International Journal of Early Childhood Special Education (INT-JECSE)
DOI:10.48047/intjecse/v18i3.28 ISSN: 1308-5581 Vol 18, Issue 03 2026

Medical Applications of Doppler Parameters and Their Effects On Blood Vessels to Demonstrate and Measure Cellular Filtration After Stem Cell Therapy

Wisam Abdulatif Jasim

1 Ibn Khaldun Private University College, Baghdad, Iraq.
* Corresponding Author: e-mail : Wissam.a.@ik.edu.iq

Abstract: One of the most important applications of Doppler theory in the medical field is to identify the nature of fluid flow, and in the medical field, it is blood flow. The applications of echo and the use of special materials in transmitting frequencies through electrical physical materials, known as transducers, which have the properties of receiving, transmitting, converting acoustic dynamic energies and re-transmitting them electrically. The effect of changing the speed of blood flow in the blood vessels appears based on the shift of frequencies between the receiver and the recipient, and from this it is possible to identify the location and diameter of the change in blood flow in the area to be examined and carry out the necessary treatment, such as using a catheter and opening narrow vessels. A device may be used to expand blocked vessels. This study is based primarily on the basic functions of echo theory and the use of mathematical and computational methods in the study. Selected educational materials, case reports, and videos are of critical relevance to all echocardiographic specialties and modalities, including pediatrics, anesthesiology, general medicine, acute medicine, and intensive care. Medical applications of Doppler parameters and their effects on blood vessels to demonstrate and measure cellular filtration after stem cell therapy by medications is the advantages fields of diageneses.

Keywords: Doppler; Echo Planar; Imaging; Physical Principles; Application.

1. Introduction

One of the modern scientific methods widely used in medicine for accurate diagnosis is the Doppler effect, which relies on the transmission of material waves through different media and their conversion into different electronic energies, and their re-analysis after scattering based on the different absorption densities that characterize them [1,2].

2. Theory and Evaluation

Calculating wavelengths requires observing any particle, let's say a blood cell moving in a blood vessel [3]. By tracking the time between two successive peaks or phases of the pressure accompanying the observed process, the change in time becomes T + ΔT. The approach or departure from the source of disturbance can be recorded and observed scientifically based on the angle of incidence and reflection between two time periods, and from this the displacement can be calculated [4]. Velocity with variation of displacements can be represents with respect to the variation of Δλ as:

$\Delta\lambda = v(T + \Delta T)$.

The known speed of sound as a carrier of material energy is (1570 m/s) which is most increases than the speed of a red blood cell (<0.5 m/s), and since ΔT <<T. Therefore, a simple form of the equation shown above can be prepared as shown below:

$\Delta\lambda = \upsilon T$ since

$c = \mathcal{F}\lambda$ or $\lambda = \frac{c}{\mathcal{F}}$

then become $\lambda + \Delta\lambda = c / \mathcal{F} + \Delta\mathcal{F}$

$$\frac{\Delta f}{f} = -\frac{v}{c+v}.$$

$$\lambda f + \Delta\lambda f + \lambda\Delta f + \Delta\lambda\Delta f = c.$$

By substituting λ for v/f in the above expression get

Can simplify the above relation become:

$$\frac{\Delta f}{f} = -\frac{v}{c} \qquad \text{or } \Delta f = -f\frac{v}{c}.$$

$$\frac{\Delta f}{f} = -\frac{v}{c} \qquad \text{or } \Delta f = -f\frac{v}{c}.$$

The variations of the frequency with respect to reflected signal in the blood cell will become:

$$\Delta f = -2f\frac{v}{c}.$$

For a simple explanation, it depends on the cosine. If the angle of that direction of movement in blood cells and ultrasound beams, then Figure 1, represents the Doppler effect equation will be as follows [5]:

$$\Delta f = -2f\frac{v}{c}\cos\theta.$$

Based on the law of refraction, the Doppler angle results as

$$\alpha = 90^{\circ} - \arcsin\left(\sin\alpha_{\mathrm{P}}\frac{c_{\mathrm{L}}}{c_{\mathrm{P}}}\right)$$

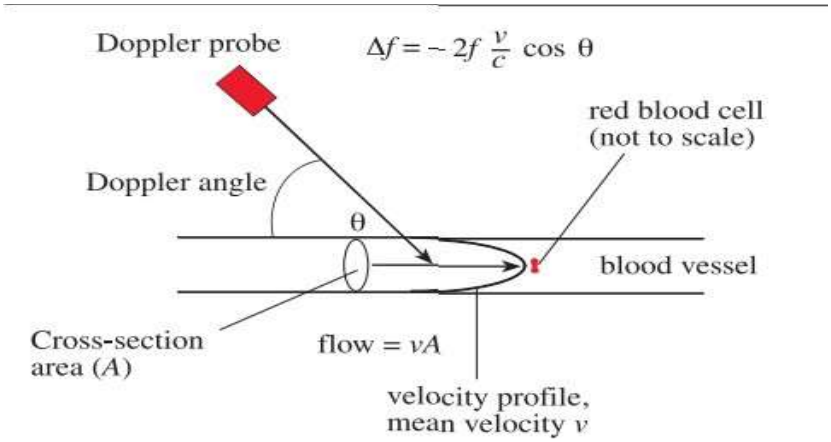

Figure 1. The Doppler effect shift [6].

3. Results

Ultrasonic pulse-echo (UP-E) technology has proven effective in identifying cracks and other internal defects [7]. It uses a transducer to generate short pulses of the waves of ultrasonic that propagate through objects and particles under technical examination. The reflection of stress pulses between the boundary conditions of materials of varying densities and different elastic moduli and their properties are taken into account, and these equations are computerized using modern software techniques based on mathematical models using the finite element method or the finite difference method [8]. The ability to convert reflected, received, or emitted energies is the basis of the dual properties of the electrodynamic transducer, electrically or by ultrasonic material waves. The role of the transducer is fundamental. The changes in these received signals then reveal the role of the cathode ray oscilloscope, or what is called an oscilloscope [9]. The measured time for the pulses to travel back and forth is calculated from the images shown on the oscilloscope for the horizontal axis, and the role of vertical axis is representing as the voltage that represents the vertical wave potential or the phase difference electronically [10]. Depending on the speed of the waves, we can deduct from them the knowledge, measurement and calculation of what we want [11].

The dependent parameters of Doppler effects represent in table (1).

Table 1. The incident angles and frequency, resistance, speed, flow and signal intensity for tube diameter (6.35).

angle	F-max.	F-mean	F-max.(Hz)/ F-mean.(Hz)	Resistance RI	Speed C/s.	Flow I/min.	Signal intensity
0	1228	690	1.78	0.84	0	0	565
10	1637	873	1.88	0.84	344	6.5	604
15	1203	647	1.86	0.31	170.9	3.2	538
30	2423	1337	1.81	0.56	182.9	3.5	567
45	777	415	1.87	0.84	40.1	0.8	839
60	1024	549	1.86	0.19	43.4	0.19	706
75	1049	586	1.79	0.75	41.5	0.8	644
80	1216	653	1.86	0.84	45.4	0.9	582
85	1170	635	1.84	0.84	43.6	0.8	501
89	1170	635	1.84	0.84	43.4	0.8	501

Tube diameter= 6.35 mm.

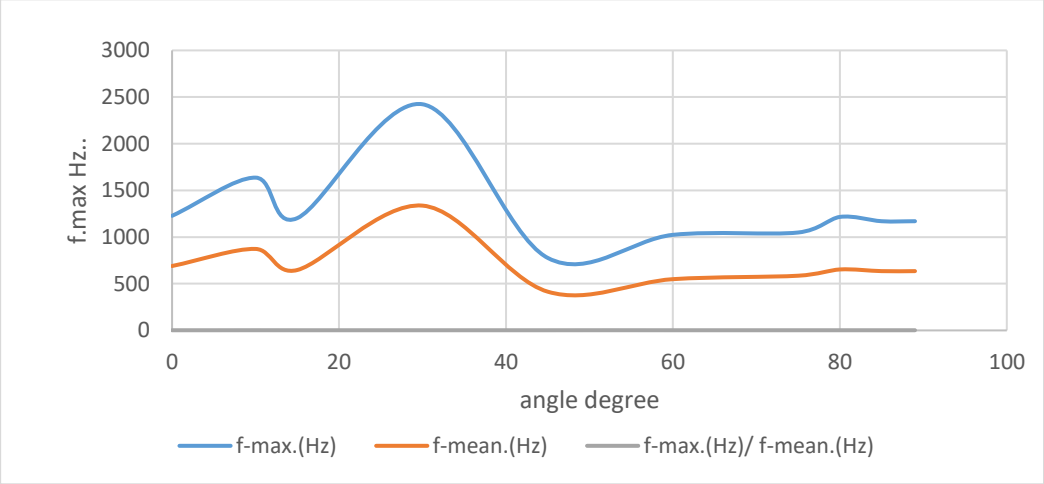

Figure 2. The relation of maximum frequency and the refraction angles.

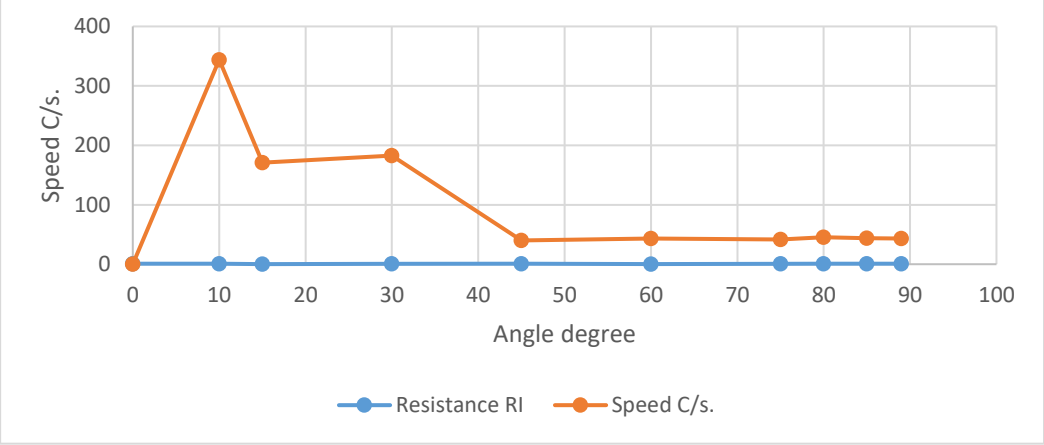

Figure 3. The relation between the angle and resistance the speed.

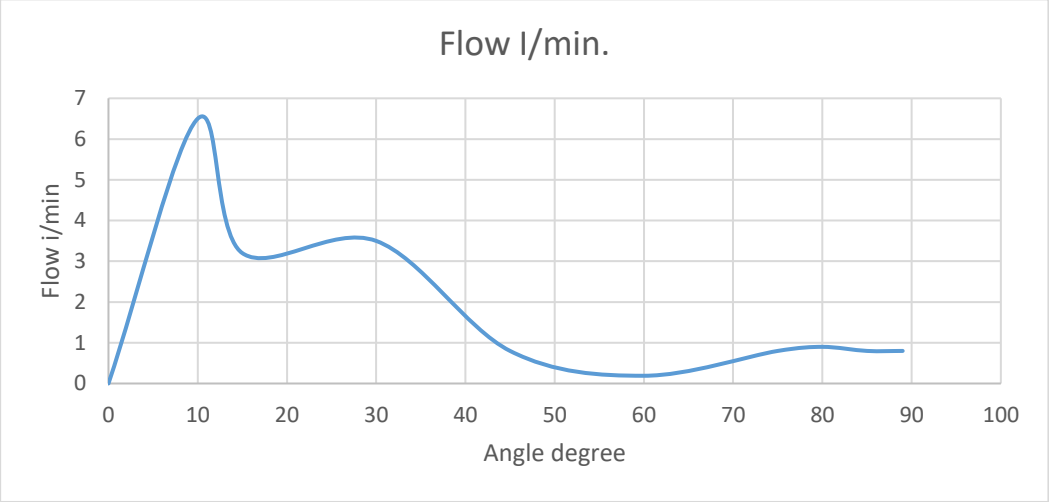

Figure 4. The relation between the angle and flow.

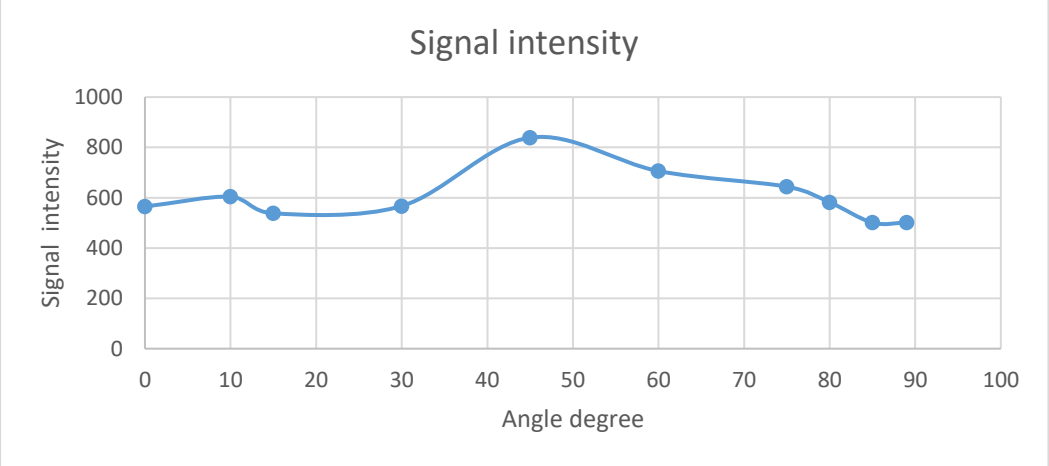

Figure 5. The relation between the angle and signal intensity.

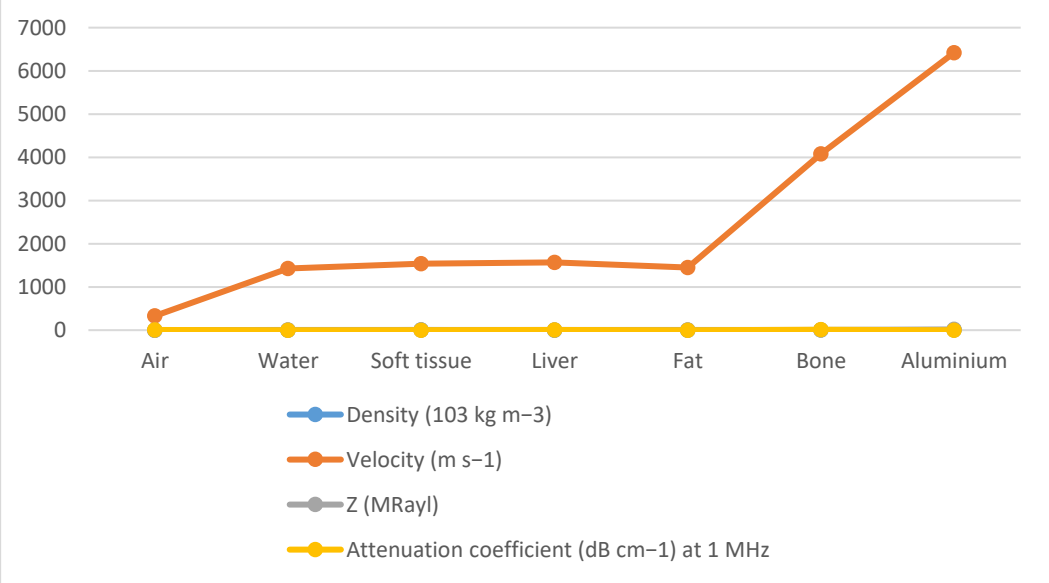

Figure 6. The relation of the Density, velocity and acoustic impedance of materials.

Table 3. Density, velocity and selection of materials.

Material	Density (103 kg m−3)	Velocity (m s−1)
Air	0.0012	330
Water	1	1430
Soft tissue	1.1	1540
Liver	1.05	1570
Fat	0.95	1450
Bone	1.91	4080
Aluminum	2.7	6420

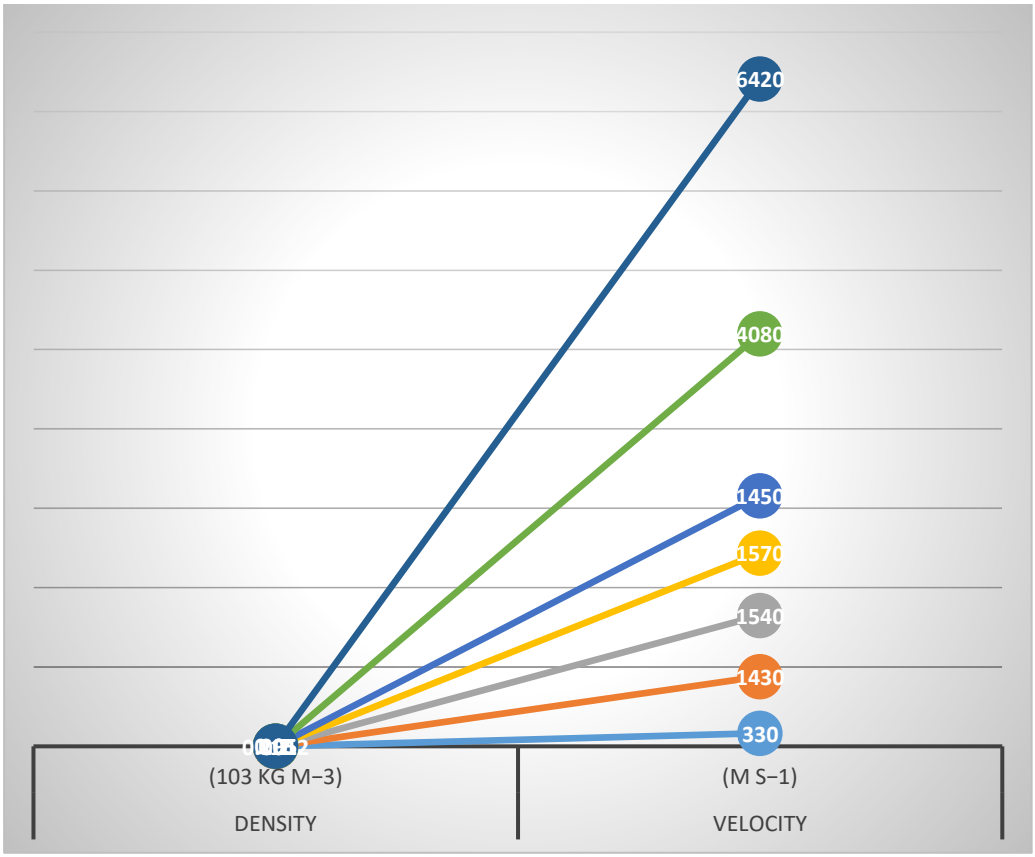

Figure 7. Density, velocity and a selection of materials.

4. Conclusion

One of the most important and widespread current uses is the application of physical changes in the Doppler effect. Medical applications of Doppler parameters and their effects on blood vessels, such as demonstrating and measuring cellular filtration after stem cell therapy with drugs, are among the advantages of diagnostic fields.

To clarify a challenging objective that requires a deeper understanding, the assessment of regional myocardial perfusion using contrast-enhanced venous echocardiography (VECE) can be considered. The contrast material, composed of a carrier fluid and gaseous microbubbles, must first be efficiently delivered through the pulmonary microvasculature. It must then be transported with the circulation through the chambers, valves, and vessels into the coronary microcirculation, allowing for quantitative echocardiography. Assuming controlled preparation and standardized use of appropriate contrast materials, it is still necessary to understand the evolution and stability of the contrast material during its passage, in the presence of diagnostic ultrasound and characteristic cardiac pressure pulsations. Clarification of the physical principles and mathematical modeling will help explain the

behavior of microbubbles in ultrasound contrast applications. This study provides background information on the key applications underlying the impact echo test. As with most concrete defect detection methods, experience is required to interpret impact echo test results. Ultrasound. Linear relationship between concentration and signal intensity. Ability to cross the pulmonary capillary bed. Stability throughout the procedure. Minimum imaging artifacts. Ability to deactivate rapidly at higher energy outputs. Safety: Non-toxic. The properties of ultrasound depend on bubble size, composition of the envelope and gas present in it. More flexible the shell, the more likely it is to compress or resonate, producing a nonlinear backscatter signature.

References

[1]: Clare M. Culshaw, Daniel Augustine, Caroline J. Coats, Ivo Andrade, Keith Pearce, Antonis Pantazis, William Bradlow, Lauren Turvey, William Moody, Lynne Williams, Rachel Bastianen, Jane Draper, David L. Oxborough and Robert M. Cooper "British Society of Echocardiography guideline for the transthoracic echocardiographic assessment of adult patients with obstructive hypertrophic cardiomyopathy receiving myosin-inhibitor therapy" 2 June 2025.

[2]: Mohammed A. Hiari, FRCR." Principles and applications of echo planar imaging in magnetic resonance" Neurosciences 2000; Vol. 5 (2): 94-97

[3]: Yanxin Zhang et al" Simulation Study on the Performance of Ultrasonic
Pulse-Echo Detector for Ice Thickness" 2024 J. Phys.: Conf. Ser. 2694 012052

[4]:J. Capon, "High-resolution frequency-wavenumber spectrum analysis," Proc. IEEE, vol. 57, pp.408–1418, Aug. 1969.

[5]:J. Krolik and D. Swingler, "The performance of minimax spatial resampling filters for focusing wide-band arrays," IEEE Trans. Signal Processing, vol. 39, no. 8, pp. 1899–1903, Aug. 1991.

[6]:IEEE Trans. Med. Imag., vol. 24, pp. 1308–1322, Oct. 2005.

[7]: J.-F. Synnev˚ag, A. Austeng, and S. Holm, "Minimum vari- ance adaptive beamforming applied to medical ultrasound imag- ing," in Proc. IEEE Ultrason. Symp., 2005, pp. 1199–1202.

[8]:F. Viola and W. F. Walker, "Adaptive signal processing in med- ical ultrasound beamforming," in Proc. IEEE Ultrason. Symp., 2005, pp. 1980–1983. [

[9] :T.-J. Shan, M. Wax, and T. Kailath, "On spatial smoothing for direction-of-arrival estimation of coherent signals," IEEE Trans. Acoust. Speech Signal Processing, vol. 33, no. 4, pp. 806–811, Aug. 1985.

[10]: Nicholas J. Carino,* Member, ASCE" The Impact-Echo Method: An Overview1" 2001

[11]:P. Stoica and R. Moses, Introduction to Spectral Analysis. En- glewood Cliffs, NJ: Prentice-Hall, 1997.