Non-invasive Bi-directional Doppler Analysis for Potential Early Detection of Severe COVID-19 Cases

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Abstract:

COVID-19, an infectious disease caused by a new virus, has been well known to cause respiratory illness and further research has been shown to cause symptoms related to multiple organ damage. This is due to the attack of the inner endothelial layer of the arterial wall. The monitoring of the cardiovascular system can potentially indicate early activity of COVID-19 on the endothelium and possibly allow earlier intervention. Bi-directional spectral Doppler waveform analysis has been an effective, non-invasive, non-radioactive, inexpensive "global" assessment tool for vascular health and reversal of vascular diseases under continual patient engagement.

COVID-19

Severe and critical COVID-19 coronavirus cases have shown endothelial damage and subsequent clotting to be common. Clotting has been shown in vessels of all organs, not only the lungs, which has produced similar symptoms by the flu, but also the heart, the liver, and the kidney similar to septicemia. The virus can bind to the endothelial cells and may cause damage to the blood vessels, leading to the formation of clots throughout the vascular system[2]. Research has shown high levels of D-dimer due to this wide spread of abnormal coagulation and autopsies show inflammatory changes in the heart[3].

Reports have highlighted patients above the age of 18 with underlying health conditions were found to have a higher percentage of non-ICU hospitalizations and ICU admissions. Other underlying health conditions and potential risk factors include, but are not limited to, obesity, hypertension, cardiovascular disease, and diabetes.[17] Cardiovascular unhealthiness in the young and old is a potential risk factor that can be detected and potentially reversed with lifestyle interventions. The protection of the cardiovascular system using lifestyle interventions to naturally produce nitric oxide by endothelial layer could protect against cardiovascular system damage by the virus or potentially prevent severe cases.

Recent reports have shown an inconsistency in the previously popular hypothesis claiming younger individuals somewhat immune to the disease. Ben, a thirty-year-old varsity baseball coach, had contracted the virus and had abruptly gotten severely sick the night he passed away.[13] A likely factor for young adults dying of COVID-19 could be cardiovascular unhealthiness. Ninety percent of hospitalizations by COVID-19 cases have some type of underlying condition.[11] Hypertension and cardiovascular disease were the most common comorbidity, respectively, in older patients and obesity in younger patients.[11]

Doppler Analysis

Bi-directional spectral Doppler waveform analysis is a non-invasive technique[14] typically used to analyze Peripheral Arterial Disease (PAD)[1], and studies have shown a correlation between the endothelial function of the peripheral arteries and of the coronary arteries.[22] Therefore, Doppler analysis is applied as the "global" assessment tool that provides analysis of vascular disease (i.e. coronary, cerebral, renal, peripheral), used in early recognition, and for applying biofeedback principles to increase the efficacy of treatment, especially that of lifestyle interventions.[16,21] Continual patient engagement can be used in measuring improvement of endothelial function from lifestyle interventions by analysis of waveform monitoring, repeating every 6-8 weeks. We have been granted patents in mobile vascular application and a patent pending on the mobile vascular devices.[6,7,8,9]

A cohort study of semi-professional baseball team, ages between 17 and 22, along with their coach aged 53 were asked to voluntarily participate in a 6-week program, which included an educational presentation, initial assessment of vascular health, nutritional guidelines, and reassessment. Assessments and reassessments included analysis of weight, blood pressure (systolic and diastolic), heart rate and vascular status via Doppler analysis. From the initial assessment, ~47% were classified as overweight according to BMI standards and ~84% had Doppler analysis waveforms signifying moderate to severely occlusive arteries. Most of the participants who followed the guidelines with greater than 50% commitment were able to achieve overall positive improvement.[10]

The 80% majority of heart attacks that occur in young adults are caused by Coronary Artery Disease that results from a process called atherosclerosis, in which fatty plaque deposits build up around the walls of the artery and can be asymptomatic.[15,17,19]

Our office followed a long-term patient who was catheterized. The interventionist, cardiologist, and the thoracic surgeon were unable to recommend angioplasty, stent placement, and open bypass surgery due to the location of the lesion. The patient was released from the hospital with a plan to re-catheterize in one week. Our practice then placed the patient on a six-week program and restarted lifestyle interventions and pharmaceuticals. Every week the patient showed improvement in her vascular studies via Doppler analysis. After the six weeks of outpatient office intervention, a re-catheterization was repeated, and the lesion had resolved and therefore no invasive procedures were recommended by the cardiologist.[4]

Our practice prefers the use of noninvasive evaluation as described above. As opposed to measuring calcium scores that require radiation, duplex arterial readings which measures stable calcified plaque instead of soft plaque, nor intravascular ultrasound for its invasiveness.

Our Treatment Protocol for Cardiovascular Disease

The monitoring of the endothelial layer of the arterial wall could prove useful against the fight against COVID-19 and other septic presentations. Early signs of endothelial damage via the monitoring of Doppler waveform analysis could indicate severe cases before serious symptoms appear. Lifestyle and pharmaceutical agents can improve or restore natural nitric oxide production that can begin to prevent these symptoms by contesting the clotting caused by COVID-19.

Our practice routinely uses Doppler analysis to assess, assign, and monitor lifestyle interventions and pharmaceuticals. These include aspirin, B12 injections, phosphodiesterase inhibitors, treating hormone deficiency states, cinnamon, fish oil, a Mediterranean like diet, and aerobic exercise. Aerobic exercise shown to produce sufficient amounts of nitric oxide include walking for an hour or running for half an hour.[23]

In addition, even though research is still evaluating the angiotensin question, our practice has been changing treatment from an angiotensin-converting-enzyme inhibitor to an angiotensin receptor blocker as a precautionary response.[24]

There is no doubt these are stressful times, and stress is an appropriate response for the current issues at hand. Our patients are stressed, and this is addressed using biofeedback as part of our overall interventions.[6,9] If we practice healthy lifestyle interventions and care for ourselves to reduce these stress levels, we could better our chances since stress plays a role in conditions such as cardiovascular disease and autoimmune disorders.[20]

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