

Active Abdominal Compression Device For Treatment of Orthostatic Hypotension

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Abstract : Background: Orthostatic hypotension (OH) is an autonomic disorder marked by a sudden drop in blood pressure upon standing resulting from autonomic dysfunction. OH is especially prevalent in elderly populations, affecting more than 30% of Americans over the age of 70. OH is one of the most significant risk factors for accidental falls in elderly populations, making it a crucial focus for medical and device therapies. Pharmacologic therapy with midodrine and fludrocortisone may alleviate hypotension but have significant adverse side effects. Abdominal passive compression devices (binders) are more effective than lower extremity compression stockings at mitigating postural hypotension, by improving venous return to the heart. However, abdominal binders are difficult to don and uncomfortable to wear, leading to poor compliance. A disadvantage of passive compression devices is their inability to selectively compress during the crucial moment of standing. It has recently developed an active compression device that applies external pressure on the abdomen during transition from prone to supine position and conducted initial prototype testing. Methods: An active abdominal compression device was developed utilizing a simple, servo-driven strap-tightening mechanism to supply tension onto foam fabric, which applies pressure to the abdomen. Healthy volunteers (n=5) were utilized for prototype testing and were subjected to three conditions: no compression, passive compression (i.e. standard abdominal binder), and active compression (device prototype). Abdominal applied pressure during device activation was measured by strain-gauge manometer placed between the skin and binder. Systolic (SBP) and mean (MAP) arterial blood pressure was measured by standard blood pressure cuff in supine position followed by repeat measurements at 1 minute intervals for 5 minutes following upright position. A survey tool was administered to determine scores (1-10) for comfort and ease of donning abdominal binders. Results: Abdominal pressure increased from 0 to 15 ± 3 mmHg upon device activation for both passive and active compression devices. During transition from supine to upright position, both active and passive compression devices demonstrated significantly higher MAP compared to the no-compression condition (67 ± 4 , 68 ± 5 , 62 ± 5 respectively $P < 0.05$), but there was no statistically significant difference in SBP or MAP when comparing active to passive compression. Active compression demonstrated significantly higher comfort scores (8.3 ± 1) compared to passive compression (3.2 ± 2) but lower when compared to no compression (10). Subjects universally reported that active compression device was easier to don compared to passive device. Conclusions: Active or passive abdominal compression prevents hypotension associated with postural changes. Active compression is associated with increased comfort and ease of donning compared to passive compression devices. Future trials are warranted to investigate the efficacy of our device in patients with OH.

Keywords : orthostatic hypotension, compression binder, abdominal binder, active abdominal compression

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