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ROLE OF THE ANKLE PUMP MANEUVER IN THE ASSESSMENT OF INCOMPETENT CALF PERFORATOR VEINS USING DUPLEX ULTRASOUND IN PATIENTS WITH VARICOSE VEINS

[1*]Dr. Noor Mohammed Jawad Mohammed M.B.Ch.B, [2]Prof. Dr. Mohammed Abd Kadhim M. B. Ch. B., F. I. B. M. S.

[1]Department of Radiology, Al-Imamain Al-Kadhemain Medical City, Baghdad, Iraq.
[2]Professor in Diagnostic Radiology/Iraqi Board of Medical Specialization, Medical College/Al-Nahrain University Consultant Radiologist, Al-Imamain Al-Kadhemain Medical City.

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***Corresponding Author: Dr. Noor Mohammed Jawad Mohammed M.B.Ch.B**

Department of Radiology, Al-Imamain Al-Kadhemain Medical City, Baghdad, Iraq.

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ABSTRACT

Background: Incompetent calf perforator veins are a major contributor to chronic venous disease and recurrence of varicose veins. **Aim:** To evaluate the diagnostic performance of the ankle pump maneuver in detecting incompetent calf perforator veins using duplex ultrasound. **Methods:** A cross-sectional study was conducted on 50 patients with clinically diagnosed varicose veins. Three provocative methods were compared: manual compression in standing, manual compression in sitting, and ankle pump in sitting. **Results:** The ankle pump maneuver demonstrated the highest detection rate (90%) and significantly longer reflux duration compared with other methods ($p < 0.001$). **Conclusion:** The ankle pump maneuver is superior to conventional compression techniques and should be incorporated into routine venous Doppler evaluation.

KEYWORDS: ankle pump, perforator veins, venous insufficiency, Doppler ultrasound, reflux.

1. INTRODUCTION

Chronic venous disease (CVD) is a prevalent condition associated with significant morbidity. Incompetent perforator veins facilitate abnormal reflux between the deep and superficial venous systems, contributing to venous hypertension and disease progression. Although duplex ultrasound remains the gold standard for evaluation, detection of perforator incompetence can be challenging. This study investigates the diagnostic value of the ankle pump maneuver as a dynamic adjunct technique.

2. MATERIALS AND METHODS

A cross-sectional study was conducted at Al-Imamain Al-Kadhemain Medical City from December 2024 to December 2025. Fifty patients with varicose veins were included. Duplex ultrasound was performed using three provocative techniques. Reflux greater than 0.5 seconds was considered pathological. Statistical analysis was performed using paired t-tests and ANOVA, with $p < 0.05$ considered significant.

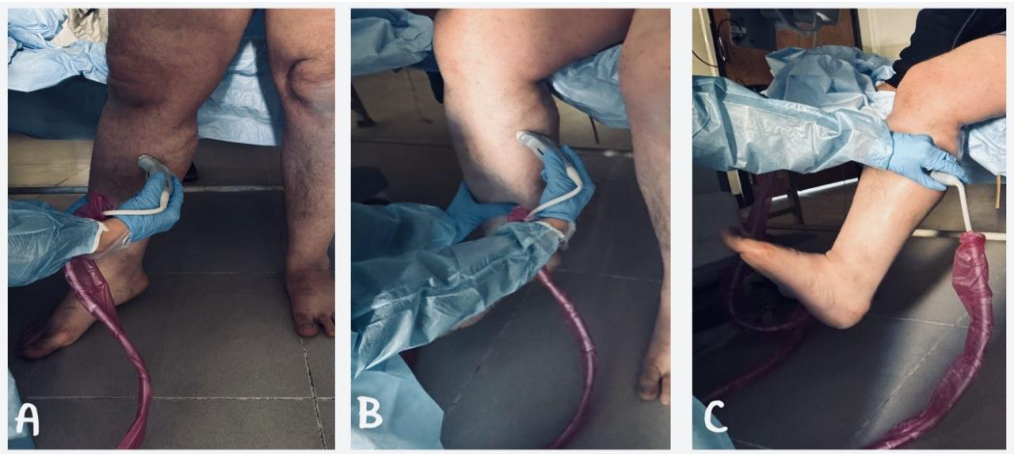

Fig. 3.1: Illustration of the three different maneuvers used to assess calf perforator veins using duplex ultrasound. A, The manual compression in a standing position (MC-stand) method. B, The manual compression in a sitting position (MC-sit) method. C, The ankle pump in a sitting position (AP-sit) method.

3. RESULTS

A total of 50 patients were evaluated, with 110 perforator veins identified. The medial calf was the most common location (64%). The ankle pump maneuver achieved the highest detection rate (90%) compared to manual compression techniques (78.2% and 76.4%). Median reflux duration was significantly longer with the ankle pump method (1465 ms) compared to other techniques.

Table 3.1: Description of the demographic characteristics of the study population.

Characteristic	Total = 50[1]
Age, years	42.0 ± 4.3
Sex	
Female	32 (64.0%)
Male	18 (36.0%)
[1]Mean ± SD; n (%)	

Table 3.2: Laterality, superficial venous competence, and perforator vein burden in examined limbs.

Characteristic	N = 50[1]
Side examined	
Right	30 (60.0%)
Left	20 (40.0%)
Superficial system competency	
Incompetent	42 (84.0%)
Competent	8 (16.0%)
Incompetent calf Perforator veins numbers	
one	10 (20.0%)
Two	20 (40.0%)
three	20 (40.0%)
Median perforator numbers	2.0 (1.0 - 3.0)
Total perforators	110
[1]n (%); Median (Range)	

Table 3.3: Difference in perforator veins diameter in stand and sit positions.

Characteristic	Stand[1]	Sit[1]	P-value[2]
Perforator diameter, mm	3.2 ± 0.3	3.3 ± 0.3	0.2
[1]Mean ± SD [2]Paired t test			

Table 3.4: Description of the anatomical distribution of calf perforator veins.

Characteristic	N = 110[1]
Location of calf perforator veins	
Medial aspect of calf	70 (64.0%)
Posterior aspect of calf	26 (24.0%)
Lateral aspect of calf	14 (12.0%)
[1]n (%)	

Table 3.5: Reflux time of calf perforators veins according to the provocative method used.

Method used	Number of PV	Median reflux time of calf PV, ms	Min - Max
MC stand method	50	490.0	383.0 - 1,991.0
MC sit method	50	600.5	355.0 - 2,729.0
Ap sit method	50	1,465.5	393.0 - 10,392.0
AP-sit = Ankle pump in a sitting position, MC-sit = manual compression in a sitting position, MC-stand = manual compression in a standing position, Min = Minimum, Max = Maximum, PV = perforator vein			

Table 3.6: Pairwise comparisons of reflux time between provocative methods.

Comparison	P-value[1]
MC stand vs MC sit	0.01
MC sit vs AP sit	< 0.001
MC stand vs AP sit	< 0.001
[1]Paired T. Test	

Table 3.7: Comparison of detection rates of incompetent perforator veins using three methods.

Diagnostic Method	Detection Rate (%)	P-value[1]
MC stand *vs* MC sit	78.2% *vs* 76.4%	0.4
AP sit *vs* MC stand	90.0% *vs* 78.2	**0.01**
AP sit *vs* MC sit	90.0% *vs* 76.4%	**0.008**

Cases from the study

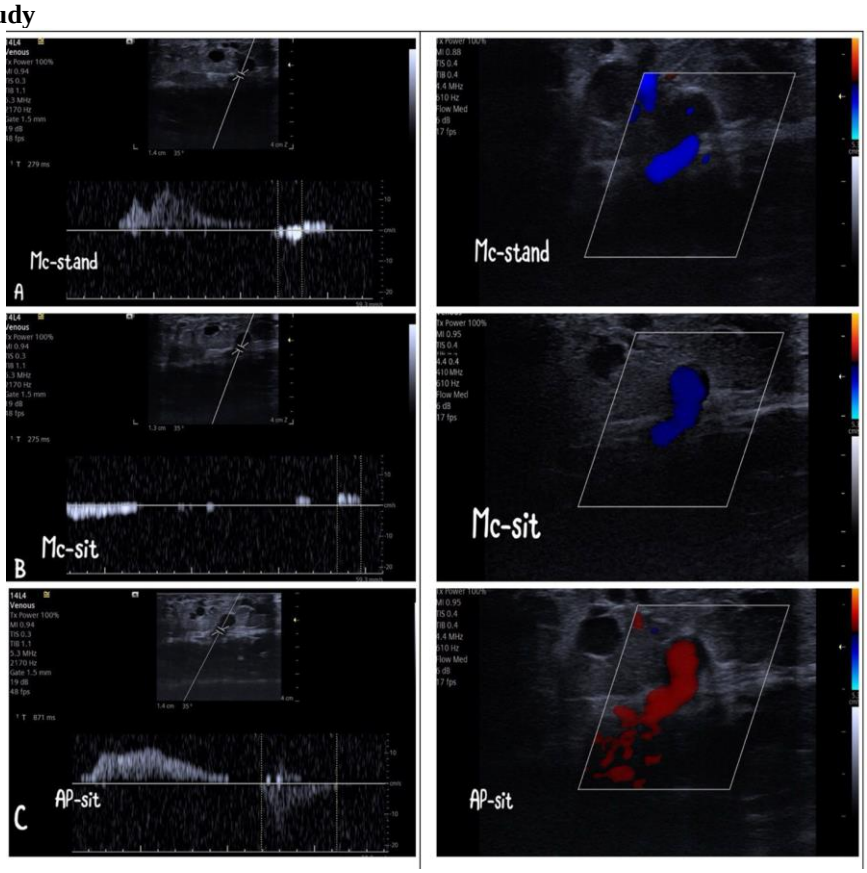

Figure 3.2: Color and spectral Doppler ultrasound of a calf perforator vein demonstrating the venous flow using three different methods. In the standing position with manual muscle compression (MC-stand), forward flow toward the deep venous system is observed with reflux duration of 279 ms. In the sitting position with manual compression (MC-sit), forward flow is also noted with reflux duration of 275ms. During the ankle pump maneuver in the sitting position (AP-sit), reverse flow (reflux) from the deep to the superficial system becomes evident with reflux duration of 871ms, indicating perforator vein incompetence.

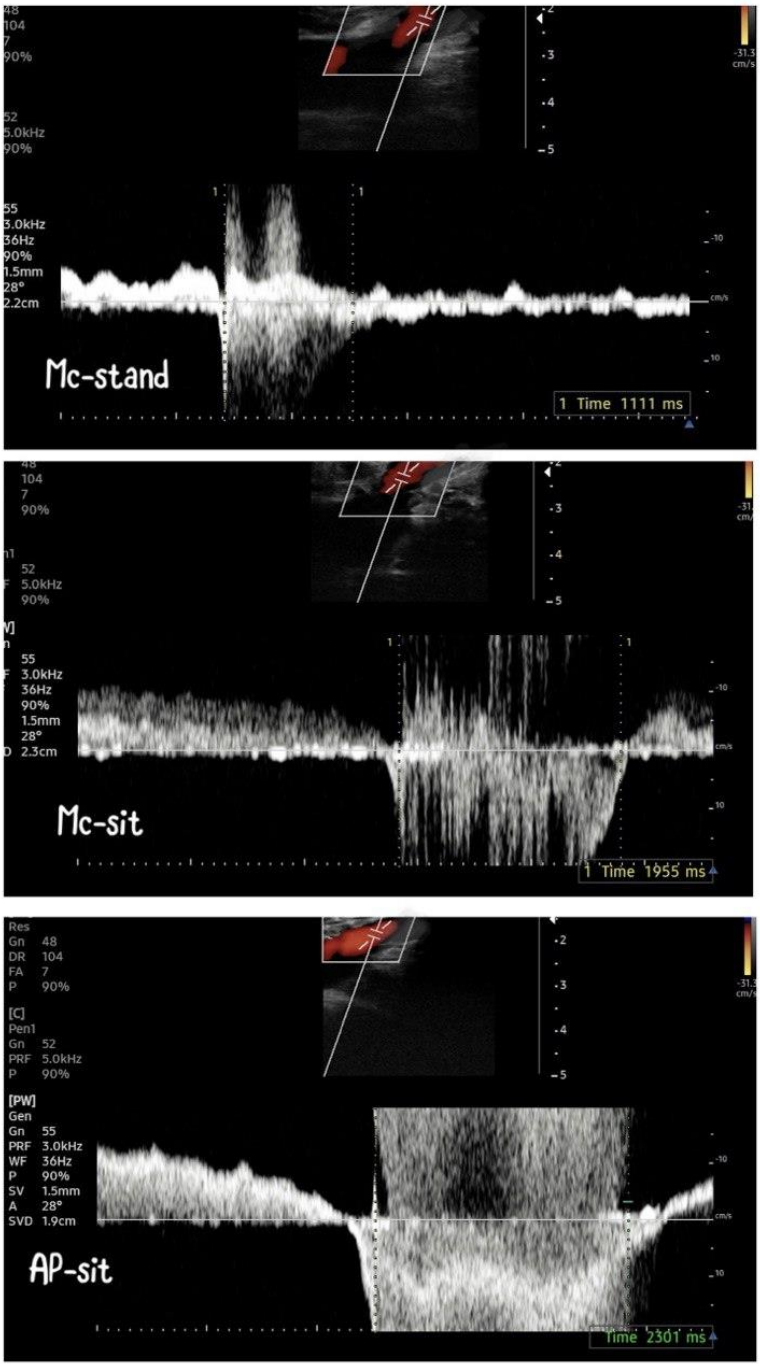

Figure 3.3: Spectral Doppler ultrasound of incompetent calf perforator vein demonstrating reflux time measurement using the three different assessment methods: (A) manual compression in the standing position (MC-stand), (B) manual compression in the sitting position (MC-sit), and (C) ankle pump maneuver in the sitting position (AP-sit). The images illustrate the variation in measured reflux duration according to patient position and provocative technique, with the ankle pump maneuver providing the most prolonged reflux.

4. DISCUSSION

The findings of this study demonstrate the superior diagnostic performance of the ankle pump maneuver. This technique enhances venous return and provokes reflux more effectively than static compression methods. The results are consistent with the physiological basis of venous hemodynamics and support the routine inclusion of this maneuver in clinical practice.

5. CONCLUSION

The ankle pump maneuver is a reliable and effective method for detecting incompetent calf perforator veins. It improves diagnostic accuracy and should be incorporated into standard duplex ultrasound protocols.

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