

A Study to See the Combined Effect of Abdominal Binder and Compression Stockings on Tilt-Induced Orthostatic Hypotension in Spinal Cord Injury Patients

Vaibhav Agarwal*, Shiv Kumar Verma*, Sharda Sharma*, Preeti Patel**

Abstract

Aims and Objectives: The aim of the study is to see the combined effect of compression stockings and abdominal binder on orthostatic hypotension in spinal cord injury. *Methodology:* A sample of 30 subjects were recruited for the study. The subjects were randomly divided into three groups. Group A (compression stockings and abdominal binder) Group B (compression stockings) and Group C (abdominal binder). All subjects were dealt individually. Prior to the intervention the subject was tilted to 30°, 60°, 90° with the help of tilt table and the blood pressure was recorded and mean arterial pressure was calculated for the subjects of all the three groups. After that, the intervention received by Group A was (compression stockings and abdominal binder) Group B (only compression stockings) and Group C (only abdominal binder) and again with the help of tilt table the blood pressure was recorded in different angles i.e. 30°, 60°, 90° and mean arterial pressure was calculated. *Results:* Post intervention there was significant increase in the blood pressure and mean arterial pressure in group A compared to group B and group C. *Discussion:* Combined use of compression stockings and abdominal binder helps to reduce the symptoms of orthostatic hypotension. Compression stocking when used with an abdominal binder provide great benefit by decreasing splanchnic pooling and interstitial pressure on legs. *Conclusion:* So, this study concluded that the combined use of compression stockings and abdominal binder (Group A) is more effective than use of compression stockings and abdominal binder alone (Group B and Group C) in spinal cord injury patients.

Keywords: Spinal Cord Injury; Orthostatic Hypotension; Tilt Table; Abdominal Binder; Compression Stockings.

Introduction

Spinal Cord Injury is a devastating injury and is a major musculoskeletal condition, it can result in alteration of normal motor, sensory and autonomic function, and it presents a serious disease burden [1]. The incidence of spinal injury in India was estimated as 15 new cases per million per year, and global incidence of spinal cord injuries is noted as 40 to 80 cases per million population per year [2,3].

The common manifestations of spinal cord injury are autonomic dysfunctions, including abnormal cardiovascular control. Autonomic dysfunction is a vascular reflex which may occur in spinal cord injury patients with lesion above fourth thoracic vertebra (T4) or in neuromuscular disorders [4].

Orthostatic hypotension (OH) is defined as a fall in systolic blood pressure (SBP) of at least 20 mm Hg and/or diastolic blood pressure (DBP) of at least 10 mm Hg within 3 min of standing [5].

Orthostatic hypotension is a common problem after acute cervical cord injury and high thoracic spinal cord injury and following cervical cord injury the thoracolumbar or sympathetic outflow is impaired and parasympathetic tone unopposed [6].

OH is associated with an abnormality of reflexive regulation of the circulation by the sympathetic noradrenergic system. Failure of sympathetic nervous system always results in failure to tolerate upright posture because of OH. OH can be an asymptomatic

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sign or manifest as symptoms that range from lightheadedness to loss of consciousness, generalized weakness, dizziness, fading vision, that are relieved by lying down [7].

Numerous studies have documented the presence of OH following spinal cord injury (SCI). Standard mobilization during physiotherapy (e.g., sitting or standing) is reported to induce blood pressure decreases that are diagnostic of OH in 74% of SCI patients, and which are accompanied by OH symptoms in 59% of SCI individuals [8]. This, in turn, may have a negative impact upon the ability of SCI individuals to participate in rehabilitation.

Methodology

Thirty patients with spinal cord injury had been taken for the study from the neurosurgery ward of the Himalayan Hospital, Jolly Grant, Dehradun. The inclusion and exclusion criteria for the study were as follows:

Inclusion Criteria

Age -18 to 40 years, both male and female, Spinal cord injury (C6-T6) and Co-operative patients

Exclusion Criteria

Unstable vital parameters, Open wounds on the calf and thigh, abdominal injury, Lower limb fracture, Pre operative patient of SCI.

To achieve the study accomplishment, following instruments were used:

- Sphygmomanometer and stethoscope
- Tilt table
- Compression stockings

- Abdominal binders
- Goniometer

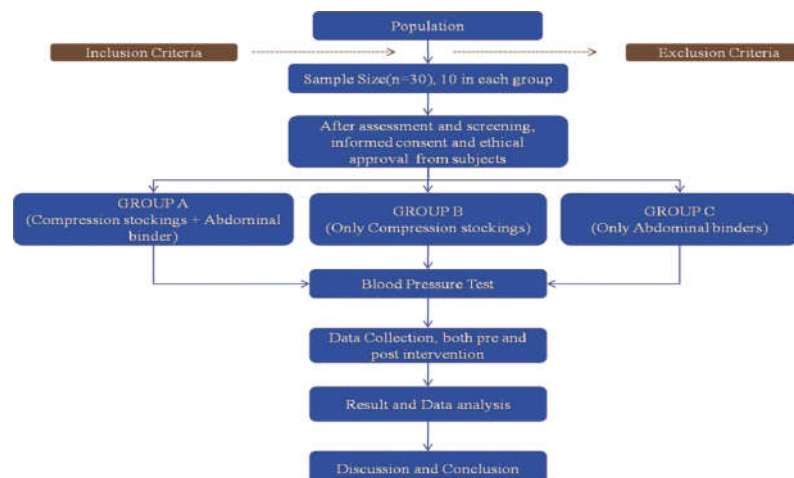
The subjects were screened who fulfill the inclusion and exclusion criteria and were randomly divided in to three groups each group having 10 subjects.

- Group A - 10 Subjects (Compression stockings and abdominal binder)
- Group B - 10 Subjects (Compression stockings)
- Group C - 10 Subjects (Abdominal binder)

The subjects were carefully shifted to the tilt table placed nearby the bed. Subject was kept supine position on the tilt table without any tilt and was fastened with straps at chest, knee and pelvic region. After that BP was recorded with the sphygmomanometer and mean arterial pressure was calculated with the equation ($MAP = DBP + 1/3(SBP - DBP)$). After 1 minute the tilt table was tilted at 30°(which is measured with the help of Goniometer) and the BP was recorded after 3 minutes and MAP was calculated. The same procedure was repeated for 60° and 90° and thereafter; the tilt table was brought back to 0 degrees.

During the procedure the subjects were constantly examined for any decrease in BP i.e. systolic BP more than 20mmHg till 90mm Hg and diastolic BP more than 10 mm Hg, till 60mm Hg, and check for any symptoms of OH like decrease in pulse, syncope, sweating, dizziness, and visual disturbances ranging from blurred vision to blackouts, weakness. If such symptom occurs then the subject was immediately brought back to 0 degree.

After that different intervention was applied to the subjects of three different groups i.e. group A, group B and group C. Compression stockings on both lower limbs and abdominal binder was applied for the Flow Chart:



subjects of group A, after 20 minute of application of the compression stockings and abdominal binder again BP was measured and MAP was noted in 30°, 60°, 90° which was achieved using tilt table. For the subjects of group B only compression stockings was applied and for Group C, only abdominal binder was applied to the subject for 20 min and again after its application the BP and MAP was noted in 30°, 60°, 90° in a tilt table.

Results

All variables for three groups have been compared for both pre and post intervention. Intra-group analysis of all three groups shows significant difference in BP (systolic, diastolic and mean arterial pressure) between pre and post intervention. However, in case of Group A (combination of compression stockings and abdominal binders) the difference is most significant.

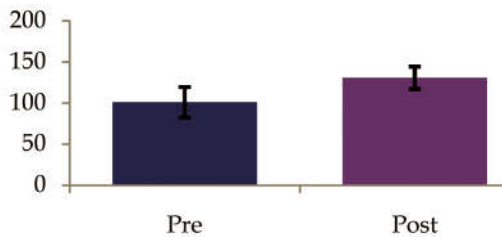


Fig. 1: Change in SBP with Combination of Stockings and Abdominal Binder

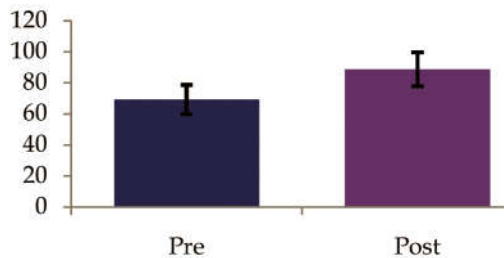


Fig. 2: Change in DBP with Combination of Stockings and Abdominal Binder

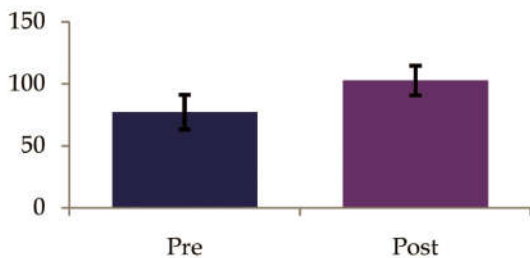


Fig. 3: Change in MAP with Combination of Stockings and Abdominal Binder

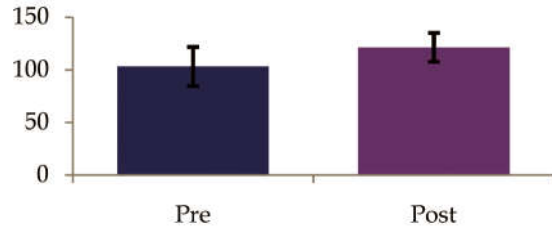


Fig. 4: Change in SBP with Compression stockings

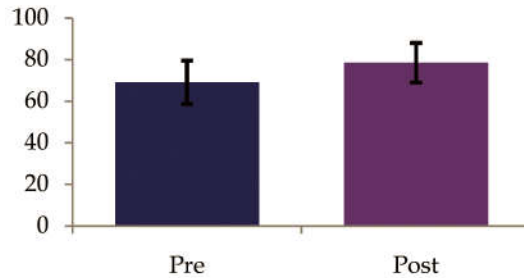


Fig. 5: Change in DBP with Compression stockings

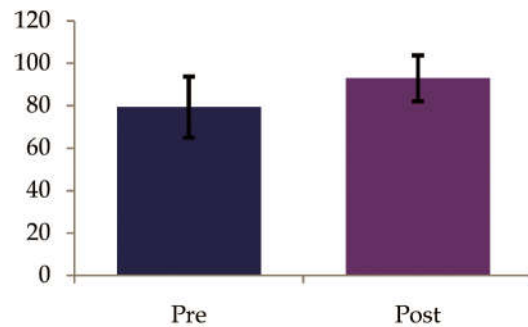


Fig. 6: Change in MAP with Compression stockings

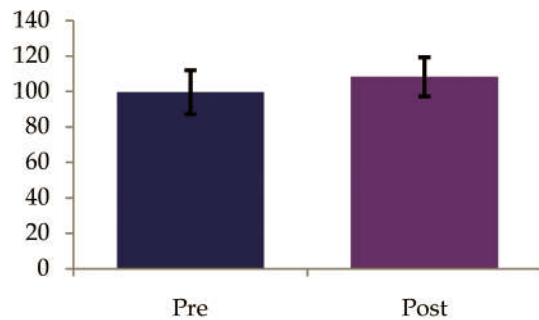


Fig. 7: Change in SBP with Abdominal Binder

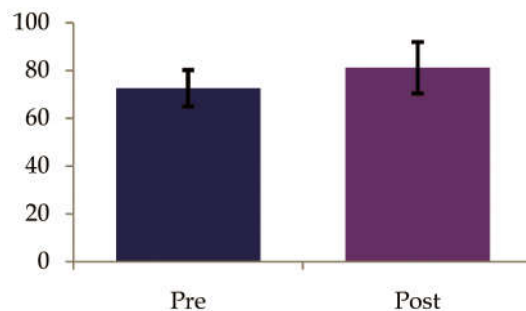


Fig. 8: Change in DBP with Abdominal Binder

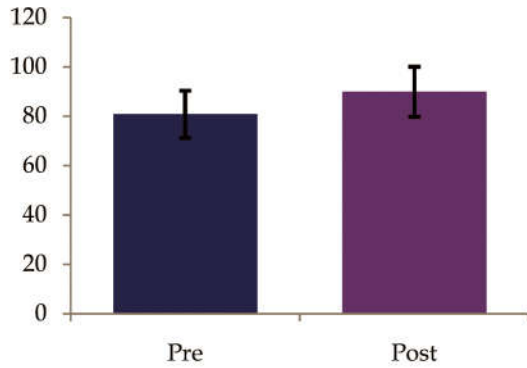


Fig. 9: Change in MAP with Abdominal Binder

Discussion

The study was performed on population affected by orthostatic hypotension that caused an inability to tolerate a standing position. OH is very common in subjects with spinal cord injury.

The result obtained from the study revealed that the combined use of compression stockings and abdominal binder (Group A) for OH in SCI shows better result than the use compression stockings and abdominal binder alone (Group B and Group C). So this study supports the experimental hypothesis that combined effect of compression stockings and abdominal binder (Group A) is better for reducing OH in SCI.

According to Jaun J Fiuroa et al, compression of capacitance beds (i.e. the legs and abdomen) improves orthostatic symptoms. The improvement is due to reduction of venous capacitance and an increase in total peripheral resistance. Compression of the legs alone is not beneficial as compression of the abdomen because the venous capacitance of the calves and thighs is relatively small compared with that of splanchnic mesenteric bed, which accounts for 20% to 30% of total blood volume.

The rationale for the use of elastic compression stockings and binder is to apply external counter pressure to the capacitance beds of the abdomen and legs to improve the venous return to the heart and prevent the occurrence of symptoms of OH.

The group B in which only compression stockings was applied had also shown a significant effect by increase in the blood pressure but it was less significant in comparison to group A but more significant compared to group C.

According to Smit et al, use of compression stockings apply pressure to the lower extremities. These stockings minimize peripheral blood pooling in the lower extremities and increase venous return

and thereby increasing the cardiac output and increase in blood pressure.

The group C had shown less significant effect among the group A and group B because only use of abdominal binder was not sufficient to increase the blood pressure as its only use cannot increase the stroke volume and cardiac output because approximately 80% of blood pooled in lower limbs which also needs appropriate intervention to improve venous return to the heart and thereby reducing orthostatic hypotension.

Clinical Implication

Orthostatic Hypotension is a very common complication in patients who are bed ridden and neurological impaired. Compression stockings and abdominal binder were proved to be beneficial in preventing orthostatic hypotension in patients of spinal cord injury to prevent the occurrence of symptoms. So, this should be widely used in patients with orthostatic hypotension.

Limitation of the Study

Small sample size and short duration were limitations of the study.

Future Research

This study can be done on large sample size with longer duration and follow-up study can be done to evaluate the compliance of elastic stockings and abdominal binder. Study to see the effects of pneumatic compression device with abdominal binder on orthostatic hypotension can be done.

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