponds to that of Coventry et al. (1973) and Sakai & Amstutz (1976). In the other series the frequency of thromboembolic complications is higher.

As there are no additional complications involved in our regimen (the reported complications following prophylactic anticoagulation range from 4.2 to 24 per cent) and as the frequency of thromboembolic complications we encountered is on a level with the lowest frequencies after warfarin medication, mechanical prophylaxis as described above is a reasonable alternative to routine anticoagulation for patients undergoing total hip replacement.

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