INTERMITTENT PNEUMATIC FOOT AND CALF COMPRESSION: DETERMINING ITS OPTIMAL EFFECT ON VENOUS HAEMODYNAMICS USING DIRECT PRESSURE MONITORING

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Introduction: Recently published data indicates that intermittent pneumatic compression (IPC) of the leg is not only an established method for the prevention of deep vein thrombosis, but also a promising treatment option in the conservative management of symptomatic peripheral vascular disease. The cardinal mechanism explaining its efficacy is believed to be due to enhanced emptying of the dorsal venous plexus of the foot and the muscular and crural veins of the calf.

Aim: To determine the combination of applied pressure, frequency and proximal inflate delay time (PIDT; defined as the time after which calf inflation follows that of the foot) of IPC delivered to the foot and calf (IFC_{F+C}) which optimizes lower limb venous emptying, using continuous direct venous pressure monitoring.

Method: IPC_{F+C} was delivered using the ArtAssist® AA-1000 (ACI, USA). Six legs of normal subjects [medium age (range) of 30 (24-35) years] free of venous reflux, as determined by duplex (HP Sonos 2500), were investigated. Venous pressure in the sitting position was measured directly in a dorsal vein of the foot using an accurately calibrated pressure transducer (S&W Medico Teknik, Denmark) attached to a 20-gauge heparinized cannula. The effect of IPC_{F+C} at 5 different applied pressures (60, 80, 100, 120 and 140 mmHg), 3 different frequencies (2, 3 and 4 impulses/min) and 3 different PIDTs (0, 0.5 and 1 sec) were evaluated in all possible combinations. After delivery of an impulse, venous pressure declined to a minimum (P_{min}) and rose to a maximum (P_{max}) just before the next impulse was delivered. The characteristic steady state P_{min} and P_{max} for a certain combination of pressure, PIDT and frequency were used in the analysis (statistics were performed using the Wilcoxon test).

Results: Resting median venous pressure (interquartile range) was 62 (57-64) mmHg. **2 impulses/min:** at any of the PIDTs examined, the effect of applied pressure on P_{min} and P_{max} was not significant (except for a pressure of 140 mmHg and a PIDT of 1 sec; $P<0.036$). **3 and 4 impulses/min:** a pressure of 120-140 mmHg was significantly more effective ($P<0.036$) on P_{min} and P_{max} than 60-80 mmHg when a PIDT of 0.5 of 1 sec was used. At all frequencies and applied pressures examined (except 60mmHg for P_{max}), a PIDT of 1 sec generated significantly lower P_{min} and P_{max} than a PIDT of 0.5 sec, and this generated lower pressure than a PIDT of 0 sec. A frequency of 3 or 4 impulses/min produced significantly lower values of P_{min} and P_{max} than a frequency of 2 impulses/min (except 60 mmHg for the P_{min} and 80 mmHg for P_{max}). There was no significant difference between 3 and 4 impulses/min on P_{min} and P_{max} over the entire pressure range (except 60 mmHg for P_{max}; $P<0.036$).

Conclusion: Intermittent pneumatic compression of the foot and calf provides optimal venous emptying at an applied pressure of 120 or 140 mmHg, a frequency of 3 or 4 impulses per minute and a proximal inflate delay time of 1 second.

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