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Accuracy of clinical methods and doppler ultrasound in detection of incompetency of sapheno-femoral junction and perforators compared with operative results

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ABSTRACT

Background: Varicose veins, though a common condition, many time remains asymptomatic. The accurate diagnosis of varicose veins is of great importance in planning effective treatment. It is essential to bring out the accuracy of various diagnostic methods of varicose veins, so that early intervention can be achieved and recurrence can be prevented. The objective of this study was to our study was done with the intention of assessing the accuracy of Clinical evaluation of incompetence of Sapheno-Femoral Junction (SFJ) and perforators over doppler ultrasound evaluation and its Intra-operative confirmation, and also to assess the sensitivity, specificity, positive and negative predictive values and significance of both clinical as well as doppler ultrasound evaluation of varicose veins.

Methods: The study was conducted in the in-patients of General Surgery Department from September 2011 to August 2013. Patients presented with dilated tortuous veins in lower limb(s) and operated were included in the study. Patients who had recurrent varicose veins and who were unfit for surgery were excluded from the study. The patients were first evaluated clinically using Brodie - Trendelenburg Test I and II, Tourniquet Test, Schwartz Test, Pratt's Test, Morrissey's Cough Impulse Test and Fegan's Method. Following this, patients were evaluated by Ultrasound Doppler study of Venous system of the Lower limb(s) and sites of perforator incompetence were marked. Intraoperative confirmation of incompetence was done by Turner Warwick's Bleed back sign. The accuracy of clinical methods and doppler ultrasound evaluation compared with operative findings were assessed.

Results: Accuracy of clinical methods in detecting SFJ incompetence was checked with intra-operative findings. The sensitivity was 100%, specificity 100%, PPV 100% and NPV 100%. Similar results were obtained when checking the accuracy of doppler with intra-operative findings. Accuracy of clinical methods in detecting perforator incompetence was checked with intra-operative findings. The sensitivity was 82.93%, specificity 22.22%, PPV 90.67% and NPV 12.5%. Accuracy of doppler evaluation in detecting perforator incompetence was checked with Intra-operative findings. The sensitivity was 97.56%, specificity 12.5%, PPV 91.95% and NPV 33.33%.

Conclusions: Diagnosis of varicose veins is essential for planning of treatment if needed. Clinical methods predict the diagnosis of incompetent SFJ and perforators for which patient need not spend money, and are easy to perform. But doppler ultrasound evaluation has been proved to be more reliable, non-invasive and compatible in detecting venous incompetence. Hence, we conclude that doppler ultrasound evaluation is more accurate than clinical methods in detecting incompetent veins.

Keywords: Doppler, Perforators, Sapheno-femoral junction

INTRODUCTION

Varicose veins have always bothered mankind and been recognized as a chronic disorder since ancient times as their discussion is documented from the days of Hippocrates 2500 years ago. 1 The condition is affected by human's upright position and by gravitational force, is wide spread and a very common condition.1 Varicose veins, though a common condition, many time remains asymptomatic.1 In the developed countries patients get treated for cosmetic reasons, however in India the complications bring the patient to the doctor, but not cosmesis.1 In India this disease is one of the common surgical problems in low socio-economic class people, which at times compel the patient to change his occupation which is very disturbing.1 The accurate diagnosis of varicose veins is of great importance in planning effective treatment. Many studies have proven that careful clinical evaluation can give a correct localization of incompetent veins.² But recent literature state that clinical methods are unreliable in assessment of varicose veins and doppler ultrasound is of greater accuracy in identifying the sites of reflux.³

With continuing advances in methods of evaluating venous anatomy and hemodynamics, it is essential to bring out the accuracy of various diagnostic methods of varicose veins, so that early intervention can be achieved and complications can be prevented.¹

Our study was done with the intention of assessing the accuracy of clinical evaluation of incompetence of Sapheno-Femoral junction and perforators over doppler ultrasound evaluation and its intra-operative confirmation, and also to assess the sensitivity, specificity, positive and negative predictive values and significance of both clinical as well as doppler ultrasound evaluation of varicose veins.

METHODS

The study was started after obtaining the clearance from Institutional Human Ethical Committee (IHEC). The Study was conducted in the in-patients in the Department of General Surgery in Mahatma Gandhi Medical College and Research Institute, Puducherry from September 2011 to August 2013. Patients presented with dilated tortuous veins in lower limb(s) and operated were included in the study. Patients who had recurrent varicose veins and who were unfit for surgery were excluded from the study. Sample size was fixed as 30 based on previous Hospital records. The patients were first evaluated clinically using Brodie - Trendelenburg test I and II, Tourniquet Test, Schwartz test, Pratt's test, Morrissey's cough impulse Test and Fegan's method. Following this, patients were evaluated by ultrasound doppler study of venous system of the lower limb(s) and sites of Perforator incompetence were marked. Then Patients were prepared and posted for surgery. Intra-operative confirmation of incompetence was done by Turner Warwick's Bleed back sign. The findings were recorded and tabulated in master chart using Microsoft Excel. The accuracy of clinical methods and doppler evaluation compared with operative findings were assessed using the following parameters: sensitivity, specificity, positive predictive value, negative predictive value. The method of statistical analysis was evaluation of diagnostic methods. Statistical analysis was done using SPSS software.

RESULTS

This Study included 50 patients who had dilated tortuous veins in their lower limbs. Of the 50 patients, 2 were in age group of 11-20 years (4%), 3 were in age group of 21-30 years (6%), 18 were in age group of 31-40 years (36%), 12 were in age group of 41-50 years (24%), 12 were in age group of 51-60 years (24%) and 3 were in age group of 61-70 years (6%) (Table 1). The mean age of the study group was 42.74 years. The lowest age of presentation was 18 years and the highest age was 65 years. Maximum number of patients were in between 31 and 40 years (36%). (P=0.055). Among the 50 patients, 43 were male (86%) and 7 were female (14%). The male: female ratio in our study was 6.1:1. (P=0.028) (Table 1).

Table 1: Demographic profile.

Parameters	Number	Percentage	P value
Age group		<u> </u>	
11 - 20	2	4.00	
21 - 30	3	6.00	
31 - 40	18	36.00	0.055
41 - 50	12	24.00	0.055
51 -0 60	12	24.00	•
61 - 70	3	6.00	
Mean age in years	42.74		
Sex			
Male	43	86.00	0.028
Female	7	14.00	0.028
Occupation			
Farmer	22	44	
House wife	5	10	
Shop keeper	4	08	
Driver	3	06	
Clerk	3	06	0.601
Vendor	3	06	
Student	2	04	
Server	2	04	
Salesman	2	04	
Labourer	2	04	
Conductor	1	02	
Hotel manager	1	02	
Total	50	100	

In the 50 patients, 22 were farmers (44%), 5 were house wives (10%), 4 were shop keepers, 3 were drivers (6%), 3 were clerks (6%), 3 were vendors (6%), 2 were college students (4%), 2 were servers (4%), 2 were salesmen

(4%), 2 were labourers (4%), 1 was a bus conductor (2%) and 1 was a hotel manager (2%) (P=0.601) (Table 1).

Three patients presented with varicose veins of both lower limbs, for whom surgery was performed in each limb separately. 1 patient was operated in 4 months and the other 2 were operated in 6 months, after getting one limb operated. Hence the total number of lower limbs evaluated were 53. Of these 53 limbs, 23 were Right limbs (43.4%) and 30 were left (56.6%) (P=0.715) (Table 2). In these 53 limbs, 35 presented with dilated tortuous veins only (66.04%), 13 with dilated tortuous veins and ulcer (24.53%) and 5 limbs presented with ulcer only (9.43%) (P=0.35) (Table 2).

Of these 53 limbs, 45 limbs had Sapheno Femoral incompetence which was detected on clinical evaluation (84.9%). 8 limbs showed negative results (15.1%). Similarly, on doppler evaluation, 45 limbs had Sapheno

Femoral incompetence (84.9) and 8 limbs showed negative (15.1%). Intra-operatively those 45 limbs which had SFJ incompetence by both clinical and doppler evaluation had the same (84.9%), which was confirmed and 8 limbs had competent SFJ (15.1%) (Table 3).

Table 2: Clinical symptoms.

Side	Number of limbs	Percentage	P value
Right	23	43.40	0.715
Left	30	56.60	0.715
TOTAL	53	100.00	
Total	110		
Clinical sy	mptoms		
DVT	35	66.04	
Ulcer	5	09.43	0.35
DVT + Ulcer	13	24.53	0.55
Total	53	100.00	

Table 3: Number of incompetent SFJ by clinical methods, doppler valuation and intra-operative confirmation.

SFJ	Clinical	Methods	Doppler		Operativ	ve findings
Incompetence	N	%	N		N	%
Positive	45	84.9	45	Positive	45	84.9
Negative	8	15.1	8	Negative	8	15.1
Total	53	100	53	Total	53	100

Table 4: Comparison of clinical methods with operative findings and doppler in detecting SFJ incompetence.

SFJ		Clinical	Clinical Description		Doppler	
SLJ		Positive	Negative	Positive	Negative	Total Total
Omanativa	Positive	45	0	45	0	45
Operative	Negative	0	8	0	8	8
Total		45	8	45	8	53

Table 5: Number of incompetent perforators by clinical methods, doppler evaluation and intra-operative confirmation.

Perforators Clinically positive		Doppler	Doppler positive		Operative positive	
Perforators	N	%	N		N	%
Above knee	9	12	10	11.5	10	12.2
Below knee	66	68	77	89.5	72	87.8
Total	75	100	87	100	82	100

Accuracy of clinical methods in detecting SFJ incompetence was checked with intra-operative findings. There were 45 True positives and 8 true negatives. There were no false positives or negatives. Hence the sensitivity was 100%, specificity 100%, PPV 100% and NPV 100% (Table 4). Accuracy of doppler evaluation in detecting SFJ incompetence was checked with intra-operative findings. There were 45 true positives and 8 true negatives. There were no false positives or negatives. hence the sensitivity was 100%, specificity 100%, PPV

100% and NPV 100% (Table 4). Accuracy of clinical methods and doppler evaluation in detecting SFJ incompetence were compared. Both methods had 100% sensitivity, 100% specificity, 100% PPV and 100% NPV (Table 4).

In these 53 limbs, by clinical methods 75 sites of perforator incompetence were made out, of which 66 were below knee (88%) and 9 were above knee (12%). Doppler evaluation revealed 87 sites of perforator

incompetence, in which 77 were below knee (88.5%) and 10 were above knee (11.55%). Intra-operatively 82 sites of Perforator incompetence were confirmed, among which 72 were below knee (87.8%) and 10 were above knee (12.2%) (Table 5).

Accuracy of clinical methods in detecting Perforator incompetence was checked with Intra-operative findings. There were 68 true positives, 2 true negatives, 7 false positives and 14 false negatives. Hence the sensitivity was 82.93%, specificity 22.22%, PPV 90.67% and NPV 12.5% (Table 6, 8). Accuracy of clinical methods in detecting above knee perforator incompetence was checked with intra-operative findings. There were 9 incompetent perforators above knee detected by clinical methods, which were confirmed intraoperatively (90%). Accuracy of clinical methods in detecting below knee perforator incompetence was checked with Intraoperative findings. There were 59 true positives, 2 true negatives, 13 false negatives and 7 false positives. Sensitivity was 81.94%, specificity was 22.22%, PPV 89.39% and NPV 13.33%.

Table 6: Comparison of clinical methods with operative findings in detecting perforator incompetence.

Perforator	•	Clinical Positive	Negative	Total
O	Positive	68	14	82
Operative	Negative	7	2	9
Total		75	16	91

Table 7: Comparison of doppler evaluation with operative findings in detecting perforator incompetence.

Perforator		Doppler		Total
1 ci ioi atoi		Positive	Negative	Total
Omanativa	Positive	80	2	82
Operative	Negative	7	1	8
Total		87	3	90

Accuracy of doppler evaluation in detecting perforator incompetence was checked with Intra-operative findings. There were 80 true positives, 1 true negative, 7 false positives and 2 false negatives. Hence the sensitivity was 97.56%, specificity 12.5%, PPV 91.95% and NPV 33.33% (Table 7, 8). Accuracy of doppler evaluation in detecting above knee perforator incompetence was checked with intra-operative findings. There were 10 incompetent perforators above knee detected by clinical methods, which were confirmed intraoperatively (100%). Accuracy of doppler evaluation in detecting below knee perforator incompetence was checked with intraoperative findings. There were 70 true positives, 1 true negative, 2 false negatives and 7 false positives. Sensitivity was 97.22%, specificity was 12.5%, PPV 90.9% and NPV 33.33%. Accuracy of clinical methods

and doppler evaluation in detecting perforator incompetence were compared. Clinical methods were 82.93% sensitive and 22.22% specific with PPV 90.67% and NPV 12.5%, whereas doppler evaluation was 97.56% sensitive and 12.5% specific with PPV 91.95% and NPV 33.33% (Table 8). Accuracy of both clinical and doppler evaluation in detecting perforator incompetence was compared with intra-operative findings and it had a sensitivity of 87.8%.

Table 8: Comparison of clinical methods and doppler evaluation in detecting perforator incompetence.

Parameters	Clinical method	Doppler
Sensitivity	82.93%	97.56%
Specificity	22.22%	12.5%
PPV	90.67%	91.95%
NPV	12.5%	33.33%

DISCUSSION

Varicose veins are always a bothering disease of mankind. Many people with varicose veins are never harmed by them and some people may present for cosmetic reasons alone. It is the complications of varicose veins and chronic venous insufficiency that warrant consideration for treatment. Lower limb symptoms such as heaviness, pain, feeling of swelling, restless legs, cramps, itching and tingling are often associated with varicose veins. 4.5

The diagnosis of varicose veins is quite important so as to plan for intervention in patients who suffer due to complications or those who are bothered very much about cosmesis. Diagnosis of varicose veins can be made by clinical methods which include:

- Brodie trendelenburg test I and II
- Tourniquet test
- Schwartz test
- Pratt's test
- Morrissey's cough impulse test and
- Fegan's method.

Doppler ultrasound (Duplex) is also used to evaluate the competency of vessel valves.

This study was done mainly to assess the accuracy of Clinical methods and doppler ultrasound evaluation in detecting SFJ and Perforator incompetence.

Our study included 50 patients who presented with dilated tortuous veins in their lower limbs. Patients with recurrent varicose veins following intervention were excluded as the normal venous anatomy would have been distorted. In those 50 patients, highest incidence was noted in 4th decade of life i.e. 31-40 years (36%) and the mean age of the study group was 42.74 years. The oldest patient was at 65 years and the youngest was at 18 years

of age. This was found to be significant with P value 0.055. Mirji P et al, have also reported the oldest patient at 65 years and the youngest at 20 years of age. In their study, highest incidence was seen in 3rd decade of life (37.5%), whereas incidence in 4th decade of life was 25%. In another study done by Bradbury A et al, the mean age among men was 45.8 years and among women was 44.8 years.6 The increased incidence of the disease among young aged people can be attributed to prolonged standing and exertion.⁶ But Canonico S et al, have done a study on prevalence of varicose veins in an Italian elderly population, concluding that obesity is a common cause for varicose veins in elderly patients. London et al, and Fowkes et al, have also reported that varicose veins are common in elderly people (61% patients more than 55 years of age).^{8,9} Abramson JH et al, have reported increased prevalence of varicose veins among women aged 65-74 (54%) and 39% among men aged 75 and above. 10 NICE Guidelines also have reported that incidence of varicose veins increases with increasing age. 11 In this study, 43 were male patients (86%) and 7 were female patients (14%). Male: Female ratio was 6.1:1, which was significant with P value of 0.028. Mirji P et al, have reported 75% male patients and 25% females, and Horrocks E et al, have reported 69% males and 31% females. 1,5 Males are affected more because of increased height, prolonged standing, smoking, obesity and positive family history and low incidence among women was attributed to less cosmetic concern.⁵ But Bradbury A et al and Canonico S et al, have reported increased incidence among female patients.^{6,7} The female preponderance may be due to obesity, pregnancy, positive family history and increased height.⁶ Abramson JH et al, have shown higher prevalence of varicose veins among women (29%) than men (10%).10 NICE Guidelines have reported increased incidence of varicose veins among females.11

Our study showed increased incidence of the disease among farmers (44%), followed by house wives (10%). Moderate significance of correlation was noted (P=0.601). This is because of prolonged standing during their working period which solely contributes to varicose veins. Mirji P et al and Lateef et al have shown that occupation involving prolonged standing significantly leads to varicose veins. ^{1,12}

In our study, 56.6% of limbs evaluated were left and 43.4% were right (P=0.715). Mirji P et al and AHM Dur, AJC Mackaay et al, also have shown increased involvement of left lower limb. The probable reason for increased incidence on left side is that the venous drainage of the left leg follows a more tortuous course through the pelvis, with left common iliac vein traversed by the right common iliac artery. In our study involving 53 limbs, 35 presented with dilated tortuous veins only (66.04%), 13 with dilated tortuous veins and ulcer (24.53%) and 5 limbs presented with ulcer only (9.43%). Fowkes et al and Furlong et al, have mentioned ulceration as the least common presentation, involving 1-

2% of individuals but London et al have reported increased incidence of ulceration to 3.6% among people more than 65 years.8,14,15 In our study, 45 limbs had Sapheno Femoral incompetence which was detected on clinical and doppler evaluation (84.9%). In 8 limbs SFJ was competent (15.1%). Intra-operative confirmation revealed 84.9% incompetent SFJ. Wong JK et al, have showed 79% of patients with SFJ involvement. 16 Kim J et al have detected reflux on duplex scanning, at the SFJ in 54% of limbs.¹⁷ This makes clear that SFJ incompetence is the most common in varicose veins. In our study, accuracy of clinical methods in detecting SFJ incompetence was checked with intra-operative findings. The sensitivity was 100%, specificity 100%, PPV 100% and NPV 100%. Similar results were obtained when checking the accuracy of clinical methods with doppler evaluation and accuracy of doppler with intra-operative findings. Accuracy of clinical methods in detecting perforator incompetence was checked with intraoperative findings. The sensitivity was 82.93%, specificity 22.22%, PPV 90.67% and NPV 12.5%. The sensitivity of clinical methods in detecting incompetent above knee perforators was 90%, whereas for below knee perforators it was 81.94%. McIrvine et al have compared the accuracy of clinical evaluation and doppler with intraoperative findings. 18 The test had good sensitivity (90%) but poor specificity (45%). 18 Poor specificity was a feature of all the tests except for thrill which was a highly insensitive test.18

Our study also has revealed high sensitivity for clinical evaluation (100% for SFJ incompetence and 82.93% for perforator incompetence) whereas specificity varies in detecting SFJ (100%) and perforator incompetence (22.22%). Specificity of clinical tests was lower in detecting perforator incompetence. In our study, accuracy of doppler ultrasound evaluation in detecting perforator incompetence with intra-operative findings had sensitivity as 97.56%, specificity 12.5%, PPV 91.95% and NPV 33.33%. The sensitivity of doppler evaluation in detecting incompetent above knee perforators was 100%, whereas for below knee perforators it was 97.22%. Chan A et al, have showed that SFJ incompetence was correctly predicted by doppler ultrasound in 97% of limbs whereas it was 82% for clinical methods.¹⁹ In our study, accuracy of both clinical and doppler evaluation in detecting perforator incompetence was compared with intra-operative findings and it had a sensitivity of 87.8%. McIrvine et al, have compared the accuracy of clinical evaluation and doppler with intra-operative findings and they have shown good sensitivity (90%). ¹⁸ In our study, intra-operative confirmation of incompetence was done by Bleed-back sign described by Turner Warwick. He has reported incompetence in 30 out of 40 patients by this method. This method appears feasible and reliable than intra-operative venography, which warrants invasion, radiation exposure, technical expertise and caution. Kim J et al have also done a similar analysis and reported that the cough test had low sensitivity (59%) and specificity (67%).¹⁷ The tap test had low sensitivity (18%) and high

specificity (92%). The Trendelenberg test had high sensitivity (91%) but low specificity (15%). TOur study also shows that Clinical tests are less sensitive (82.93%) but more specific (22.22%) when compared with doppler evaluation (97.56% sensitive and 12.5% specific). Many studies done before have proven that clinical evaluation of varicose veins is less accurate than doppler ultrasound (Duplex) imaging. 14-16 Duplex imaging has the advantage of detecting DVT also. 18 In our study, both clinical methods and doppler ultrasound evaluation are equally accurate and effective in detecting SFJ incompetence, whereas doppler ultrasound gains importance in detecting perforator incompetence owing to its increased sensitivity and PPV. Intra-operative confirmation of incompetence by Turner Warwick's Bleed back sign appears to be reliable. Hence, as a whole, doppler ultrasound seems to be more accurate than clinical methods in detecting incompetent SFJ as well as perforators and bleed back sign by Turner Warwick is the confirmatory method of choice for testing incompetence during surgery.

CONCLUSION

Varicose veins are an annoying disease either symptomatic or cosmetic. Diagnosis of varicose veins is essential for planning of treatment if needed. Clinical methods predict the diagnosis of incompetent SFJ and Perforators for which patient need not spend money, and are easy to perform. But the accuracy of clinical methods is lower when compared to doppler ultrasound evaluation of perforator incompetence, though both are equally effective in detecting SFJ incompetence. Doppler ultrasound evaluation has been proved to be more reliable, non-invasive and compatible in detecting venous incompetence. Hence, we conclude that doppler ultrasound evaluation is more accurate than clinical methods in detecting incompetent veins. Our study was limited to comparison between clinical methods and doppler ultrasound (Duplex) evaluation involving 50 patients only. Studies involving larger groups may help in better evaluation of these methods.

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REFERENCES

- 1. Mirji P, Emmi S, Joshi C. Clinical features and management of varicose veins of lower limb. J Clin Diagnost Res. 2011;(Suppl-2):5(7):1416-20.
- Chilvers AS, Thomas MH. Method for the localization of incompetent ankle perforating veins. Br Medi J. 1970;2:577-9.

- 3. Wills V, Moylan D, Chambers J. The use of routine duplex scanning in the assessment of varicose veins. Aust N Z J Surg. 1998;68(1):41-4.
- Tortora GJ. Principles of Anatomy and Physiology. 4th edition. Harper and Row, New York NY; 1984.
- Horrocks E, Roake J, Lewis D. Best practice for assessment of patients with varicose veins. N Z Med J. 2008;121(1274):42-9.
- Bradbury A, Evans C, Allan P, Lee A, Ruckley CV, Fowkes FG. What are the symptoms of varicose veins? Edinburgh vein study cross sectional population survey. BMJ. 1999;318(7180):353-6.
- 7. Canonico S, Gallo C, Paolisso G, Pacifico F, Signoriello G, Sciaudone G, et al. Prevalence of varicose veins in an Italian elderly population. Angiol. 1998;49(2):129-35.
- London N, Roddy N. Varicose veins. London NJM (Eds). ABC of arterial and venous disease. BMJ Books, London: 2000:42-5.
- 9. Burnand K. Venous disorders. Bailey and Love's Short Practice of Surgery. 26th edition; 2012:901-922...
- Abramson JH, Hopp C, Epstein LM. The epidemiology of varicose veins- A survey in western Jerusalem. J Epidemiol Comm Health. 1981;35:213-7.
- Varicose veins in the legs. The diagnosis and management of varicose veins. NICE Clinical Guideline 168; 2013:1-23.
- Lateef MA. Clinical pathological study of the primary varicose veins in the lower limb. Br J Surg. 1995;82:855-
- Fowkes G. Epidemiology of venous disease. Venous disease simplified. TFM Publishing, Shrewsbury; 2006:13-32.
- 14. Dur AHM. Duplex assessment of clinically diagnosed venous insufficiency. Br J Surg. 1992;79:155-61.
- Furlong W. Venous disease treatment and compliance: the nursing role. Br J Nurs. 2001;10(11):S18-26.
- Wong JK. Whole-leg duplex mapping for varicose veins: observations on patterns of reflux in recurrent and primary legs, with clinical correlation. Eur J Vasc Endovasc Surg. 2003;25(3):267-75.
- Kim J. Clinical examination of varicose veins-a validation study. Ann R Coll Surg Engl. 2000;82(3):171-5.
- McIrvine AJ. The demonstration of saphenofemoral incompetence; doppler ultrasound compared with standard clinical tests. Br J Surg. 1984;71(7):509-10.
- 19. Chan A, Chisholm I, Royle JP. The use of directional doppler ultrasound in the assessment of saphenofemoral incompetence. Aust N Z J Surg. 1983;53(5):399-402.

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