BLOOD FLOW, ELECTROMAGNETISM, AND COAGULATION

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Abstract

The theory of hemodynamics is rife with uncertainty. The left ventricle cannot perform the amount of labour required to move the blood through the circulatory system. As a result, blood flows more slowly in between heartbeats, altering the pattern of the accompanying electrocardiogram's Womersley number (ECG). Coagulation exhibits strong viscoelastic change. The blood transient flow resistance and the ECG must be correlated. It was investigated how the electromagnetic field affected blood coagulation. In 25 healthy subjects, the oscillated electromagnetic field (500–5000 Hz) with the square wave input signal had an impact on venous blood (15 males, 10 females in the age 18 - 57 years). Time of the sample's electromagnetic irradiation (EMI): 3–10 min. In normal blood samples, hypocoagulation was seen together with thrombolysis following blood stasis (decreased platelet quantity up to 10–23 109/L, Prothrombin index up to 9%–10%, Fibrinogen concentration up to 0.20–0.21 g/L). Electroacoustic phenomena are started by the cardiac depolarization's ac electric field. Together with the heart's pulse pressure, a growing repulsive electromagnetic force operates on red blood cells (RBC) to drive blood mobility and viscoelastic changes. The magnetic properties of haemoglobin make it easier for changes to the blood's inertia, elasticity, and hemodynamics. The external electromagnetic signal has the ability to control all aspects of thrombolysis and blood coagulation.

Keywords: Information Filter, Viscoelastic Blood Flow, Coagulation, Parcel Resident Time, Electromagnetic Force

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1. Introduction

It is now widely acknowledged that the heart consists of two independent pumps that circulate blood through the lungs and other organs (McMillan, 2008). Although blood is a unique bodily fluid, it only circulates passively. Yet, the heart's energy is insufficient to do the transporting task.
Blood is a thixotropic, viscoelastic material. It rapidly alters its high flow resistance, practically between heartbeats. This characteristic is now known as transient flow resistance as a result. The additional effort required to align red cells into the plane of flow as the flow starts or resumes has been proven to be the source of thixotropy. When elastic red cells shift away from the plane of flow as flow slows or ceases as they relax elastically, transient resistance is regained quickly. Growing contact between red blood cells, which occurs when they lose the orientation they maintained during flow, is a major contributor to blood's temporary resistance (Prado et al., 2015).
Human blood has a feature known as viscoelasticity, which is principally caused by the elastic energy stored in the deformation of red blood cells during the heart's pumping of blood throughout the body (Nader et al., 2019). Viscosity loses another portion of the energy, leaving the remaining energy to be stored in the kinetic motion of the blood.

Blood rheology is greatly influenced by RBCs' ability to aggregate and deform. At low shear rates, RBC aggregation results in a significant rise in viscosity. RBC concentration and shear rate both influence the magnitude of the RBC aggregation (Parry & Squire, 2017). The plasma proteins albumin and fibrinogen are also necessary for the aggregation to occur. Both elastic and viscous characteristics apply to fibrin. The fibrin network's extraordinarily high elasticity and durability despite having very little protein content may be its most impressive rheological property (Garmo et al., 2018).
Blood coagulation clearly displays changes in viscoelasticity. The three elements required for the development of thrombosis—blood stasis, vascular wall damage, and altered blood coagulation—have been dubbed "Virchow's trinity" (Berg, 2010). Blood turns from a liquid (sol) to a gel during coagulation, which results in the formation of blood clots. It is more accurate to describe the blood in the first hemostasis as a fluidized suspension of elastic cells. A gel's dispersed phase is a liquid. As a result of hydrogen bonding, crystallisation, helix creation, complexation, and other processes, the gel comprises covalent polymer networks that were created by physical aggregation and function as the connection sites for the networks (Prandoni, 2009).
It has long been believed that platelet activation plays a major role in the development of arterial thrombosis, whereas the activation of the clotting system plays a major role in venous thrombosis. When platelet-rich thrombi grow around ruptured atherosclerotic plaques and damaged endothelium, arterial thrombosis happens under conditions of high shear flow. Venous thrombosis generally develops in areas with intact endothelium walls and modest shear flow. There is proof, nevertheless, that this dichotomy is oversimplified. It is recommended to treat arterial and venous thrombosis as an unified disease by treating the same early coagulation events (Palta et al., 2014).

In a healthy individual, primary hemostasis typically takes 1 to 3 minutes to complete. Blood coagulation, also known as secondary hemostasis, hemocoagulation, or plasma hemostasis, is actually a complicated biological process that results in the formation of fibrin protein strands in the blood. These strands then polymerize to form blood clots, which cause the blood to become less fluid and develop a curdled consistency. In a healthy individual, the major platelet plug forming location is where blood clots develop. The typical period for the production of a fibrin clot is 3 to 8 minutes (Furie & Furie, 2005).
Through mechanisms that guarantee balanced hemostasis, the coagulation and fibrinolytic systems are tightly controlled and interconnected (Senise et al., 2015). There have been reports of sudden cardiac deaths in locomotive drivers who were in the vicinity of electromagnetic storms and a decrease in blood fibrinolytic activity in humans (Kazimierska, 2001). In guinea pigs, homogenous magnetic fields as low as 0.005 T have been shown to affect platelets, blood coagulation, and fibrinolysis (Gorczynska & Wegrzynowicz, 1983). Reports on the orientation of fibrinogen, retinal cells, sickled cells, etc. as well as dates about the impact of an evenly distributed static magnetic field of 8 T on normal erythrocytes are all available.
When applied to live cells, time-varying electric fields can cause a variety of biophysical reactions. Electroporation, also known as electro permeability, is a phenomena of interest in which the plasma membrane's permeability is increased by a rapidly changing, time-varying field. Dielectrophoresis is a different phenomena, in which fields of a certain frequency are used to separate cells or to orient and control nanoparticles and nanowires.
The functional modification of the cell architecture involves both low-frequency and high-frequency electric fields.

Erythrocytes oscillate at a high frequency of 1.2 GHz when they tread water in a tank. The electrical and dielectric properties of red blood cells are significantly impacted by this rhythmic motion.
It has been argued that the processes underlying electromagnetic field-induced blood viscoelastic effects are not entirely understood. The blood's potential electromechanical activity is explored.

Proposed methods and materials
The toroid transformer's silicone catheter coil was filled with blood and subjected to electromagnetic field irradiation in order to produce the conditions for ac current flow in the blood. A square waveform with frequencies between 500 and 5000 Hz was used to apply voltage to the transformer's primary electric coil (Figure 1).
An analogue to the square wave, or the acute spikes of the wavefront, is the cardiomyocyte action potential curve. A cardiomyocyte depolarizes in 2 msec (at a frequency of 500 sec1).
Particle polarisation is created by the external magnetic field's oscillations inside the blood sample. Cooper electrodes were positioned at the catheter's ends and linked to an external resistor (external load). The blood has an ac current. The digital oscilloscope was in charge of controlling the signals. Blood samples were gathered from 25 healthy people (15 males, 10 females in the age 18 - 57 years). Time of the sample's electromagnetic irradiation (EMI): 3–10 min.
Syringes attached to the ends of silicone catheter coils were used in the early stages of the research to transfer the blood at the radiation site. After that, the blood was kept in the catheter motionless for 30 minutes to allow for the creation of thrombi before being exposed to an electromagnetic field (Table 1, Table 2).

2. Results and Discussion

Blood viscoelasticity changes and artery hemodynamics.
The displacement of blood in the veins, structural changes in the shear blood flow, and heat generation must all be accomplished by the heart's action alone, according to the rule of energy conservation.

Table 1: Blood cell count

Investigation	Data before EMI	Data after EMI	Referral date
White blood cells (WBC)	5.29 - 6.58	3.63 - 6.77	4 - 10 × 10^9/L
Red blood cells (RBC)	4.13 - 4.95	4.47 - 5.51	3.8 - 5.9 × 10^{12}/L
Hemoglobin (HGB)	127 - 170	134 - 170	116 - 170 g/L
Hematocrit (HCT)	39.0 - 47.5	39.9 - 49.0	35% - 50%
Mean cell volume (MCV)	94.4 - 96.0	88.9 - 89.3	80 - 97 fl
Platelets (PLT)	199 - 260	10 - 23	150 - 400 × 10^9/L
Plateletcrit (PCT)	0.19 - 0.25	0.01 - 0.03	0.12% - 0.35%
Mean platelet volume (MPV)	9.5 - 9.8	10.2 - 11.3	6.5 - 12 fl
Platelet distribution width (PDV)	10.3 - 11.1	8.3 - 19.9	9.9 - 16.1 fl
Neutrophils (NEUT)%	53.9 - 60.7	59.2 - 63.9	50% - 70%
Lymphocytes (LYMPH)%	28.4 - 35.2	30.0 - 33.7	20% - 40%
Monocytes (MONO)%	6.8 - 8.1	5.2 - 5.9	4% - 10%
Eosinophils (EO)%	2.4 - 3.9	0.6 - 0.9	1% - 4%
Basophils (BASO)%	0.3 - 0.6	0.3 - 0.4	0% - 1%

Table 2: Secondary hemostasis

Imaging	Data before EMI Data after EMI Referral date

Activated partial thromboplastin clotting time (APPT)	30.4 - 37.5	180	20 - 37 sec
Prothrombin time (PT)	13.0 - 13.2	90.0 - 90.1	9 - 16 sec
Prothrombin index (PI)	100	9 - 10	75% - 110%
International normalized ratio (INR)	1.0	0.00	0.9 - 1.3
Fibrinogen concentration (FIB)	2.81 - 3.81	0.20 - 0.21	2 - 4 g/L
Thrombin time (TT)	15.7 - 19.4	240 - 240.1	14 - 20 sec

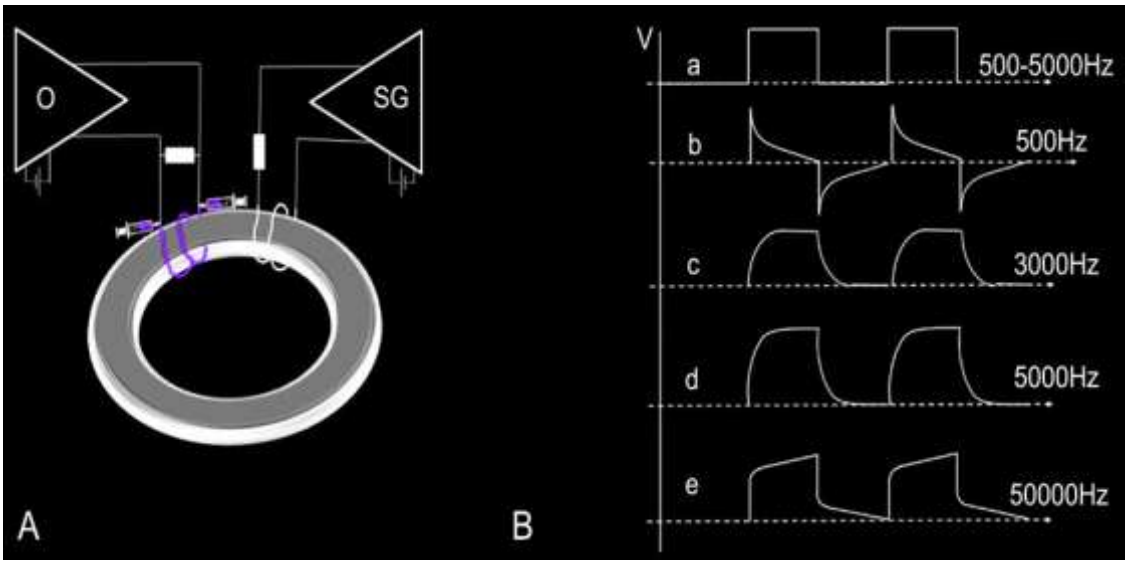

Figure 1: A. The primary coil of the high-frequency transformer receives square form electric impulses from the signal generator (SG). Secondary coil resistor-induced voltage uptakes that are detected via an oscilloscope (O). The catheter, which is the secondary coil, is filled with blood. B. The main coil's signals range from 500 to 50,000 Hz. Blood inducting signals resemble voltage oscillations coming from the high pass filter of the RC Differentiator at b—500 Hz, c—3000 Hz, d—5000 Hz, and e—50,000 Hz. The blood capacity experiences the biggest voltage dips at 5000 Hz, charging up to Vc and discharging down to zero in accordance with the input voltage.

Certain simplifications should be made because the researching problem has several facets. Calculating the heart's effort can be successful if the circulatory system is shown as a frictionless compression pump. Calculating the work done at the various segments of the hydraulic pump is feasible by looking at the physical characteristics of the heart's ventricle and blood arteries.
The left ventricle performs around 0.99 J of work, whereas the systemic arteries and capillaries perform 2.3 J of work in whole.

Given the given circumstances, the pressure (P) and volume (V) of the displaced mass are precisely proportional to the labour required to move the blood.
$W = P \times V = F \times D$
A pressure is the amount of force applied per unit of area perpendicular to an object's surface.
$P = -F/A$

A is the area of the surface in contact, P is the pressure, F is the magnitude of the normal force opposing the pressure, and D is the displacement.
Aortic mean pressure of 100 mmHg is equal to 1.33 104 N/m2.
1.5 cm is the average inner diameter of the ascending aorta. Aorta's median area is 1.77 cm2.
Each cardiac cycle results in a mean movement of 42.46 cm of volumetric (75 ml) blood in the ascending aorta.
The left ventricle generates a force of F = P A = 1.33.104 N/m2 1.77 104 m2 = 2.35 N.
W = 2.35 N x 0.42 m = 0.99 J represents the left ventricle's work for the blood displacement in the ascending aorta during each heartbeat.
Capillary hydrostatic pressure on average is 17 mmHg, or 22.66 102 N/m2.
The capillary's average diameter is 0.0006 cm. The capillary's average length is 0.06 cm.
Single capillary volume is equal to 2.83 x 1011 m2 x 6.10 4 m = 16.98 x 1015 m3 x 16.98 x 109 cm3.

The amount of capillaries that the 75 ml of blood can fill is equal to 75 cm3/16.98 109 cm3, or around 4.42 109 open capillaries.

In a single capillary, the hydrostatic pressure force is given by F = P A = 64.13 109 N/m2 2.83 1011 m2.

Work performed for the displacement of blood in a single capillary during each heartbeat is given by the formula W = 64.13 109 N 6.10 4 m = 79.14 1012 J.

W = 79.14 1012 J 4.42 109= 0.39 J is the work in blood distribution in all systemic open capillaries (without filtration) throughout each cardiac cycle.

In an analogy between electronics and hydraulics, electrical equations can represent hydraulic equations. With this work (W) done, it is possible to represent the blood flow in systemic arteries and capillaries as W = UIT. Voltage U = IR follows from the Ohm's law.

T-flow time, U-voltage (hydraulic pressure), I-current (hydraulic flow rate), and R-resistance.

The arteries and capillaries both have the same net flow and flow time. The pressure drop (U) in the arterial network is 4.9 times greater than that in capillaries (83 mmHg) (17 mmHg).

The systemic artery system must perform 0.39 J 4.9 = 1.91 J of work, while the combined systemic arteries and capillaries must perform around 2.3 J of work. It exceeds the job completed by the left ventricle.

Together with the displacement, the structural reorganisation of the blood as it travels from the aorta to the systemic capillaries has an accompanying energy cost. Hence, it's important to consider the extra energy required for producing heat and venous blood flow. i.e., a different energy source should be used since the left ventricle's labour to move blood through the systemic circulation must be several times greater.

Pulsatile blood flow propagates in the waveform. Transverse and later longitudinal pressure waves displace mass, resulting in the formation of rotating surface waves at the interface of various mediums (Figure 2). Surface waves in protodiastola disrupt cell aggregates in arterial flow, reducing inertial/elastic characteristics, whereas reflection at the vascular wall might damage the endothelium sheet, generating denudation—the first step in atherosclerosis.

Hemodynamics and blood viscoelasticity due to electromagnetic forces.

It is demonstrable that electromagnetic forces provide extra energy in the blood flow. They emerge from the heart's revolving dipole and spread through ac current to every live cell in the body. It is given by the oxygen electronegativity in the cell mitochondria, the RBC electromagnetism, and the electroacoustic phenomena of the colloid system. Together with the pulse pressure caused by the myocardial contraction, the electric impulse from the heart creates an oscillating electric field surrounding the red blood cells and a growing repulsive electromagnetic force that encourages blood flow. The modulated signal ECG starts the blood's viscoelastic changes before the flow does (Figure 3).

Linear momentum is constant and subject to the conservation of energy in the isolated system.

Here, there is elastic energy transfer between the inertial masses. The Womersley number can be used to describe inertial forces in pulsing fluid motion. The aorta blood's high Womersley's number reveals the organ's strong inertia and flexibility.

Blood loses its inertial/elastic characteristics as it travels from the elastic artery to the capillaries, and viscous interactions become more noticeable. Contrarily, the blood gets elastic as it moves from capillaries to veins. Here, the blood coagulation system must play a significant role by supplying blood flow without impeding it by altering the parcel residence time.

Residence time is a sign of the mixing and flow patterns. The blood residence time is increased by non-uniform wall shear stress fluctuations in areas with secondary or disturbed near-wall flows, particularly in the vicinity of vascular bifurcation, branching junctions, and acute bends (i.e. slow-moving flows). Low flow rates are typical for venous blood and are usually related with stasis and thrombus development.

The capacity of the electromagnetic field to affect erythrocyte behaviour is crucial to the structural reorganisation of the blood. The erythrocyte may be seen of as a toroidal dielectrophoretic electromagnetic field-driven cell. To maintain its zeta potential, the erythrocyte uses a chloride anion, which acts as a dielectric constant between a positively charged Stern layer and a negatively charged membrane surface. The preservation of this zeta potential that stops cell aggregation may depend on ferromagnetic (iron) and ferroelectric (chloride anion) effects. Based on magnetic correlations, it is possible to explain the functional characteristics of haemoglobin, such as the binding of oxygen, the Bohr effect, and cooperativity. According to this investigation, magnetism may have a role in how haemoglobin works.

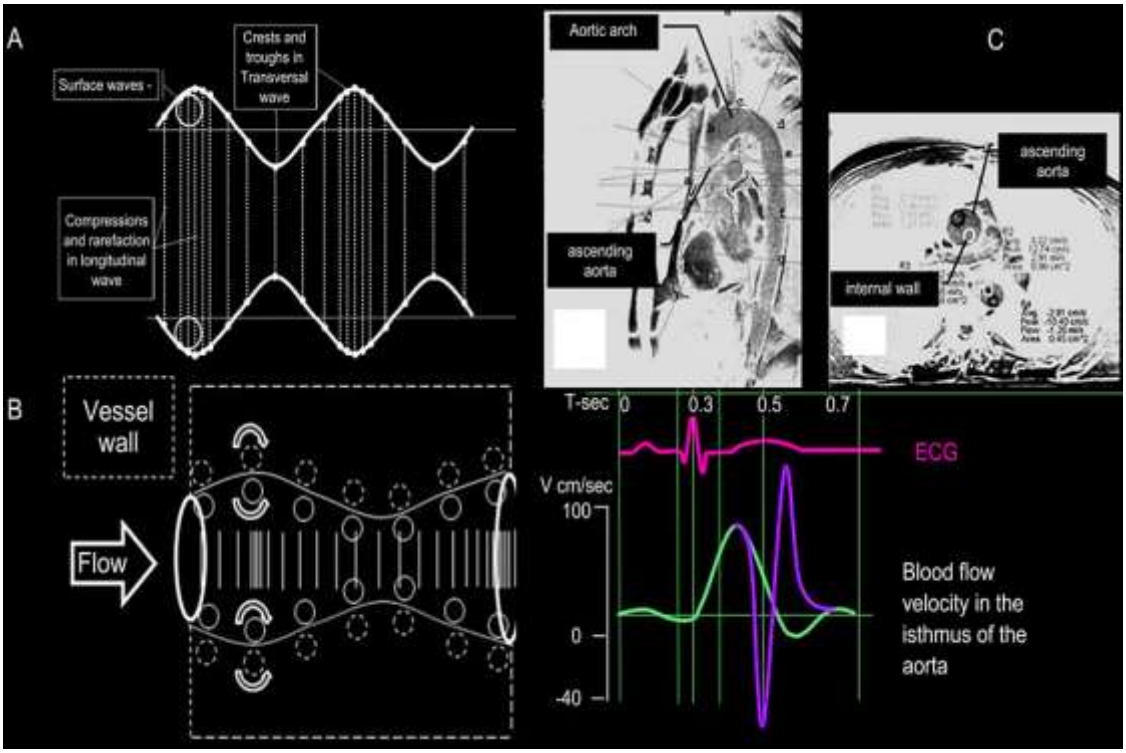

Figure 2: A longitudinal wave is made up of compressions and rarefactions, whereas transverse waves are composed of crests and troughs. B. The development of surface waves at the boundary layer. D. In the bifurcations and places of circular flow, blood rotates. The retrograde pressure decrease causes the flow to segregate during the first diastole. Together with it was the ECG-T potential. Retrograde flow acceleration is 11.6 times greater (red line) at the exterior wall of the isthmus of the aorta in the initial diastole than in the initial systole (blue line). Different frequencies are used for oppositely directed waves. Blood flow at a wall reflection causes frequency dispersion, which annihilates the vessel wall. Blood flow is influenced by the ECG signal.

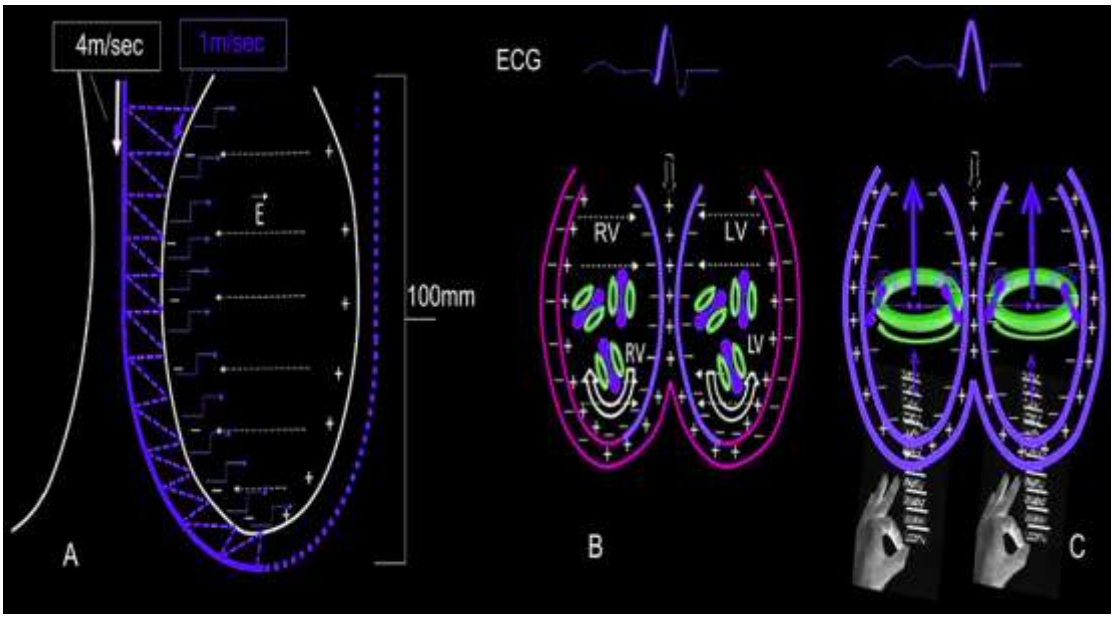

Figure 3: A. The intraventricular septum is where cardiomyocytes first experience depolarization.

The dielectric polarisation of the intraventricular material is created by the displacement current and the oscillating electric field that exists between the septum and free walls of the ventricles. An amplitude-modulated pulse of depolarization—the QRS of the ECG—is created by the septal depolarization. All body cells get an evoked signal. Time to depolarize a cardiomyocyte: 0.002 seconds, frequency: 500 Hz. The Purkinje network is reached through the left bundle branch. Purkinje fibres and bundle branches both exhibit high conduction signal velocities of up to 4 m/sec. The

cardiomyocyte group will significantly enhance the electric surface charge by synchronously depolarizing at a frequency of 500 Hz. Moreover, electroacoustic waves from RBCs (1.2 MHz) travel through blood. B. The RBC's ac electric field encourages the cell membrane's ultrasonic oscillation and other electroacoustic events. The ventricular wall tension balances the repelling electromagnetic forces created by the rotation of the charges in the vicinity of the Z-potential around the RBC (blue circle, magnetic field direction). D. Once the flow starts or resumes and transverse pressure waves are created, repelling electromagnetic forces acting on the RBC do the additional effort required to align red cells into the plane of flow. As a result, blood platelets and leukocytes are "marginalised" and displaced/segregated to the near-wall region. The apical heart muscles first constricted at the conclusion of the QRS electric oscillation. It accelerates the domino effect of pushing the blood out of the chambers in the major arteries by upsetting the delicate balance between the electromagnetic repulse force and wall tension. The waveform's processes are dispersed throughout the arteries.

Due to the deoxygenated (paramagnetic) haemoglobin in venous blood, electromagnetic forces help to promote the RBCs' reciprocal attraction, enhancing blood elasticity. Zeta potential serves as a crucial regulating mechanism in this situation and ensures the stability of colloidal dispersions among the blood's constituent parts. The distance between RBCs is influenced by the surface negative charge, but the venous blood is elastic (Womersley number in the inferior vena cava is 8.8).

The venous valves in the systemic venous circulation provide the direction of blood flow. Capillary venous pressure, muscular contraction, and negative pressure at the breath combine to create flow. Thus, the distal transmission of the proximally produced attractive force depends on elasticity (at the rest only breath is active). Moreover, the blood coagulation system and venous compliance are encouraged: The thrombi in venous stasis have a high elastic mass, are fibrin-rich, and include activated platelets as well as a significant amount of red blood cells.

Venous blood and the oxygen-rich pulmonary lymph are combined during pulmonary circulation. Because to the fact that oxygen is also paramagnetic, these electromagnetic forces from the ECG make it easier for the deoxygenated paramagnetic haemoglobin in RBC to absorb oxygen. The right ventricle acts as a low-pressure elevator, directing elastic venous blood into the elastic pulmonary artery. The pulmonary artery has the highest blood inertia and flexibility in the circulatory system (Womersley number: 15). This explains why the pulmonary circulation's length, blood flow velocity, and blood acceleration are all modest.

Blood flows over a short distance to minimise the oxygen loss from the diamagnetic oxygenated haemoglobin in the pulmonary venous (as in systemic arterial circulation, rotating cardiac dipole effects this). Here, electromagnetic force helps to fill the left atrium by facilitating RBC repulsion and pulmonary venous compliance.

Electromagnetic forces on the oxygenated (diamagnetic) haemoglobin in arterial blood (Womersley number in ascending aorta—13.2) enhance the mutual repulsion of RBC and the liberation of oxygen in plasma. Moreover, during protodiastole, surface wave frequency dispersion breaks up cell aggregates and raises system entropy up to arterioles, allowing for the progression of spontaneous biochemical reactions in capillaries (Womersley number—0.005). Increased flow resistance at the arterial turbulence and resistance paradox in arterioles is linked to higher viscoelastic transformation energy costs. Since haemoglobin has magnetic properties, a magnetic field can affect the inertial characteristics of blood (attractive-paramagnetic and repulsive-diamagnetic). Magnetism is used here to regulate the material's flexibility.

The substance's flexibility is significantly impacted by coagulation. Platelet activation, adhesion, and aggregation as well as fibrin deposition and maturation are all components of the blood coagulation process. According to our experimental investigation, thrombus develop in the catheter after 10 to 15 minutes if there is no electromagnetic influence. Hypocoagulation can be detected when electromagnetic oscillation occurs between 500 and 5000 Hz. Here, the developed thrombus is destroyed by electromagnetic oscillation. Several factors may contribute to hypocoagulation, including: Coagulation is a fermentative process that depends on the redox conversion of substances via enzyme activity. Fermentation conditions are managed by the external ac electric field (electro-fermentation). The failure of the chemicals' electro-fermentative redox reactions may lead to thrombolysis.

Given that the erythrocyte is a toroidal electromagnetic field-driven cell, electromagnetic contact between 500 and 5000 Hz raises the Z potential of the erythrocyte, reduces PLT/PI/FIB, and can help the colloid system stay stable.

In addition, time-varying electric fields have been intensively studied for pumps in the outer plasma membrane, may electroporate the plasma membrane, and can alter the conformational states of membrane proteins. The platelets appear to be timed the most in this process. Their population is

drastically declining. Hence, primary and secondary coagulation are affected by electromagnetic field.
Leukocyte and RBC structure and function were unaffected.
The existence of ultrasonic cavitation, which is the production, growth, and eventual collapse of bubbles in water utilising ultrasonic irradiation and the release of high energy into the liquid, should also be recognised.
Blood coagulation is known to be impacted by changed flow conditions (stasis, turbulence). The rotating and elongational flow components of motion are overlaid in the turbulent flow (shear rate 5000 sec1), parcel resident time increases and influences from various directions, and the coiled Von Willebrand factor (VWF) is unfolding.

Here, the shear rate's mathematical dimension (in seconds per one) is the same as the frequency of electromagnetic waves. It conveys the rotational nature of the motion of the measured component, such as the rotation of the dipole or the surface wave in turbulent flow.
In our work, the external oscillating magnetic field creates an ac electric field in the blood for dielectrophoresis. The shear force needs to activate the VWF at 5000 Hz in order to cause dielectrophoretic activity. Despite having a coiling frequency of 500 Hz. It appears that the coagulation is altered by the ac electric field when combined with RBC electroacoustics.
The dates of the disseminated intravascular coagulation are expressed in the blood following electromagnetic radiation (DIC). It involves the aberrant, excessive production of fibrin and thrombin in the blood stream. Increased platelet aggregation and coagulation factor consumption take place throughout the procedure. Thrombocytopenia, a raised partial thromboplastin time and prothrombin time, and declining plasma fibrinogen levels all serve to identify DIC.
Although while electromagnetic effect is present in both arterial and venous blood, only pulsatile blood is subject to structural alterations caused by rising entropy. It must be connected to the diamagnetic blood's frequency dispersion at the border reflection. The ECG-T wave ac potential makes this possible. The system entropy is reduced when the coagulative mechanism is activated in the vena at a low shear rate.
All substances and body cells are capable of being polarised by the external ac field, and the process of charge displacement and current flow is represented by the system impedance. The human body is one example of a material or system that frequently displays a universal dielectric response. The oscillation and relaxation movements of the cell envelopes' typical dielectrophoretic frequencies are often between 103 and 106 Hz. According to a theoretical analysis of the bilayer lipid membrane's natural oscillations, which are thought to be thin films of viscous fluid, the lower frequency limit is approximately 100 Hz for oscillations of the bilayer thickness and approximately 5 103 Hz for oscillations of the bilayer's bending at an invariable thickness. Endogenous electromagnetic fields are produced together with the metabolism and cell-to-cell long-range electromagnetic signalling processes. Cell membrane mechanical vibrations have been linked to dynamic fluctuations in the length of cytoskeleton microtubules associated to membrane microdomains.
The electromagnetic influence's selective effects on blood formations reveal a person's inclinations towards certain information. The investigated chemical compounds and cell architectures may act as filters that have the capacity to store and dissipate energy as they pass various electric impulses. Here, reactance, whose value varies in relation to the applied frequency, is connected to energy storage (capacitance). The kind of filter used in an electrical circuit is defined by the direction in which the resistor and capacitor are connected in relation to the output signal. making a Low/High Pass Filter possible (Figure 4). When the input signal has the shape of a "square wave" (nearly vertical step input, like in the cardiomyocyte depolarization curve), the filter's output response generates a distinct kind of output signal (a circuit of the integrator or differentiator). They have the ability to selectively activate several biological processes within the bodily cell.
Complex phenomena called electromagnetic fields carry energy and information throughout space. Electromagnetic waves may be modulated in a variety of ways to impose information on them.

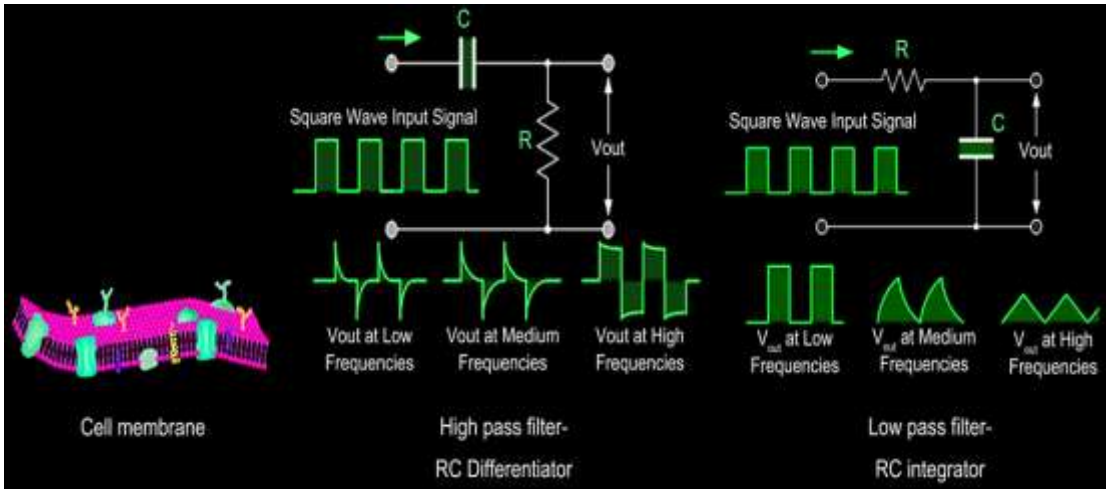

Figure 4. The outer layer of a cell resembles a capacitor. Amino acids, proteins, and saline all serve the purpose of energy storage and reactance (our experiments, were not shown in the tables). The result signal will reflect the difference depending on the applied frequency.

Since electric fields move relativistically, magnetic fields also exist, which is why electricity and magnetism are intertwined.

Due to the transmission of electromagnetic signals during intermediate chemical steps, chemical reactions can be initiated at a distance. Although electromagnetic signals serve as the energy/information carrier for much lower frequencies, they are widely recognised at optical frequencies, such as in photosynthetic processes.

It is well acknowledged that energy and information make up a living system. In essence, the organism's metabolism represents a cost associated with information processing. The ability to handle information is regarded as the most crucial aspect of a living system. With the addition of their negative and positive entropy values, energy and information components interact with and influence the biological system at the level of microphysical events. We come to the conclusion that lowering the energy cost of biological reactions is crucial to the emergence of the living system and its biological evolution after taking into account examples of the function of a biological membrane and its models, calculations of experimental equivalents of information negentropy, and lowering the energy cost of biological reactions during onto- and phylogenesis.

The next step in medicine will be to identify and utilise electromagnetic signalling parameters operating to improve health of the regular biological processes, minimising dependency on medications, although the many unanswered problems remain. A team of scientists with an appropriate lab must investigate the data foundation in pathophysiological processes. The author is willing to work with you.

3. Conclusion and Future Scope

Electroacoustic phenomena are started by the cardiac depolarization's ac electric field. Together with the heart's pulse pressure, a growing repelling electromagnetic force acts on the RBC, causing it to move blood and undergo viscoelastic changes.

The magnetic properties of haemoglobin make it easier for changes to the blood's inertia, elasticity, and hemodynamics.

The external electromagnetic signal has the ability to control all aspects of thrombolysis and blood coagulation.

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