DYNAMIC COMPRESSION PRESSURES AND SKIN BLOOD PERFUSION
ACCOMPANYING LEG BANDAGING AND ACTIVITY

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INTRODUCTION

BACKGROUND

Compression bandaging is a main treatment modality for lower extremity venous disease and is a principal component of the treatment of peripheral edema and lymphedema. Bandaging effectiveness is in part related to the pressure it exerts which depends on bandage type, wear-time and other factors. Under resting conditions, sub-bandage pressures achieved and measured were static, and previous work has shown these affect lower extremity blood circulation. In particular, bandaging that achieves sub-bandage pressures of 28-42 mmHg results in increased leg pulsatile blood flow at rest. However, the possibility of dynamic pressure changes that occur during normal walking and other activities has, until recently, received little investigative attention.

OBJECTIVES

Static sub-bandage pressures can be very similar for quite diverse bandage materials but once applied, working muscle induces radial expansion which depends on the bandage elastic properties. Pressure changes accompanying normal activities will vary with bandage material, likely being greater for more inelastic materials. The exact role of such dynamic pressure changes in the therapeutic efficacy of compression bandaging is not known.

Our working hypothesis is that such differences may differentially affect blood and lymphatic circulations. Our initial goals were to:

1. Investigate the blood circulation aspect
2. Obtain basic information on the magnitudes of static and dynamic sub-bandage pressures of the two different bandaging materials and to describe how these are affected by different activities.
3. Determine if skin blood perfusion (SBF) after activity is differentially affected.

METHODS

Eleven volunteer subjects were evaluated during a single test session. One leg was spiral wrapped from foot-to-knee with an elastic crepe self-adherent bandage (Coban, 3M Company) at full stretch extension with Coban® bands.

After a series of pressures and SBF measurements, the bandage was removed and the leg was wrapped with a long stretch bandage (ACE); measurements were then repeated.

The leg circumference at ankle and calf were measured (figure 1). With subjects seated, a pressure sensor pod (Cleveland TheraPakets) on to which a laser Doppler probe (Vasomedics) was taped near the sensor (figure 2), was placed on the posterior calf. A second sensor pod was placed on the lateral gaiter area (figure 3).

Subjects then stood flat-footed while a baseline non-bandaged SBF was measured for two minutes starting one minute after standing. Subjects then sat and one leg was wrapped with Coban. Static pressures were measured and subjects returned to a flat-footed standing position (figure 4).

Then a standardized sequential protocol (figure 5) was followed in which SBF was measured before and after two minutes of heel-up maneuvers at a rate of 15 minutes and again after bandage removal. The sequence was then repeated with the leg bandaged with an ACE wrap at full extension.

RESULTS

Static Sub-bandage Pressures

At the gaiter, seated pressures tended to be greater with Coban compared to ACE (figure 6).

Pulse Pressures

Pulse pressures were significantly (p<0.001) greater for Coban vs. ACE bandaging, but only after exercise or after exercise with either Coban or ACE. However, SBF showed a similar pattern at the gaiter and calf sites (19.0 ± 4.2 vs. 8.7 ± 2.8 mmHg). In comparison, corresponding values for ACE were 9.6 ± 1.6 vs. 2.6 ± 0.8.

Blood Perfusion

Baseline SBF (13.3 ± 6.8) did not significantly change after bandaging or after exercise at the gaiter and calf sites (figure 7). Pulse pressures achieved with Coban were similar at gaiter and calf (19.0 ± 6.7 vs. 22.2 ± 1.4 mmHg). In comparison, corresponding values for ACE were 9.6 ± 1.6 vs. 1.9 ± 2.8.

CONCLUSIONS

- Sub-bandage pulse pressures achieved with an elastic crepe self-adherent bandage (Coban) during activity were about twice that achieved with a standard long-stretch bandage.
- Pulse pressure amplitudes found with Coban (≥ 20 mmHg), are consistent with the notion that activity-related pulse effects underlying tissue fluids and lymphatic vessels with the possibility of beneficial displacement of lymphatic and tissue fluids.
- But, as no direct measurements of fluid movement associated with the pulses have been made, definitive statements as to actual effects of bandaging on patients with lymphedema are premature.
- On average, pressures achieved did not adversely affect sub-bandage skin blood perfusion. In fact, with the elastic crepe bandage, SBF tended to be greater than when non-bandaged.
- In a few cases, as shown by figure 6, slight reductions in SBF were observed.
- During activity-induced pressure changes, possible direct effects on SBF are masked by movement artifact. However, post-activity resting SBF was found to be significantly different from pre-activity values. This suggests that if pressure pulsations alter SBF, then these would be restricted to the activity interval.

REFERENCES