IOSR Journal of Mathematics (IOSR-JM)
e-ISSN: 2278-5728, p-ISSN: 2319-765X. Volume 16, Issue 5 Ser. IV (Sep. – Oct. 2020), PP 20-28
www.iosrjournals.org

A mathematical model on two phased capillary blood flow during lung cancer

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Abstract: *The present piece of work has been devoted to human circulatory system. The structure and function of pulmonary capillary has been discussed so as to develop a mathematical model in tensorial form. The resulting governing equations have been transformed in to cylindrical polar form taking in view the shape of capillaries. The relationship between blood pressure drop and hematocrit has been derived to interpret a clinical data into graphical approach.*

Keywords: *Pulmonary blood flow, Hematocrit, Blood pressure drop, Lung cancer.*

Date of Submission: 05-10-2020 Date of Acceptance: 19-10-2020

I. Introduction

The circulatory system of individual (human being) is controlled by homeostatic mechanism which constantly screens (continuously screens) and modifies with conditions in the human body and their conditions. It is as now demonstrated that it clarifies the physical laws which deal with all courses of blood in the circulatory system. Circulatory system divided in two sections pulmonary and systemic flow in human body. Some previous researchers have done few works in this field one phase and two phase but they have considered one or both phase solid particles not fluids. There was we have considered both phase liquids which is one of red blood cells and other is plasma. We have used power law model and suitable its boundary conditions there micro circulation in human pulmonary capillaries blood vessels during lung cancer patient.

Fahraeus R. and Lindqvist, 1931**,** have already considered the pulmonary capillaries are narrow and thin enough. The velocity of blood flow becomes already very slow in the capillaries; the blood flow is possible in capillaries due to Fahreaus- Lindqvits effect. Blood flows in two separate layers when moving through capillaries according to this effect. Fast no red blood cells are present in the plasma layer. The second layer is that of the blood cells that flow along the capillary axis. The successful blood viscosity in this cycle depends on the size of the capillary. The effective viscosity decreases as the radius of capillary and thus the blood flow becomes possible**.** Core layer may be supposed to be non-Newtonian power law because here the ratio of blood cells is too high in the comparison to plasma [Upadhyay V., 2000].

According to Fung 1984, "the aorta and thoracic arteries have nonlinear stress strain curves. The pulmonary arteries and veins, in contrast, have linear pressure diameter relationship. The capillary blood vessels of the mesentery appear to be rigid-without measurable change in diameter when blood pressure changes over a range of $100\ mmhg$. But the capillary blood vessels in the lung are very distensible in which the variation of the thickness of the capillary sheet with the transmural pressureΔP. The pulmonary capillaries are closely knit into a dense network which occupies about 90% of the total space in the interalveolar septa".

II. Hypothesis of two phase blood volume

Blood has always held a special position in human though. The quantity of blood in the body is substantial, making up about 7% of the total body weight. Blood function in the transport of blood, oxygen, waste material and hormones in the regulation of temperature and in the control of disease [Upadhyay V., 2000]. According to Bessonov*et al*., 2016; "The human blood is a concentrated suspension of several formed cellular elements. The human blood cells volume more than 99% of all blood cells and total volume concentration of leukocytes and thrombocytes is only about 1%". Which is ignorable; so we have selected two phases where one phase-plasma and another is red blood cells phase. Plasma is a fluid that comprises packets of RBC semi-permeable membranes. Blood activity is about Newtonian at high shear rates, while blood is stressful and non-Newtonian at low shear levels. The presence of blood cells is making blood flow valuable. That effect is directly proportional to the volume of the received blood cells. Let the volume part of blood cell-covered unit volume be

X, X being replaced by H/100 where H is the hematocrit, the percentage of blood cells.The hematocrit is typically about 3 times the hemoglobin concentration 'recorded as grams per deciliter' (Berkow 1997). Then the volume portion which will be covered by plasma (1-X). The proportion of cell-to-plasma mass is given r by:

$r = \frac{X\rho_c}{(1-X)\rho_p}$.

Where ρ_c and ρ_p are densities of blood cells and plasma respectivily.

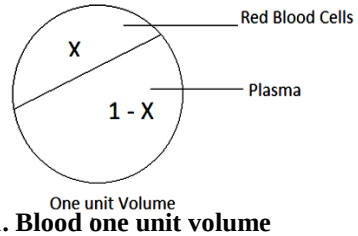


Fig. 1. Blood one unit volume

This mass ratio is generally not a constant. This may even then be supposed to be constant at the moment [Upadhyay, 2000].

2.1 Constitutive equations of Non-Newtonian fluids:

$$\tau = \eta e^n$$
$$[\text{if } n \neq 1]$$

Where,τ is denoted by stress e is denodet by Strain rate.
The nature of the liquid (fluid) is n=1, Newtonian at that point and on the off chance that n is not equal to one implies that the nature of the fluid is Non-Newtonian fluids at that point. Where τ is meant by stress, e is meant by strain rate and n is meant by the parameter, this condition uses the state of motion.

2.2 Power Law:
The percentages of red blood cells which constitute a major part of blood cells in blood i.e. Hematocrit (H) increases; the effective viscosity begins to depend upon the strain rate tensor. In other words, there is a non-linear relation between the strain rate tensor and stress tensor. In this way, the blood may be treated as non-Newtonian. If the strain rate varies from 5 to 200 per second, then the Power law-

$$\tau = \eta e^n$$

Where,$0.68 \leq n \leq 0.80$, holds good for blood flow (Upadhyay et al., 2012 & Kumar et al., 2017)

2.3 Boundary conditions:

1. The velocity of blood flow on the axis of blood vessels at $r = 0$ will be maximum and finite, say $v_0 =$ maximum velocity.
2. The velocity of blood flow on the blood vessel wall at r = R, where R is the radius of blood vessels, is going to be nil. This condition is known as no-slip.

III. Mathematical formation

The successful viscosity of blood circulating in the arteries distant from the heart depends on the strain rate, as the hematocrit increases. The blood flow in this state is non-Newtonian. The constitutive equation of blood is as follows in this case.

$$\tau^{ij} = -pg^{ij} + \eta_m (e^{ij})^n = -pg^{ij} + \tau'^{ij} \qquad (3.1)$$

Where, τ^{ij} is stress tensor and τ'^{ij} is shearing stress tensor.

One phase is Newtonian and other is non-Newtonian:

The equation of continuity in tensorial form for power law will be as follows:

$$\frac{1}{\sqrt{g}}(\sqrt{g}v^i)_{,i} = 0 \qquad (3.2)$$

Again, write down the equation of motion as follows

$$\rho_m \left(\frac{\partial v^i}{\partial t}\right) + (\rho_m v^j)v^i_{,j} = \tau^{ij}_{,j} \qquad (3.3)$$

Where τ^{ij} is taken from constitutive equation of power law flow (3.1). $\rho_m = X\rho_c + (1-X)\rho_p$, is the density of blood and $\eta_m = X\eta_c + (1-X)\eta_p$ is the viscosity of mixture of blood, $X = \frac{H}{100}$ is volume ratio of blood cells. H is hematocrit. Many symbols have their own common meanings. Since the blood vessels are cylindrical, the

main equations described above have to turn the equations (3.23) and (3.24) into cylindrical shape. For cylindrical coordinates, as we know,

$$X^1 = r, X^2 = \theta, X^1 = r, X^3 = z$$

As we know earlier:

Matrix of metric tensor in cylindrical coordinates is fallows:

$$[g_{ij}] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & r^2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

While matrix of conjugate metric tensor is follows:

$$[g_{ij}] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & {}^{1}/_{r^2} & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Whereas the Chritoffel's symbol of 2nd kind is as follow-

$\begin{Bmatrix} 1 \\ 2\ 2 \end{Bmatrix} = -\mathrm{r}, \begin{Bmatrix} 1 \\ 2\ 2 \end{Bmatrix} = \begin{Bmatrix} 1 \\ 2\ 2 \end{Bmatrix} = \frac{1}{\mathrm{r}}$, Remaining others are zero.

The relation between covariant components and physical component of the velocity of the blood flow are as follows will be as:

$$\sqrt{\mathrm{g}_{11}}v^1 = v_{\mathrm{r}} \Longrightarrow v_{\mathrm{r}} = v$$

$$\sqrt{\mathrm{g}_{22}}v^2 = v_{\theta} \Longrightarrow v_{\theta} = \mathrm{r}v^2$$

And $$\sqrt{\mathrm{g}_{33}}v^1 = v_{\mathrm{z}} \Longrightarrow v_{\mathrm{z}} = v^3$$

Again the physical components of $-\mathrm{p}_{,\mathrm{j}}\mathrm{g}^{\mathrm{ij}}$ is $-\sqrt{\mathrm{g}_{\mathrm{ii}}}\mathrm{p}_{,\mathrm{j}}\mathrm{g}^{\mathrm{ij}}$

The matrix of physical components of sharing stress tensor $\tau'^{ij} = \eta_m(e^{ij})^n = \eta_m(g^{ik}v_{,k}{}^{i} + v_{,k}{}^{j})^n$ will be as follows

$$\begin{bmatrix} 0 & 0 & \eta_m\left({}^{dv}/_{dr}\right)^n \\ 0 & 0 & 0 \\ \eta_m\left({}^{dv}/_{dr}\right)^n & 0 & 0 \end{bmatrix}$$

The covariant derivative of τ'^{ij} is

$$\tau'^{ij}_{,j} = \frac{1}{\sqrt{g}}\frac{g}{\partial X^i}\left(\sqrt{g}\tau'^{ij}\right) + \begin{Bmatrix} i \\ jk \end{Bmatrix}\tau'^{ik}$$

Taking the facts into consideration, the governing tensorial equations can be transformed into a cylindrical shape which is the following:

Equation of continuity

$$\frac{\partial v}{\partial z} = 0 \qquad (3.4)$$

Equation of motion

Components of equations of motion

r- Component

$$-\frac{\partial P}{\partial r} = 0 \quad (3.5)$$

θ – Component

$$0 = 0 \qquad (3.6)$$

Z – Component-

$$0 = -\frac{\partial P}{\partial z} + \frac{\eta_m}{r}\frac{\partial}{\partial r}\left[r\left\{\frac{\partial v_z}{\partial r}\right\}^n\right] \qquad (3.7)$$

Here this reality has been taken in see that the blood stream (flow) is pivotally (axially) symmetric in supply routes concerned.

i.e.$v_\theta = 0$ And $v_r = 0$,

v_z and p do not depend upon θ. Also the blood flow steadily, i.e.

$$\left(\frac{\partial \mathrm{p}}{\partial \mathrm{t}}\right) = \left(\frac{\partial v_{\mathrm{r}}}{\partial \mathrm{t}}\right) = \left(\frac{\partial v_{\theta}}{\partial \mathrm{t}}\right) = \left(\frac{\partial v_{\mathrm{z}}}{\partial \mathrm{t}}\right) = 0 \qquad (3.8)$$

IV. Solution

On integrating equation (3.3) we get

Vz = V(r) since V is not dependent on Θ , the integration of motion equation (3.5) yields the following:

P = p (z) since p doesn't rely on Θ .

Now, the equations of motion (3.6) transform in the following form with the aid of equation (3.7) and (3.8)

$0 = -\frac{dp}{dz} + \frac{\eta_m}{r}\frac{d}{dr}\left\{r\left(\frac{dV}{dr}\right)^n\right\}$(4.1)

The pressure-gradient $-\frac{\partial p}{\partial z} = P$ of blood flow in the capillary can be supposed to be constant and hence the equation (3.8) takes the following form

$\frac{d}{dr}\left\{r\left(\frac{dV}{dr}\right)^n\right\} = -\frac{pr}{\eta_m}$(4.2)

On integrating equation (4.2), we get

$r\left(\frac{dV}{dr}\right)^n = \frac{pr}{2\eta_m} + A$(4.3)

We know that maximum and constant is the velocity of blood flow on the axis of the cylindrical capillary. So that's it

The boundary condition is applied to r=0, V=V_0on equation (4.3) as follows.$r\left(\frac{dV}{dr}\right)^n = \frac{pr}{2\eta_m} \Longrightarrow \frac{-dV}{dr} = \left[\frac{pr}{2\eta_m}\right]^{\frac{1}{n}}$ (4.4)

Integrating equation (4.4) once again, we get

$V = -\left[\frac{P}{2\eta_m}\right]^{\frac{1}{n}} \frac{r^{\frac{1}{n}+1}}{n+\frac{1}{n}} + B$(4.5)

To determine the arbitrary constant B, the non-slip condition will be applied to the capillary interior wall at r = R,V = 0, where R = vessel radius, on equation (4.7) to obtain

$$B = \left[\frac{P}{2\eta_m}\right]^{\frac{1}{n}} \frac{nR^{\frac{1}{n}+1}}{n+1}$$

Hence the equation (4.7) takes the following form

$V = \left[\frac{P}{2\eta_m}\right]^{\frac{1}{n}} \frac{n}{n+1}\left[R^{\frac{1}{n}+1} - r^{\frac{1}{n}+1}\right]$ (4.6)

That defines the velocity of the blood flow in the capillary where the blood pressure gradient is P and the velocity of the blood mixture is η_m .

Two layered blood flow one layer is Newtonian while the other is Non-Newtonian Power Law:

Now the velocity of blood flows can be get through changing η_m with η_p in of Newtonian model as follows-

$v_p = \frac{P}{4\eta_p}(R^2 - r^2);\ R - \delta \le r \le R$(4.7)

Where, δ is the radius of core layer.

The velocity of core layer is obtained as the formula of power law model as follows -

$v_m = \left[\frac{P}{2\eta_m}\right]^{\frac{1}{n}} \frac{n}{n+1}\left[R^{\frac{1}{n}+1} - r^{\frac{1}{n}+1}\right] + \left[\frac{P}{4\eta_p}(R^2 - (R-\delta)^2) - \left(\frac{P}{2\eta_m}\right)^{\frac{1}{n}} \frac{n}{(n+1)}\left(R^{\frac{1}{n}+1} - (R-\delta)^{\frac{1}{n}+1}\right)\right]$

(4.9)

$$0 \le r \le R - \delta$$

Where, the 2nd term is the relative velocity of plasma layer with respect to core layer.

V. Result and Discussion

The flow flux blood is capillaries are:

$$Q = \int_0^{R-\delta} V_m\, 2\pi r dr + \int_{R-\delta}^{0} V_p\, 2\pi r dr$$

$Q = \int_0^{R-\delta}\left[\frac{P}{2\eta_m}\right]^{\frac{1}{n}} \frac{n}{n+1}\left[R^{\frac{1}{n}+1} - r^{\frac{1}{n}+1}\right] + \left[\frac{P}{4\eta_p}(R^2 - (R-\delta)^2) - \left(\frac{P}{2\eta_m}\right)^{\frac{1}{n}} \frac{n}{(n+1)}\left(R^{\frac{1}{n}+1} - (R-\delta)^{\frac{1}{n}+1}\right)\right] 2\pi r dr +$

$R-\delta R[P4\eta pR2-r2]2\pi r dr$ (5.1)

Bio-physical interpretation:

We know that the average human pulmonary blood flow flax $(Q) = 0.00708333 m^3/\text{second}$ [Srivastava*et al*, 2012]. $\eta_p = 0.0013$ pascal second [Gustafson and Daniel R., 1980] and $\eta_m = 0.0271$ pascal second [Glenn Elert, 2010].ApproximateR radius of capillary $= 0.0965$ m. Approximate capillary length $(Z_f - Z_i)$ of capillary = 19000 m. δ thickness of RBC layer $= \frac{1}{3}R = 0.0322$ m. and$R - \delta = 0.0643$ m.

Examination of hematocrit v/s blood pressure in during lung cancer with respect to clinical data for patient- SS (male), 65 years old.

Table (I) Hemoglobin & blood pressures in clinical data

Date	**HB(Hemoglobin) in (gram/dl)**	**Hematocrit In $(3 \times HB)$ (kg/l)**	**Blood Pressure (BP) in (mmhg)**	**Capillary Pressure Drop In Pascal-second** $\frac{2}{3}\left(\frac{\left(\frac{S+D}{2}\right)+D}{3}\right)-\frac{\left(\frac{S+D}{2}\right)+D}{3}$	
2/3/2017	8.7	0.024622642	100/70	-2292.828889	
10/4/2017	8.8	0.02490566	110/70	-2366.791111	
25/4/2017	8.7	0.024622642	100/80	-2514.715556	
15/5/2017	8.6	0.024339623	115/70	-2403.772222	
28/5/2017	8.5	0.024056604	110/60	-2144.904444	
12/6/2017	8.4	0.023773585	100/60	-2070.942222	

In according to used clinical data (Table-II. 5.11) (Hematocrit) $H = 0.024339623$ and Capillary Pressure Drop$(P_f - P_i) = 2403.772222$Pascal second.

Using relation (A) and we find out η_c

$$0.0271 = \eta_c \frac{0.024339623}{100} + \left(1 - \frac{0.024339623}{100}\right) 0.0013$$

$$\eta_c = 106.0129984$$

Again using relation (A) and change in to the hematocrit-

$$\eta_m = 0.7725553825H + 0.001299566$$

Now substituted the values of r_p and R in Equation (5.1)-

Flow flux $Q = \int_0^{R-\delta} \left[\left(\frac{p}{2\eta_m}\right)^{\frac{1}{n}} \left(\frac{n}{n+1}\right)\left(R^{\frac{1}{n}+1} - r^{\frac{1}{n}+1}\right) + \left\{\frac{p}{4\eta_p}(R^2 - (R-\delta)^2) - \left(\frac{p}{2\eta_m}\right)^{\frac{1}{n}} \frac{n}{n+1}\left(R^{\frac{1}{n}+1} - (R - \right.\right.$

$\delta 1n + 12\pi rdr + R - \delta Rp4\eta pR2 - r22\pi rdr$ …… (N)

$$Q = \int_0^{0.0643} \left[\left(\frac{0.1265}{2 \times 0.0271}\right)^{\frac{1}{n}} \left(\frac{n}{n+1}\right)\left(R^{\frac{1}{n}+1} 2\pi rdr - r^{\frac{1}{n}+2} 2\pi dr\right)\right.$$

$$+ \left\{\frac{0.1265}{4 \times 0.0013}((0.0965)^2 - (0.0643)^2) 2\pi rdr\right.$$

$$\left.\left. - \left(\frac{0.1265}{2 \times 0.0271}\right)^{\frac{1}{n}} \frac{n}{n+1}\left((0.0965)^{\frac{1}{n}+1} - (0.0643)^{\frac{1}{n}+1}\right) 2\pi rdr\right\}\right]$$

$$+ \int_{0.0643}^{0.0965} \frac{0.1265}{4 \times 0.0013}(0.0965^2 2\pi rdr - 2\pi r^3 dr)$$

$$Q = \left[(2.33)^{\frac{1}{n}}\left(\frac{n}{n+1}\right)\left(0.0965^{\frac{1}{n}+1} 2\pi \left[\frac{r^2}{2}\right]_0^{0.0643} - 2\pi \left[\frac{n\, r^{\frac{3n+1}{n}}}{3n+1}\right]_0^{0.0643}\right)\right.$$

$$+ \left\{\frac{0.1265}{4 \times 0.0013}((0.0965)^2 - (0.0643)^2) 2\pi \left[\frac{r^2}{2}\right]_0^{0.0643}\right.$$

$$\left.\left. - (2.33)^{\frac{1}{n}} \frac{n}{n+1}\left((0.0965)^{\frac{1}{n}+1} - (0.0643)^{\frac{1}{n}+1}\right) 2\pi \left[\frac{r^2}{2}\right]_0^{0.0643}\right\}\right]$$

$$+ 24.32\left(0.0965^2 2\pi \left[\frac{r^2}{2}\right]_{0.0643}^{0.0965} - 2\pi \left[\frac{r^4}{4}\right]_{0.0643}^{0.0965}\right)$$

$$Q = \left[(2.33)^{\frac{1}{n}}\left(\frac{n}{n+1}\right)\left(0.0965^{\frac{1}{n}+1} \times 0.01298 - \frac{n(0.0643)^{\frac{1}{n}}}{3n+1} \times 0.00167\right)\right.$$
$$\left. + \left\{0.00163 - (2.33)^{\frac{1}{n}}\frac{n}{n+1}\left((0.0965)^{\frac{1}{n}+1} - (0.0643)^{\frac{1}{n}+1}\right)0.01298\right\}\right] + 0.00134$$

$$Q = (2.33)^{\frac{1}{n}}\left(\frac{n}{n+1}\right) \times 0.0965^{\frac{1}{n}+1}[0.01298 - 0.01298] - (2.33)^{\frac{1}{n}}\frac{n}{n+1}(0.0643)^{\frac{1}{n}}\left[\frac{0.00167n}{3n+1} - 0.01298\right] + 0.000297$$

$$Q = -(0.1498)^{\frac{1}{n}}\frac{n}{n+1}\left[\frac{0.00167n}{3n+1} - 0.01298\right] + 0.000297$$

Putting $Q = 0.00708333\ m^3/\text{sec}$

$$0.00708333 - 0.000297 = -(0.1498)^{\frac{1}{n}}\frac{n}{n+1}\left[\frac{0.00167n}{3n+1} - 0.01298\right]$$

$$0.00678633 = -(0.1498)^{\frac{1}{n}}\frac{n}{n+1}\left[\frac{0.00167n}{3n+1} - 0.01298\right]$$

On solving we get $n = 4.61355$

Now putting all values in equation (N) and get Δp

$$Q = \int_0^{R-\delta}\left[\left(\frac{p}{2\eta_m}\right)^{\frac{1}{n}}\left(\frac{n}{n+1}\right)\left(R^{\frac{1}{n}+1} - r^{\frac{1}{n}+1}\right)\right.$$
$$\left. + \left\{\frac{p}{4\eta_p}(R^2 - (R-\delta)^2) - \left(\frac{p}{2\eta_m}\right)^{\frac{1}{n}}\frac{n}{n+1}\left(R^{\frac{1}{n}+1} - (R-\delta)^{\frac{1}{n}+1}\right)\right\}\right] 2\pi r dr$$
$$+ \int_{R-\delta}^{R}\frac{p}{4\eta_p}(R^2 - r^2)\,2\pi r dr$$

$$Q = \int_0^{0.0643}\left[\left(\frac{p}{2\eta_m}\right)^{\frac{1}{4.61355}}\left(\frac{4.61355}{4.61355+1}\right)\left(0.0965^{\frac{1}{4.61355}+1} - r^{\frac{1}{4.61355}+1}\right)\right.$$
$$\left. + \left\{\frac{p}{4 \times .0013}((0.0965)^2 - (0.0643)^2)\right.\right.$$
$$\left.\left. - \left(\frac{p}{2\eta_m}\right)^{\frac{1}{4.61355}}\left(\frac{4.61355}{4.61355+1}\right)\left(0.0965^{\frac{1}{4.61355}+1} - (0.0643)^{\frac{1}{4.61355}+1}\right)\right\}\right] 2\pi r dr$$
$$+ \int_{0.0643}^{0.0965}\frac{p}{4 \times .0013}(0.0965^2 - r^2)\,2\pi r dr$$

$$Q = \left[0.00601\left(\frac{p}{2\eta_m}\right)^{0.2167} + \left\{0.024964P - \left(\frac{p}{2\eta_m}\right)^{0.2167} \times 0.000294\right\}\right] + 0.0087623P$$

$$Q = \left[\left(\frac{p}{2\eta_m}\right)^{0.2167}[0.00601 - 0.000294] + \right] + 0.024964P + 0.01406P$$

$$Q = \left[0.005716\left(\frac{p}{2\eta_m}\right)^{0.2167}\right] + 0.039024P$$

Now ignoring the term 0.039024P (negligible value)

$$0.00708333 = \left[0.005716\left(\frac{\Delta p}{2 \times 1900 \times \eta_m}\right)^{0.2167}\right]$$

We know that, $P = -\frac{dp}{dz} = \frac{\Delta p}{\text{length of capillary}}$

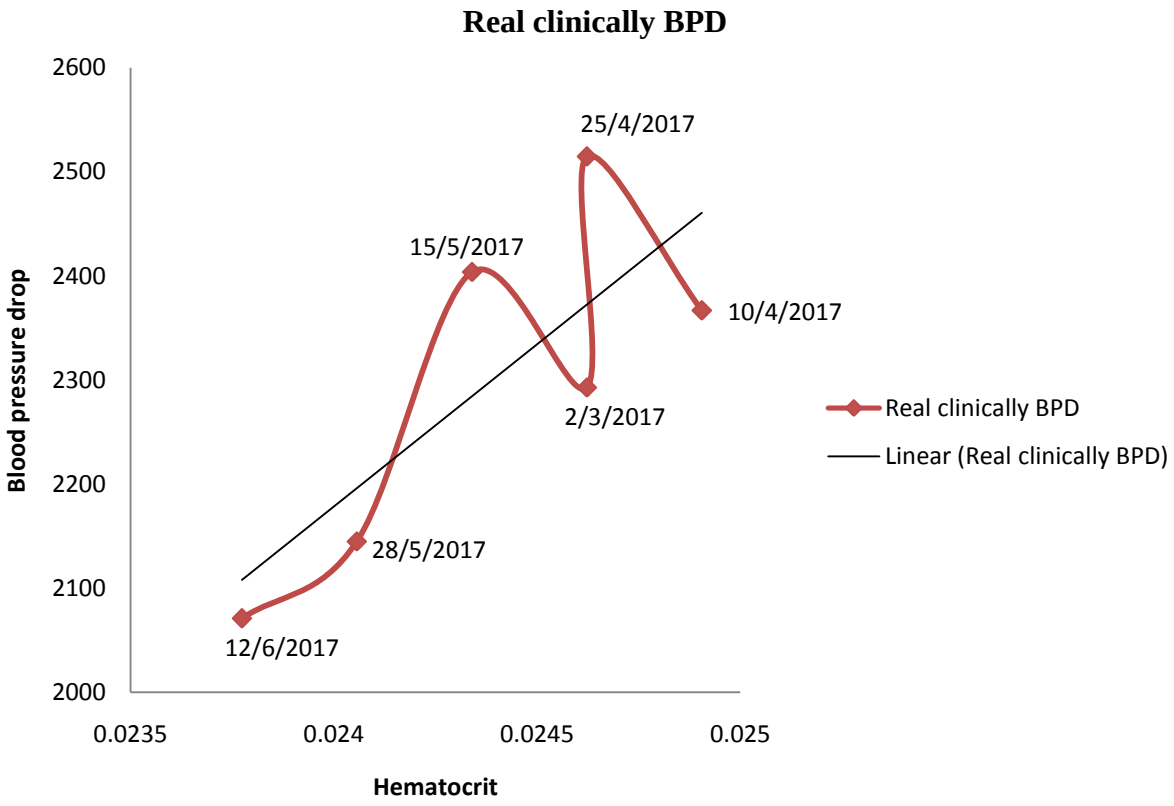
$$\frac{\Delta p}{3800 \times \eta_m} = \left(\frac{0.00708333}{0.005716}\right)^{\frac{1}{0.2167}}$$

$$\frac{\Delta p}{3800 \times \eta_m} = 2.69035$$

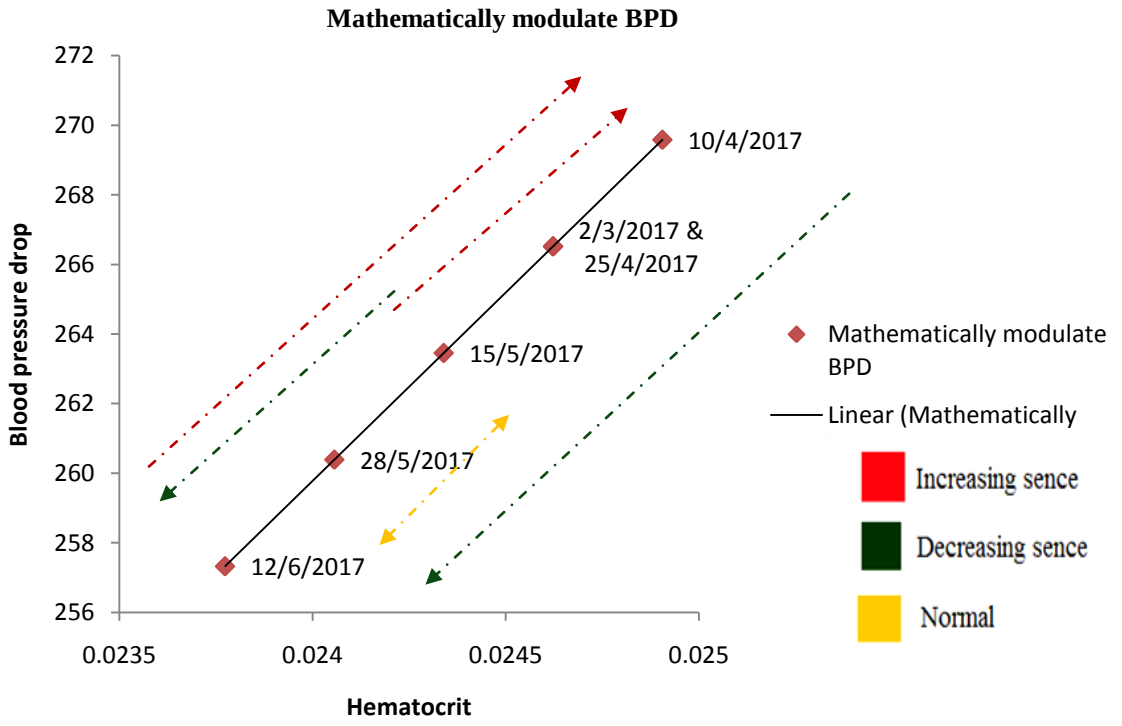
$$\Delta p = 10223.33\eta_m$$
$$\Delta p = 10223.33\eta_c\left[\frac{H}{100} + \left(1 - \frac{H}{100}\right)\eta_P\right]$$
$$\Delta p = 1083805.876\left[\frac{H}{100} + \left(1 - \frac{H}{100}\right)0.0013\right]$$
$$\Delta p = 10823.966928H + 0.0013$$

Table (II) Blood pressures drop v/s Hematocrit in Clinical data

Date	Hematocritin($3 \times HB$)(kg/m^3)	BPD(Blood Pressure drop)In Pascal-second
2/3/2017	0.024622642	266.5159627
10/4/2017	0.02490566	269.5793402
25/4/2017	0.024622642	266.5159627
15/5/217	0.024339623	263.4525744
28/5/2017	0.024056604	260.3891861
12/6/2017	0.023773585	150.2911375



Graph: a. (table I) real clinically blood pressure drop & hematocrit



Graph: b. (table II) mathematical modulated blood pressure drop & hematocrit.

VI. Observation

Graph (a) & (b) shows the relationship between blood pressure drop and hematocrit of lung cancer patient for various dates. Graph (a) shows that these 6 different dates were observed minimum about 2070.942222 on dated 12/6/2017 and maximum value obtain 2514.715556 on dated 25/4/2017 (BDP). The value from 0.023773585 to 0.024339623 via 0.024056604 of hematocrit value, the blood pressure drop shows slowly down convex in increasing sence and the value from 0.024339623 to 0.024622642 via 0.024622642 of hematocrit value, the blood pressure drop shows upper convex in increasing sence. Again the value from 0.024622642 to 0.02490566 via 0.024622642 of hematocrit value, the blood pressure drop shows upper convex in decreasing sence. Graph (b) shows that these 6 different dates were observed minimum about 257.3257978 on dated 12/6/2017 and maximum value obtains 269.5793402 on dated 10/4/2017 (BPD). At the value from 0.02490566 to 0.023773585 via 0.024622642, 0.024622642, 0.024339623 & 0.024056604 of hematocrit value, the blood pressure drop straightly decreases on dated 10/4/2017 to 12/6/2017 via 2/3/2017, 25/4/2017, 15/5/2017 & 28/5/2017.

VII. Conclusion

In clinical data figure 1.1b; graph b (table. II) shows from 10/4/2017 to 12/6/2017 via 2/3/2017, 25/4/2017, 15/5/2017 & 28/5/2017 blood pressure drop straightly decreases.

According to this study we've concluded that designate the function of hematocrit inside the willpower of blood pressure drop. For this reason the hematocrit is extended then the blood pressure drop is likewise multiplied.

When graph shows increasing sence then we cannot suggest for serious dose and when graph shows decreasing sence then we suggest for serious dose but according to steepness of slops (triad line) at different condition (critical, middle, normal). We have suggested for successful operation but subject to the condition that the clinical data is collected in the duration of declared operation.

References

[1]. Berkow, Robert, ed. Merck Manual of Medical Information. Whitehouse Station, NJ: Merck Research Laboratories, 1997
[2]. Bessonov N., A., sequeira S. Simakov, Yu.,Vassilevskii V. Volpert; Mthods of blood flow modeling, *math. model. nat. phenom.* 2016, Vol. 11, No. 1, pp. 1-25.
[3]. Fung Y.C.; Structure and Stress-Strain Relationship of Soft Tissues, *AMER. Zool.*,1984, Vol. 24.
[4]. Glenn Elert 2010. "Viscosity, the physics hypertext book".

[5]. Gustafson, Daniel R. 1980. Physics, Health and the Human Body, Wadsworth.
[6]. Guyton, A. C. and Hall, J. E.; Text Book of Medical Physiology. 11th Edition, Elsevier Inc., India, 2006, Pp 471.
[7]. Kumar Dheerendra, Chaturvedi Surya Kant,Upadhyay V., and Pandey P. N.; Analysis of Two Phase Blood Flow in
[8]. Human Pulmonary Artery During Lung Cancer by Mathematical Modeling, *American International Journal of Research .in Science, technology Engineering & Mathematics*, 2017, 20(1), pp. 44-49
[9]. Sherman, R. S. and Sherman, V. G.; Biology- A Human Approach Oxford Univ. press,New York, Oxford, 1989,278-79
[10]. SrivastavaManoj K., Upadhyay V., Agrawal A.K., and Pandey P.N.; A Study of Mathematical of Two Phase Pulmonary
[11]. Blood Flow in Lungs with Special Reference to Asthma, *Int. Journal of Eng. Research and Development*, 2012, Vol. 4, No.1, pp.81-87.
[12]. Upadhyay V., Chaturvedi S. K. and Upadhyay A.; A Mathematical Model on Effect of Stenosis in Two Phase BloodFlow in Arteries Remote From the Heart, *Journal of Int. Academy of Physical Sciences*, 2012, Vol. 16, No.3, pp. 247-257.
[13]. Upadhyay, V.; Some phenomena in two phase blood flow. Ph. D. Thesis, Central University, Allahabad, 2000.

Dheerendra Kumar, et. al. "A mathematical model on two phased capillary blood flow during lung cancer." *IOSR Journal of Mathematics (IOSR-JM)*, 16(5), (2020): pp. 20-28.