

# DIAGNOSTIC ULTRASOUND FOR THE DETECTION OF ATHEROSCLEROTIC CHANGES INSIDE FEMORAL ARTERIES OF LOWER LIMB

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**Abstract-** This research study was carried out to see the effect of atherosclerotic changes inside femoral arteries with the help of diagnostic Ultrasound. Atherosclerosis in femoral arteries is meant by any kind of damage to internal thin cell lining of arterial walls of femoral arteries called as endothelium, which may be due to consistent or rapid increase in blood pressure or high level of fat deposition. To see the effect of atherosclerotic changes in the femoral arteries of some cases, the method of finding a change along x-axis and y-axis in the structure of triphasic type of ultrasound image waveform was used. The change was found to be like the production of biphasic type of ultrasound image with prolonged portion of diastole and small peak of systole. In case of monophasic type only low peak systole occurred with no portion of diastole. Five cases were taken for study. All these cases had a history of high blood pressure and use of unbalanced diet in their normal routine. It was concluded that formation of prolonged diastole along x-axis with low peak of systole along y-axis in biphasic type of ultrasound image, and formation of low peak systole along y-axis without any component along x-axis in monophasic type of ultrasound image, both are good indicator of atherosclerotic changes in the femoral arteries.

**Keywords-** Ultrasonography for femoral arteries, diagnose femoral arterial disease, Effects of defects in femoral arteries, femoral arterial disease, images of diseased femoral arteries.

## I. INTRODUCTION

Atherosclerotic changes in femoral arteries produce irregular or turbulent flow of blood through the femoral arteries and its types which may lead to the death of the corresponding tissue. Atherosclerosis means any kind of damage to internal thin cell lining of femoral arterial walls called as endothelium, which may be due to consistent, periodical or rapid increase in blood pressure or high level of fat deposition. Strength of growth of atherosclerosis may be different in different regions of femoral artery which is termed as atherosclerotic change in femoral artery. This atherosclerotic change in the femoral artery is responsible for the turbulent or irregular flow of blood inside the artery.

First of all it was great Satomura, who described the use of ultrasound for the determination of normal blood flow inside the arteries in 1959.<sup>[1]</sup> He deduced that this process can be easily used for the diagnosis of atherosclerosis (Arterial disease). Domorais D and Johnston KW studied the effect of aortoiliac disease by using Doppler waveform analysis in 1981 and concluded this method to be good indicator of aortoiliac

disease.<sup>[2]</sup> Evans DH and Macpherson DS studied the effect of proximal stenosis on ultrasound waveforms and concluded that changes in the shape of waveforms are equivalent to changes in velocity of blood through the arteries thus showing the arterial disease.<sup>[3]</sup> The shift in the regular normal type of waveform image can be used to diagnose the blockage of artery or vessel.<sup>[4]</sup> In 2008 Flanigan DP studied to see the effectiveness of ultrasonography for superficial femoral artery as compared to ankle brachial index and concluded that the ultrasonography technique is far better indicator than the ankle brachial index to determine atherosclerosis in superficial femoral artery.<sup>[5]</sup> Paraskevi and Christos used ultrasound process for diagnosis of iatrogenic femoral artery in January 2011 and concluded that this process is effective in the treatment of iatrogenic femoral artery by percutaneous ultrasound guided thrombin injection.<sup>[6]</sup> Walter and christian used ultrasound in march 2013 for the detection of femoral artery thrombosis and concluded this method as the effective method for the purpose of evaluating thrombosis inside femoral artery.<sup>[7]</sup> Marie-ange and samir used ultrasound in januray 2014 to detect and quantify the lower limb arterial stenosis and concluded that this method is good for adequate representation of lower limb arteries and to clinically evaluate the stenosis for therapy planning.<sup>[8]</sup>

## II. FEMORAL ARTERIES

Femoral arteries starts in the thigh region of human leg, it is also termed as common femoral artery. After its start in the thigh region, this artery is further divided into two more arteries named as Superficial femoral artery and deep femoral artery. These arteries are responsible for the flow of blood towards the knee, which is very most important part of human leg. Hence if any disease in femoral arteries occurs it will definitely affects the performance of knee. So femoral arteries get more intention to be diagnosed for atherosclerosis by using ultrasonography.

## III. METHOD AND MATERIALS

Cases were selected according to patient condition in which patients claimed to have regular high blood pressure. Five such cases were taken for study and these cases were diagnosed with the help of Madison ultrasound machine. Technique of finding any characteristic change in triphasic type of ultrasound image waveform was used to evaluate

atherosclerotic changes inside femoral arteries. Each patient was briefly told about the nature of the examination process and the patient was laid on his back with straight position for the diagnosis of superficial femoral artery and for the diagnosis of deep femoral artery the patient was laid such that his back now at upper level. The normal healthy condition of femoral arteries and its types show following pattern on ultrasound image waveform.



**Fig: Triphasic type waveform of femoral arteries**

Atherosclerotic changes inside the femoral arteries produces a change in required triphasic type of waveform in the ultrasound image. This change can be like as the production of biphasic type with prolonged diastole along horizontal axis and reduced peak of systole along vertical axis or the formation of monophasic type with only low peak systole along vertical axis without any horizontal components of diastole. Sometimes a mild spectrum do occurs which disable to clarify the type of image waveform and its components along x-axis or y-axis, thus indicates a well strengthen atherosclerosis. In other words it can be said that production of biphasic type of waveform with prolonged diastole along x-axis in ultrasound image indicates a small atherosclerotic changes in the femoral arteries. Whereas the production of monophasic type of waveform with low peak systole along y-axis in ultrasound image indicates the increased atherosclerotic changes in femoral arteries. The more the shift occurs in required triphasic type of waveform in the ultrasound image, more it is indicating the atherosclerotic changes in the femoral arteries. During this study every case was observed in this manner so as to have an indication of atherosclerotic changes in the femoral arteries.

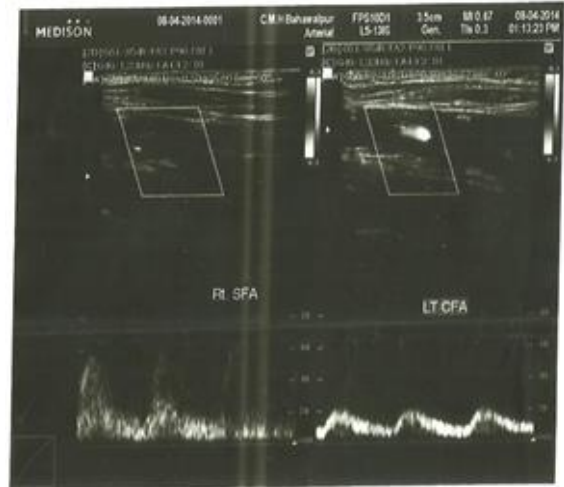
#### IV. RESULTS AND DISCUSSION

This study use Ultrasonography for detecting the atherosclerotic changes in the femoral arteries by noticing any characteristic change along x-axis and y-axis in required triphasic type of waveform from the femoral arteries. Any change in this required type of waveforms image is due to the occurrence of atherosclerotic changes in the femoral arteries.

This must be noticed that not only the whole length of femoral artery can show change in triphasic type of waveform image but it can happen that only a small or any particular region along the whole length of femoral artery may show a shift in triphasic type of waveform image and then that area will be termed as the area of atherosclerosis. In case if the strength of atherosclerosis is well increased that it completely block the femoral artery then it shows the image with a very mild spectrum or may show no spectrum. It should be clearly noticed that no portion of diastole occurs in case if monophasic type of waveform in ultrasound image is obtained.

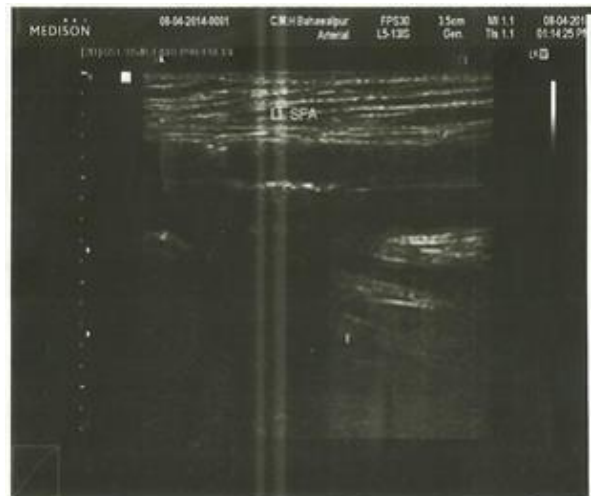
A patient (see image-01) whose both right superficial femoral and left common femoral artery was diagnosed using

Ultrasonography process and it was found that the right superficial femoral artery showed biphasic type of waveform image with low peak systole covering three divisions along y-axis and prolonged diastole covering two divisions along x-axis, which indicated the atherosclerotic changes in it. The common femoral artery also showed biphasic type of waveform but with very low peak systole covering only one division along y-axis and little prolonged diastole covering only one division along x-axis. It indicated atherosclerotic changes in common femoral artery.



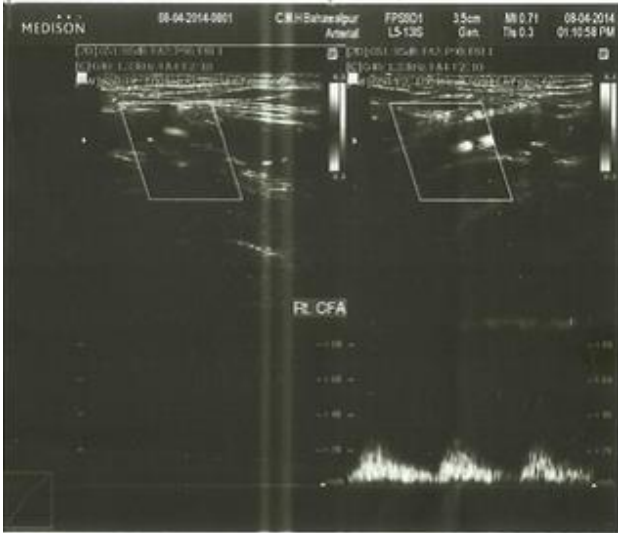
**Image-01: left common femoral artery & right superficial femoral artery**

A Patient (see image-02) whose left superficial femoral artery was diagnosed with the help Ultrasonography process and it was observed that this artery showed no spectrum, no systolic peak along y-axis and no component of diastole on x-axis, indicating increased effect of atherosclerotic changes in that artery. It means that the left superficial artery of this patient is completely disturbed by atherosclerosis. This patient was further evaluated and it came to notice that the patient was suffering from knee bursitis in left leg. No doubt that was the effect of large atherosclerosis in left superficial artery which blocked the normal blood supply as required by the tissues in the knee.



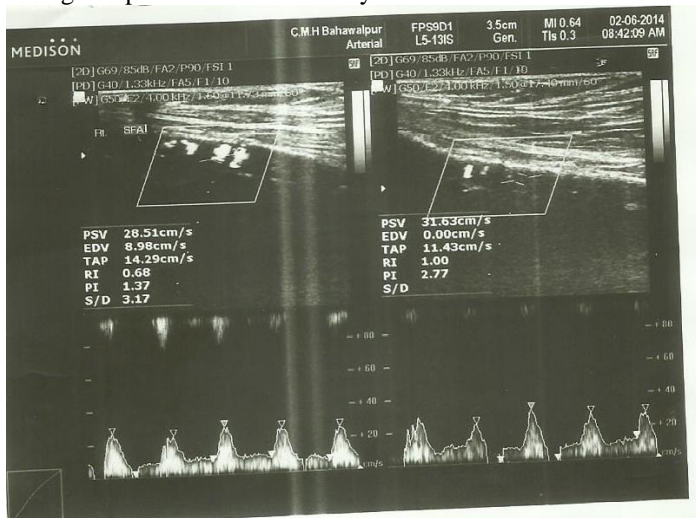
**Image-02: left superficial femoral artery**

A patient (see image-03) whose right common femoral artery was diagnosed and it showed biphasic type of ultrasound image waveform covering two divisions along x-axis and as well as the spectrum showed mildness in some certain regions along x-axis and at its low peak systole covering 01 division along y-axis. This indicates the increase growth of atherosclerosis in that artery which can rapidly grow to produce more atherosclerotic changes in this artery.



**Image-03: right common femoral artery**

A patient (see image-04) whose both right common femoral and right superficial artery were diagnosed and it was noticed that both of these arteries show biphasic type of waveform image with diastole prolonged after one cycle which covered one and half divisions along x-axis and covering three division along y-axis with peak systole. Hence indicating the presence of small atherosclerotic changes in that artery. Further it was also noticed the right common femoral artery also showed some mildness in the spectrum along x-axis region of diastole, which indicated that right common femoral artery carries little more atherosclerotic changes than the right superficial femoral artery.



**Image-04: right common femoral artery & right superficial femoral artery**

A patient (see image-05) whose both left superficial artery and left common femoral artery were diagnosed. It was seen that markedly dampened monophasic type of waveform image was obtained from both of these arteries both carrying low peak systole covering two division along y-axis and no portion of diastole along x-axis. It means that both of these arteries carry a large strength of atherosclerotic changes. That patient was further evaluated and it was found that cellulitis occurs in the lower thigh region and calves. No doubt it was due to poor condition of left common femoral artery and left superficial artery which affects the inner tissue of that region. Hence the presence of large degree atherosclerosis in both of these arteries produce it worse effects on lower thigh region and calves.



**Image-05: left superficial & left common femoral artery**

## V. CONCLUSION

It is been concluded that when any of femoral artery carries atherosclerotic changes, then it produces characteristic changes in triphasic type of ultrasound image along x-axis and y-axis with the formation of new type of ultrasound image. In the formation of biphasic type of ultrasound image the diastole is prolonged to more than two divisions along x-axis with low peak systole covering three divisions along y-axis and in the formation of monophasic type of ultrasound images the systole peak is reduced and it covers only three divisions along y-axis and produce no portion of diastole along x-axis. Both of these are better indicator of atherosclerotic changes in femoral arteries. So whenever such change is noticed in the ultrasound image waveforms then atherosclerotic changes are the most occurring factors in the femoral arteries.

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