A Study of Chronic Venous Insufficiency in Relation with BMI and Diameter of SAPHENO Femoral Junction and Great Saphenous Vein

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Abstract

Introduction: Chronic venous insufficiency is a condition that occurs when the venous wall and/ or valves in the lower limb veins are not functioning effectively, making it difficult for the blood to return to the heart from the lower limb. Over time, it can lead to pain, swelling, skin changes over the lower limb, and ulcers around the ankles. Some common etiological factors of chronic venous insufficiency (CVI) are obesity, more than 50 years of age, family history of CVI, smoking, and pregnancy. The combination of obesity and other genetic and environmental factors create a higher risk for development of CVI.

Objective: The objective was to study the relation between BMI and CVI at its various stages using the clinical, etiological, anatomical and pathophysiologic classification (CEAP) of CVI. In addition, it was to study whether there was a notable increase of diameter seen in sapheno-femoral junction and great saphenous vein as the BMI increases and in patients of chronic venous insufficiency.

Materials and Methods: The study was conducted on 100 patients; The data used in the current study was collected from Vascular Surgery OPD where patients presented with venous disease. The grade of the venous disease was recorded using the CEAP criteria. BMI was calculated for each patient. Based on the BMI, the patients were classified into underweight ($< 18.5 \text{ kg/m}^2$), normal ($18.5 - 22.9 \text{ kg/m}^2$), overweight ($23.0 - 24.9 \text{ kg/m}^2$) and obese ($> 25 \text{ kg/m}^2$) according to the BMI [10]. Mean, standard deviation, p value and percentage of each stage of venous disease in each group was calculated accordingly and studied.

Results: A total of 100 patients were included for this study, 78 were males and 22 were females. The clinical stage according to CEAP criteria, BMI, diameter of the sapheno-femoral junction and diameter of the great saphenous vein was recorded for each patient. Clinical stage (CEAP criteria) was discovered to become more advanced as the BMI increased.

According to the data, 50% underweight patients reported of CVI, 53% normal weight patients reported of CVI, 72% overweight patients reported of CVI, and 87% obese patients reported of CVI.

Also, it was noted that there was an increase in diameter of the great saphenous vein as the BMI increased, although no change was seen in the diameter of the sapheno-femoral junction.

Conclusion: Lower limb venous flow parameters differ significantly amongst normal, overweight, and obese individuals. The CEAP clinical stage of venous disease is more advanced in obese patients than non-obese patients with comparable anatomical patterns of venous incompetence. This could possibly be a result of raised intra-abdominal pressure leading to greater reflux, increased vein diameter and venous pressures. In addition, an increase in diameter was noted in the great saphenous vein, however no change in diameter was observed at the sapheno-femoral junction, as the BMI of the patients increased. Hence, the findings support the mechanical role of abdominal adipose tissue, which may potentially lead to elevated risk for both, venous thromboembolism and chronic venous insufficiency.

Keywords: Chronic Venous Insufficiency (CVI); Obesity; Body Mass Index (BMI); Varicose Veins; CEAP Criteria; Mean $\pm$ SD; p Value

Introduction

Chronic venous insufficiency (CVI) is one of the most important conditions seen in Vascular Surgery, although it remains under-di-

agnosed due to the several factors contributing to its development. CVI is the impairment of the vessels in the lower limb, leading to difficulties in return of the blood to the heart causing increase in

pressure in the veins of the lower extremity. Venous insufficiency is strongly associated with venous ulceration and hence chronic CVI can result in chronic and recurrent venous ulcers [1].

Age above 50 years old, pregnancy, genetics, smoking, standing for long hours, obesity are the main risk factors that lead to CVI. Obesity is known to be one of the most important factors that contribute to the development of CVI. The complications of CVI impair the ability of a person to be involved in social or routine occupational activities and also result in an economic burden on the patient and family due to the loss of work hours [2].

Excess body weight is also related to alterations in the coagulation system, including impaired fibrinolytic activity and elevated plasma concentrations of clotting factors [3]. These modification in endothelial function and coagulation are thought to be relevant not only for arterial but also for venous thrombosis [4].

Factors contributing to the development of deep vein thrombosis as per Virchow's triad of hypercoagulability, stasis and venous injury contribute to the development of CVI [5]. Hormonal supplement therapy in women and smoking in men increase the risk of deep vein thrombosis and resultant CVI [6].

Clinical history, detailed physical examination and non-invasive vascular investigations are the three essential factors in evaluating the incompetence of the venous system.

Materials and Methods
Study design

This study included 100 patients presented to the Vascular Surgery OPD with venous disease. This study used the CEAP criteria (clinical, etiological, anatomical and pathophysiological classification) to aid in the assessment of the patients. BMI was calculated for each patient. The patients were then categorized into underweight (< 18.5 kg/m²), normal (18.5 - 22.9 kg/m², overweight (23.0 - 24.9 kg/m²) and obese (> 25 kg/m²) according to the BMI [10]. Percentage of each stage of venous disease in each group was then studied. The study was conducted from January 2013 - September 2013.

Inclusion criteria

- 1. All patients presenting with varicose veins.

Exclusion criteria

- 2. Patients with a past history of deep vein thrombosis.
- 3. Patients with history of surgery/ trauma over the lower limb in case of C5 and C6 disease.

Ethics

Consent was taken from the patients asking for their permission to use their details for the study. All the personal information was kept confidential and in no manner manipulated.

Results

The study included a total of 100 patients, among them 78 were males and 22 were females. The clinical stage according to CEAP

Clinical Class (C)	Characteristic Features
0	No clinical findings or symptoms
1	Telangiectasia or reticular veins
2	Varicose veins
3	Edema, only due to venous etiology
4a	Pigmentation and/or eczema
4b	Lipodermatosclerosis, atrophie blanche
5	Prior ulceration, now healed
6	Active ulceration
Etiology (E)	
C	Congenital
S	Secondary
P	Primary
Anatomy (A)	
S	Superficial
P	Perforator
D	Deep
Pathophysiology (P)	
R	Reflux
O	Obstruction
R-O	Both
N	No evident disease

Table 1: CEAP classification.

criteria, BMI, diameter of sapheno-femoral junction and diameter of great saphenous vein was recorded for each patient. All the variables were studied based on percentages, mean ± standard deviation (SD) and p values; p value < 0.05 was considered as significant.

Among 100 patients, 0 patients reported in C1 class, 20 patients in C2 class, 9 patients in C3 class, 28 patients in C4 class, 15 patients in C5 class, and 28 patients in C6 class (Table 2).

Clinical Stage	Frequency	Percentage of Total Patients (%)
C1	0	0
C2	20	20%
C3	9	9%
C4	28	28%
C5	15	15%
C6	28	28%
TOTAL	100	100%

Table 2: Total number of patients according to CEAP criteria.

According to the BMI classification, 2 patients were underweight (< 18.5), 15 patients were normal (18.5 - 22.9), 11 patients were overweight (23.0 - 24.9) and 72 patients were obese (≥ 25) (Table 3). The numbers greatly differed when the patients were grouped according to the clinical stage (CEAP criteria) in correlation with BMI (Table 4).

BMI (kg/m ²)	Frequency	Percentage of total patients
Underweight (< 18.5)	2	2%
Normal (18.5 - 22.9)	15	15%
Overweight (23.0 - 24.9)	11	11%
Obese (≥ 25)	72	72%
Total	100	100%

Table 3: Total number of patients according to BMI.

There was a distinguishable difference found in the percentage of underweight and normal weight patients having CVI compared to overweight and obese patients. According to the data, 50% underweight patients reported of CVI, 53% normal weight patients reported of CVI, 72% overweight patients reported of CVI, and 87% obese patients reported of CVI (Table 5). In addition, the collective p value was 0.001, which proved that as the BMI increases, the probability of developing CVI also increases in the patients (Table 6).

Clinical Stage	BMI (kg / m ²)				Total
	Underweight (< 18.5)	Normal (18.5 - 22.9)	Overweight (23.0 - 24.9)	Obese (≥ 25)	
C1	0	0	0	0	0
C2	1	7	3	9	20
C3	0	1	1	7	9
C4	0	2	3	23	28
C5	0	3	0	12	15
C6	1	2	4	21	28
Total	2	15	11	72	100

Table 4: Total number of patients according to CEAP criteria in co-relation with BMI.

BMI (kg/m ²)	Total patients	Clinical Stage		Percentage of CVI (%)
		C1-C2	C3-C6	
Underweight (< 18.5)	2	1	1	50%
Normal (18.5 - 22.9)	15	7	8	53%
Overweight (23.0 - 24.9)	11	3	8	72%
Obese (≥ 25)	72	9	63	87%

Table 5: Percentage of patients having CVI according to BMI.

BMI (kg / m²)	Clinical Stage	Mean ± SD	P Value
Underweight (< 18.5)	C1-C2	24.4 ± 4.6	0.001
Normal (18.5 - 22.9)			
Overweight (23.0 - 24.9)	C3-C6	28.1 ± 4.6	
Obese (≥ 25)			

Table 6: Co-relation between BMI and patients having CVI.

Furthermore, a comparison was performed between the clinical stage (CEAP criteria) and the diameter of the sapheno-femoral junction and the great saphenous vein. An increase in size by ≥ 6 mm was considered to be significant. Mean, standard deviation and p values were calculated comparing along each group. There was no significant increase in diameter noted, as the clinical stages got more severe, leading to chronic venous insufficiency (Table 7).

Moreover, a comparison was also performed between various groups of BMI and the diameter of the sapheno-femoral junction and the great saphenous vein. Again, an increase in diameter by ≥6mm was considered to be significant. Also, mean, standard deviation and p values were calculated for diameter of sapheno-femoral junction and great saphenous vein. There was no significance

Clinical stage	Number of patients	Mean ± SD	P Value
A) Sapheno Femoral Junction			0.233
C1	0	0	
C2	20	8.2 ± 2.2	
C3	9	10.3 ± 2.9	
C4	28	8.9 ± 2.1	
C5	15	8.5 ± 2.6	
C6	28	9.2 ± 2.4	
Total	100		0.673
B) Great Saphenous Vein			
C1	0	0	
C2	20	6.7 ± 2.6	
C3	9	7.8 ± 4.0	
C4	28	7.2 ± 1.7	
C5	15	6.4 ± 1.7	
C6	28	7.1 ± 2.8	
Total	100		

Table 7: Co-relation between Clinical stage (CEAP criteria) and diameter of sapheno femoral junction and great saphenous vein.

found in the increase in size of sapheno-femoral junction as the BMI increased. Although, significance was noted in the increase in the diameter of the Great Saphenous Vein as the BMI increased; p value being 0.002. It was noted that overweight and obese patients had an increase in the diameter of the great saphenous vein (Table 8).

BMI (kg/m ²)	Number of Patients	Mean ± SD	P Value
A) Sapheno Femoral Junction			0.512
Underweight (< 18.5)	2	7.0 ± 1.4	
Normal (18.5 - 22.9)	15	8.4 ± 2.5	
Overweight (23.0 - 24.9)	11	9.0 ± 2.7	
Obese (≥ 25)	72	9.1 ± 2.4	
Total	100		
B) Great Saphenous Vein			0.002
Underweight (< 18.5)	2	5.5 ± 2.1	
Normal (18.5 - 22.9)	15	5.2 ± 1.8	
Overweight (23.0 - 24.9)	11	6.1 ± 2.0	
Obese (≥ 25)	72	7.6 ± 2.5	
Total	100		

Table 8: Co-relation between BMI and diameter of Sapheno Femoral junction and great saphenous vein.

Discussion

A high BMI is a crucial risk factor for chronic venous insufficiency. In this study, patients with a BMI of > 25 (kg/m²) were considered to be obese. It was established that a patient with a high BMI had a higher probability of developing chronic venous insufficiency in comparison to a patient with a lower BMI. Another Indian study showed correlation between patients with a BMI of > 30 (kg/m²) and its effects on the development of chronic venous insufficiency [7]. It is possible that obesity per se results in adverse changes in structural and functional vein wall properties under the influence of the associated hemodynamic and hormonal alterations. The correlation between obesity and venous hemodynamic changes has mainly been associated to visceral obesity, which leads to an increase in the intra-abdominal pressure. The high pressure is transmitted to the end of the femoral vein, leading to distension of the vein walls, which favor stasis and venous valve dysfunction. This phenomenon occurs because the venous wall is constantly under greater tension in obese individuals.

In addition, a comparison between the various BMI groups and the diameter of sapheno-femoral junction and great saphenous vein was also performed which showed that there was an increase in diameter of the great saphenous vein as the BMI increased.

In chronic venous insufficiency, the venous diameters are directly associated with venous incompetence. There are numerous factors that may lead to an increase in diameter such as age, gender, occupation, CEAP criteria. A study performed by K. Kroger established that as the CEAP class increases there was a notable increase in the diameter of the great saphenous vein [8]. Compared to the normal GSV, CVI shows thickening of the wall intima and media and a transverse greater diameter; changes in smooth muscle composition, endothelial disruption, and fibrosis. Studies have shown hypertrophic changes in the smooth muscle cells (SMC) in the media of vein walls with remodeling of the alignment and

structure of the muscle cells. Overall, the literature tends to support a higher content of SMC, which suggests that the pathological abnormalities in varicose veins are not due to deficiency of smooth muscle but to the inability of the SMC to produce the necessary venous tone [9].

Some of the limitations found in the study were that BMI might not always be the best resource to determine a correlation between obesity and development of CVI because BMI does not determine the distribution of the body fat. Potentially, variations in disposition of abdominal rather than peripheral adiposity could present as mechanical obstruction to the venous outflow from the lower legs and contribute to venous hypertension and disease. Venous return on its way back to the heart from the legs passes through the retroperitoneum of the abdomen where it is subjected to changes in intra-abdominal pressures. A different study can be performed which highlights the distribution of body fat and its correlation to development of CVI. The results of this study being a single institution study cannot generalize the entire Indian population.

Conclusion

In conclusion, the results of this study showed that the probability of development of chronic venous insufficiency increases as the BMI increases. It also showed that more obese patients were found to be in the C6 classification of the CEAP criteria. In addition, an increase in diameter of the great saphenous vein was also noted in patients with a higher body mass index. The presence of chronic venous insufficiency should be identified and treated promptly in obese individuals with close follow up in order to prevent complications.

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