Vol. 5 No. 1 Year 2024
jurnal.umj.ac.id/index.php/MMJ
mmjfkk@umj.ac.id
e-issn: 2721–317X
Muhammadiyah Medical Journal

Case Report

# The Severity Measurement of Chronic Venous Insufficiency in Patients with Type 2 Diabetes Mellitus Using Duplex Sonography

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## ABSTRACT

Chronic Venous Insufficiency (CVI) is a long-term condition that affects the veins in the legs, disrupting the blood flow to the heart. It is more common in patients with type 2 Diabetes Mellitus as it is one of the risk factors. Patients with CVI and a history of Type 2 Diabetes Mellitus may experience various symptoms depending on the severity of their condition. The severity of chronic venous insufficiency (CVI) was assessed in three patients from Cibinong Regional General Hospital with a history of type 2 diabetes using duplex sonography. According to the results, Patient I was diagnosed with moderate severity of CVI in the left leg (500 msec) and mild in the right (330 msec). Patient II was identified with moderate severity in both legs (430 msec left, 460 msec right). Patient III was found to have severe severity in both legs (750 msec left, 760 msec right). Patient I, who has mild-moderate chronic venous insufficiency (CVI) and a history of type 2 diabetes mellitus, experiences swollen feet, changes in skin texture, pitting edema, and a sense of heaviness and numbness in their legs. Patient II, who has moderate CVI, suffers from swollen legs, diabetic ulcers, pitting edema, discomfort and numbness in their legs, and skin discoloration. Patients III with severe CVI suffer swelling in both legs, pitting edema, venous dermatitis, ulcers, and numbness in their legs during activities and at night. Compression bandage treatment is recommended for patients who have moderate and severe CVI and a history of type 2 diabetes.

**Keywords:** chronic venous insufficiency, cvi, duplex sonography, type 2 diabetes mellitus

## INTRODUCTION

Chronic Venous Insufficiency (CVI) is a long-term condition that affects the veins in the legs, disrupting the blood flow to the heart. This condition is usually caused by damage to the vein valves or blockage of the veins. (1). In the USA, an estimated 6 to 7 million people experience vein problems, including CVI. Recent studies in Thailand have revealed that females have a higher prevalence of CVI at 77.4% compared to males at 25.6%. Out of all CVI cases, around 1% to 2.7% result in ulceration due to venous stasis. (2–4). Risk factors associated with CVI include age, gender, family history of varicose veins, obesity, pregnancy, phlebitis, and type 2 diabetes mellitus. Environmental or behavioral factors such as prolonged standing and sitting posture at work are also linked to CVI. Type 2 diabetes mellitus is one of the most frequently encountered comorbidities of chronic venous disease (5).

Diabetes Mellitus (DM) is a chronic disease characterized by blood glucose (blood sugar) levels that exceed normal, namely when blood sugar levels are equal to or more than 200 mg/dl and fasting blood sugar levels are above or equal to 126 mg/dl (6). One of the four diseases that contribute significantly to this disease's death is cardiovascular disease in as many as 17.9 million people. Type 2 diabetes mellitus is characterized by relative insulin deficiency caused by pancreatic cell dysfunction and insulin resistance (7). Recent studies have shown that people with type 2 diabetes are at a higher risk of developing chronic venous insufficiency (CVI) due to structural or functional changes in the venous system, including valvular incompetence, reduced filling time, and reduced venous output. Diabetic patients are also more likely to have altered microcirculation and pro-inflammatory status, which can contribute to the development of CVI (8).

People with type 2 diabetes are more likely to develop vascular complications after 5-10 years of onset. These complications can include venous damage or CVI. This increased risk is likely driven by pathophysiology concomitant with hemodynamic abnormalities in the lower limbs, including vascular wall remodeling, increased vascular permeability, impaired blood flow, vascular inflammation, and endothelial dysfunction, reflected in symptoms such as edema and foot ulcers (9).

Duplex sonography is a type of tool that is used to diagnose Chronic Venous Insufficiency (CVI). It uses Doppler ultrasonography to provide color Doppler images and Doppler venous spectra. This helps identify any obstructions or blockages due to blood clots and flow from blood vessels, which can disrupt venous function. Previously, imaging tests were conducted only if there was suspicion of CVI recurrence. All patients with lower extremity venous disorders must be examined using duplex sonography. The severity of CVI can be assessed by the reflux found. A longer duration of reflux indicates a more severe CVI severity (10). The severity of Chronic Venous Insufficiency (CVI) is assessed by dividing the reflux into three categories based on the duration of venous reflux. The duration of reflux is measured in milliseconds (msec), and the categories are classified as mild, moderate, and severe. The cutoff value of the mild category is 350 msec or less, while the moderate category ranges from 350 to 750 msec. The severe category lasts for more than 750 msec (11). There are limited studies that have discussed the description of the severity of CVI cases in patients with a history of type 2 Diabetes Mellitus in Indonesia. Therefore, the authors intend to examine some cases of CVI in Cibinong Regional General Hospital, categorized by their levels of severity, to gain a deeper understanding of the overview of CVI examination in patients with a history of Type 2 Diabetes Mellitus.

## CASE DESCRIPTION

### Patient I

A 49-year-old man who is an active smoker has been diagnosed with Type 2 diabetes mellitus, hypertensive heart disease (HHD), acute decompensated heart failure (ADHF), pneumonia, and old and MI. The patient has undergone treatment for heart disease and is suffering from type 2 diabetes mellitus. During the day, the patient's blood sugar level was measured at 236 mg/dl, while his fasting blood sugar level was 229 mg/dl. A 49-year-old man who is an active smoker has been diagnosed with Type 2 diabetes mellitus, hypertensive heart

disease (HHD), acute decompensated heart failure (ADHF), pneumonia, and old and MI.The patient has undergone treatment for heart disease and is suffering from type 2 diabetes mellitus. During the day, the patient's blood sugar level was measured at 236 mg/dl, while his fasting blood sugar level was 229 mg/dl. The patient is displaying signs of CVI, such as swelling in the legs (pitting edema) for the past week, skin changes in the lower legs, and heavy and numb legs. Reflux measurements on the Doppler spectrum have been carried out, with the left image showing a Resistive Index (RI) of 500 msec sinistra (CVI Moderate) and 330 msec dextra (CVI Mild) obtained by measuring the duration of the range that is above the baseline after augmentation with the squeeze distal test (SQD). The right image shows reflux using color Doppler with the Valsalva maneuver, allowing reflux to be seen in the veins. (Figure 1a).

After the patient visited with the cardiologist, the doctor did not provide compression bandage therapy as a preventative measure against blood clots. Instead, the cardiologist instructed the patient to elevate their legs above their heart while resting. However, the patient has not yet scheduled a follow-up appointment for additional evaluation and ongoing care under the cardiologist's supervision.

**Patient II**

A 64-year-old woman has been diagnosed with Chronic Venous Insufficiency (CVI), Type 2 Diabetes Mellitus (DM), and Hypertensive Heart Disease (HHD). She has been suffering from Type 2 Diabetes Mellitus for the past five years, with a blood sugar level of 287 mg/dl. During her physical examination, it was found that she had swelling in both legs, and the feet often felt numb and heavy, pitting edema, a diabetic ulcer (wet ulcer) on the left calf, and a change in the skin color of the lower leg. Reflux measurement on the Doppler spectrum (left image) to look at the duration of the spectrum which is above the baseline after augmentation with the squeeze distal test (SQD), so that the results obtained are Resistive Index (RI) 430 msec sinistra, 460 msec dextra, moderate CVI on both legs. While the picture on the right shows reflux with the color Doppler without using the Valsalva maneuver, the vein has turned red in almost the entire lumen of the vein (Figure 1b).

After wearing compression bandages for a month, the patient reported that the edema in her legs had disappeared, but she still felt numbness and heaviness during activities. The doctor recommended the patient continue using compression bandages for treatment and instructed her to elevate both legs higher than the heart when lying down to avoid numbness. On June 19, 2023, Patient II returned to the Cardiac Polyclinic at the Cibinong Regional General Hospital for a check-up. She reported no complaints of leg swelling but still experienced numbness and heaviness during activities.

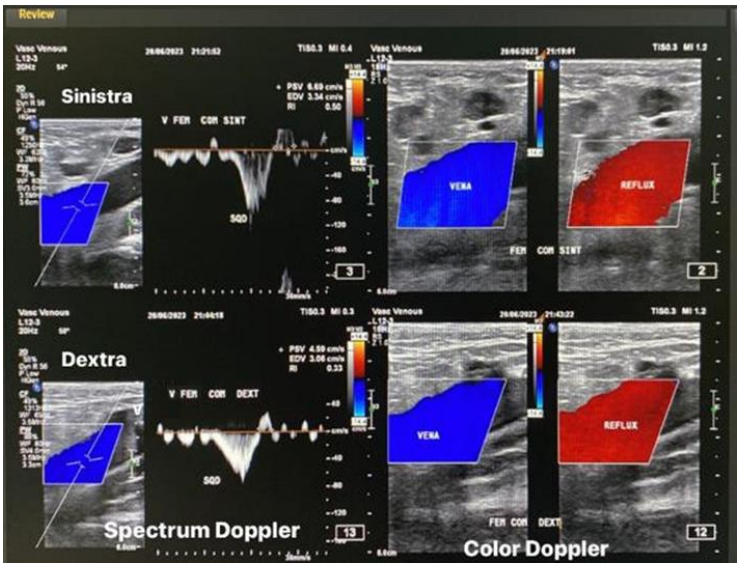
**Patient III**

Patient III is a 61-year-old man who has been diagnosed with type 2 diabetes, suspected peripheral artery disease (PAD), and coronary artery disease (CAD). The patient complained of swelling in both legs one week ago. During a physical examination, the doctor found that the patient had pitting edema, numbness in his feet during both activity and rest, and venous dermatitis and ulcers on the tips of his toes. The patient has a history of type 2 diabetes, and his blood sugar level was 230 mg/dl. Reflux measurements were taken using the Doppler

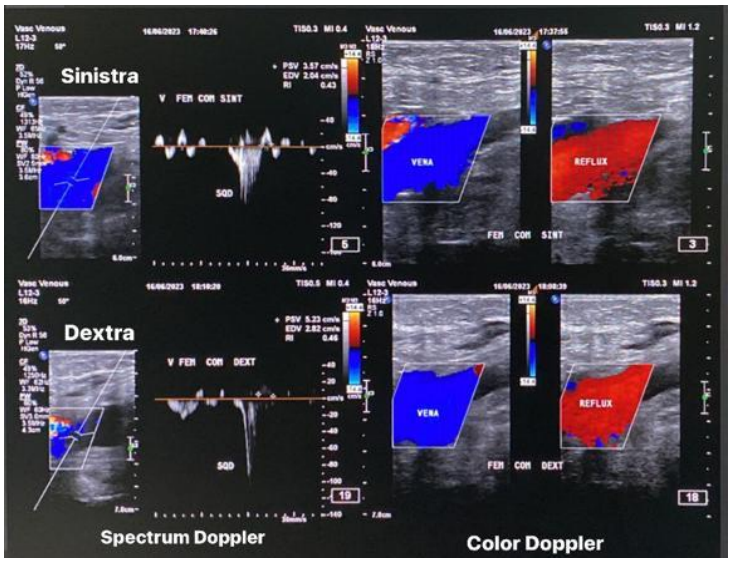
Vol. 5 No. 1 Year 2024
jurnal.umj.ac.id/index.php/MMJ
mmjfkk@umj.ac.id
e-issn: 2721–317X
Muhammadiyah Medical Journal

spectrum (left image) to measure the duration of the spectrum above the baseline after augmentation with the squeeze distal test (SQD). The results showed that the Resistive Index (RI) was 750 msec on the right leg (dextra) and 760 msec on the left leg (sinistra), indicating severe CVI. The right image shows reflux with color Doppler without using the Valsalva maneuver, as the veins in the picture have turned red throughout the lumen of the veins (Figure 1c).

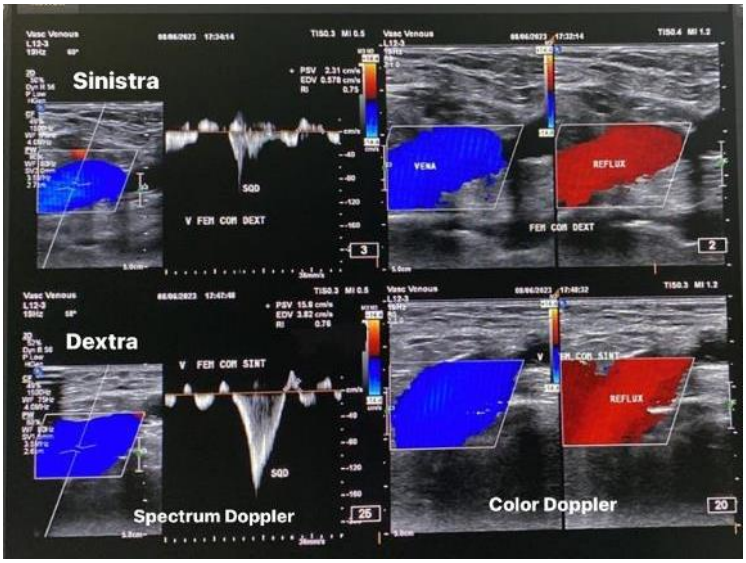
The patient was advised to do compression bandage therapy; after using stockings for one month, the swelling in his legs was still visible, and the patient still felt numbness. To achieve a more significant reduction in the numbness experienced by patients, it is necessary to wear stockings for a more extended period.




(a)




(b)




(c)

**Figure 1.** Description reflux on the doppler spectrum (*left*) and color doppler (*right*) from the dextra (*below*) and sinistra (*above*) femoral veins (a) Patient I, (b) Patient 2, and (c) Patient 3.

## DISCUSSION

The initial diagnosis of CVI is typically indicated by the dilation of leg veins, also known as varicose veins. When applying pressure to the legs, they may experience pain or cramps due to pitting edema or swelling. It takes a long time to return, especially the ankles, followed by other signs such as brownish-red pigmentation and dry and scaly skin. As CVI progresses, other symptoms may include venous dermatitis, characterized by red rashes on the feet that feel itchy, a throbbing sensation when standing for too long, and lipodermatosclerosis features like a champagne bottle flipped over. The skin may feel stiffer and thicker, eventually leading to ulceration (12). However, more than physical examination is needed due to the limitations of direct observation of the veins. This may lead to false positive results, which can be similar to the symptoms of Peripheral Arterial Disease (PAD), such as ulcers, hyperpigmentation, and swelling of the legs. Therefore, a supporting examination is needed, such as duplex sonography (13).

Duplex sonography operates on the same principle as other types of Doppler ultrasounds, which involve producing sound waves that can penetrate a patient's body. These sound waves bounce off the blood flowing through the blood vessels and return to the ultrasound device for detection, enabling healthcare professionals to evaluate the velocity, direction, and nature of blood flow in the arteries and veins (10). To examine the limbs using duplex sonography, healthcare professionals use ultrasonic waves with a linear transducer with a frequency of approximately 3.5 – 5 MHz while applying a gel-coated transducer to the patient's skin. The movement of the blood flow reflects sound waves, which are detected by the transducer and recorded and turned into an image (B-Mode), spectral shape (Spectrum Doppler), or color (Color Doppler) on the monitor screen. Analyzing these sound waves provides information about the patient's circulatory system, including the speed of blood flow, identifying any obstacles or factors that narrow blood flow, and determining the direction of abnormal blood flow or accumulation of blood and fluid in the blood vessels (14,15)

In this case study, it was observed that Patient I, aged under 50, has no risk factors associated with Chronic Venous Insufficiency (CVI) as in previous research (12,16). However, there was a notable difference in the severity of the condition between the left and right legs, with the left leg showing moderate CVI status while the right leg showed mild CVI status. We suspect that the severity of Chronic Venous Insufficiency (CVI) in the left leg has progressed from mild to moderate over time. This could be due to disruption of venous hemodynamics caused by several comorbidities such as Type 2 Diabetes Mellitus (DM), Hypertensive Heart Disease (HHD), Acute Decompensated Heart Failure (ADHF), Pneumonia, and an old Anterior Myocardial Infarction (MI). It is important to note that the patient is also an active smoker, which is a risk factor that can aggravate the diagnosed conditions. Cigarette smoke causes oxidative stress by generating free radicals and suppressing antioxidants, which causes inflammation in the walls of blood vessels, damage to the vein walls, and valve dysfunction in the veins. This is characterized by edema, skin changes, and a feeling of heaviness and numbness in the legs (17–20).

Patients II and III presented with venous leg ulcers, which are a common complication of chronic venous insufficiency (CVI). Venous ulcers arise due to the inability of the venous valves, which causes the blood vessels to widen and stretch to accommodate the additional

blood flow. The valves cannot close effectively, resulting in retrograde blood flow and venous hypertension. Venous hypertension causes fluid leakage out of stretched veins into the tissue, resulting in the deposition of brownish pigment in the legs and hemodynamic changes directly related to changes in vasoactive substances from the endothelium and then previous venous obstruction (21).

Patient II, who had a history of type 2 diabetes mellitus for about five years, had a diabetic ulcer with wet and festering wound characteristics. Diabetic ulcers can occur in patients suffering from DM2 within 5-10 years, but they can occur sooner if the patient has other comorbidities such as CVI. Moreover, patient II's elderly age further worsened the condition of the diabetic foot ulcers, as aging decreases body functions such as blood circulation in the legs, dysfunction of valves in the veins, healing ability, and tissue damage (22,23). The cardiologist instructed patient II to take glimepiride and candesartan to treat the wet ulcers. Next, patient III felt numb with every activity or rest, while patient II felt their feet numb only with activity. According to theory, the more serious the CVI, the more the clinical signs increase, with a tendency to ulceration, intense discomfort, and itching on the feet (24). Both patients underwent compression bandages, which involve using special socks designed to compress the legs, increase blood flow back to the heart, and reduce swelling. This treatment is effective in managing CVI and preventing the recurrence of venous leg ulcers (25). It is important to note that this study only uses medical record data from health care without images of evident leg patients, so the next research will use primary data to gather more objective information on the condition.

## CONCLUSION

The severity of chronic venous insufficiency (CVI) was assessed in three patients who had a history of type 2 diabetes mellitus using duplex sonography examination. Patient I with mild-moderate CVI showed reflux with a duration of 330 msec to the right (dextra) and 500 msec to the left (sinistra), while patient II with moderate CVI had reflux durations of 430 msec to the left and 460 msec to the right. Patient III with severe CVI had reflux durations of 750 msec to the left and 760 msec to the right. Moderate CVI patients showed characteristics of diabetic foot ulcers, while severe CVI patients did not have diabetic ulcers. Compression bandage therapy was recommended for both moderate and severe CVI patients due to the presence of manifest ulcers in the leg.

## ACKNOWLEDGMENTS

The author would like to thank Cibinong Regional General Hospital for allowing us to collect medical records data and the Faculty of Medicine UHAMKA for support and assistance so that the authors can complete the preparation of this journal well.

## CONSENT

We confirm that the research has been approved by the relevant institutional review board or ethics committee with the reference number KEPKK/FK/017/07/2023. Additionally, the hospital has granted permission to collect all patient data for this research with reference number 800.2.4.1/5632-Kepeg.

## CONFLICT OF INTEREST

The author(s) declare that they do not have a conflict of interest and that they do not have affiliations or relationships with any organization or entity that could raise biased questions or statements in the discussion and conclusion sections of the paper.

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