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CHANGE IN BLOOD CAPACITANCE WITH GESTATIONAL AGE LINKED WITH DATA MINING

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Abstract: It has been observed recently that the dielectric property of blood and thus the blood capacitance shows a definite change at different stages of pregnancy. The authors have discussed their observations in the paper. Blood samples of pregnant ladies at different gestational age have been collected from recognized laboratory. Erythrocyte Sedimentation Rate (ESR), hemoglobin (Hb) and dielectric of the samples have been measured. The changes in ESR, Hb, dielectric of blood and the blood capacitance with gestational age have been studied in detail and their relation has been established. The trend of the gestational age can be correlated with the simulated output for which classification is done in the data mining using software DTREG for helping the physicians so that they can prescribe the treatment of the subject in a precise manner.

Keywords: Dielectric property of blood, Gestational age, Erythrocyte Sedimentation Rate (ESR), equivalent circuit of blood, data mining.

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INTRODUCTION

The dielectric property of blood cell changes with diseases thus changing the capacitance of blood cell. Diabetes, cancer, renal disorder and other chronic diseases have significant impact on the dielectric properties of blood [S. Gabriel , et al (1996); H. F. Cook, et al (1951); Irimajiri, et al (1991)]. The white (WBC) and red blood cell (RBC) count increases with pregnancy. The significant increase in RBC mass (250-450mL) is due to the increase in erythropoietin production [American Pregnancy Association (2008)]. Though RBC increases in pregnancy but plasma volume increases much higher which causes anemia during pregnancy. Thus Hemoglobin of pregnant women decreases with gestational age [H. Kieler et al (1995)]. Due to high RBC mass the Erythrocyte Sedimentation Rate (ESR) also increases. ESR reflects the tendency of RBC to settle more rapidly [van den Broe NR, et al (2001); Alexander Zhbanov , et al (2012)]. The plasma and the cell interior consist of conducting fluids with certain electrical resistance which can be simulated by resistors, whereas the membrane is consist of phospholipids and proteins with dielectric properties and can be represented by capacitance. The equivalent model of the blood is as shown in the fig1. R_p represents plasma resistance, R_i represents cell interior resistance and C_m represents membrane capacitance [L. I. Kalakutskiy, et al (2009); Arpita Gupta, et al (2014)]

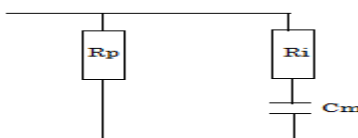


Fig1: Equivalent Circuit of blood

Recently a close association between the dielectric property of blood and ESR has been reported. It has been observed that the dielectric property of blood is also affected by the gestational age of pregnancy [Anil Lonappan (2012)]. With the change in the dielectric property of blood cell the capacitance of the cell changes too because $C = \epsilon A / D$. The area (A) and distance (D) is constant but the dielectric constant of blood cell changes with ESR. It is observed from fig 6 that with increase in ESR of blood, the dielectric constant of blood increases [G.W.Parker (2002); T. K. Basak, et al (2009); T.K.Basak, et al (2012)].

Data mining is the process of collecting and analyzing data from different dimensions and angles and then summarizing it into useful information. Authors used DTREG software. Technically, data mining is the process of finding correlations. In this paper the authors tried to

analyze a relation between ESR and membrane capacitance of blood cell with gestational age [T.K.Basak , et al (2008); J. A. Costa , et al (2001); Han, et al (2005)].

METHODOLOGY:

Blood samples of pregnant women have been collected from recognized pathological lab from Ghaziabad at regular interval. The ESR and Hemoglobin have been measured. The dielectric of the blood samples have been measured in BNN Laboratory. The measured values of four patients are as shown in table1.

Gestational Age	Patient 1		Patient 2		Patient 3		Patient 4	
	ESR (mm/h)	Hb (g/dL)	ESR (mm/h)	Hb (g/dL)	ESR (mm/h)	Hb (g/dL)	ESR (mm/h)	Hb (g/dL)
Second Month	10	13.8	15	12.5	32	11.8	52	11.6
Fourth Month	12	12.1	28	10.8	40	9.8	47	9.7
Sixth Month	20	10.7	31	10.1	48	10.6	59	9.7
Ninth Month	32	10.1	45	9.5	67	9.8	65	9.5

Table 1: change in ESR and Hemoglobin with gestational age

RESULT AND CONCLUSION:

It has been observed that the hemoglobin of a pregnant women decreases with increase in gestational age as shown in fig2.

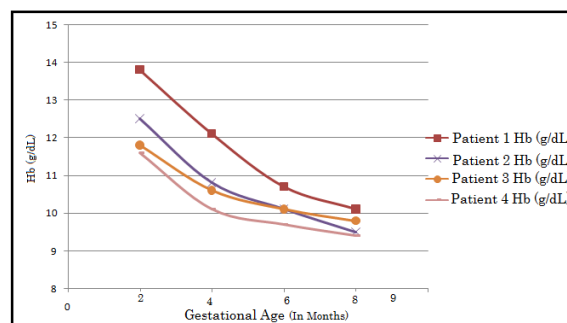


Fig 2 Relation between gestational age and hemoglobin

With decrease in hemoglobin the ESR of pregnant women increases with increase in gestational age as shown in fig3.

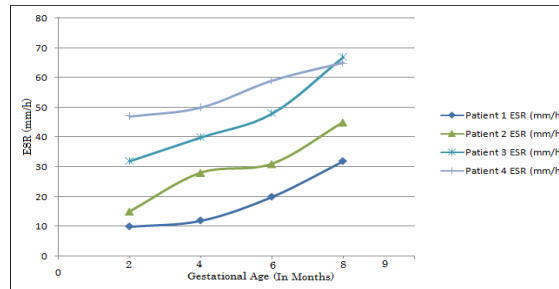


Fig3: Relation between gestational age and ESR

The dielectric of blood has been measured using DAK dielectric meter as shown in fig 4 and the experimental setup is shown in fig 5.



Fig 4: DAK Dielectric Meter



Fig 5: Experimental Setup

The measured value of dielectric constant of blood which has different ESR is given in fig 6.

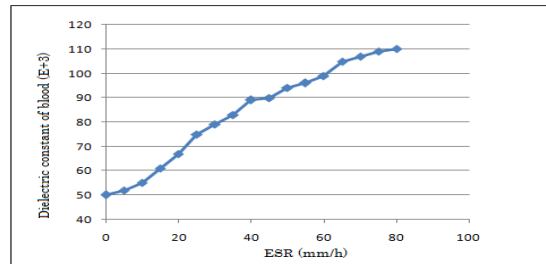


Fig 6: Relation between ESR and Dielectric of the blood cell

As a result the capacitance of the blood also increases. Fig 7 shows the relation between ESR and capacitance of blood cell.

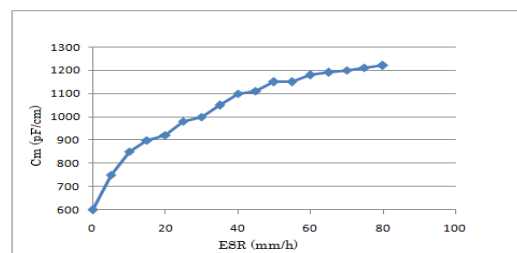


Fig 7: Relation between ESR and Capacitance of blood cell

DATA MINING

Fig 8 shows the decision tree of the prediction of gestational age with membrane capacitance. Figure 9 indicates the prediction of gestational age and esr.

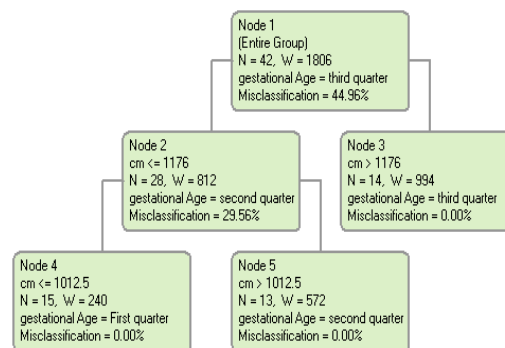


Fig 8: Prediction of Gestational age with membrane capacitance

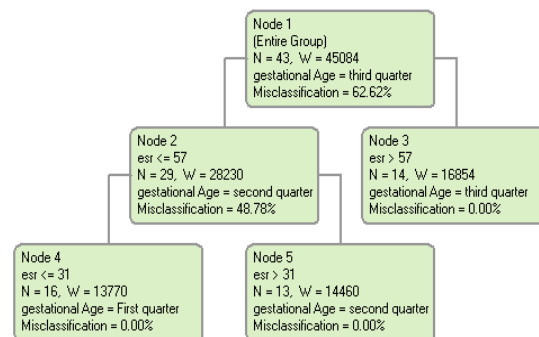


Fig 9: Prediction of Gestational age with ESR

Conclusion:

The status of pregnancy with ESR and hemoglobin has a great impact on the physiological condition of the subject. In this respect the gestational age can be estimated easily with the dielectric property or blood capacitance of the subject.

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